

MARKET REACTION TO PUBLIC INFORMATION: THE ATYPICAL CASE OF THE BOSTON CELTICS

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Abstract

The publicly traded Boston Celtics Limited Partnership shares provide a unique means of studying the impact of information on equity prices. The results of the Celtics' basketball games significantly affect partnership share returns, trading volume, and volatility. Controlling for the expected value of the signal using betting-market point spreads has little effect on these relations. Investors respond asymmetrically to wins and losses, and playoff games have a larger impact on returns than regular-season games. Opening prices do not fully reflect game results, consistent with previous findings that significant volatility is caused by traders acting on private information.

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1. Introduction

Typical value-relevant information signals are revealed to markets in an infrequent and potentially confounding way. Even the most frequent of regular signals, such as earnings announcements, occur only a few times per year. The information is commonly revealed during trading hours, and even when investors expect an announcement, they are often forced to rely on proxies for the market's expectations (e.g., mean analysts' forecasts). Of interest would be a case in which the signals are very frequent, easy to quantify, occur solely when the market is closed, and have observable ex ante expectations.

The Boston Celtics Limited Partnership (LP) provides such a case. Their partnership shares are publicly traded, providing observable prices and returns. Eighty-two times a year (not including playoffs), its team, the Celtics, plays a basketball game as part of the National Basketball Association (NBA) schedule. These games provide a regular measuring stick for the team's performance, which we in turn find to be related to the firm's operating performance. The expected outcome of each game is known and observable by virtue of the sports betting market. The games occur exclusively when the stock market is closed, allowing easier isolation of their impact on the variation in trading patterns.

This paper has two main goals. At a general level, we seek to better understand how markets incorporate publicly available information. For example, does the timing of signals -- here, basketball games -- offer further evidence on when markets incorporate information revealed during market closures? Furthermore, at the individual-firm level, we examine the informational impact of game results on the value of the Boston Celtics LP. Specifically, we seek to determine if, how, and when the market reacts to the outcome of these (potentially) value-relevant signals.

We analyze a sample of game results, point spreads, trading volume, returns, and volatility of the Celtics partnership shares from January 1, 1987 to May 31, 1998. We find that volume and volatility are higher during the season as a whole and on days that follow games. Returns reflect game results, and losses drive the relations during the regular season. Playoff games have a significant, incremental impact on returns, but this effect is found for both wins and losses. Finally, we show that the increased volatility associated with games occurs largely when the market

is open, even though the games occur when the market is closed. We interpret this as new evidence that much of the difference between open- and closed-market volatility can be attributed to traders acting on private information.

The next section describes our data. Section 3 presents our hypotheses, empirical tests, and results. Section 4 discusses the possible implications of the games' atypical timing. In Section 5, we explore the impact of two non-game events: the building of the new Boston Garden and the hiring of head coach Rick Pitino. Section 6 concludes the main text. We summarize the results of several robustness checks in a short appendix.

2. Data

The Boston Celtics were first listed for public trading on the New York Stock Exchange on December 4, 1986. While the traded securities are limited partnership units, we will refer to them as units and shares interchangeably, and we will call the unitholders stockholders. In order to allow a few weeks for prices and volume to settle following the initial public offering, our sample covers the period from January 1, 1987 through May 31, 1998. Although other studies omit longer periods, the data show that volume and volatility had settled to levels near their sample average by January 1, 1987. Our sample covers 12 seasons (the first of which is incomplete due to the IPO date). NBA teams play 82 games each regular season. We exclude games for which no point spreads are available. The resulting sample contains 2,884 daily returns and 1,032 games.

Daily returns and trading volume for the Boston Celtics Limited Partnership are taken from the Center for Research in Security Prices (CRSP) tapes, along with the returns to the CRSP equal-weighted index. Intraday, bid-ask, and open-to-close data are taken from The New York Stock Exchange Trade and Quote (TAQ) Database for 1993 through May 1998. Daily opening, high, and low prices are from Prophet Data Services. Point spreads are from the Las Vegas betting market, as given in Livingston (1990, 1992, and 1995; he stopped publishing after the 1995 season) and by the Gold Sheet, an Internet betting-information provider. Livingston compiles spreads as of 5:00 p.m. EST (on the day of the game); these spreads should capture the vast majority of bettors' expectations. Table 1 contains descriptive information about the returns and the Celtics' on-the-court performance over the sample period. The table shows the means of both the market and the Celtics' returns, as well as the Celtics' win-

loss record, against and ignoring the spread. Note that, for this sample, the point spread is an extremely good predictor of game outcome on average. Versus the spread, the Celtics had 498 wins and 499 losses over the 12 seasons in our sample.

[Please insert Table 1 about here]

The Celtics' shares are not heavily traded. Daily trading volume averages roughly 4,500 shares over our entire sample period. The 1993-1998 TAQ data shows an average of about 12 transactions a day, with an average trade size of 350 shares. The average market capitalization over the full sample period is roughly \$115 million, with an average of 6.2 million shares outstanding. The amount of institutional ownership is small, with no institutional investor holding more than 1% of shares outstanding. As of October 1998, Bloomberg listed total institutional holdings as approximately 0.3% of the total shares outstanding.

3. Do games matter?

There is ample evidence that publicly announced and unanticipated firm-specific information affects stock prices (e.g., Malkiel, 1989) as do more frequent value-relevant signals, such as the stock price effect of quarterly earnings announcements (e.g., Joy et al., 1977). Even at their most frequent, though, the events addressed in these studies occur only a few times each year with effects often confounded by other contemporaneously revealed signals.

The Celtics provide an interesting study of how information that is easily observed and measured affects the market characteristics of a publicly traded firm.¹ The revenue of the Celtics LP is almost purely derived from

¹ As a publicly traded partnership, there are few substantive differences between the Celtics and a typical corporation. One exception is taxation; as a publicly traded partnership, the Celtics partnership shares are subject to slightly different taxation rules than ordinary common stock. Since the partnership was formed prior to 1987, it is treated as a partnership for tax purposes during the sample period. So, income is taxed (once) at the individual level, independent of the cash distributed during the tax year. This changes for

the operations of the basketball team. Consequently, the games (as a visible indicator of team performance) contain information about a large percentage of the firm's operations. The games' frequency allows us to more confidently ignore structural changes in the firm or economy that can confound results in studies using less frequent data. For example, one year of games provides as many signals as about 20 years of quarterly earnings announcements.

Investors in typical stocks receive performance signals through such means as analysts' reports, news announcements, and periodic operating results. In contrast, shareholders of the Boston Celtics can, at least 82 times per year, open the sports pages and check how their investment is doing. Further, few other companies feature television and radio broadcasts of business activities and such widespread public debate over successes and failures. So the first question we address is whether or not the market responds to these signals. That is, do investors use game results to revise their expectations of future cash flows?

This begs the question of why people invest in sports franchises and, specifically, the Celtics. While the motivation for buying stock in a Fortune 500 firm is most probably financial, owning part of a sports franchise could be fundamentally different. For example, many owners of sports franchises receive extensive media coverage due to their teams' exploits. The utility they derive from such exposure, as well as utility from winning -- even "at all costs" -- could confuse the relations between financial (or team) performance and franchise value. That said, Celtics' shareholders, due to the diluted nature of their claim, cannot realistically expect to benefit from ownership to the same extent as the majority owner of a sports team can (e.g., the attention garnered by Jerry Jones of the Dallas Cowboys). They also receive virtually no control rights due to their limited partner status. Celtics' shareholders might want simply to own a piece of the team, possibly to be able to put a stock certificate on the wall, and this demand could be independent of the financial fortunes of the franchise. However, this type of demand could be satisfied by a very small number of shares and would seem unlikely to lead to significant trading.

tax years after 1997, when all publicly traded (or master) limited partnerships are treated as a corporation for tax purposes (see Jones and Sommerfield, 1993, for a nontechnical discussion, or I.R.C. § 7704). The other possibly material difference is in the area of agency considerations. For example, given their "limited" status, it might be very difficult for limited partners to replace the general partner should they desire to do so.

Nonetheless, we cannot erase the possibility that the firm's performance in the market is disconnected from its value to its owners. A win-at-all-costs attitude, present or not, in the Celtics (or any other firm) is most difficult to detect.

We hypothesize that the trading behavior of the Celtics' shares (e.g., returns, volume, and volatility) is a function of the financial performance of the firm, either changes in expectations of future performance or deviations in realized performance from expectations. Due to evolving expectations of the firm's fortunes and the plethora of available definitions of financial performance, it is difficult to directly test this hypothesis with a sample of our size (ten full fiscal years of data). The data seem consistent with our hypothesis, however. For example, returns on the Celtics shares during the season ending in year t have a positive significant statistical relation with the firm's income from continuing operations in fiscal year $t+1$ (results not reported). This is consistent with investors trading on their expectations of future performance (and those expectations being accurate on average).

Operating under the belief that trading in the Celtics' shares is a function of the financial performance of the firm, it remains an open question whether the financial performance of the firm is in turn a function of the *team's* performance (i.e., winning versus losing). For some franchises (e.g., the Chicago Cubs), there might not be a positive relation. Perhaps they do not need a winning team in order to maximize firm value; they might be more profitable by fielding a fairly competitive but less expensive team.

However, there are many reasons why game results might affect cash flows. First, winning can lead to better game attendance and, therefore, more revenue. For the Boston Celtics, this is a limited effect, as their home games are sold out during most of the sample period. However, winning teams should be able to increase ticket prices more than losing teams, *ceteris paribus*. Also, continued fan interest, due at least in part to the team's successful track record, has most certainly contributed to the Boston area's construction of a new arena, where the Celtics began play in 1995. This new venue added dramatically to the ticket sales revenue of the team, boosting it from approximately \$22 million during the last year in the Boston Garden to \$35 million during the first year of play in the new Fleet Center (the 1995-6 season). The increased capacity was a double-edged sword, however. During the Celtics' second year in the new arena, the team's record fell to 15 wins and 67 losses, leading to the only decline in ticket sales revenue in our sample (from \$35 million to less than \$32 million).

Winning can also have a potentially large effect on ticket revenue through the terms of leasing of luxury boxes and suites. As the most successful NBA team of the 1990s, the Chicago Bulls were able to sell lucrative multiyear leases for their suites when they moved into their new arena. In contrast, the Golden State Warriors were saddled with poor recent on-the-court performance and were forced to offer one- and two-year leases (for less money per year) when their new venue opened.

Advertising and licensing revenue is another source of income that is likely to be closely tied to team performance. Successful teams should be able to attract more viewers and potential customers for clients as well as sell more team-related items. For the NBA, such effects are local. National television contracts and licensing revenues are shared across all teams, independent of their respective records. However, teams are free to negotiate local media deals and also to keep any profits from merchandise sales in their franchise-owned stores. Thus, teams' revenue from advertising packages and, to a lesser magnitude, merchandise is indirectly a function of how well they play.

A large (and immediate) variable source of revenue that depends on winning games is the playoffs. If most home games are sellouts, and the team plays a fixed number of home games each regular season, then the playoffs are the only way to dramatically increase the current year's game revenue. Over the entire sample, the *net* revenue per playoff game for the Boston Celtics is approximately \$200,000. Whether or not the team makes the playoffs, and how far it goes into the playoffs, can have a significant impact on the year's earnings. For example, in 1992, the net income applicable to the Celtics' limited partners was \$1,149,285. For the same year, the net income from the playoffs was \$1,733,818. Thus, making the playoffs turned an annual loss of \$0.09 per share into a profit of \$0.18 per share.

Aside from the more direct impact on cash flows, winning can have an impact on the value of the franchise through the value of its reputation. Many studies have found that corporate conduct, for example, has a significant impact on the value of firms (e.g., Barber and Darrough, 1996, and the references therein). The Celtics have a proud and illustrious history, including 16 league titles and two of the top ten teams in history (as selected by a panel of sportswriters). By winning, the Celtics could add to or maintain their "goodwill" or franchise value, and losing

could detract from the value built over the years before their public offering.

3.1. *The relation between winning, value, and income: empirical evidence*

Ultimately, the links from firm or franchise value to cash flows and to team performance is an empirical question. We address this question in two stages. First, we test for relations between team performance and estimated franchise values and net income using panel data from teams of the National Football League (NFL), Major League Baseball, and the NBA. Second, we look for relations between the Celtics' performance and their cash flows.

To test for a relation across several sports franchises, we use data from *Financial World's* annual valuation of major sports franchises. Their analysis, done from 1991 to 1997, produces estimates of operating income (including gate receipts, media revenue, stadium revenues, player salaries, and operating expenses) and franchise value for each team. Table 2 shows the results of random-effects regressions of franchise value and operating income for a given year on winning percentages for the two most recent seasons. A Hausman test for the random effects fails to reject the null hypothesis of no relation between the regressors and the error terms. The random effects control for team-specific unobserved variables, such as market size and lease arrangements. We also include (but do not show) dummy variables for each sport-year in order to control for sportwide effects (e.g., player strikes).

Column 1 of Table 2 presents the results for regressions of franchise value (in millions) on the prior two seasons' winning percentages. The relation between lagged winning percentage and franchise value is positive and significant at the 1% level. A ten percentage point increase in a team's winning percentage is associated with a \$2.6 million increase in franchise value the following year. This could be the result of *Financial World's* methodology; the multipliers they use for franchise income could implicitly reflect the team's performance. A measure of financial performance that is less dependent on their judgment is operating income, which does not depend on a subjective multiplier. Column 2 of Table 2 presents regressions of franchise operating income on the previous two seasons' winning percentages. The results are consistent with those in Column 1; lagged winning percentage has a significant

(at the 1% level) positive relation with operating income. A 10 percentage point increase in a team's winning percentage is associated with a \$740,000 increase in operating income the following year.

[Please insert Table 2 about here]

To test for a similar relation for the Celtics alone, we regress changes in net basketball revenue for the Celtics LP on the number of wins in the prior season plus a dummy variable set to one for the year of the stadium change. We define net basketball revenue as regular-season plus playoff revenues minus the sum of regular-season costs, playoff costs, general and administrative expenses, and selling and promotional expenses. Our goal in constructing this measure is to exclude discontinued operations as well as taxes and interest expense. While the data here are certainly limited (we only have financial data for the fiscal years 1986-1997), the evidence is consistent with a positive relation between winning and cash flows. In Column 3 of Table 2, we use the change in net basketball revenue per share as the dependent variable, and exclude playoff-related income and expenses. The number of wins in the prior year is significant at the 5% level and the coefficient implies that an extra win in year t is associated with an almost \$0.06 per share increase in *net* revenue from year t to $t+1$. Column 4 presents results for changes in net basketball revenue (including playoffs) as the dependent variable. Here again, the results are significant at the 5% level; an extra win is associated with an almost \$290,000 increase in *net* revenue. The results in Table 2 suggest that successful (in terms of wins) sports franchises – both in general and the Celtics specifically - are profitable. Furthermore, subject to the *Financial World* estimates, winning increases franchise value.

Even if games contain information about future cash flows from the firm, transactions costs could wash away any observable effect on the Celtics' share price. Since acting on information is costly, investors might accumulate information until their revisions are large enough to justify action. Such accumulation would imply a negligible effect on a game-to-game basis. This line of reasoning leads to our first testable null hypothesis: *Returns and trading activity (e.g., volume and volatility) in the shares of the Boston Celtics LP are unrelated to team performance (i.e., game results)*. In other words, "games don't matter." The alternative hypothesis is that trading activity is related to team

performance.

3.2. Evidence from volume and volatility

There are many ways to test the hypothesis, but the simplest is to examine if trading volume and volatility are different during the season and on trading days after games. Table 3 shows that mean daily trading volume is higher during the basketball season. We define the Celtics season as the period from November 1 to the later of May 31 or the Celtics' last game. Using a nonparametric Mann-Whitney (U) test, the difference between on-season and off-season trading volume is significant at the 1% level. Furthermore, at the 5% level, the average volume for days following games (4,934 shares) is higher than that of all other trading days (4,378 shares). On-season trading days that do not follow a game have a higher mean trading volume (5,089 shares), although the data are positively skewed and trading volume for trading days following games is still significantly larger at the 5% level using the nonparametric test.²

[Please insert Table 3 about here]

We also test whether volatility differs across these subsamples by calculating the daily variance of returns using the Garman and Klass (1980) "Best" Analytic Scale-invariant Estimator. The advantage of this estimator is that it incorporates daily opening, high, low, and closing prices, yielding a more accurate estimate than simple close-to-close estimators. (The authors show that this estimator yields an estimate of variance about 7.4 times more efficient than an estimator using only close-to-close data.) The formula for this "Best" estimator of day t variance is

² The means are affected by three high trading volume days. Two of these days are during the season but not following games. We are suspicious of the validity of these three volume figures for three reasons. First, the differences between the daily high and low prices are only one tick for two of the days and only two ticks for the third day even though volume is roughly 100 times the daily average. Second, for one of the days, Comstock reports a significantly lower (normal) volume. Third, one of the days with a one-

$$\hat{S}_t^2 \equiv 0.511(u_t - d_t)^2 - 0.019[c_t(u_t + d_t) - 2u_t d_t] - 0.383c_t^2, \quad (1)$$

where u_t , d_t , and c_t are daily high, low, and closing prices minus the opening price.

Using Eq. (1), the mean volatility (standard deviation) for the sample is 15.38%. As Table 3 shows, the mean volatility during the season is higher than that of the off-season; the difference is significant at the 1% level. Likewise, mean volatility is higher on trading days following games (15.92%) compared to all other days (15.18%) and to on-season, no-game days (15.48%), and both differences are significant at the 5% level. Both the volume and volatility tests support the hypothesis that the Celtics' games matter to investors, and there is an ordering of both measures of trading activity. The least activity occurs on off-season days, followed by on-season days that do not follow a game, with the most activity occurring during the season on days following games. These statistics on volume and variance reject our first hypothesis in favor of its alternative: *yes, games do matter*.

3.3. Evidence from returns

In addition to volume and volatility, games can affect returns. Of course, in an efficient market, if shares are trading on financial performance and financial performance is in turn based on the team's performance, the expected team results should be incorporated into the share price before the games are played. If the Celtics win, but the market expected them to, the game might have no new information about the firm's future cash flows. Consequently, there is no reason to expect a strong relation between game outcomes that are unadjusted for the expected result and changes in the Celtics' share price. The obvious way to capture these market expectations is to use the betting-market point spreads.

Intuitively, point spreads should reflect expected point differences. Gamblers benefit from private information or superior ability to predict game outcomes. Through betting, their beliefs are incorporated into the

tick move is available on the TAQ database and high volume is due to one large trade that did not move the price. Consequently,

betting market's analog to price, the point spread. Betting-market participants have incentives to bet until the spread matches their assessment of the expected outcome (within a range dictated by transaction costs). The final spread should be a good measure of informed investors' consensus opinion of the likely outcome.

This question has been examined at length in the betting market literature; see Sauer (1997) for a review of that literature. With a couple of exceptions, the empirical evidence supports the assertion that point spreads are unbiased predictors of game outcomes. In his survey of the betting-market literature, Sauer concludes that "as a rule, point spreads are efficient estimates of the median of the distribution of score differences" (p. 71). The results of earlier studies utilizing small samples are not so promising. For example, Zuber et al. (1985) and Amoako-Adu et al. (1985) find little evidence of a statistical relation between point spreads and actual outcomes. However, later studies use larger samples of NFL and NBA games and find greater evidence of an efficient betting market. Sauer et al. (1988), Gandar et al. (1988), and Dare and McDonald (1996) cannot reject the null hypothesis that the betting market is efficient, at least to the point at which profit opportunities exist.³

Thus, it seems reasonable to operate under the assumption that the NBA betting market is efficient. For our sample of 1,032 games, the average margin of victory net of the point spread is less than a quarter of a point, and bets on the Boston Celtics against the spread win almost *exactly* 50% of the time (see Table 1). Consequently, we propose a second related hypothesis: *The return-relevant measure of team performance is the unexpected outcome, or the game result net of the point spread.* In a world free of transactions costs, a violation of this hypothesis could be thought of as an arbitrage opportunity. That is, if the share price reacts to game outcome, but does not reflect the betting

we suspect these three days' abnormal volume is due to keying errors.

³ A study reaching a different conclusion is Golec and Tamarkin (1991). See Sauer's (1997) review article for a discussion of the difficulties in interpreting their results. In addition to this evidence, other strands of the betting market literature provide further support for the use of point spreads in the study here. First, while there is some evidence of in-sample trading rules that take advantage of possible inefficiencies in the point-spread market, due to transaction costs or out-of-sample results, such rules do not appear to be inconsistent with an efficient market. For example, Camerer (1989) finds that bettors in the basketball market irrationally believe in the "hot hand," but that the observed irrationality is not large enough for a bettor to profitably exploit. Another example is the apparently profitable trading rules of Zuber et al. (1985), whose results are not robust to out-of-sample tests (Sauer et al., 1988). Second, point spreads for NBA games have been shown to move in the direction of the actual outcome

market's expectations, one can hedge one's stock market position via the betting market and expect to capture returns in at least one set of possible outcomes. For example, if the Celtics are favored to win, but the stock price responds to the actual game outcome, one can buy the stock and bet against the Celtics. If the Celtics lose, depreciation in the stock will be offset by betting winnings. If they win by an amount greater than the spread, gains in the stock will offset losses on the bet. If the Celtics win, but do not beat the spread, the above strategy will profit on both the stock position and the bet. However, there are significant transaction costs in the Las Vegas betting market, characterized by the "eleven for ten rule," whereby one must bet \$11 to receive \$10 upon winning. Combined with the bid-ask spread faced by investors trading Celtics' shares, these costs make violations of our hypothesis unlikely to generate any realistic arbitrage opportunities.

That said, testing this hypothesis is also a means of testing a type of market integration. We are trying to assess whether the two markets of interest, the stock market and the betting market, reflect similar expectations. The betting market provides a clean signal of these expectations via the observable point spread, leaving the question of whether the stock market is incorporating the same expectations. By isolating the Celtics' results net of expectations (point spreads) and looking for a market reaction to this "net" information, we address that question.

To test for the relation between returns and game outcomes, we first regress the Boston Celtics' daily returns on the CRSP equal-weighted market index returns, using the entire sample period. Using the value-weighted index or the S&P 500 index return lowers the R^2 s and t -statistics from the regressions but does not change the significance of the variables. The estimated market model is $Return = 0.00030 + 0.29167 * EWRETD$, where $Return$ is the Celtics' daily return and $EWRETD$ is the daily return on the CRSP equal-weighted index. The market coefficient is significant at the 1% level. The residuals from this regression, labeled $Abnormal Return_t$, capture the return not explained by the market and the Celtics' covariance with the market. Panel A of Table 4 gives the mean abnormal returns for days following games, grouped by wins and losses (absolute and spread-adjusted). For Panel

(Gandar et al., 1998). Finally, Brown and Sauer (1993) find that errors from a point-spread model appear related to fundamentals rather than noise.

A of Table 4, we sum the point differences and spreads over all games since the last trading day. For example, consider a weekend when the Celtics are favored by five points Friday night and are seven-point underdogs on Sunday. If they win Friday by five points and lose Sunday by six, then the Celtics “lose” for the weekend but “win” against the spread. In other words, positive summed point differences are “wins” and positive summed spreads indicate an expected “loss.” For Panel B, returns count toward all appropriate groups (e.g., if over the weekend the Celtics unexpectedly lose, and have an expected win, the Monday return will be included in both of these groups).

[Please insert Table 4 about here]

It is clear that different outcomes lead to different average returns. Regardless of the outcome against the spread, unadjusted wins yield positive returns and unadjusted losses yield negative returns. Winning the game results in a positive price change, independent of the outcome versus the spread. Similarly, losing the game results in a negative average return, regardless of the outcome versus the spread (although the average return in the event of a win versus the spread is very small). On the surface, these results seem to indicate that it is the unadjusted game outcome that matters rather than the results against the spread. Table 4 also shows the significance of differences between mean returns. For example, winning the game and beating the spread results in a significantly higher return than losing the game and losing against the spread.

Another way of analyzing the importance of actual outcomes versus ex ante expectations is to partition trading days into four groups based on whether the Celtics are expected to win or lose and whether they actually win or lose. (Partitioning returns in the manner used in Panel A and excluding any return for which different outcomes have occurred since the last trading day do not qualitatively change the results.) The four possible combinations are expected win (denoted $E[\text{Win}:\text{Win}]$), unexpected loss ($E[\text{Win}:\text{Loss}]$), unexpected win ($E[\text{Loss}:\text{Win}]$), and expected loss ($E[\text{Loss}:\text{Loss}]$). Panel B of Table 4 shows the results of this analysis. Notice that the signs are as we naively would expect given the categorical breakdowns. A win results in a positive average abnormal return and a loss in a negative average abnormal return. Surprisingly, an unexpected win results in a

smaller positive price change than an expected win. Difference-in-means tests show that only the differences between actual wins and losses are significant. These results offer only moderate support for the hypothesis that the stock market's expectations are reflected in the point spreads. If both markets have the same expectations (assuming that the point spread is an unbiased estimator of expected outcome), we would expect a greater (more negative) return for an unexpected win (loss) than an expected win (loss). Counter to this hypothesis, expected wins are associated with bigger returns on average than unexpected wins, but unexpected losses have more negative returns than expected losses. Note that neither of these differences is statistically significant.

To further test our predictions concerning the role of investor expectations, we can examine the degree to which the signal received was expected (and, equivalently, unexpected). To proxy for the magnitude of unexpected game results, we construct a variable labeled *Cumulative Spread_t*, which for a given trading day equals the cumulative points by which the Celtics beat (or lost to) the point spread since the last trading day. An analogous variable, *Cumulative Points_t*, equals the cumulative points by which the Celtics won or lost since the last trading day, ignoring the point spread. Our second hypothesis can be tested by determining if *Cumulative Spread_t*, the spread-adjusted results, has a stronger relation with returns than *Cumulative Points_t*, the results unadjusted for expectations.

3.4. Which games matter?

There is no obvious reason to expect a different market reaction (in magnitude) to good news as compared to bad news. The evidence above is consistent with the hypothesis that firm cash flows are a function of the team's on-court performance. If the team performs above expectations (e.g., winning when they are not expected to or by more than they are expected to), it should imply a higher expected present value of the cash flows from the stock (for example, due to increases in expected ticket revenue). This should then lead to a higher market price and higher observed returns. Likewise, performing below expectations should lead to lower returns. However, the literature contains examples of investors giving different weight to positive and negative signals. For example, Camerer (1989) finds evidence that in assessing the team's outlook, bettors place different weights on winning and losing streaks. They place a higher probability on losing streaks persisting versus winning streaks; in a

way, they are pessimistic. Applied here, this leads to another null hypothesis: *Investors (and therefore returns) respond symmetrically to positive and negative unexpected team performance*. That is, the effect on returns should be equal in magnitude for unexpected wins and unexpected losses. We have already seen from Table 4 some evidence against this hypothesis in that investors seem to respond differently to wins and losses (both expected and unexpected and before and after adjusting for the spread).

While wins and losses can have effects of differing magnitudes, the timing of the game might also alter the strength of any effect. As mentioned previously, one of the most immediate reasons that winning implies greater expected cash flows to investors is the increased expected playoff revenue. Playoff wins (or losses) could have a greater effect on returns than regular-season wins due to a much greater impact on the probability of future playoff games. This implies the following hypothesis: *Playoff wins and losses have a greater impact on returns than regular season results*. If true (i.e., playoffs matter more), this could have two possible implications for the previous results. First, due to their relative importance to the firm's cash flows, the playoff games could be driving the observed relations. Alternatively, the effect of regular-season games could remain, with the playoffs having added impact.

In order to test these hypotheses, we use *Abnormal Return_t* (in basis points) as the dependent variable in the following regressions. The sample for these regressions is limited to days after games are played (i.e., trading days when games were played since the last market close). There are 793 trading days that follow games. Due to the nature of the regressions, the estimates are virtually identical when run over all of the days. In this case, the independent variables take on zero values on days other than post-game trading days. To test for a relation between the returns and game outcomes, we regress *Abnormal Return* on *Cumulative Spread*. We then replace *Cumulative Spread* with *Cumulative Points* in the regression for an alternative model. In additional regressions, we allow for differential slopes for wins and losses, testing our third hypothesis (equal magnitude of response to wins and losses).

To test for the importance of playoffs, we construct a categorical variable, *Playoffs_t*, that equals one if there

is a playoff win since the previous trading day, negative one if there is a playoff loss, and zero otherwise.⁴ This variable is then included in each regression. Thus, including the differential slopes, we estimate the following equations:

$$\begin{aligned} \text{Abnormal Return}_t = & \mathbf{a}_0 + \mathbf{a}_1 \cdot \text{Cumulative Spread}_t + \\ & \mathbf{a}_2 \cdot \text{Cumulative Spread}_t \cdot \text{Loss Dummy}_t + \mathbf{a}_3 \cdot \text{Playoff}_t + \mathbf{e}_t, \end{aligned} \quad (2)$$

$$\begin{aligned} \text{Abnormal Return}_t = & \mathbf{b}_0 + \mathbf{b}_1 \cdot \text{Cumulative Points}_t + \\ & \mathbf{b}_2 \cdot \text{Cumulative Points}_t \cdot \text{Loss Dummy}_t + \mathbf{b}_3 \cdot \text{Playoff}_t + \mathbf{e}_t, \end{aligned} \quad (3)$$

where *Loss Dummy*_{*t*} in Eq. (2) (Eq. (3)) equals one if *Cumulative Spread*_{*t*} (*Cumulative Points*_{*t*}) is negative and zero otherwise. Thus, these dummy variables allow for the slope coefficient of game outcomes to differ across cumulative wins and losses. These are "cumulative" losses in the sense that *Cumulative Spread* (*Cumulative Points*) measures the total amount by which the Celtics win or lose to the spread (to opponents, ignoring the spread) since the last trading day. Over the entire weekend, for example, if the Celtics lose by more than they win, then this is counted as a cumulative loss. If returns reflect game results and point spreads capture the stock market's expectations, we expect the \mathbf{a}_1 coefficient in Eq. (2) to be positive, and it should be larger (and more significant) than the \mathbf{b}_1 coefficient in Eq. (3). Another confirmation of the importance of point spreads would be a higher R^2 for Eq. (2).

[Please insert Table 5 about here]

The basic results for the importance of wins, losses, and playoffs are summarized in Columns 1 and 2 of

⁴ We use a categorical variable because the real key is whether or not the team wins and enhances its chances of advancing in the playoffs. We believe this should be more important than by how much the team wins, even if the margin of victory is used to infer the probability of future playoff wins. An alternative specification in which the playoff win dummy is multiplied by the cumulative point spread difference (a slope instead of intercept effect) yields similar results. Subsequent results using the expectation variables also support the specification used here.

Table 5. The estimated a_1 and b_1 coefficients are both significantly different from zero at the 10% level. While these coefficients are very small in magnitude, it is important to remember that they represent the change in return for a one-point change in game outcome. Thus, holding all else constant, winning by ten points would predict about a five basis-point higher return for the next day than matching the spread. While this is less than transaction costs, it is not small compared to the mean daily return for the Celtics of 0.044%. The point-spread-adjusted coefficient indicates that the expectations captured by point spreads do not explain returns significantly better than the naive estimator (e.g., it is larger in magnitude, but has less significance). Consequently, it is not clear how much value-relevant information point spreads capture, and we cannot reject our hypothesis that expected outcomes matter. As above, these results reject the hypothesis that there is no relation between the Celtics' return and the game outcomes.

Due to the multicollinearity between the spread-adjusted outcome and the unadjusted outcome, it is not possible with our sample size to detect separate effects of these variables in a regression model including both variables. Another source of concern is the models' explanatory power. While the slope coefficients and the regressions as a whole are significant, the adjusted R²s from both equations are small (3%).

These results are somewhat in contrast to those of Scherr et al. (1993), who concentrate solely on the relation between the Celtics' game outcomes and returns. They use ANOVA analysis to test for a potential effect of win/loss/no-game on returns. The results indicate that there are differences among the three conditions, but that playoff games drive their results. During the playoffs, wins are followed by greater returns than losses, and these effects are stronger than those for the regular season. In fact, Scherr et al. argue that "regular season results are no news at all" (p. 80).⁵

⁵ Scherr et al.'s analysis can be viewed as incomplete for several reasons. First, they do not adjust for the market's expectations about the team's performance. If the Celtics win a game in which they are favored, there is no obvious reason to expect a price effect. Second, their methodology only differentiates between potential signals (i.e., the previous day's win or loss), and not the relative strength of the signal (i.e., by how much the team wins or loses). They also only include games played the day before the trading day, ignoring games played since the most recent trading day but before the preceding day (e.g., Saturday or Friday games). Their sample period is necessarily shorter than the one used here, possibly limiting their ability to find the proposed relations between

Columns 3 and 4 of Table 5 summarize the results of the tests of equivalent magnitude of responses to wins and losses. The estimated coefficients for the *Cumulative Spread_t* and *Cumulative Points_t* variables are no longer significantly positive. In contrast, the slope coefficients for the loss dummy times the point differential variables are significantly positive at the 1% and 5% levels, respectively, with estimated \mathbf{a}_2 equal to 3.24 (p-value of 0.002) and \mathbf{b}_2 equal to 1.98 (p-value of 0.026). F-tests of the null hypothesis that $\mathbf{a}_1 + \mathbf{a}_2 = 0$ and $\mathbf{b}_1 + \mathbf{b}_2 = 0$ reject the null at the 1% level. These coefficients are four to five times the slope estimates in Columns 1 and 2; it is apparent that losses are driving the relation. This is evidence of an asymmetric response by investors to game results: *losses are penalized by much more than wins are rewarded*. These findings allow us to reject the null hypothesis that the returns are symmetric. They also weakly support our second hypothesis that spreads matter: incorporating spreads into the analysis increases the loss coefficient by about 50%, but with a small effect on adjusted R²s. As another check of this asymmetry, we model the effect due to wins and losses as differences in intercept rather than slope. These estimates, not reported here, result in significant negative intercepts for losses for the unadjusted differential and insignificant intercepts for the wins for either differential. This evidence is also clearly inconsistent with our symmetric response hypothesis. Allowing for differential slopes and intercepts (i.e., separate regressions) yields similar results.

The playoff games result in a significant effect on the following day's return, regardless of the specific equation used. In fact, after including the potential impact of playoffs, the coefficients on the regular-season loss variables are essentially of the same magnitude as those without the playoffs variable (results not reported). The economic impact of the *Playoffs* coefficient in all of the specifications is larger than that implied by the results for regular-season games. For example, the average margin of victory or loss against the spread is about nine points. For a regular-season loss by this average margin, the Column 4 coefficients of Table 5 imply a subsequent return of -0.20%, compared to a predicted return of -0.89% if the game had been during the playoffs. We therefore

games and returns. Scherr et al.'s paper only addresses returns, ignoring other important variables, such as volume and volatility.

conclude that the playoff effect is significant above and beyond the regular-season impact of losses. This is consistent with our prediction that playoff games matter more than regular-season games. We also estimate the equations allowing the magnitude of the playoff response to vary over wins and losses. We are unable to reject the null that the return coefficient for a playoff win equals the opposite of that for a playoff loss. (This could be attributable to a small sample of playoff games.)

Another way of determining the importance of investor expectations is to regress returns on the expectation variables (described above and shown in Panel B of Table 4). Each trading day after a game is put into at least one category based on the expected outcome of the game(s) and the actual outcome(s) since the previous trading day. These categories result in four time series containing nonnegative integer values which represent the number of games played (since the previous trading day) that fit into each category. Four additional series are created by multiplying each series by a dummy variable that is equal to one for a trading day after a playoff game and zero otherwise. Estimated regressions of *Abnormal Return* on these variables (not reported) are as we would expect given the previous results: regardless of expected outcome, only actual losses (expected or unexpected) seem to have a significant impact on returns. Interpreting regression magnitudes also yields similar results to those shown in Table 4. For example, an actual loss when a win is expected results in an average -0.4% abnormal return over the effect from covariance with the CRSP equal-weighted index. This approach shows that, surprisingly, wins seem to matter only in the playoffs. The coefficients for the playoff variables are each of the expected sign and significantly larger than the coefficients for the regular-season variables. An expected playoff win results in a positive abnormal return of about 1.1%, and an unexpected playoff win yields an abnormal return of about 0.7%. An unexpected loss during the playoffs implies a negative abnormal return of about -0.8%, and an expected playoff loss results in a negative abnormal return of -0.4%. Note that these returns are much more symmetric than the equivalent regular-season returns.

The playoff effect actually appears slightly larger than one would expect based on the cash flows directly

Finally, they do not exploit the fact that games occur when the market is closed.

from playoff games. As mentioned above, the average net revenue per playoff game during our sample is about \$200,000. Dividing this by the roughly six million shares outstanding during the sample implies an increase in net revenue of \$0.033 per share per playoff game. The estimated 1.1% return effect for a playoff win implies a price increase of \$0.20 using the sample average closing price of \$18.55. Thus, the returns based on our point estimates above appear a little large compared to this direct revenue effect, especially considering that the market should have some ex ante beliefs about the likelihood of future playoff games. Of course, the impact on other cash flows from playoff success (e.g., next season's ticket sales), error in estimating our coefficients, and the impact of one game on the likelihood of several future games being played could close the gap.

This section has detailed evidence consistent with the hypotheses that games matter and playoff games matter even more. Clearly, games contain value-relevant information that is used by investors. Playoff games contain comparatively more information than regular-season games, but do not explain the entire relation. However, the evidence is mixed with respect to our point-spread hypothesis (spreads capture the relevant expectations) and the symmetry hypothesis (investors respond symmetrically to wins and losses). There is no obvious change in estimated relations when point spreads are used to capture market expectations. Investors respond asymmetrically to regular-season games but symmetrically to playoff games. The response to playoff games appears large given the direct impact of one game on revenues but is of roughly the same order of magnitude. As many of our data are atypical (e.g., the potentially large impact of discrete price changes), the Appendix discusses several checks for the robustness of the results of this section and the next section. These tests show that the above results are robust to corrections for autocorrelation in the errors, the possibility of non-normally distributed OLS coefficients, alternative specifications exploiting the discrete nature of price changes, and alternative measures of the variables employed.

4. The timeliness of information effects

Since games occur exclusively when the market is closed, analyzing the Celtics provides insight as to when publicly available information is embedded into stock prices. French and Roll (1986) cite evidence of

increased variance during trading hours and test hypotheses that could explain the observed pattern. They consider whether high trading-time volatility is caused by public information which is more likely to be observed during normal business hours, by private information which can only affect prices through trading when the exchanges are open, or by pricing errors (noise) that occur during trading. French and Roll conclude that while there is evidence of mispricing, this leads to a small fraction of daily variance and explains very little of the difference between trading and non-trading variances. Differences in the information flow is then the most likely explanation. Furthermore, the authors give evidence that most of this information is private.

While French and Roll implicitly observe closed-market volatilities, Stoll and Whaley (1990) are able to directly estimate closed-market volatilities using opening stock prices. Stoll and Whaley also find that stocks on the NYSE tend to be more volatile during the day, particularly so near the market's opening. The authors conclude that at least some component of the higher daytime volatility is due to private information revealed through trading, but most of the difference between closed- and open- market volatility is found to be due to the availability of public information. More recently, Chang et al. (1995) find that volatility in the Standard & Poor's 500 index futures market drops significantly after the NYSE closes, supporting the hypothesis that substantial volatility is contemporaneous with trading. Because it seems unlikely that there would be a big difference in the amount of publicly available information released right before the bell versus right after, we take this as further evidence that noise or private information is responsible for substantial volatility. Ederington and Lee (1993) find that variations in volatility in the fixed income and foreign exchange markets are strongly related to macroeconomic news releases. After correcting for these public signals, intra-week seasonal patterns in volatility essentially disappear. Though the authors do not attempt to estimate closed-market volatilities, we interpret their results as supporting the finding of Stoll and Whaley (1990) that higher open-market volatility is mainly due to releases of publicly available information.

We add further evidence by considering a security whose relevant information flows are in direct contrast to those of the typical stock. The Boston Celtics' games represent substantial public information that is not revealed during normal business hours. Games are played at night and over the weekend, when markets are closed. This

leaves the empirical question of when and if this information is impounded into the share price. If the price-relevant information in games is a primarily objective (or public) reassessment of future cash flows or risk, then the price should adjust while the market is closed, re-opening at a new equilibrium price. If the price-relevant information is evaluated subjectively (or privately), then the price will respond as investors trade on it, which they can only do once the market is again open. This reasoning leads to the following hypothesis: *If there is a private component to game-related information, it will not affect prices until after the market has opened.*

French and Roll (1986) construct a ratio of the variance of the return from Friday's close to Monday's close to the average weekday close-to-close return variance. They find an average weekend-to-weekday ratio of 1.107 across all stocks in their sample; the null hypothesis of constant variance implies a weekend/weekday ratio of 3.0. Interpretation of this small ratio is difficult since it can be attributed to either (1) the reduced amount of public information released over the weekend, (2) the inability of traders to incorporate private information into stock prices while the market is closed, and/or (3) temporary mispricing caused by trading itself.

Compared to a typical stock, the Celtics have a much larger portion of their value-relevant public information released between Friday's close and Monday's close. This suggests that if the low weekend ratios are attributable to less public information, then the ratio should be larger for the Celtics during the season, compared to the off-season. For our full-sample period, the Celtics' weekend close-to-close variance ratio is 1.35. The on-season ratio is 1.84, and the off-season ratio is 0.92. This is evidence that some of the widespread low closed-market variance is due to the absence of new public information over the weekend. When such information is present during the season, the ratio is about twice as large but still far from 3.0. This result implies that public information accounts for a little more of the volatility observed in stock prices than is suggested by the French and Roll results.

To formally test our hypothesis, we construct two volatility series using daily opening and closing prices. Closed-market volatility is defined as the absolute percentage price change from the previous day's close to the open. Likewise, open-market volatility is defined as the absolute percentage price change from the open to the close. We annualize the figures by multiplying by the square root of 506 since there are on average this many total

open- and closed-market periods each year during our sample. Note that another way of normalizing the volatilities would be to measure average hourly volatilities. We run the following tests with these hourly estimates and without exception strengthen the significance of the results. We do not compare the Garman and Klass (1980) “Best” estimator for open-market volatility with this naive estimator for closed-market volatility because we want to use the same type of estimator for both subperiods. Using the “Best” estimator results in higher volatility estimates than using the naive close-to-close estimator; this would result in a systematic bias toward higher relative open-market volatilities.

[Please insert Table 6 about here]

Panel A of Table 6 shows the median closed- and open-market volatilities for the period from January 1993 through May 1998 for which we have trades available from the TAQ database.⁶ It is not surprising that a Mann-Whitney (U) test for differences between open- and closed-market volatilities rejects the null hypothesis of no difference at the 0.1% level. Partitioning the sample into days after games are played and all other days yields similar results. The last row of Panel A compares sub-period volatilities for trading days after games and all other days. Closed-market volatilities are not significantly higher for closed-market periods during which at least one game is played. Interestingly, open-market volatility is higher for trading periods directly following games. This suggests that, in support of our hypothesis, games cause investors to revise their private beliefs about the firm. These revisions lead to increased volatility the following day, as the private information is impounded into prices after the market opens. Aside from interpreting the games’ scores differently, investors could be subjectively evaluating (1) the effect of injuries or minutes played, (2) the individual performance of players, (3) how the team “looked,” or (4)

⁶ Our concern over the validity of opening-price data from 1986-1993 leads us to present the TAQ results. Results for the entire sample (using opening prices from Prophet Data Services) are very similar to those reported here. (Prophet, in turn, receives their data from Comstock, a unit of Standard and Poor’s.) Our doubts over the Prophet opening-price data stems from the fact that

what the new subjective odds are of making the payoffs.

Median closed-market volatility for periods that include games is slightly greater than, but not significantly different from, closed-market volatility of no-game periods. This does not offer much support for the hypothesis that the timing of public information leads to the difference between open- and closed-market volatility. The difference in medians between open-market volatility and closed-market volatility for game periods is slightly less than the same difference when no game is played, and open-market volatility is significantly greater than closed-market volatility at the 1% level. If public, rather than private, information were driving the difference in volatility, then one would expect this gap to narrow for game periods.

We can further break down investors' reaction to games by the games' expected and actual outcomes. Comparing closed- to open-market volatilities by game outcome consistently rejects the null hypothesis of equal volatility at the 1% level; open-market volatility is higher for *each* group (results not shown here). Panel B of Table 6 shows volatilities for periods containing (or following) games with periods not containing (or following) games. Regardless of game outcome, closed-market volatility is never significantly higher when games are played than when games are not played. In fact, when there is an expected win or an unexpected loss, closed-market volatility is significantly *lower* than when no game is played.

The opposite is generally true for open-market periods following games. The median open-market volatility for all four game outcomes is higher than the no-game median. Comparing the open-market medians for the four game-day subgroups to the median for all game days may be confusing, as all four subgroups have a higher median than the total group. However, due to multiple games over weekends and holidays, a given trading day can be counted in more than one subgroup. Furthermore, unexpected wins and losses result in significantly higher volatility on trading days following these outcomes. Because the outcomes are unexpected, these are the days we would expect to have higher volatility. These results further support the hypothesis that investors are acting on

roughly 70% of opening prices prior to 1992 are the same as the previous close (and simply from bid-ask bounce we would expect about 50% to differ).

private information after the market has opened. Furthermore, they provide additional evidence in support of our earlier hypothesis that it is the unexpected outcomes that should matter most, with our proxy for the expected game outcome given by the sign of the betting-market point spread.

These conclusions are broadly consistent with the French and Roll (1986) results that high trading-time volatility is caused by private information that can only be acted upon when markets are open, and are inconsistent with the conclusion of Stoll and Whaley (1990) that public information released when the market is open is primarily responsible for higher open-market volatility. We believe that the Celtics' shares provide a very clean test of these hypotheses. While some information is revealed while the market is open (e.g., trades, details about player injuries, interviews with players and coaches), the bulk of the Celtics' value-relevant signals occur when the market is closed. In no case are closed-market volatilities higher than open-market volatilities. The Appendix also discusses several robustness checks.

5. Non-game events

While the above analysis addresses the impact of Celtics' games, there are many potentially interesting non-game events that can also shed light on the trading patterns of the Celtics' stock. In this section, we study two important events: the collapse and rebirth of the deal for constructing the new Boston Garden and the hiring of Rick Pitino as the Celtics' head coach.

5.1. The new Boston Garden

In February 1993, the deal for the construction of the new Boston Garden fell apart. Two weeks later, the deal was revived, and construction went forward later that spring. The "old" Boston Garden was no longer a state-of-the-art facility and had made it difficult for the Celtics to be financially competitive. For example, the Celtics fell from first in the league in revenues in 1984 to ninth in 1992 because "they did not have the building perks or good seats to charge top dollar" (Boston Globe, February 13, 1993, p. 83). In fact, the NBA was exerting pressure on the team to find a more modern place to play.

The owners of the old Garden agreed to build a new Garden at an estimated cost of \$160 million, a deal struck after nearly 20 years of debate over a new arena in Boston. The new arena appeared to be an attractive arrangement for the Celtics, who had negotiated a ten-year, rent-free lease. The facility would contain increased luxury suites and approximately 2,000 more seats. Ex post, the new Garden proved to be more profitable. From the 1994-5 season (the last in the old Garden) to the 1995-6 season (their first in the new Garden, then named the Fleet Center), ticket revenues rose almost 60%, from \$22 million to \$35 million. Game expenses, meanwhile, were actually slightly lower after the change, from \$2.88 million to \$2.61 million. Combined with a slightly lower team payroll, this led to a jump in the Celtics' income from continuing operations from \$515,000 in 1994-5 to \$15.95 million in 1995-6.

Looking back, the new Garden was close to never materializing. On February 10, 1993, the Massachusetts House Ways and Means Committee approved legislation clearing the way for construction of the new Garden. On February 11, the owner of the old Garden and developer of the new arena abruptly withdrew from the project, saying it had become "too risky" (United Press International, February 11, 1993). This announcement sent the whole arrangement (and thus the Celtics' expected cash flows) into a world of increased uncertainty. The Boston Globe reported a variety of possible outcomes, from the team relocating to spending a season or two in a makeshift arena (e.g., Boston Globe, February 13, 1993, p. 83). With the impending demolition of the old Garden in 1995, the only consensus appeared to be that the current situation was untenable. Then, on February 24, 1993, the uncertainty of the situation suddenly cleared, as a new deal was struck between the legislature and the developers. This agreement paved the way for construction to begin in June 1993. The new plan did not change the planned arena, merely the division of cash flows between the government and developers.

Based on the news accounts of these events, and with the benefit of perfect hindsight, we view the February 11 announcement as "bad news" for Celtics investors. Of course, the collapse of the deal opened up the possibility of the Celtics obtaining an even more lucrative arrangement. However, given the strength of the Boston market for basketball, the Celtics' history there, and the attractiveness of the proposed arena and lease, we judge this unlikely. Even so, at the minimum, the deal collapse introduced substantial uncertainty over the Celtics' cash flows

from 1995 forward. It also seems likely that the announcement would have produced a divergence in opinion over the eventual outcome, leading to increased trading in the Celtics' stock. We regard the subsequent reconciliation on February 24 as "good news." Even if investors could not foresee the strength of future cash flows, there was certainly resolution of uncertainty.

Fig. 1 shows the trading activity around these dates. We present volume and stock price, but adjusting the returns for market effects gives very similar results. Estimating a market model using 150 days or one year prior to February 1993 results in a very low slope coefficient (0.06 and 0.22, respectively). Thus, creating abnormal returns is little more than a monotonic shift by the estimated intercept. The observed trading pattern is not consistent with our expectations. First, volume is relatively low around the events, even compared to the on-season average of 4,876 shares. Second, prices (and therefore returns) do not move as predicted: the price actually rises somewhat after the deal collapses, and then increases only slightly after the new deal is announced (\$0.25 per share in the five days following the announcement). One possible explanation of the initial price response is that the collapse was moderately good news, possibly due to the likelihood of relocating the team to an even more profitable environment. However, if this were true, one would then expect higher volume and a subsequent price decline when the arena was finally approved later in the month.

The only explanations we can think of that are consistent with the evidence are that either (a) Celtics' investors could not foresee the effect of the stadium on cash flows, or (b) they never doubted that the project would be completed. Given the huge eventual impact on profitability, the first of these seems unlikely (e.g., it was publicly known that in addition to the 2,000 additional seats, the new arena would have 104 lucrative executive suites compared to the old Garden's 34 boxes). Furthermore, based on the media coverage of the events (and admitted uncertainty over the eventual outcome), the second of our explanations also seems unlikely. As a more rigorous check of this second explanation, we analyze the trading behavior surrounding four Garden-related events leading up to February 1993, each of which indicates that the arena was incrementally closer to being built. These were the leak from City Hall that financing for a new arena seemed likely (August 30, 1991); the announcement that a new Garden would be built (May 6, 1992); the announcement of three banks that would provide financing (June

27, 1992); and the reaching of a tax accord, the “last major hurdle” (October 22, 1992). Based on the returns of the five trading days on either side of these announcements, only the second and third events have positive net returns, and they are only 0.6% (results not presented here). For the day of the announcement and the five subsequent trading days, the third event returns 1.9% and the fourth event returns 0.6%; the others have zero or negative returns. These magnitudes do not seem sufficient to support the hypothesis that the construction of the Garden was fully reflected in the stock price at the beginning of February 1993 and hence that the events of that month were no news. We are at a loss, then, to explain the apparent lack of trading on the information inherent in these events.

5.2. The hiring of Rick Pitino

In May 1997, the Celtics hired Rick Pitino as their new head coach. This event provides an interesting contrast to the one above. The cash flow implications were (and probably still are) much more ambiguous, but as we will show, the trading activity around the event is much more pronounced. In other words, it was and still probably is uncertain whether the hiring of Pitino is a positive-net-present-value decision, compared to the new stadium which reasonably could only have been expected to increase the Celtics’ net cash flows. Another difference is that the hiring of Pitino was expected to have both an on-the-court and financial impact, while the new arena affected mainly the financial side of the firm. It is possible that the on-the-court, team-related nature of the announcement is what distinguishes investors’ response to this event compared to the stadium-related events.

The chronology of the Pitino hiring is as follows. First, on April 30, 1997, M. L. Carr resigned as the Celtics’ coach. Speculation began immediately that Larry Bird or Rick Pitino would be his successor, with a source indicating that the Celtics were prepared to offer Pitino \$8-\$9 million per season for five seasons, plus 3% of the team (Boston Globe, May 1, 1997, p. C1). On May 1, Pitino said he would make a decision in the next week (Boston Globe, May 2, 1997, p. E1). On May 4, Pitino met with his University of Kentucky team, saying he was going to “sleep on it” and would decide May 5 or 6 (Boston Globe, May 5, 1997, p. D1). The same article quotes

sources close to Pitino as saying that he was “leaning toward taking the Celtics job.” On the night of May 5, Celtics president Red Auerbach confirmed that Pitino was taking the job, reportedly for a ten-year, \$70 million contract, but with no ownership in the team (Boston Globe, May 6, 1997, p. E1). On the afternoon of May 6, the Celtics held a press conference and officially announced the hiring of Pitino. Pitino denied that the contract was worth \$70 million, but confirmed that it was for ten years, six as head coach and the last four in the front office (Boston Globe, May 7, 1997, p. C1). Over the next few days, Auerbach relinquished his title of president and Larry Bird left his position as special assistant to be head coach of the Indiana Pacers. A confounding event to the Pitino story was the Celtics’ announcement of third-quarter 1997 earnings on May 9, which were down slightly versus the third quarter of 1996 (\$10 million versus \$10.9 million).

After the dust had settled, the opinions on Pitino’s hiring appeared to reach a consensus that it was a good basketball move but not necessarily a good financial move. For example, analyst Peter A. Russ of Shelby Cullom Davis in New York said the short-term impact was “of negative economic value” and that Pitino would not provide enough additional revenue opportunity to cover his salary for the next two to three years (Boston Globe, May 15, 1997, p. C1). Stock price behavior around the hiring mimicks this chain of events: initial optimism followed by more caution.

Panel A of Fig. 2 shows the volume and high, low, and closing unit prices for the Celtics during May 1997. As the figure shows, investors certainly appear to have been trading on the Pitino hiring information. Volume is high on April 30 and May 1 then skyrockets on May 4 and May 5 to 283,000 and 87,500 shares, respectively. The unit price also rises significantly, from a close of \$25.375 on May 2 to \$28.125 on May 5 and \$27.25 on May 6. The price then drifts down, up, and back down slightly, finishing May at a price of \$26.50. (For comparison, the closing price on April 1, 1997 is \$24.00.)

The price response in Panel A is much larger than the typical price response for CEO turnover. Furtado and Karan (1990) survey the corporate turnover literature; among the ten studies they discuss, the *largest* average abnormal return around a turnover event is 2.48% (Bonnier and Bruner, 1989, for a group of poor-performing firms). This is dwarfed by the 7.4% return to the Celtics’ shares over the comparable day -1 to day 0 period, with

day 0 the May 6 announcement date. Longer-horizon returns, while certainly suffering from potentially confounding events, do not eliminate this disparity. For example, over the day -5 to day $+15$ interval, the Celtics' shares have a cumulative return of 6.6%. While we use raw returns here, these results are robust to abnormal returns. For example, using the 250 trading days prior to day -30 from the announcement, the estimated market model is not significant (based on an F-test). Furthermore, the estimated beta for the Celtics' shares is only -0.04 and not significantly different from zero.

Based on the financial results from Pitino's first season, it is difficult to judge if this change in valuation is due to an accurate forecast of increased future cash flows. Comparing the fiscal year ending June 30, 1998 (encompassing the 1997-1998 season) to fiscal 1997, the Celtics partnership had a much better year. For example, net income applicable to limited partners rises from \$358,000 1997 to almost \$12 million in 1998. The net effect of the coaching change appears to have been negligible for this first year. While ticket revenue increases almost 23%, from \$31.8 million in 1997 to \$39.1 million in 1998, player and coaching salaries increases by approximately \$7.4 million. This excludes nonrecurring charges in 1997 of approximately \$8 million due to changes in players and coaches (e.g., \$4.6 million in contract termination costs), which make 1998's expenses almost equal to those of 1997. Aside from the jump in ticket revenue, the increase in net income is largely attributable to a more than 20% increase in revenue from broadcast rights (from \$23.3 million to \$28 million), although most of this change is due to increased national broadcast fees, not Pitino's effect on local agreements. The net impact of the hiring of Pitino on the partnership's operating performance remains to be seen. Due to the impact of the league-wide lockout that delayed the 1998-99 season and canceled 32 games, financial results from Pitino's second season might not add much more information about his long-term effect on firm value.

Panel B of Fig. 2 shows the opening and closing prices over the same period. Most of the volatility over the key days occurs while the market is open (i.e., the opening price is typically near the previous day's closing price). This is in spite of some of the information being released while the market is closed (e.g., the Globe's source story available prior to open on May 5, and Auerbach's announcement after close the same day). This is consistent with our results in Section 4, i.e., that the trading process impounds investors' private interpretations of a public signal.

5.3. *Summary*

We analyze the market response to two significant sequences of events. The first of these, the collapse of the new Boston Garden arena deal followed by the resurrection of the deal, could quite reasonably be interpreted as a “bad news” event followed by a “good news” event. The stock price response, however, is inconsistent with this story; volume never rises significantly and the unit price drifts slightly upward after both events. Ex post, the stadium was a boon for the Celtics’ finances; net income rises dramatically due to increased ticket revenue while costs are relatively flat.

The second sequence of events relates to the eventual hiring of Rick Pitino as the Celtics’ head coach. While the net present value of this decision is an open question (in contrast to the huge positive NPV produced by the new arena), the stock price response is very large. Volume soars to about 70 times its daily average, and over the month of the event (approximately), the unit price rises \$2, or 8.2%.

The fact that investors responded to Pitino’s hiring but not the Garden deal’s ups and downs could be due to the lack of information conveyed by the arena events or its lack of expected financial impact. However, based on the media coverage of the events and the ex post cash flow impact, neither of these explanations seems likely. An alternative explanation consistent with the data is that Celtics investors are more interested in trading on team-related news than non-team-related news. This explanation is also more in line with the evidence that Celtics investors respond more strongly to losses than wins. However, given the evidence that game results are positively correlated with future cash flows, Celtics investors do appear to be trading on new cash-flow relevant information.

6. Conclusion

In this paper, we address three themes. First, we analyze the impact of the Boston Celtics’ games on their partnership shares. This analysis shows that investors use game results. Volume and volatility are both higher during the basketball season than during the off-season. Returns also reflect game results. However, this reflection is asymmetric. Losses significantly affect the stock price, but wins do not. Playoff games have an even greater

impact, but the response is symmetric; payoff wins *and* losses matter.

A more interesting feature of the stock market's reaction is its potential incorporation of the *expected* game results. If the betting market and stock markets are integrated (i.e., participants in these markets have the same expectations), then controlling for point spreads should isolate the unexpected component of the game results. However, the evidence is mixed with respect to this hypothesis. For example, even expected losses have a negative price impact and unexpected wins have no significant effect. Furthermore, in our regressions of returns on various measures of team performance, adjusting the game results for the point spread only marginally increases explanatory power. Asymmetric price response and a lack of betting/stock market integration is consistent with investors, but not bettors, always expecting the Celtics to win.

Second, we extend the literature by presenting new evidence on the impact of information on volatility. Previous research has documented that volatility is higher when the stock market is open. This research seeks to attribute such a finding to the timing of public information releases, private information, and/or noisy trading. Celtics games are played when the market is closed but their effect on volatility is not observed until the next time the market is open. In support of betting/stock market integration, this effect is strongest for unexpected outcomes. We interpret these findings as consistent with the private information hypothesis.

Finally, we analyze the Celtics' unit price reaction to two sequences of events. The first of these is the collapse and subsequent rescue of the deal to build a "new Boston Garden" for the team. We expected the collapse of the stadium deal to have been treated as bad news and the subsequent rescue as good news. The Celtics unit price and trading volume, however, do not react accordingly. The second chain of events occurs around the hiring of Rick Pitino as the Celtics' head coach. Given the size of the contract, the financial impact of these events is arguably more ambiguous. Trading on the Celtics' shares certainly responds, with very high volume around the announcement and a net positive return over the period. While obviously constituting a small sample, these events are consistent with investors trading more heavily on team-related than non-team-related news.

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Appendix: Robustness of the Results

Prior research on daily stock returns has documented several properties that make us question the applicability of OLS regression methods and the assumption of normally distributed errors for inference. For example, Fama (1976, Ch. 1) and Brown and Warner (1985) describe the leptokurtic nature of daily returns and abnormal returns. Lo and MacKinlay (1990) and Roll (1984) model and test autocorrelation in daily returns. Hausman, Lo, and MacKinlay (1992), Harris (1991), Ball (1988), and others investigate the discrete nature of individual stock price changes. Each of these findings could imply that our models are misspecified or that the inference is incorrect. To determine if any of these potential problems are driving our results, we conduct a series of robustness checks on our results. These checks include several alternative specifications of our models and bootstrapping the distribution of estimated coefficients.

Perhaps the most obvious potential problem is autocorrelated errors. Estimating a simple market model but allowing for serially correlated errors results in a significant first-order autocorrelation coefficient of -0.060 (p -value = 0.000). Box-Jenkins analysis of the residuals from this model is unable to reject the null of white-noise (out to ten lags) at the 1% level. To determine if this small, but highly significant, autocorrelation has any effect on our results, we rerun all of the regressions in Table 5 using the residuals from this AR(1) market model. The results are extremely similar to those reported. Both coefficient estimates and significance levels are essentially unchanged. No qualitative change in the interpretation of the results is necessary and only one coefficient changes significance group (e.g., 1% to 5% significance level). As we would expect *a priori*, if the source of autocorrelation is random bid-ask bounce, the bounce effect should be orthogonal to the effects we are measuring. Since we suspect the autocorrelation to be the results of bid-ask bounce, an MA(1) specification seems an attractive alternative. Use of residuals from an MA(1) model also has little effect on the results.

The next source of concern is the likely non-normal distribution of the residuals. For example, the empirical distribution of the errors for the model estimated in Column 1 of Table 5 has a skewness of 1.19 and kurtosis of 8.89. These values are very similar to those reported by Brown and Warner (1985, p. 9) for a large sample of individual common stocks. A Wald test for normality yields a chi-squared statistic of 1,305.2, indicating

that the null hypothesis of normally distributed errors can be rejected at the 1% level (see Greene, 1993, pp. 309-310). Consequently, inference assuming normally distributed errors may be significantly and systematically biased. The empirical distribution and associated p-values for each of the coefficients in Table 5 are estimated using simple OLS bootstrapping techniques (see Amemiya, 1985, p. 135). Without exception, each of the reported coefficients remains in the same significance group or increases in significance.

Another concern is the discrete nature of price changes. Over our sample the share price ranges from a minimum of \$10.625 to a maximum of \$28.125. The smallest allowed price change (the tick size) is \$0.125, so using the maximum share price yields a smallest nonzero return of about 0.4%, much larger than the average daily return. Furthermore, for the full sample, 86% of the daily price changes are zero, one, or two ticks up or down. The assumption of continuous prices and errors might be inappropriate in this setting. (On June 24, 1997 the NYSE started trading with a tick size of one-sixteenth of a dollar; the subsequent analysis uses data before this date.)

To test for the effects of games in a discrete price setting, we employ the Hausman, Lo, and MacKinlay (1992) ordered probit model with the assumption of homoskedastic errors. We allow for discrete price (tick) changes in the set $\{-4, -3, \dots, 3, =4\}$. We augment the models in Table 5 by including market returns and using all days in the sample period. This allows us to estimate the market and game effects in one step. Results of this alternative estimation technique are qualitatively unchanged from those above that relied on the assumption of continuous returns. In Table 5, all of the significant coefficients increase or stay at the same significance level. While the discrete price-change models seem to fit the data better, we present the continuous-variable results above because the coefficients can be more easily interpreted. That our inference does not change in any meaningful way under the ordered probit models gives us more confidence in the results of Table 5.

Two other discrete price change models yield similar results. The first assumes a binomial distribution to price changes and restricts the maximum number of up or down moves. The probability of an up move is parameterized as the inverse of the cumulative normal function of a linear specification of independent variables (much like a probit). The second is a Poisson hurdle model. We model the absolute price change in number of ticks. These models are estimated using maximum likelihood for parameterizations designed to capture similar

effects as those in Table 5. The results are qualitatively very similar to those reported, but significance of estimated coefficients depends on the maximum allowed tick size for the binomial model and the set of hurdle factors used in the Poisson hurdle model.

As noted in the previous section, our data for opening prices might be wrong. These opening prices are used in the Garman and Klass (1980) "Best" estimates of volatility reported in Table 3. To insure that these prices do not bias our results, we also calculate volatility using a simple close-to-close estimator similar to Eq. (6), the Parkinson (1980) extreme value method (which uses only high and low prices), and the Kunitomo (1992) extreme value method (a refinement of Parkinson's). All of these estimators yield similar qualitative results, but with lower significance levels. This is as we expect since each of these estimators is theoretically less powerful than the Garman and Klass (1980) "Best" estimator. Infrequently traded stocks tend to have their volatility overestimated using the "Best" estimator, and Garman and Klass derive a correction based on the number of daily trades. Because we only have the number of trades for 1993 through 1998 (from the TAQ database), we estimate the corrected volatility series for these observations. We also divide daily volume by average trade size to get an estimate of the number of daily trades for the full sample. Use of these "corrected" volatility series also leads to interpretations and inference of results qualitatively similar to those presented in Table 3.

There is no possible way to eliminate the potential influences of bid-ask bounce in the estimates of closed- and open-market volatility presented in Table 6 if we limit ourselves to transaction data. The next-best alternative is to use closing and opening quotes. These quotes are available for 1993 through 1998 on the TAQ database. The final daily quote before 4:00pm EST and the first new quote after 9:45am EST are recorded for each day. We wait until after 9:45 to eliminate any opening-auction effects (any such bias should work against our results). For example, Jang and Lee (1995) find that the opening spread is systematically the widest of the day. Three other estimates of closed- and open-market volatility are then obtained by using (1) the bid prices, (2) ask prices, and (3) the average of the bid and ask prices. Each of these methods results in nearly identical results to those presented in Table 6. Using closing quotes might also introduce a bias since Jang and Lee (1995) find that "NYSE specialists appear to reduce bid-ask spreads sharply at the market close and report them to the exchange solely for the

purpose of window dressing” (p. 61). Because the effect is mainly in bid prices, and the results of our analysis appear to be independent of which measure of closing price we use, we conclude that this effect is not driving our results.

In conclusion, we are very confident that the previously reported relations are not the result of model misspecification, poor data, or other potentially systematic estimation errors. The corrections for autocorrelation, non-normally distributed errors, discreteness of prices, and the use of alternative estimators do not appreciably change the inferences in Sections 3 and 4.

Table 1**Descriptive Statistics**

This table details mean daily returns, mean average annual returns, and the number of observations for both the Boston Celtics LP and the CRSP market indices over the January 1, 1987 to May 31, 1998 sample period. The Celtics' actual win-loss record as well as their record against the spread over this period are also presented. Post Game-Day Only values are not reported for the equal-weighted index because of problems associated with aggregating daily equal-weight returns (see Caninia, Michaely, Thaler, and Womack, 1998).

	Full Sample	Off-Season Only	On-Season Only	Post-Game Day Only
Mean Annual Return				
Celtics Limited Partnership	11.7%	21.50%	5.54%	-17.2%
CRSP equal-weighted index	14.2%	-1.85%	26.30%	--
CRSP value-weighted index	16.3%	4.35%	25.10%	35.9%
Observations	2,884	1,162	1,722	793

	Wins	Losses	Total Games
Win-loss record	533	499	1032
Win-loss record vs. spread*	498	499	997

* Total Games is less for Record vs. Spread because of ties (which are not allowed as an actual game result) and missing spreads.

Table 2

Franchise Value, Operating Income, and Winning

This table presents results of regressions of team value and income on team performance. Columns 1 and 2 present random-effects regressions for all teams in the NBA, NFL, and Major League baseball for the 1991-1997 period. Dummy variables for each sport-year are included in the regressions but are not presented. *Franchise Value* and *Operating Income* are in millions of dollars and are from *Financial World's* estimates. Columns 3 and 4 are for the Boston Celtics LP only. The dependent variables are the change in net revenue from basketball-related operations of the LP (i.e., excluding discontinued operations, interest expense, and taxes). Column 3's dependent variable is on a per-share basis and excludes any playoff revenues or expenses. Column 4's dependent variable is in dollars and includes the net effect of the playoffs. *Stadium Change* is a dummy variable set to one in the year the Celtics moved from the Boston Garden to the Fleet Center and zero otherwise. One, two, and three asterisks denote significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Three Major Sports		Celtics Only	
	<i>Franchise Value_t</i>	<i>Operating Income_t</i>	<i>ΔBasketball Revenue Per Share_t</i> (excludes playoffs)	<i>ΔBasketball Revenue_t</i> (includes playoffs)
	(1)	(2)	(3)	(4)
Constant	104.45 (0.000) ***	3.88 (0.056) *	-3.072 (0.011) **	-16,177,571 (0.029) **
<i>Winning Percentage_t</i>	8.16 (0.172)	-0.08 (0.970)		
<i>Winning Percentage_{t-1}</i>	26.20 (0.000) ***	7.37 (0.001) ***		
<i>Number of Wins_{t-1}</i>			0.057 (0.018) **	289,502 (0.048) **
<i>Stadium Change</i>			0.033 (0.001) ***	17,817,321 (0.003) ***
Number of teams	85	85	1	1
Number of observations	575	575	10	10
R-Squared	0.583	0.229	0.817	0.749

Table 3**Volume and Volatility Statistics**

This table presents the mean daily trading volume and return volatility over the full sample period (January 1, 1987 to May 31, 1998) for the unit shares of the Boston Celtics LP. P-values from Mann-Whitney (U) tests for the differences in these variables between off-season and on-season, and between days that follow games, and do not follow games are also presented. Mean volume estimates are noticeably affected by three high-volume trading days, two of which were on-season but not after games (see main text for further discussion). Volatility is calculated using the Garman and Klass (1980) "Best" estimator.

	Mean	p-value
Daily trading volume	4,531	
Off-season	3,809	<u>On > Off</u>
On-season	5,018	0.000
No game since last trading day	4,378	<u>Game > No Game</u>
Game since last trading day	4,934	0.012
No game since last trading day (season only)	5,089	<u>Game > No Game</u>
Game since last trading day	4,934	0.040
Daily return volatility (annualized)	15.38%	
Off-season	14.94%	<u>On > Off</u>
On-season	15.68%	0.000
No Game Since Last Trading Day	15.18%	<u>Game > No Game</u>
Game Since Last Trading Day	15.92%	0.017
No Game Since Last Trading Day (Season Only)	15.48%	<u>Game > No Game</u>
Game Since Last Trading Day	15.92%	0.039

Table 4

Mean Returns

This table details mean market-adjusted returns for the Boston Celtics LP over the January 1, 1987 to May 31, 1998 sample period. Panel A shows post-game-day market-adjusted returns by game outcome. Market-adjusted returns are defined as the residuals from a market-model regression of the Celtics' return on the CRSP equal-weighted index return. Categories are defined by unadjusted game outcome and spread-adjusted outcome pairs. For example, Win : Loss indicates that the Celtics won the game but lost against the spread. The number of games in each category and p-values for two-tailed tests comparing each mean against the null hypothesis of zero mean are presented below each value. Equivalent mean p-values for mean pairs are also noted below. Panel B details mean returns based on expected game outcome and actual game outcome pairs. For example, E[Win]:Loss indicates that the spread was negative and the Celtics lost the game. The number of games in each category and p-values for two-tailed tests comparing each mean against the null hypothesis of zero mean are presented below each value. Equivalent mean p-values for mean pairs are also noted below. (Means tests assume normally distributed returns.) For post-game days when multiple games have been played since the last trading day, the category is determined by aggregated data (i.e., summed across games) for Panel A and by any outcome fitting the appropriate category for Panel B.

Panel A
Mean Post-Game Day Market-Adjusted Returns

	Unadjusted Game Outcome : Outcome Against Spread			
	Win : Win	Win : Loss	Loss : Win	Loss : Loss
Mean post-game return	0.054%	0.305%	-0.124%	-0.229%
Observations	314	87	76	285
p-value: Mean = 0	0.214	0.016	0.110	0.002
Difference in Mean			p-values	
	Win : Win	0.056	0.072	0.003
	Win : Loss		0.007	0.001
	Loss : Win			0.207

Panel B
Mean Post-Game Day Returns Conditioned on Expectations and Game Outcome

	Expected Game Outcome : Actual Game Outcome			
	E[Win]:Win	E[Win]:Loss	E[Loss]:Win	E[Loss]:Loss
Mean post-game return	0.077%	-0.301%	0.028%	-0.168%
Observations	334	129	136	307
p-value: Mean = 0	0.132	0.009	0.390	0.005
Difference in Mean			p-values	
	E[Win]:Win	0.002	0.312	0.007
	E[Win]:Loss		0.009	0.169
	E[Loss]:Win			0.033

Table 5

**Regressions of Market-Adjusted Returns on Game Result Variables
Including Playoff Variable**

Dependent Variable: *Adjusted Return* (in basis points)

This table reports results of OLS regressions of market-adjusted returns on both win-loss point differentials and spread-adjusted win-loss point differentials, including a variable for playoff games. The regressions encompass the sample period from January 1, 1987 to May 31, 1998. P-values are shown below coefficients. *Adjusted Return* is defined as the residual (in basis points) from a market-model regression of the daily Celtics return on the CRSP equal-weighted index return. *Cumulative Spread* is defined as the cumulative points by which the Celtics beat (lost to) the spread since the last trading day. *Cumulative Points* is the cumulative points by which the Celtics won (lost) since the last trading day. The *Loss Dummy* variable is defined as equal to one when the independent variable associated with the loss dummy is less than zero and zero otherwise. *Playoffs* is a categorical variable equal to one if the Celtics won a playoff game during the previous day, negative one if they lost, and zero otherwise. One, two, and three asterisks denote significance at the 0.10, 0.05, and 0.01 levels, respectively.

	(1)	(2)	(3)	(4)
Constant	-10.60 (0.015) **	-10.90 (0.012) **	5.80 (0.394)	1.90 (0.787)
<i>Cumulative Spread</i>	0.61 (0.070) *		-1.05 (0.095) *	
<i>Cumulative Points</i>		0.50 (0.065) *		-0.46 (0.366)
<i>Cumulative Spread</i> * <i>Loss Dummy</i>			3.24 (0.002) ***	
<i>Cumulative Points</i> * <i>Loss Dummy</i>				1.98 (0.026) **
<i>Playoffs</i>	70.60 (0.000) ***	69.60 (0.000) ***	69.10 (0.000) ***	68.30 (0.000) ***
Observations	793	793	793	793
Adj. R-Squared	0.030	0.030	0.041	0.036

Table 6

Closed-Market and Open-Market Price Volatility

This table presents the median price volatility for the Boston Celtics LP for times when the market is closed and open. The sample is broken into two groups based on whether a game was played since the last trading day. Volatilities for closed- and open-market periods are calculated from closing and opening prices. P-values for Mann-Whitney (U) tests for the differences between closed-market and open-market volatility, and between volatility for periods that follow games, and do not follow games are also presented. Panel A shows results for the subperiod January 1, 1993 to May 31, 1998. These data are from the TAQ database. Panel B compares volatilities based on expected and actual game outcomes for 1993-1998. In addition to presenting the median volatility, the volatility for each subgroup is compared to the volatility when the market was closed or open, and no game was played. For example, the (upper-left) Closed-Market - E[Win]:Win cell presents median volatility for times when the market is closed and the Celtics have an expected win. The asterisks represent significance of tests of equal volatility over these periods compared to all periods when the market is closed and no games are played. One, two, and three asterisks denote significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel A: 1993-1998

Median Price Volatility (annualized)	Number of Observations	Closed- Market	Open- Market	p-value Open > Closed
All Trading Days	1366	11.96%	13.35%	0.008 ***
No game since last trading day	1008	11.89%	13.31%	0.007 ***
Game since last trading day	358	12.02%	13.39%	0.011 **
p-value: Game > No Game		0.487	0.014 **	

Panel B: Median Volatility by Expected and Actual Outcome (1993-1998)

Market Sub-Period	No Game	E[Win]:Win	E[Win]:Loss	E[Loss]:Win	E[Loss]:Loss
Closed-Market	11.89%	9.37% ***	10.50% ***	12.15%	12.22%
Open-Market	13.31%	13.68%	15.11% ***	14.33% **	13.39%

Figure 1

Stock Price and Volume Around Garden Event

Celtics' unit price and volume around "new" Boston Garden announcements of February 1993. The stock prices shown are closing prices, and volume is shown in shares.

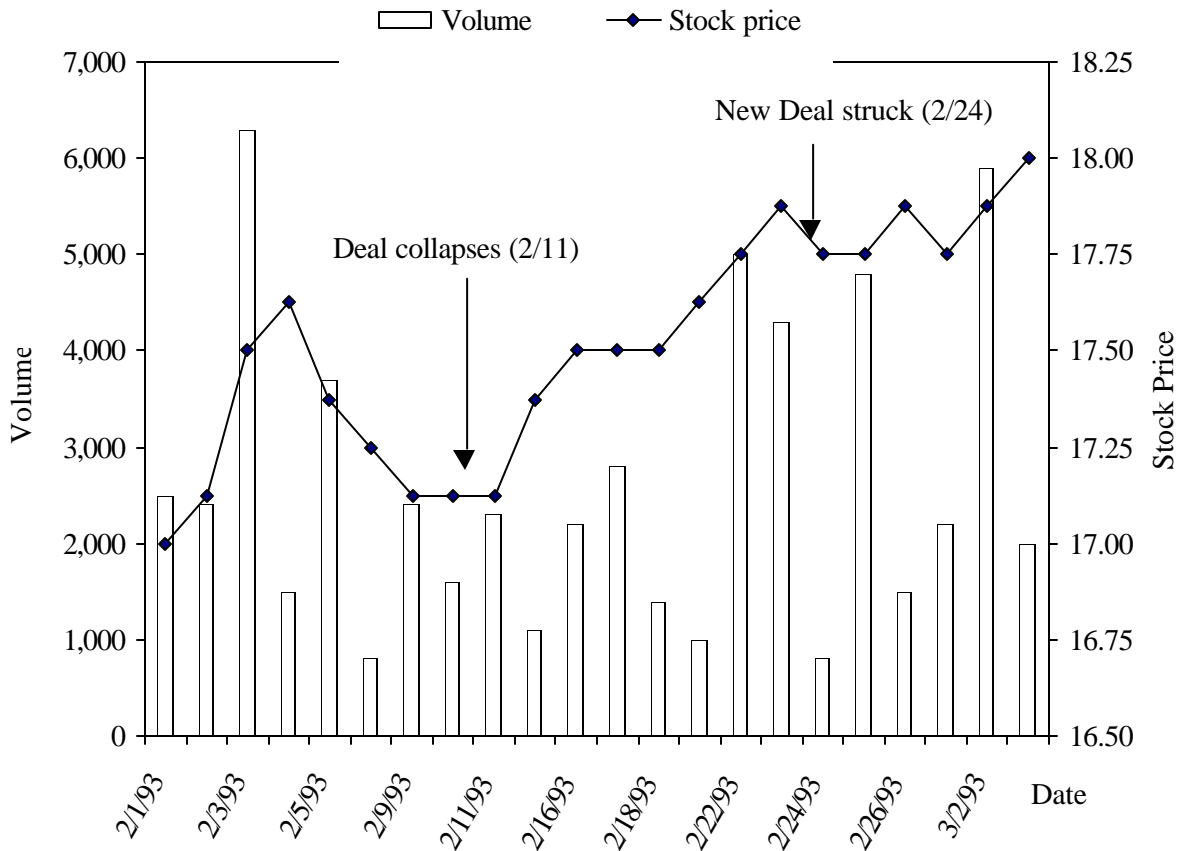


Figure 2

Stock Price and Volume Around the Hiring of Rick Pitino

Panel A shows daily volume and the unit price daily high, low, and closing values for May 1997. Panel B shows the opening and closing prices for each day. The official announcement of Rick Pitino's hiring occurred on May 5.

