

The Supportive Crowd Effect upon (Relative) Performance Production: A Behavioral Economic Theory and Natural Experiment

Shane Sanders and Christopher Boudreaux

Abstract. The home advantage is an important concept in behavioral economics. Indeed, the phenomenon can alter (the fairness of) sports match outcomes. As the marginal revenue of a win can be sizable, it is important to understand the expected magnitude of home advantage. Moreover, an understanding of the phenomenon promises to further our understanding as to the nature of performance production under pressure. The existing literature largely attributes home advantage to learning factors, travel factors, and crowd bias. Given that learning factors and crowd factors change largely in simultaneity, it has been difficult to isolate the crowd effect upon home advantage. In that it serves as home stadium to two National Basketball Association teams, the Staples Center in Los Angeles offers a unique natural experiment by which to isolate the crowd effect upon relative performance. Within the match-up, each team possesses essentially equal familiarity with the built environment. However, the team designated as “home team” in a contest enjoys a largely sympathetic crowd due primarily to extensive advanced season ticket sales. Within this environment, we find that crowd sympathy is a significant source of home advantage.

JEL Codes: D01,D03, L83

Keywords: Supportive Audience, Crowd Factors, Performance, Home Advantage, Sports, Basketball, Social Support, Social Pressure.

I. Introduction

The home advantage is typically defined as the tendency of home teams in (sport) competitions to win over half of games played under a balanced home and away schedule (Courneya and Carron, 1991). The phenomenon has been observed in countless sporting venues. Hockey (Agnew and Carron 1994; Pace and Carron 1992), soccer (Clarke and Norman 1995; Nevill et al. 1996; Yiannakis et al. 2006), basketball (Greer 1983; Jurkovic 1985; Moore and Brylinsky 1993; Harville and Smith 1994; Jones 2007), football (Schwartz and Barsky 1977), and baseball (Courneya and Carron 1992) are among the sports in which a consistent home advantage has been uncovered. Past studies in the area of

psychology and behavioral economics have suggested that spectator effects upon performance production are an important cause of this advantage. However, it has proven difficult to truly isolate this result in a natural setting. An improved understanding as to the nature of spectator effects may contribute to our general understanding of performance production under (social) pressure. Labor is often performed in the presence of social pressure. Examples of such labor include air traffic control, combat soldiering (commanding), financial trading, legislature, legal representation, (peace or economic) negotiations, emergency medical treatment, and various forms of entertainment (e.g., sports performance). In still other professions, worker productivity is estimated through a process of transparent, real-time evaluation by superiors. Reminiscent of the observer effect in particle physics, the very act of observing (human) productivity may induce a social pressure response and alter the worker's productivity level (in an indeterminate direction).

In a seminal article, Schwartz and Barsky (1977) advance three major sources of home advantage: learning factors, travel (fatigue) factors, and crowd factors.¹ They explain that the home team has typically learned to play more effectively in the built environment (i.e., to adjust to factors such as lighting, playing surface texture, and rim flexibility). Home advantage may also result from the greater expected travel demands of the visiting team. In sports such as professional basketball, a visiting team is more likely to have played a prior game and subsequently traveled within one day of competition. Lastly, biased spectators can influence a competition outcome through multiple channels.

¹ Courneya and Carron (1992) and Nevill and Holder (1999) also consider sequence-of-play rule factors as a potential source. As an unbiased "tip-off" is utilized to establish first possession in a basketball game, rule factors do not tend to be important in basketball.

Several important studies have advanced our understanding of the relationship between individual factors and the home advantage. In a novel natural experiment, Pollard (2002) studies the effect of familiarity with built environment upon home advantage. From 1987 to 2001, 37 professional sports teams in the United States moved to a new stadium but remained in the same city. Pollard finds that the magnitude of the home advantage was significantly less during the first season in a new stadium than in the (prior) final season of an old stadium. This reduction was true for baseball, basketball, and ice hockey in North America. The author estimates that 24 percent of the advantage of playing at home may be lost for the year that a team relocates to a new facility.

As the visiting team has greater expected travel demands prior to competition, one might expect said team to be more fatigued during play. Largely, it has been found that travel (fatigue) effects do not contribute to home advantage (du Preez and Lambert, 2007; Courneya and Carron, 1992) or that travel effects provide a small but significant contribution to home advantage (Steenland and Deddens, 1997 ; Entine and Small, 2008). Of particular interest to the present article, the nature of the crowd effect upon performance is not well understood in natural environments (although some progress has been made). Schwartz and Barsky (1977) and Agnew and Carron (1992) find that the magnitude of home advantage significantly increases in crowd density. The approach of these studies is limited, however, in that it is not made clear *why* crowd density varies. If crowd density is positively related to expected likelihood of a home team win, then there may be no causal relationship between crowd density and home advantage.

It is unclear, *a priori*, that crowds are helpful to the home team. In fact, some experiments in social psychology suggest that the marginal crowd effect may be to produce a home

disadvantage. Wallace, Baumeister, and Vohs (2005) find that supportive audiences cause performers to “avoid failure rather than to seek success.” In many cases, such a behavioral modification can lead to performance decrements. Indeed, Butler and Baumeister (1998) find, across three experiments, that subjects perform less proficiently before supportive audiences than before unsupportive audiences provided that the task is sufficiently difficult. Moreover, the authors find that performers are unaware of this perverse effect.

Dohmen (2008) and Sanders and Walia (2012) note that spectators may directly influence a competitive outcome by affecting player performances. Supportive spectators may enhance a (home) player’s performance through social support, inadvertently harm a (home) player’s performance through social pressure, or intentionally harm a (visiting) player’s performance through conscious techniques of distraction. Further, Sutter and Kocher (2004) find that referees are, on average, partial to the home team in making discretionary decisions. They explain that this may be an unintentional reaction to processes of positive and negative reinforcement undertaken by the home crowd. If the (counterproductive) social pressure effect dominates the sum of all other (productive) crowd effects, then sympathetic crowds will exert a negative influence upon (relative) home performance.

It has proven difficult to understand the effect of crowds upon relative performance (in sport) because several variables change in simultaneity when a team transitions from “home team” to “visitor.” The visiting team typically travels within a day of the game to reach the stadium, addresses less familiar playing conditions in the new stadium (e.g., variation in stadium lighting, texture of playing field, or flexibility of goal), and endures an unsympathetic or hostile crowd during the game. This last effect, in turn, is expected to

cause home team bias among referees. Wallace, Baumeister, and Vohs (2005) note, "...the exact source of the home advantage is impossible to pinpoint from the inherently ambiguous archival data that home advantage researchers typically rely upon." While there is some variation in the travel behavior of visiting teams, it is difficult to separate crowd effect from stadium effect in a normal sports setting. This state of affairs has created difficulty in estimating the effect of (biased) spectators upon performance outcomes. The attainment of such an estimate would further our understanding as to the relative importance of (friendly, productive) social support effects, (friendly but counter-productive) social pressure effects, and (hostile) distraction effects in a performance environment. That is to say, an isolation of the spectator effect in a real-world sporting environment would improve our understanding as to the (behavioral economic) foundations of performance production.

Wallace, Baumeister, and Vohs (2005) point out the advantage of generating and using experiments to understand the effects of a sympathetic crowd upon performance. There are strong advantages to the experimental approach to social science research. Namely, experiments allow the researcher to isolate a particular relationship of interest. The approach of the present study is to explore the nature of biased spectator effects within a natural experimental setting of sorts. In so doing, we hope to combine some of the "cleanness" of the experimental approach with the potential for added realism afforded by natural data. Within the home advantage literature, our methodology is perhaps most akin to Pollard (2002), who explores learning effects by examining the extent of home advantage in the season before and in the season after a new home stadium was opened. The case of the Los Angeles Lakers and the Los Angeles Clippers offers a unique lens

through which to observe the effect of biased spectators (crowd sympathy) upon relative performance. Since October 1999, the two teams have shared the Staples Center as a home arena. Interestingly, one team must be designated as “visitor” when the two teams oppose one another in the Staples Center. The teams have competed against each other in the 51 regular season games from the 1999-2000 season through the 2011-2012 season (i.e., in the first 13 seasons of the Staples Center era).² Until the recent lockout-shortened season, the teams have opposed one another four times per year in the regular season with each team serving as the home team in two games.³ The Lakers have served as home team in 25 of the 51 games, while the Clippers have served as home team in the remaining 26 games. The ordering with which each team serves as home (away) team varies in an apparently random pattern.

From the 1999-2000 season through the 2011-2012 season, the Lakers won 21 of 25 games against the Clippers when designated the home team and won 17 of 26 games against the Clippers when designated the visiting team. In other words, the Lakers won 84 percent of games when designated the home team and 65.4 percent of games when designated the visiting team. These 51 contests, though sparse, serve as an uncommon natural experiment. In the case of Lakers and Clippers games since 1999, the Clippers (Lakers) experience the same (familiar) stadium characteristics (e.g., lighting and rim flexibility) whether designated as home team or away team. With respect to learning factors, therefore, it is as if there are two home teams when the teams oppose one another. This feature of the match-up will allow us to more cleanly isolate the crowd effect upon

² We consider only regular season games in this analysis. Preseason games typically feature reserve players to a much larger extent than regular season games and, therefore, are not generally comparable.

³ This tradition was temporarily altered during the lockout-shortened 2011-2012 season, in which the Lakers hosted the Clippers only once.

relative performance. The match-up provides a relatively “clean” natural experiment in one other sense. Neither team, home nor away, typically travels to Los Angeles from another city within a day of a game between the two teams. In sampled games between the two teams, the Lakers (Clippers) returned to Los Angeles within a day of the game for only 3 (3) of the 51 games. In other words, a team in the match-up returned to Los Angeles within a day of a game between the two teams in 6 of 102 cases. For a typical NBA team match-up, the visiting team would *usually* travel within a day of the game, and the home team would seldom travel within a day of the game. There exists both a dearth and equality of pre-game travel in the Lakers-Clippers match-up. Therefore, we expect the effect of travel upon relative team performance to be minimal.

In contests between the Lakers and Clippers during the Staples Center era, it appears that home team designation influences fan attitude alone. Due to substantial advanced season ticket purchases, the crowd is considerably more sympathetic to the Lakers (Clippers) when said team is deemed the home team rather than the visiting team. This is apparent when watching a game between the teams or by viewing the general clothing colors of the crowd for a given pair of games. Controlling for factors such as (relative team abilities during) season of play, recent travel behavior, and maturity of season when a game is played, we explore the importance of home team designation in determining outcomes for this series of games. Given the environment of the study, we take any remaining home advantage (disadvantage) to be indicative of biased spectator effects (e.g., social support, social pressure, distraction, and crowd effect upon referees) alone. The remainder of the paper proceeds as follows. In Section II, a behavioral economic theory is constructed to explore the supportive crowd effect upon (relative)

performance production in a competitive environment. In Section III, data is analyzed on Lakers-Clippers games in the Staples Center era. The regression analysis uses both standard logistic regressions with cluster robust standard errors and logistic regression with random effects to determine whether (in what direction) biased observer effects influence relative performance production. Section IV concludes the study.

II. A Behavioral Economic Theory of Competitive Performance with Spectator Effect

Consider two separate contests between Team 1 (Contestant 1) and Team 2 (Contestant 2). In the first contest, Team 1 opposes Team 2 in the presence of a crowd that is sympathetic to Team 1 (i.e., as the home team). In the second contest, Team 1 opposes Team 2 in the presence of a crowd that is sympathetic to Team 2 (i.e., as the visiting team). As in the case of Lakers and Clippers games, assume that there are no other *major* differences between the two contests (in terms, e.g., of familiarity with stadium conditions or prior travel). In such a setting, we are able to consider the effect, if any, of biased spectators upon relative team performance. In Setting 1, Team 1 acts as the home team.

Setting 1: Team 1 hosts Team 2

In this setting, the contest success functions governing probability of team success are represented in equations (1) and (2).

$$p_1 = \frac{\beta\gamma e_1}{\beta\gamma e_1 + \delta r e_2} \quad (1)$$

$$p_2 = \frac{\delta r e_2}{\beta\gamma e_1 + \delta r e_2} \quad (2),$$

where $\beta (> 1)$ represents the (positive) social support effect of (friendly) spectators upon the productivity of home team effort and can also represent referee bias motivated by

spectators, $\gamma (< 1)$ symbolizes the (negative) social pressure effect of (friendly) spectators upon the marginal productivity of home team effort, $\delta (< 1)$ represents the (negative) distraction effect of (hostile) spectators upon the marginal productivity of visiting team effort, and r represents the effectiveness of a unit of Team 2 effort relative to the effectiveness of a unit of Team 1 effort in a setting void of (biased) spectators. The parameter r allows for the possibility that the two teams are asymmetric in terms of innate ability. Note that $\beta\gamma$ represents the net effect of friendly home fans upon the productivity of home team effort. Equations (3) and (4) represent objective functions for each team in Setting 1.

$$U_1 = p_1V - e_1 \tag{3}$$

$$U_2 = p_2V - ce_2, \tag{4}$$

where c represents the marginal cost of a unit of Team 2 effort relative to the marginal cost of a unit of Team 1 effort. Like the parameter r , the parameter c allows for asymmetry between teams in terms of innate ability. Whereas the parameter r allows the effort of Team 2 to be more (less) marginally productive than the effort of Team 1, the parameter c allows the cost of putting forth effort to be higher (lower) for Team 2 than for Team 1. To distinguish between r and c , one might consider two basketball players running from the defensive end to the offensive end of play. The first player is a very good runner but a very poor shooter. The second player is a very poor runner but a very good shooter. The first player's cost of effort (in transition) is low but his or her benefit (marginal productivity) from transitioning is also low. It is easy for the first player to get down the court, but he or

she will probably not make a shot at the offensive end. The second player has a higher cost of effort (in transition) and a higher benefit from effort (in transition). It is difficult for the second player to get down the court, but he or she will probably make the shot once at the offensive end. In this setting, where cost and benefit asymmetries are present, it is unclear which player will put forth more effort, *ceteris paribus*. We assume interior solutions herein (i.e., that the contest is sufficiently prized to elicit some level of bi-lateral participation) and derive first order conditions in equations (5) and (6).⁴

$$\frac{\beta\gamma\delta re_2}{(\beta\gamma e_1 + \delta re_2)^2} V = 1 \quad (5)$$

$$\frac{\beta\gamma\delta re_1}{(\beta\gamma e_1 + \delta re_2)^2} V = c \quad (6)$$

From these conditions, we obtain optimal effort allocations for Setting 1 in (7) and (8).

$$e_1^* = \frac{cV\beta\gamma\delta r}{(\beta\gamma c + \delta r)^2} \quad (7)$$

$$e_2^* = \frac{V\beta\gamma\delta r}{(\beta\gamma c + \delta r)^2} \quad (8)$$

The likelihood of victory for Team 1 when playing at home is represented in equation (9).

$$p_{1,\text{home}}^* = \frac{\beta\gamma c}{\beta\gamma c + \delta r} \quad (9)$$

⁴ This is not a strong assumption. Forfeitures are exceedingly rare, even in amateur sport.

Setting II: Team 1 visits Team 2

This setting is similar to Setting 1. However, the “friendly” spectator effects, both productive and counter-productive, now influence Team 2 performance, and hostile spectator effects (distraction) now influence Team 1 performance. Parameters representing innate asymmetries (i.e., r and c) maintain the same association across setting. In Setting II, the contest success functions governing probability of team success are featured in equations (10) and (11).

$$p_1 = \frac{\delta e_1}{\delta e_1 + \beta \gamma r e_2} \quad (10)$$

$$p_2 = \frac{\beta \gamma r e_2}{\delta e_1 + \beta \gamma r e_2} \quad (11)$$

In equations (12) and (13), we represent objective functions for each team in Setting II.

$$U_1 = \frac{\delta e_1}{\delta e_1 + \beta \gamma r e_2} V - e_1 \quad (12)$$

$$U_2 = \frac{\beta \gamma r e_2}{\delta e_1 + \beta \gamma r e_2} V - c e_2 \quad (13)$$

From the objective functions, we assume interior solutions (i.e., bi-lateral participation) and derive first order conditions in (14) and (15).

$$\frac{\beta \gamma \delta r e_2}{(\delta e_1 + \beta \gamma r e_2)^2} V = 1 \quad (14)$$

$$\frac{\beta\gamma\delta re_1}{(\delta e_1 + \beta\gamma re_2)^2} V = c \quad (15)$$

From these conditions, we obtain optimal effort allocations for Setting II in (16) and (17).

$$e_1^* = \frac{cV\beta\gamma\delta r}{(\delta c + \beta\gamma r)^2} \quad (16)$$

$$e_2^* = \frac{V\beta\gamma\delta r}{(\delta c + \beta\gamma r)^2} \quad (17)$$

The likelihood of victory for Team 1 when visiting Team 2 is represented in (18).

$$p_{1,away}^* = \frac{\delta c}{\delta c + \beta\gamma r} \quad (18)$$

Recall from equation (9) that $p_{1,home}^* = \frac{\beta\gamma c}{\beta\gamma c + \delta r}$. We can compare $p_{1,home}^*$ and $p_{1,away}^*$ to determine the net effect of spectators upon relative performance. If $p_{1,home}^* > p_{1,away}^*$, then spectators induce a home advantage in this setting, *ceteris paribus*. Below, we determine the condition under which $p_{1,home}^* > p_{1,away}^*$.

Condition 1: *If $\frac{1}{\gamma} < \frac{\beta}{\delta}$, then $p_{1,home}^* > p_{1,away}^*$, and the net spectator effect is to create a home field disadvantage, ceteris paribus.*

Condition 1 obtains if performance distortion from the social pressure effect is less than performance distortion from the interaction of the (friendly) social support effect and

the (hostile) distraction effect . As δ is always less than or equal to 1 (i.e., the home crowd never improves the productivity of visiting team efforts), a weak condition for spectator-induced, home field advantage is that $\beta\gamma > 1$. That is, if the home crowd improves the productivity of home team efforts on net (i.e., social support effect dominates social pressure effect), then we can be sure that the spectator effect will be to create a home advantage, *ceteris paribus*. Conversely, the spectator effect may be detrimental to the productivity of home team effort (likelihood of winning) if the social pressure effect dominates both the social support effect and the distraction effect.

Condition 2: If $\frac{1}{\gamma} > \frac{\beta}{\delta}$, then $p_{1,home}^* < p_{1,away}^*$, and the spectator effect is to create a home field disadvantage, *ceteris paribus*.

According to Condition 2, the model predicts that spectators do not necessarily induce a home advantage, *ceteris paribus*. Thus, a natural experiment that is able to isolate the spectator effect upon game outcome can inform us as to whether performance distortion from the interaction of social support and distraction effects is greater than performance distortion from the social pressure effect.

IV. Data

We examine all regular season games between the Los Angeles Lakers and Los Angeles Clippers from the 1999-2000 season through the 2011-2012 season (e.g., during the first 13 regular seasons of the Staples Center era). This includes 51 regular season games, of which the Clippers (Lakers) have won 13 (38).⁵ The Lakers have won 21 of 25 games (84

⁵ The two teams have not faced one another during the post-season.

percent of games) when designated the home team and have won 17 of 26 games (65.4 percent of games) when designated the visiting team. The (anterior) likelihood that the Lakers won game j in season i of the sample, p_{ij} , is estimated using logistic regression models. The dependent variable in each regression is a binary dependent variable that equals one (zero) if the Lakers win (lose) game i against the Clippers in season j . Each independent variable controls for other factors that may affect the situational likelihood that the Lakers win a given game. These variables are defined as follows: $home_{i,j}$ is a dummy variable that equals 1 (0) if the Lakers were home (visiting) in game i of season j , $diffpercent_i$ represents the Lakers' winning proportion in season i (against teams other than the Clippers) minus the Clippers' winning proportion in season i (against teams other than the Lakers), $Lak_travel_{i,j}$ ($Clip_travel_{i,j}$) equals 1 if the Lakers (Clippers) had played in another city one day prior and 0 otherwise, $finalmeeting_{i,j}$ equals 1 (0) if the two teams are (not) meeting for the last time in a season, and $firsthalf_{i,j}$ equals 1 (0) if the two teams are (not) meeting during the first 41 games of the (82-game) regular season. Respectively, these variables control for observed differences in the ability of the two teams as observed from outside games, asymmetry in travel-induced fatigue, and (potential changes in motivation due to) period of season. Independent variables are summarized in Table 1 below.

(Table 1 here)

The first four models are specified within a logistic regression model that features (season) cluster robust standard error terms to account for unobserved factors related to

the manner in which the two teams match-up with one another in a given year. The models are specified in (19) through (22).

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1 \text{home}_{i,j} + b_2 \text{diffpercent}_i + b_3 \text{finalmeeting}_{i,j} + b_4 \text{Lak}_{\text{travel}_{i,j}} + b_5 \text{Clip}_{\text{travel}_{i,j}} + e_{i,j} \quad (19)$$

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1 \text{home}_{i,j} + b_2 \text{diffpercent}_i + b_3 \text{diffpercent}_i^2 + b_4 \text{finalmeeting}_{i,j} + b_5 \text{Lak}_{\text{travel}_{i,j}} + b_6 \text{Clip}_{\text{travel}_{i,j}} + e_{i,j} \quad (20)$$

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1 \text{home}_{i,j} + b_2 \text{diffpercent}_i + b_3 \text{firsthalf}_{i,j} + b_4 \text{Lak}_{\text{travel}_{i,j}} + b_5 \text{Clip}_{\text{travel}_{i,j}} + e_{i,j} \quad (21)$$

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1 \text{home}_{i,j} + b_2 \text{diffpercent}_i + b_3 \text{diffpercent}_i^2 + b_4 \text{firsthalf}_{i,j} + b_5 \text{Lak}_{\text{travel}_{i,j}} + b_6 \text{Clip}_{\text{travel}_{i,j}} + e_{i,j} \quad (22)$$

Results for this set of regressions are provided in Table 2.

(Table 2 here)

Three observations and one variable ($\text{Clip}_{\text{travel}_{i,j}}$) were dropped because the Clippers lost on each of three occasions the day before which they traveled (i.e., perfect prediction). Each model finds the coefficient of $\text{home}_{i,j}$ to be positive and significant at the $\alpha=.01$ or $\alpha=.05$ level. We take this to be a fairly strong indication that a supportive crowd has a positive effect upon (relative) own team performance. Team characteristics naturally eliminate any significant heterogeneity in stadium (court) familiarity. Moreover, we have controlled for any effects of asymmetric travel within one day of competition, while noting

that these effects are infrequent and occur almost symmetrically (between home and visiting team) as compared to the case of a traditional NBA team match-up.

This result suggests that the social support and distraction effects dominate the social pressure effect to provide a sympathetic crowd effect that is positive, on net. It is interesting to note that the present result may be consistent with that of Wallace, Baumeister, and Vohs (2005), who find that supportive audiences cause absolute performance decrements. The present result simply finds that home team *relative* performance improves with a supportive audience. Such a result may obtain even if a supportive audience causes the home team's absolute performance level to decline (i.e., if the audience imposes a sufficiently strong distraction effect upon the visiting team). In the NBA, there is sometimes a systematic relationship between home games and prior travel. We do not expect such a relationship in this case, as each team faces the same constraint in games between the two teams (i.e., traveling to each team's home city of Los Angeles). However, we test for autocorrelation to be certain. The variance inflation factors for specified independent variables range between 1.16 and 2.21 (i.e., well below reasonably "acceptable" levels). Thus, we can be reasonably confident that our coefficient estimates are not greatly biased by the presence of multicollinear independent variables.

We now consider a set of regressions featuring (season) random effects to account for unobserved characteristics with respect to how the two teams match up in a given year. A Hausman test suggests selection of the random effects model rather than selection of the fixed effects model (i.e., that the individual specific effect is uncorrelated with other explanatory variables). The set of random effects models considered is specified in (23) through (26).

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1home_{i,j} + b_2diffpercent_i + b_3finalmeeting_{i,j} + b_4Lak_travel_{i,j} + b_5Clip_travel_{i,j} + u_i + e_{i,j} \quad (23)$$

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1home_{i,j} + b_2diffpercent_i + b_3diffpercent_i^2 + b_4finalmeeting_{i,j} + b_5Lak_travel_{i,j} + b_6Clip_travel_{i,j} + u_i + e_{i,j} \quad (24)$$

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1home_{i,j} + b_2diffpercent_i + b_3firsthalf_{i,j} + b_4Lak_travel_{i,j} + b_5Clip_travel_{i,j} + u_i + e_{i,j} \quad (25)$$

$$\ln\left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}}\right) = b_0 + b_1home_{i,j} + b_2diffpercent_i + b_3diffpercent_i^2 + b_4firsthalf_{i,j} + b_5Lak_travel_{i,j} + b_6Clip_travel_{i,j} + u_i + e_{i,j} \quad (26)$$

The results of these specifications are provided in Table 3.

(Table 3 here)

Each random effects model finds the coefficient of $home_{i,j}$ to be positive and significant at the $\alpha=.05$ level. We again take this to be a fairly strong indication that a sympathetic crowd has a positive effect upon (relative) own team performance. We lastly consider the same set of random effects model specifications but with a delete-one jackknife (resampling) variance estimator. In a random effects logistic model, the delete-one jackknife approach allows one to generate standard errors that are robust to (potential) heteroskedasticity. In this way, we are able to conduct statistical inference while accounting for both unobserved random effects and potential heteroskedasticity. In the present case, we prefer the jackknife resampling approach to bootstrapping mainly because we lose fewer degrees of freedom through jackknife resampling. Also, jackknife

resampling provides invariant (i.e., verifiable) regression results for a given specification. The results of this latter regression set are captured in Table 4.

(Table 4 here)

Each of the models in Table 4 finds the coefficient of $home_{i,j}$ to be positive and significant at or very close to the $\alpha=.05$ level (i.e., the range of associated p-values is .031 to .056). We also find that the jackknife resampling methodology provides large corrections in estimating the standard errors for $Clip_travel_{i,j}$.

Lastly, we compare the predict probability of a Lakers' win given that $home_{i,j} = 0$ and $home_{i,j} = 1$, *ceteris paribus*. We do so in the post-estimation of each random effects model specification, while holding other independent variables at mean. Through such an analysis, we can gauge the *magnitude* of the crowd sympathy effect in terms of win probability. Table 5 lists predicted probabilities for each random effects model.

(Table 5 here)

Note that predicted probabilities are considerably higher than the sampled probability for the variable $won_{i,j}$. This may be due to the respective distributions of the independent variables. Holding all other variables at mean, our random effects models estimate that crowd sympathy increases the probability of winning by between 7.4 and 9.2 percentage points. In somewhere between 1 in 11 and 1 in 14 games, therefore, we conclude that a sympathetic crowd alters the game outcome in favor of the home team. We conclude that the social support and distraction effects dominate the social pressure effect such that a supportive crowd aids the relative performance of the home team.

V. Conclusion

In the paper, we have constructed a theoretical model of performance behavior in the presence of a supportive crowd. In the model analysis, we derive conditions under which a supportive crowd aids (impairs) the relative performance of an individual or team. If performance distortion from the social pressure effect is less (greater) than performance distortion from the interaction of the (friendly) social support effect and the (hostile) distraction effect, then a supportive crowd aids (impairs) the relative performance of an individual or team. We then test for the effect of a supportive crowd via a natural experiment of sorts. Since 1999, the Los Angeles Lakers and Los Angeles Clippers have both played in the Staples Center. Moreover, neither team typically travels a day prior to a match-up between the two teams. By examining games between the two teams, it is therefore (uniquely) possible to isolate the sympathetic crowd effect within the context of a natural environment. In doing so, we find that a supportive crowd causes the home team to win at a significantly higher rate. Holding all other variables at mean, our random effects models estimate that crowd sympathy increases the probability of winning by between 7.4 and 9.2 percentage points. We therefore conclude that the social support and distraction effects dominate the social pressure effect such that a supportive crowd aids the relative performance of the home team.

There are possible extensions to the present work. For example, the manner by which supportive crowds contribute to home advantage is not well understood. They may do so simply by causing the visiting team (competitor) to be less effective. Alternatively, a supportive crowd may reduce the effectiveness of both home and visiting teams (competitors) in an asymmetric manner. An understanding as to the effect of supportive crowds upon absolute performance levels would further our understanding as to the roles

of the social support effect, the social pressure effect, and distraction effects in altering performance.

VI. References

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Table 1: Summary of Independent Variables

Variable	Obs	Mean	Std. Dev.	Min.	Max
home _{i,j}	51	.4902	.5049	0	1
diffpercent _i	51	.2650	.2093	-.036	.6340
Lak_travel _{i,j}	51	.0588	.2376	0	1
Clip_travel _{i,j}	51	.0588	.2376	0	1
finalmeeting _{i,j}	51	.2549	.4401	0	1

firsthalf _{ij}	51	.5098	.5049	0	1
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Table 2: Logistic Regression Results (cluster robust standard errors)

	(1)	(2)	(3)	(4)
home _{ij}	1.94**	1.87**	1.81***	1.74***
	(2.51)	(2.48)	(2.74)	(2.76)
diffpercent _i	5.90***	2.88	5.74***	2.31
	(3.83)	(0.81)	(3.49)	(0.62)

diffpercent ² _i	--	7.42	--	8.51
	--	(1.11)	--	(1.19)
finalmeeting _{i,j}	-0.81	-0.81	--	--
	(-0.83)	(-0.81)	--	--
firsthalf _{i,j}	--	--	0.77	0.79
	--	--	(0.94)	(0.99)
Lak_travel _{i,j}	-2.35*	-2.23*	-2.75*	-2.68
	(-1.82)	(-1.68)	(-1.70)	(-1.56)
Clip_travel _{i,j}	--	--	--	--
	--	--	--	--
Model	Logistic with cluster robust standard errors			
N	48	48	48	48

Numbers in parentheses are absolute values of t-statistics, and asterisks indicate significance at the .10, .05, and .01 levels (two-tailed test).

Table 3: Random Effects Regression Results

	(1)	(2)	(3)	(4)
home _{i,j}	1.94**	1.87**	1.80**	1.74**
	(2.06)	(2.01)	(2.01)	(1.96)
diffpercent _i	5.90***	2.88	5.75**	2.31

	(2.62)	(0.49)	(2.55)	(0.38)
diffpercent ² _i	--	7.42	--	8.51
	--	(0.52)	--	(0.56)
finalmeeting _{i,j}	-0.81	-0.81	--	--
	(-0.91)	(-0.90)	--	--
firsthalf _{i,j}	--	--	0.77	0.79
	--	--	(0.95)	(0.98)
Lak_travel _{i,j}	-2.35	-2.23	-2.75*	-2.68
	(-1.46)	(-1.35)	(-1.66)	(-1.57)
Clip_travel _{i,j}	27.97	27.03	27.88	28.06
	(0.00)	(0.00)	(0.00)	(0.00)
Model	Random Effects Logistic	Random Effects Logistic	Random Effects Logistic	Random Effects Logistic
N	51	51	51	51

Numbers in parentheses are absolute values of t-statistics, and asterisks indicate significance at the .10, .05, and .01 levels (two-tailed test).

Table 4: Random Effects Regression Results (with jackknife resampling)

	(1)	(2)	(3)	(4)
home _{i,j}	1.94*	1.87*	1.80**	1.74**
	(2.13)	(2.11)	(2.41)	(2.43)

diffpercent _i	5.90**	2.88	5.75**	2.31
	(3.03)	(0.60)	(2.73)	(0.43)
diffpercent ² _i	--	7.42	--	8.51
	--	(0.73)	--	(0.71)
finalmeeting _{i,j}	-0.81	-0.81	--	--
	(-0.70)	(-0.69)	--	--
firsthalf _{i,j}	--	--	0.77	0.79
	--	--	(0.86)	(0.90)
Lak_travel _{i,j}	-2.35	-2.23	-2.75*	-2.68
	(-0.08)	(-0.08)	(-0.11)	(-0.10)
Clip_travel _{i,j}	27.97***	27.03***	27.88***	28.06***
	(8.15)	(7.10)	(9.24)	(11.30)
Model	Random Effects Logistic with Jackknifing			
N	51	51	51	51

Numbers in parentheses are absolute values of t-statistics, and asterisks indicate significance at the .10, .05, and .01 levels (two-tailed test).

Table 5: Predicted Probability that $won_{i,j} = 1$ given variation in $home_{i,j}$

home _{i,j}	(1)	(2)	(3)	(4)
0	.891	.899	.894	.908
1	.983	.983	.980	.982

*In the analysis, other independent variables in a given specification are held at mean.

