2015

Time Zones, Game Start Times, and Team Performance: Evidence from the NBA

Andrew Nutting
Bryn Mawr College, anutting@brynmawr.edu

Joseph Price

Custom Citation

A. Nutting and J. Price, "Time Zones, Game Start Times, and Team Performance: Evidence from the NBA." *Journal of Sports Economics*, forthcoming.

Time Zones, Game Start Times, and Team Performance: Evidence from the NBA

Andrew Nutting

Joseph Price

Abstract

Research has found that, controlling for team quality, NBA visiting teams win more often when playing to the east of their home time zones and less often when playing to the west. We reaffirm this finding for 1991-2002. Results show that only these seasons' day games, and not their far more frequent night games, featured a significant relationship between time zone and visiting team win probability. We hypothesize that some of these day-game effects were biological in origin. The 2002-2013 seasons featured no significant relationship between time zones and visiting team win probability for either day or night games.

I. Introduction

Many jobs require that workers frequently travel. While jet lag effects are well known for long international trips (Reilly, Waterhouse, and Edwards 2005), it is also important to know how frequent short trips that cross a few cross time zones affect worker productivity. Since high frequency measures of productivity are hard to estimate many settings, research often turns to sports data since it provides objective and accurate measures of worker productivity (Kahn 2000).

Using data from the National Basketball Association, both Nutting (2010) and Steenland and Deddens (1997) found that, controlling for team quality, visiting teams won more frequently when playing to the east of their home time zones and less frequently when playing to the west. Both papers hypothesized, but did not empirically test, that teams performed better when playing to the east because further-east night games start closer to mid-afternoon from the perspective of a visiting team's own time zone, and mid-afternoon is a time circadian rhythm research has shown to be optimal for athletic performance (Reilly and Waterhouse 2009, Forbes-Robertson et al 2012). This hypothesis would be consistent with findings that National Football League (NFL) teams from the west coast experience substantial relative benefits from playing games at night (Jehue, Street, and Huizenga 1993; Smith, Guilleminault, and Efrom 1997).

This paper incorporates data on start times of NBA games to directly test whether "night" games, defined as starting at 7:00pm local time or later and constituting over 85% of NBA games, are responsible for the time zone relationships observed in Nutting (2010) and Steenland and Deddens (1997). *Contra* expectations, we find no significant relationship between time zone and visiting team win probability among night games. We instead find evidence that, from 1991-2002, visiting teams won games that started at or before 4:00pm local time more often

when playing to the east of their home time zones and less often when playing to the west. The strong relationship in these "day" games appears to drive the full-sample results observed in previous research and reaffirmed in this paper. From 2002-13 we find no significant effects of playing in different time zones among either night games or day games.

Though explanations for our findings are only speculative, it is possible that the effects of playing in different time zones were insignificant for night games because NBA teams have long taken measures preparing for night games in different time zones. Night games are the vast majority of NBA games, and teams may have prepared for them with diet, sleep, and training methods designed to mitigate disruptions involving travel and time zone changes. The strong effects for 1991-2002 day games, which were fairly rare and therefore more difficult to systematically prepare for, may have reflected underlying biological effects of changing time zones. That time zone effects for day games are insignificant in the 2002-13 seasons suggests that NBA teams may have begun better preparing for day games by these years.

The rest of this paper is organized as follows. Section II explains our data. Section III explains our regression estimations and Section IV shows our results. Section V offers possible explanations for our findings. Section VI concludes.

II. Data

The data in this paper consists of NBA regular season games from the 1991-92 through 2012-13 seasons. We exclude the 1998-99 and 2011-12 seasons, both of which were shortened by labor disputes, and thirteen games played outside the U.S. and Canada (ten in Japan, two in the U.K., and one in Mexico). Our data, drawn from the website basketball-reference.com,

include information on date, home team, visiting team, winning team, and start time for each game.[1] Visiting teams in our sample win about 40% of games.

Our data provides substantial variation in the number of time zones that teams play away from their home. Approximately 37 percent of visiting teams play in their own time zone, 31 percent play one time zone away, 18 percent play two time zones away, and 13 percent play three time zones away. Since the same teams play each other, about half of each of these groups involve playing in a more western time zone and the other half involve playing in a more eastern time zone. We use these time zone differences as the key variables in our analysis.

All games in the sample begin between 12:00 Noon and 9:00pm local time, and the most common start times are 7:30pm (44%) and 7:00pm (37%). About 6% of games start at 8:00pm or later, 6% start between 4:30pm and 6:30pm, and the remaining 7% start at or before 4:00pm local time. Our main contribution in this paper involves splitting our analyses based on different start times to examine how time zone effects differ based on what time of day the game occurs.

III. Estimation Strategy

We estimate versions of the regression equation

$$VISITWIN_{ijkt} = \rho TIMEZONE_{ijkt} + \alpha_{jt} + \gamma_{kt} + \varepsilon_{ihvt} \quad (1)$$

where i is game, j is home team, k is visiting team, and t is season. The dependent variable is an indicator for whether the visiting team wins. Our key variables of interest are in *TIMEZONE*, a vector measuring how many time zones the visiting team is playing away from its home time zone. *TIMEZONE* contains two variables, one capturing the number of time zones to the east a visiting team is playing from home and the other capturing the number of time zones to the west

[1] Most of the data was collected from basketball-reference.com via a web-crawler, and remaining observations were filled in by examining newspapers on Google News archive.

it is playing from home. Both variables are lower-bounded at zero, e.g. a Pacific Time Zone team playing in the Central Time Zone is defined as playing 2 time zones to the east and 0 time zones to the west of its home time zone. The coefficients on both of these variables are based on comparisons to the omitted group where the *TIMEZONE* variables are both equal to zero, and where the visiting team plays an opponent from its own time zone.

α_{jt} and γ_{kt} are separate team-year fixed effects that control for quality of the home and away teams. That the fixed effects are separate for home teams and road teams allows each team, within the same season, to have different average qualities when playing at home versus playing on the road. That the fixed effects vary by year accounts for differences in team quality across different seasons, including differences associated with changes in home arena (Quinn et al 2003). All of our estimates are based on linear probability models instead of probit or logit estimations to provide more easily interpretable coefficients. Standard errors are robust to heteroskedasticity.

IV. Results

We separate our data into two sets of ten seasons each: first, from Fall 1991 – Spring 2002, omitting the shortened 1998-99 season; and then from Fall 2002 – Spring 2013, omitting the shortened 2011-12 season.

Panel A of Table 1 shows results for 1991-2002. In the first column of Table 1 we show *TIMEZONE* coefficients from an estimation including every game over these seasons. Our results are consistent with Nutting (2010) and Steenland and Deddens (1997). Each time zone that a visiting team plays to the east significantly increases its probability of winning by 8.4 percentage points. This effect is similar in magnitude but with the opposite sign as visiting teams

travel to the west, with a visiting team 7.7 percentage points less likely to win for each time zone further from home.

In Column 2, we limit the sample to games starting at 7:00pm local time or later, which constitute about 88% of the games in the 1991-2002 sample. Coefficients are smaller for these night games and are not statistically significant. Column 3 includes all games starting at 4:30pm local time or later, which constitute about 93% of our games in the sample. Despite the overwhelming majority of all games being in this sample, coefficients are again small and statistically insignificant.

Column 4 shows results when the sample is limited to games starting at or before 4:00pm local time, i.e. the 7% of games that are not included in Column 3. The coefficients are statistically significant, point the same directions as those in the overall sample (Column 1), and are extremely large. Columns 1-4 collectively suggest that the significant and substantial positive effects of playing to the east and negative effects of playing to the west seen among the full sample are concentrated among day games, not night games. This is exactly the opposite of what Nutting (2010) and Steenland and Deddens (1997) hypothesized. (Since the sample size in Column 4 is small and the fixed-effects approach yields few degrees of freedom, we view the size of its large estimated coefficients with caution.)

Panel B shows results for shows results for the 2002-2013 seasons. Results for the full season (Column 1), night games (Columns 2-3), and day games (Column 4) are all statistically insignificant. Thus the significant results from Panel A do not continue through more recent NBA seasons.

We performed some robustness checks that are available from the authors upon request. First, we added controls for the number of time zones crossed, both by the home team and the

visiting team, since their respective most recent games. Controls were separate for zones traveled to the east and to the west and were lower-bounded at zero, so that traveling to the east (west) yielded a zones-crossed to the west (east) value of zero. The Table 1 Panel A coefficients were all robust to these inclusions and the significant *TIMEZONE* coefficients in Columns 1 and 4 actually increased in intensity. This suggests that playing in different time zones, not crossing time zones in the recent past, drives the significant effects observed in Panel A. The Panel B *TIMEZONE* coefficients remained insignificant when these controls were added.

We also checked for robustness by adding controls for distance traveled and game frequency (Nutting 2010)[2] and length of home stands and road trips (Nutting 2013).[3] The Panel A coefficients retained their signs and significances and the Panel B coefficients all remained insignificant when these controls were added.

V. Possible explanations

Our paper shows that, *contra* the expectations of Nutting (2010) and Steenland and Deddens (1997), NBA games played at night feature no significant evidence of a relationship between time zone and visiting team performance. This contrasts with results from professional football, where teams play better to the east and worse to the west during night games (Jehue, Street, and Huizenga 1993; Smith, Guilleminault, and Efrom 1997).

[2] These controls include, for each team, covariates representing the number of days and miles traveled since the most recent game, plus the number of games played and miles traveled from 1-3 days ago, from 4-7 days ago, from 8-14 days ago, from 15-28 days ago, and more than 28 days ago. Each time a team plays consecutive games in different arenas, it is assumed to have travelled between those arenas. Miles traveled are calculated by as-the-crow-flies distances between zip codes of each arena that account for curvature of the earth. Teams are assumed to travel home during the all-star break.

[3] These controls include the number of consecutive games and days a team has played at home (on the road), the number of games and days it will spend at home (on the road) before its next road trip (homestand), and the number of miles the visiting team has traveled and has yet to travel on its current road trip.

Though our explanations are only speculative, NBA teams might be different than NFL teams in their response to night games because they play night games more frequently. While NFL teams play 16 games per season with games typically occurring during the day on a roughly weekly basis, NBA teams play 82 games, roughly one every 2.0-2.1 days, the vast majority being at night. The frequency of games, especially night games, may have made it beneficial for NBA teams to prepare for night games in different time zones, perhaps by utilizing methods uncovered by researchers to combat adverse effects of travel. For example, Waterhouse et al (2002) find that adverse travel effects can be ameliorated by controlling for the time of day that travel takes place. Herxheimer and Waterhouse (2003) suggest that planning travel ahead of time and eating well during a plane trip can assist in reducing jet lag. There is anecdotal evidence that NBA teams (Laggner 2009, Beck 2009) and NFL teams (Clark 2012, McCauley 2013) take proactive measures to reduce negative productivity effects associated with travel by managing player sleep and travel patterns before, during, and after road trips.

The large effects for day games from 1991-2002 may have demonstrated large, biological effects of playing in different time zones discovered in medicine and physiology research. A controlled experiment found that eastward travel enhanced the physical performance of racehorses (Tortonese et al 2011), and a study of German Olympic athletes found relatively larger interruptions to their training performances a few days after traveling to the west (Lemmer et al 2002).[4] These biological effects, combined with the fact that the paucity of day games provided less incentive for NBA teams to prepare for them as they prepared for night games, could have yielded strong effects on game outcomes.

[4] That said, though the literature in medicine and physiology has shown mixed results on the relative performances of athletes after eastward and westward travel (Arendt and Marks 1982), it typically has found that eastward travel yields longer-lasting negative jet-lag effects than westward travel (Waterhouse et al 2007; Recht, Lew, and Schwartz 1995).

In any case, the strong and substantial effects for day games are not observed for 2002-13. Perhaps by these years visiting teams had begun preparing for days games as well as night games using methods like those described above.

V. Conclusion

This paper finds that, from Fall 1991 – Spring 2002, NBA visiting teams won more often when playing games to the east of their home time zones and less often when playing games to the west of their home time zones. This reaffirms previous research. The results were driven by strong time zone effects on games that began at or before 4:00pm local time. Among night games, which are the vast majority of NBA games, there was no evidence of a statistically significant relationship between time zone and visiting team win probability from 1991-2002.

We had expected the positive effects of playing to the east and negative effects of playing to the west to be concentrated among night games. This would have been consistent with prior research on circadian rhythms and team performance in professional football. It is possible, though, that the frequent travel and night-game schedule of NBA teams provided teams with the incentive to prepare for night games in different time zones. Day games, being fairly rare, may have been more difficult to adapt to.

We also found that, from 2002-13, NBA teams experienced no significant effects of playing in different time zones for either night or day games. That the previous substantial effect among day games did not exist during this period indicates that NBA teams may have begun preparing for time zone effects of day games by these years.

References

Arendt, Josephine; Marks, Vincent. "Physiological Changes Underlying Jet Lag." British Journal of Medicine 284:1630, 16 January 1982, pp. 144-46.

Beck, Howard. "Bowing to Body Clocks, N.B.A. Teams Sleep In." The New York Times. December 20, 2009, p. SP1.

Clark, Kevin. "Sleeping Your Way to the Top." *Wall Street Journal*, Nov. 14, 2012.

Forbes-Robertson, Sarah; Dudley, Edward; Vadgama, Pankaj; Cook, Christian; Drawer, Scott, Kilduff, Liam. "Circadian Disruption and Remedial Interventions Effects and Interventions for Jet Lag for Athletic Peak Performance." Sports Medicine 42:3, March 2012, pp. 185-208.

Herxheimer, Andrew; Waterhouse, Jim. "The Prevention and Treatment of Jet Lag." British Medical Journal 326(7384), 8 February 2003, pp. 296-97.

Jehue, Richard; Street, David; Huizenga, Robert. "Effect of time zone and game time changes on team performance: National Football League." Medicine and Science in Sports and Exercise 25:1, November 1993, pp. 127-131.

Kahn, Lawrence M. "The Sports Business as a Labor Market Laboratory." Journal of Economic Perspectives 14:3, Summer 2000, pp. 75-94.

Laggner, Kyle. "Blazers adjust their snoozing—to stop losing." The Oregonian, January 11, 2009.

Lemmer, Björn; Kern, Ralph-Ingo; Nold, Gudrun; Lohrer, Heinz. "Jet Lag in Athletes after Eastward and Westward Time-Zone Transition." Chronobiology International 19:4, pp. 743-64.

McCauley, Janie. "49ers Accustomed to Winning with Long Travel." Associated Press, October 22, 2013.

Nutting, Andrew W. "Travel Costs in the NBA Production Function." Journal of Sports Economics 11:5, October 2010, pp. 533-548.

Nutting, Andrew W. "Immediate Effects of On-the-Job Training and Its Intensity: Team Defensive Production during NBA Homestands and Roadtrips." Journal of Sports Economics 14:3, June 2013, pp. 303-20.

Quinn, Kevin G.; Bursik, Paul B.; Borick, Christopher P.; Raethz, Lisa. "Do New Digs Mean more Wins?: The Relationship between a New Venue and a Professional Sports Team's Competitive Success." Journal of Sports Economics 4:3, August 2003, pp. 167-182.

Recht, Lawrence D.; Lew, Robert A.; Schwartz, William J. "Baseball teams beaten by jet lag." Nature 377. October 19, 1995. p. 583.

Reilly, Thomas; Waterhouse, Jim. "Sports performance: is there evidence that the body clock plays a role?" European Journal of Applied Physiology 106, June 2009, pp. 321-332.

Reilly, Thomas; Waterhouse Jim; Edwards Ben. "Jet lag and air travel: Implications for performance. *Clinics in Sports Medicine* 24(2), April 2005, pp. 367–380.

Smith, Roger S.; Guilleminault, Christian; Efron, Bradley. "Circadian Rhythms and Enhanced Athletic Performance in the National Football League." Sleep 20:5, May 1997, pp. 362-65.

Steenland, Kyle; Deddens, James A. "Effect of Travel and Rest on Performance of Professional Basketball Players." Sleep 20:5, May 1997, pp. 366-69.

D. J. Tortonese, D.J.; Preedy, D. F.; Hesketh, S. A.; Webb, H.N.; Wilkinson, E.S.; Allen, W.R.; Fuller, C.J.*, Townsend, J.; Short, R. V. "Experimental Jetlag Disrupts Circadian Clock Genes But Improves Performance in Racehorses After Light-Dependent Rapid Resetting of Neuroendocrine Systems and the Rest–Activity Cycle." Journal of Neuroendocrinology 23:12, December 2011, pp. 1263-72.

Waterhouse, Jim; Edwards, Ben; A Nevill; S Carvalho; G Atkinson; P Buckley; Reilly, Thomas, R Godfrey; R Ramsay. "Identifying some determinants of 'jet lag' and its symptoms: a study of athletes and other travelers." British Journal of Sports Medicine 36:1, February 2002, pp. 54-60.

Waterhouse, Jim; Reilly, Thomas; Atkinson, Greg; Edwards, Ben. "Jet lag: trends and coping strategies." The Lancet 369, Issue 9567, March 31 2007, pp. 1117-1129.

Table 1. Relationship between time zone and probability the visiting team wins

A: Fall 1991 – Spring 2002	All games	≥ 7:00pm	≥ 4:30pm	≤ 4:00pm
Zones to east	0.084**	0.053	0.051	0.327**
	[2.41]	[1.33]	[1.33]	[1.98]
Zones to west	-0.077**	-0.046	-0.044	-0.353**
	[-2.22]	[-1.15]	[-1.16]	[-2.21]
N	11,553	10,188	10,749	804
R^2	0.240	0.250	0.244	0.668
B: Fall 2002 – Spring 2013				
Zones to east	0.012	0.038	0.027	-0.145
	[0.34]	[0.95]	[0.72]	[-0.37]
Zones to west	-0.008	-0.031	-0.020	0.200
	[-0.20]	[-0.78]	[-0.52]	[0.53]
N	12,212	10,576	11,444	768
R^2	0.210	0.218	0.214	0.676

Notes: The unit of observation is the game and the outcome variable is an indicator for whether the visiting team wins the game. t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1