

# **If You Can't Take the Heat, Get Out of the Region: Spatial Competition and Strategic Firm Relocation**

by

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**Abstract:** Firms compete spatially for customers who have some degree of brand loyalty. The number and attractiveness of the alternatives available to these customers dictates the level of competition facing firms. In this study, a model of spatial pricing in the presence of heterogeneous customer preferences is used to specify an empirical analysis of spatial competition. Results, using spatial autoregressive techniques and ticket pricing data from professional sports, suggest that sports franchises spatially compete when pricing their tickets, and that the level of spatial competition has partially influenced the relocation of teams over time.

*Keywords:* spatial competition, location, market dominance

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## 1. Introduction

Spatial competition between firms and their resulting pricing and location decisions have been important topics of study since Hotelling's (1929) seminal work. According to this work, firms strategically choose their location in an effort to maximize profits.<sup>1</sup> While space and location have been fruitful areas of research since Hotelling's work, it hasn't been until relatively recently that econometric techniques and data have been available for measuring these relationships. This study adds to this literature by empirically connecting spatial competition and location. Using a theoretical model of spatial pricing in which firm's pricing decisions are based on the availability of substitute products, which is determined by the spatial location of the firm, data on the pricing decisions of teams in the four major sports leagues in North America are used to estimate the impact of spatial competition on pricing. These data also allow for the analysis of strategic relocation, as there were ten team relocations from the period 1995 to 2005.

The work following Hotelling (1929) has largely been theoretical in nature examining the importance of different assumptions on equilibrium price, location, and market areas (e.g. Lerner and Singer (1937), Chamberlin (1953), Lösch (1954), Spence (1976), Dixit and Stiglitz (1977), Salop (1979), Gabszewicz and Thisse (1979), D'Aspremont, Gabszewicz and Thisse (1979), Osborne and Pitchik (1987), and Anderson and Neven (1991)). While this literature focuses on location decisions stemming from competition, a related strain of literature focuses on the firm's location/relocation decisions when facing differing regulatory rules in different areas (e.g. Levinson (1996), Stafford (2000) and Becker and Henderson (2000)). While these papers all deal with

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<sup>1</sup> Note that while Hotelling's actual result was shown to be invalid by D'Aspremont, Gabszewicz and Thisse (1979), the notion that firm's strategically choose their location still holds.

location/relocation decisions based on the regulatory rules present at different locations, they establish, along with the aforementioned spatial competition literature, the desire of firms to location/relocate to regions which offer the firm the highest level of profits possible. Directly linking these two literatures, it follows that firms spatially compete for business and that, in the long-run, should there be another market available to a firm which offers a more competitively “friendly” environment they will locate/relocate to that market.

Empirically, data and econometric limitations have made the estimation of these relationships difficult. The first of these limitations, the availability of spatial data, has been all but removed with the growth of Geographic Information Systems (GIS), and the econometric limitations have been addressed with the contributions of Ord (1975) and Anselin (1988) among others. These developments have allowed for the empirical examination of spatial competition in many industries, including examinations of the pricing of hamburgers (Kalnins (2003)), the pricing of gasoline (Pinske, Slade and Brett (2002)) and the pricing of college tuition (McMillen, Singell and Waddell 2007)).

This study follows this previous work by examining spatial pricing data from the four professional sports leagues in North America (Major League Baseball, the National Basketball Association, the National Football League and the National Hockey League) over the period 1995-2005. Using a spatial autoregressive empirical specification, the results of this analysis indicate that professional sports franchises do spatially compete in all four professional sports, and that there is a positive relationship between ticket prices and the spatially weighted average ticket prices of neighboring teams (i.e. the estimated spatial lag term is positive). These estimates are then used to explore the predicted

impact on ticket prices of moving a franchise from one city to another by exploiting the differences in the competitive environment in the origin and destination city. The conclusion from this examination is that, of the ten franchise moves from 1995-2005, nine were to areas which offered a more competitively friendly attributes and one was to an area with a negligible predicted impact on ticket prices.<sup>2</sup>

While ticket pricing has been studied before in general (e.g. Rosen and Rosenfield (1997)), and for sports in particular (e.g. Ferguson, Stewart, Jones and Dressay (1991) and Rishe and Mondello (2004)), this is the first study, to my knowledge, to empirically estimate spatial competition in the ticket pricing of professional sports. Winfree, McCluskey, Mittelhammer and Fort (2004) do link location, space and attendance in Major League Baseball, finding that the closer two teams are geographically, the lower the fan attendance for each team. While this result implies that fans view sports teams, at least in Major League Baseball, as substitutes for one another, this current study represents the first work, to my knowledge, linking spatial competition and pricing to strategic firm relocation in any industry as data limitations make this task difficult in all but a few industries.

The remainder of this study is divided into four sections. Section 2 presents a theoretical model of firm pricing with heterogeneous goods. Section 3 then develops an empirical model stemming from the theory and discusses the data used in this analysis. Section 4 presents the results of this study and links the results to strategic firm relocation, while Section 5 offers concluding comments.

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<sup>2</sup> Note that there were many new franchises that entered these leagues during this period as well. However, new franchises are located in cities that are approved by current franchise owners who are attempting to maximize their profits rather than the profits of the entrant, therefore these new locations are not explicitly modeled, instead the focus remains on relocations where the franchise owner selects the new city to maximize their profits.

## 2. Theoretical Model

The focus of this study is on spatial competition between sports franchises within the four major professional sports leagues. These teams are located at distinct geographic points, and to maximize profits, these teams must optimally price the tickets to their games given the available alternative options present at their location. In addition to being located at different point in space, these teams also offer differentiated products to their customers. For example, fans may be able to choose between one team which has a low payroll and plays in an antiquated stadium or another team with a high payroll and a new more modern stadium.

Given this framework, the demand for sports franchises can be derived from the individual discrete choices of their customers as they choose between a variety of teams located in their geographic area.<sup>3</sup> In particular, consumers derive utility from attending sporting events, and the level of this utility is a function of the characteristics of team. In addition to the utility obtained from attending games, the customers also face costs of attending these events. Specifically, these customers must pay for admission into team  $j$ 's event,  $P_j$ , and must travel to the location of the team which costs them  $\theta D_j$  where  $\theta$  is the transportation cost per mile, and  $D_j$  is the roundtrip distance from the customer to team  $j$ 's location.<sup>4</sup>

A customer,  $i$ , will choose to attend team  $j$ 's game if:

$$U_i(\delta_j) - P_j - \theta D_j > U_i(\delta_r) - P_r - \theta D_r, \text{ for } r = 0, 1, 2, \dots, J \quad (1)$$

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<sup>3</sup> As such, the model here draws on previous work by Bresnahan (1987), Berry (1994) and Berry, Levinsohn and Pakes (1995) among others.

<sup>4</sup> Note that it is implicitly assumed that each customer faces the same transportation cost per mile, but that customers located at different geographic locations will face different travel costs to attend team  $j$ 's games.

where  $\delta$  represents team attributes and  $r = 0, 1, 2, \dots, J$  denotes the alternatives available to the customer. Note that  $r = 0$  represents the consumer's option to not attend any of the various teams' games. Given equation (1) above, if there were only two teams,  $j$  and  $k$ , team  $j$ 's market area can be found by solving for the customer who is indifferent between attending team  $j$ 's games and team  $k$ 's games. This customer is indifferent between these two team's games if they are located at a point in space such that:

$$D_j = \frac{U_i(\delta_j) - U_i(\delta_k)}{2\theta} + \frac{P_k - P_j}{2\theta} + D \quad (2)$$

Notice that the location of indifferent fan,  $i$ , and subsequently team  $j$ 's market area given by equation (2), is increasing in the indifferent fan's preferences for its team characteristics,  $U_i(\delta_j)$ , decreasing in fan preferences for its competitor's team characteristics,  $U_i(\delta_k)$ , increasing in the ticket price charged by its competitor,  $P_k$ , decreasing in the ticket price that it charges,  $P_j$ , and is increasing in the distance between teams  $j$  and  $k$ ,  $D$ .

Equation (2) above shows the distance from team  $j$  to the customer who is indifferent between attending team  $j$ 's game and team  $k$ 's game. However, there are more than two teams in any professional sports league, implying that there is a set of equations of the form of equation (2), equations which define the distance from team  $j$  to the customers who are indifferent between team  $j$  and the set of all other teams. This set of distances to indifferent fans bounds the team's market area, and summing up the number of individuals within this market area yields each team's demand given by:

$$Q_j = Q_j(\delta_j, \delta_r, P_j, P_r, \theta, N, D) \quad \text{for } r = 0, 1, \dots, J \quad (3)$$

where  $N$  is the population base over which teams are competing. Notice that because the team's demand is determined by summing up the individuals within their market area,

any of the aforementioned changes to the variables influencing the size of this market area will change the team's demand. In particular, an increase in the team's market area translates into an increase in the team's demand, while a decrease in their market area will have the opposite effect.

This last point, the relation between a team's market area and a team's demand, has implications for the location choice of both new entrants into the sports league and the relocation of existing teams. Specifically, if a new or relocating team wants to ensure the greatest demand for their team possible, they will choose to locate where the combination of population, fan preferences and competitor's prices maximizes their market area, and subsequently, their demand. This translates into new or relocating teams preferring locations which offer higher population bases, greater fan interest in their team and higher competitor ticket prices.<sup>5</sup> Given that every potential location available to these teams involves different levels of these three desirable attributes, the team will locate in the city believed to be associated with the highest level of demand as given by equation (3) above. As will be explicitly shown later, this explains why both Los Angeles football teams moved out of Los Angeles into cities with smaller population bases.

The costs to sports franchises of providing games for fans to attend can be thought of, in general, as product quality costs. These costs are positively correlated with the number of games attended by fans and consist of: player labor costs,  $L_j$ , stadium costs,  $S_j$ , and operational costs,  $O_j$ :

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<sup>5</sup> Note that information regarding fan preferences for a particular team/sport may or may not be available prior to moving. For example, a team moving to a city which has previously had a sports team in the same league will give the owners a sense of the fan preferences for their sport. However, if the city has never hosted a team in the same league or a professional sports team in any league, information regarding the fan's preferences will not be available and/or reliable.

$$Costs_j = C_j(Q_j, L_j, S_j, O_j) \quad (4)$$

Given these costs, team j's profit maximization problem is:

$$\underset{P_j}{Max} P_j Q_j - C_j(Q_j) \quad (5)$$

where  $Q_j$  is the team's demand given by equation (3) and  $C_j$  is firm j's costs given by equation (4). The solution to (5) yields firm j's profit maximizing price which is a function of both the demand and cost determinants:

$$P_j^* = P_j^*(\delta_j, \delta_r, P_r^*, \theta, N, D, L_j, S_j, O_j) \quad \text{for } r = 0, 1, \dots, J \quad (6)$$

Notice that, according to equation (6), team j's profit maximizing price depends on: the team characteristics of team j,  $\delta_j$ , the team characteristics of competing teams,  $\delta_r$ , the price of competing teams,  $P_r^*$ , travel costs per mile,  $\theta$ , the population base,  $N$ , the distance between j and its competitors,  $D$ , labor costs,  $L_j$ , stadium costs,  $S_j$ , and operations costs,  $O_j$ . The inclusion of the prices of competing teams stems from the observation that sports franchises are spatially competing with one another to determine their market area, which subsequently determines the demand for their team. Also, as was discussed before, this model offers predictions regarding the location choice of new or relocating teams within these leagues.

### 3. Empirical Model & Data

Empirically, the specification dictated by the theoretical model in the previous section is one where the price of a team is dependant upon the aforementioned demand parameters and cost factors. Due to data limitations, estimating a pricing model such as this, that accounts for all competitive options and then relates spatial competition to relocation, has been difficult. To accomplish this task, this study employs data from the four major professional sports: the National Football League (NFL), Major League

Baseball (MLB), the National Basketball Association (NBA) and the National Hockey League (NHL). The pricing data used was collected from Team Marketing Report who publishes yearly weighted average ticket prices for each team in all four of the aforementioned leagues.<sup>6</sup> Figures 1 and 2 illustrate these pricing data, with figure 1 showing a histogram of prices by league and figure 2 showing the trend in prices over time by league. Focusing specifically on figure 2, it can be seen that all four leagues have seen a general increase in prices from 1991 to 2006; however, because of limitations on the other variables described below, attention is restricted to the period 1995-2005.

To these pricing data, demand and cost factors are added, which include: the previous year's attendance percentage, the team's payroll, the per capita income of the Metropolitan Statistical Areas (MSA) in which the team is located, the population of the MSA in which the team is located, a dummy variable equal to 1 in years following a labor dispute in the league in question, a dummy variable equal to 1 for teams who made the playoffs in the previous year, a dummy variable equal to 1 for teams who were the league champions in the previous year, a dummy variable equal to 1 for expansion franchises in their first year, a dummy variable equal to 1 for teams in their first year in a new stadium, a dummy variable equal to 1 for teams who are playing their first season in a new city, a dummy variable equal to 1 for teams located in Canada and a trend variable to capture any patterns in prices.<sup>7</sup> Note that several variables refer to the team's previous year's performance; this is because the ticket prices are set prior to the season based on the results from their previous season and expectations regarding the current season.

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<sup>6</sup> The weighted average ticket price is calculated by multiplying the number of seats in each pricing section by the price of seats in that section and then calculating the average ticket price.

<sup>7</sup> All non-price variables were either obtained directly from each of the four sports leagues, from the Bureau of Economic Analysis (population and per capita income), and from Statistics Canada.

Additionally, to capture the demand for the team, the previous year's attendance percentage is used rather than attendance to capture differences in the capacity of teams. All variables measured in monetary terms (price, payroll and per capita income) are measured in real terms, with the mean values of all variables used presented in Table 1.

Notice that the structure outlined, in the previous section, implies that the price of competing firms is endogenous. As is common in the spatial econometrics literature, this endogeneity is accounted for by using a spatial autoregressive (lag) model to examine firm pricing.<sup>8</sup> The general spatial lag model is specified as:

$$P = X\beta + \rho WP + u \quad (7)$$

where  $P$  is a vector of firm prices and  $X$  is the vector of cost and demand parameters discussed above.<sup>9</sup> Notice that equation (7) is a typical OLS specification with an additional term,  $\rho WP$ , which captures the impact of competing firm's prices on the price charged. Specifically,  $W$  is a spatial weighting matrix which is specified as:

$$W = \begin{bmatrix} W_{1995} & 0 & 0 & 0 \\ 0 & W_{1996} & 0 & 0 \\ 0 & 0 & . & 0 \\ 0 & 0 & 0 & W_{2005} \end{bmatrix}$$

where  $W_i$  is defined as:

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<sup>8</sup> Although others have estimated spatial autoregressive processes using instrumental variables techniques (see Anselin (1988)) or Bayesian techniques (see LeSage (1997)), the standard approach is to use MLE in estimating these models.

<sup>9</sup> Anselin (1988) provides a general overview and development of spatial econometrics. In addition to the aforementioned pricing models, there are many examples of the use of such models, including the examination of patterns in foreign direct investment (e.g. Coughlin and Segen (2000), Baltagi, Egger and Pfaffermayr (2007) and Blonigen, Davies, Waddell and Naughton (2007)), explaining government actions (e.g. Brueckner, (1998) and Brueckner and Saavedra (2001)), and the impact of tournaments on performance (e.g. Haraguchi and Waddell (2007)).

$$W_r = \begin{bmatrix} 0 & \frac{1}{\gamma_{i,j}} & \frac{1}{\gamma_{i,k}} \\ \frac{1}{\gamma_{j,i}} & 0 & \frac{1}{\gamma_{j,k}} \\ \frac{1}{\gamma_{k,i}} & \frac{1}{\gamma_{k,j}} & 0 \end{bmatrix}$$

and  $\gamma_{i,j}$  is based upon the degree of contiguity between firms  $i$  and  $j$ .<sup>10</sup> If firms  $i$  and  $j$  are located within 50 miles of one another,  $\gamma_{i,j}$  takes a value of 1, if they are located between 50 and 100 miles from one another  $\gamma_{i,j}$  takes a value of 2, so on and so forth with 50 mile increments up until 700 miles at which point  $\gamma_{i,j}$  takes a value of 14. For all firms located further than 700 miles apart,  $\gamma_{i,j}$  is set to zero as, for the typical fan, these firms are not competitors for their business. As with all spatial autoregressive models, the specification of the weighting matrix is chosen based on one's belief about the relationship between spatially related observations. For this study, it is assumed that teams located closer together provide fans with better alternatives which accounts for the decreasing weight placed on the prices of firms as location increase. However, it is also assumed that because the good in question, a sporting event, is an experience good that customers have tastes for, absolute distance matters less than proximity which is why the weighting matrix above incorporates degrees of contiguity rather than actual distances. In addition, a 700 mile radius was used because it is assumed that a fan located halfway between two firms would be facing a full day drive to reach either team and that a larger radius would imply an even longer driving distance for the fan located half way between the firms, which would seem an unlikely distance for fans to be traveling on a regular

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<sup>10</sup> Note that the on diagonal elements are set to zero to prevent a firm's price being regressed on itself.

basis.<sup>11</sup> As is common in the spatial econometric literature, the spatial weighting matrix,  $W$ , is row standardized so that  $WP$  is interpreted as the weighted average price of competing firms, and  $\rho$  is our estimated term in equation (7) which relates the effect of the weighted average price of competing firms on the price charged.

Assuming that the error term in equation (7) is normally distributed with constant variance, the log-likelihood function is:

$$\log L = -\frac{n}{2}\log(2\pi) - \frac{1}{2\sigma^2} \sum_{i=1}^n u_i^2 - \frac{n}{2}\log \sigma^2 + \log|I - \rho W| \quad (8)$$

where the last term,  $\log |I - \rho W|$  is the Jacobian of the transformation from  $u$  to  $P$  and is implicitly assumed to be zero in non-spatial linear regression models. This log likelihood function is estimated separately for each of the four professional sports leagues for the period 1995-2005.<sup>12</sup>

#### 4. Results

The results of estimating equation (7) for each of the four professional sports leagues via both OLS and the likelihood function given by equation (8) are presented in table 2. The OLS results of estimating equation (7) are included in Table 2 to assess the stability of the parameter estimates; however, all tests for the appropriateness of the spatial autoregressive model indicate that prices are spatially correlated in all four leagues. Note that while the data from each league span the same time frame, there is a noticeable difference in the number of observations for each league, with as few as 282 observations for the NHL and as many as 341 observations for the NFL from the period 1995-2005. This discrepancy in observations stems from both work stoppages and the

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<sup>11</sup> It should be noted that numerous alternative specifications of the weighting matrix were examined and the results presented in this paper are robust to all specifications.

<sup>12</sup> Note that in this estimation, all non-dummy variables are measured in logs.

differing numbers of teams over this time frame. The remainder of this section is broken into three parts: in the first subsection the results of the non-spatial variables are discussed, in the second subsection the existence of spatial competition is examined and in the final subsection explores the relation of the estimates presented in table 2 to the strategic relocation decision.

### Non-Spatial Pricing Variables

As was noted in the previous section, several of the relevant pricing variables included in equation (7) measure the previous year's performance on current year pricing. Examining the coefficient estimates on these variables in table 2, there are several noteworthy trends. First, across all four leagues the higher the attendance percentage is in the previous year, the higher the price charged. Specifically, a one percent increase in attendance percentage in the previous year leads to between a .281 (NFL) and a .548 (NBA) percent increase in ticket prices. Note that attendance percentage measures how close to "selling out" every game during the season the team was, so this result implies that as teams get closer to reaching their capacity they raise their prices in the following year. Fort (2006) discusses why sports franchise owners are unlikely to want to sell out all of their games, as it is unlikely that the level of attendance associated with selling out all of their games is their profit-maximizing level of attendance, which explains why teams would increase their ticket prices as their attendance percentage increases. Linked to the effect of the previous year's attendance percentage on ticket prices is the estimated coefficient on the trend variable. These estimates indicate that real ticket prices are

falling over time in MLB, the NBA and the NHL, with no statistically significant trend found for the NFL in the spatial autoregressive model.<sup>13</sup>

As for the impact of the previous year's product on ticket pricing, the results are less unanimous. The first of these measures, winning a championship in the previous year, has no statistically significant impact on ticket pricing in any of the four sports leagues.<sup>14</sup> In addition, making the playoffs in the previous year is only statistically significant for the NHL, where making the playoffs in the previous year leads to higher ticket prices. While these results may seem to indicate that ticket prices are not correlated with the team's previous year's performance, one has to remember that the team is charging higher ticket prices as attendance percentage increases as discussed before. Combined with the results on the previous year's performance, this indicates that a team will not charge higher ticket prices, even if they had put a good product on the field in the previous season, unless fans supported that team in the previous season.

The impact of the current year's product quality on ticket prices is captured in the payroll, expansion and new stadium variables. For the MLB, NBA and NHL an increase in the team's payroll for the upcoming season is shown to lead to an increase in the ticket prices charged. Specifically, a one percent increase in the team's payroll leads to a .202 percent increase in ticket prices in MLB, a .351 percent increase in ticket prices in the NBA and a .097 percent increase in ticket prices in the NHL. Note that while the estimate on team payroll in the NFL is insignificant, this is likely due to the stringent

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<sup>13</sup> Part of the reason for this effect is because sports have become more popular over time, while also building smaller stadiums, which has led to an increase in attendance percentage over time which does lead to higher ticket prices. Also, it should be noted that for the NFL, there is a positive trend in ticket prices when using OLS.

<sup>14</sup> Although all of the estimates indicate that winning a championship and ticket prices are positively correlated.

salary cap in the NFL which doesn't allow much variation in team salaries across the league. Expansion is included to capture any effect on ticket prices associated with teams playing in their first season as a franchise. This effect could be negative because these teams don't have an established fan base and the team wants to price their tickets lower to gain fans, or could be positive because the team knows that there will be a buzz around the team in their first year due to the newness of the sport in a particular town, leading the team to charge higher ticket prices. The estimates on the expansion variable presented in table 2 indicate that expansion franchises do not charge different prices than other teams when they are in their first year in all leagues except for the NHL. In the NHL, teams in their first year of existence are found to charge higher prices. The final measure of the impact of the current year's product on ticket prices indicates that teams who are playing their first year in a newly built stadium raise ticket prices significantly across all four leagues.

In addition to team controlled quality measures, there have also been labor disputes in MLB, the NBA and the NHL over the period in question. For baseball, the estimates indicate that the labor dispute, the 1994 MLB Strike, had a negative impact on ticket prices when play resumed in 1995. In the NBA, ticket prices were actually higher following the 1998 NBA lockout. The NHL actually had two labor disputes over the time period in question, both lockouts in 1994 and 2005, and the estimates presented in table 2 indicate that these disputes lead to a decrease in ticket prices when play resumed.

### Spatial Competition

The remaining variables in table 2 are all included to capture the variables relevant to the spatial environment in which the team is operating, and include: the

population in the MSA the team is located in, the per capita income of the MSA that the team is located in, a dummy variable for the first year a team is in a new city, a dummy variable for Canadian teams and the spatial autoregressive term, *WP*. MSA population represents the potential number of customers that the team is competing over. The estimated impact of population on ticket prices indicates that a one percent increase in the population in the MSA where the team is located leads to a .029 percent increase in ticket prices in MLB, a .123 percent increase in ticket prices in the NBA, a .063 percent increase in ticket prices in the NHL and no impact on ticket prices in the NFL. Per capita income measures the money available to be spent on tickets and the estimates indicate that a one percent increase in the per capita income in a team's MSA leads to a .434 percent increase in ticket prices in MLB, a .414 percent increase in ticket prices in the NFL, a .150 percent increase in ticket prices in the NHL and no impact on ticket prices in the NBA.

A dummy variable for teams playing their first year in a new city is included to capture fan interest in teams new to their area and the resulting increase in ticket pricing. The estimates on this variable indicate that teams playing their first year in a new city raise their ticket prices in all of the leagues except for the NHL. While all of the variables discussed thus far pool both U.S. and Canadian teams together, there is reason to believe that teams located in Canada may face a different pricing pressures which may keep their ticket prices either higher or lower than those of U.S. based teams.<sup>15</sup> To account for this possibility, the Canada dummy variable was included, and the estimated

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<sup>15</sup> As will be discussed below, many teams have relocated from Canadian cities to U.S. cities, presumably seeking higher profits in the U.S.

coefficients for this variable indicate that ticket prices are lower for Canadian teams in the NBA, higher for Canadian team in MLB, and insignificant for Canadian NHL teams.

The final variable of interest is the coefficient on the spatial autoregressive term which indicates whether professional sports teams are spatially competing when choosing their ticket prices. Across all four sports leagues, the estimated impact of the spatially weighted average ticket price of competitors indicates that teams do spatially compete in prices. Specifically, the positive estimate on the spatial lag term indicates that team's whose geographic neighbors price higher will also price higher, i.e. that ticket prices are positively correlated across space. All of these estimates indicate that as the competitors of a team increase their price the team increases its price as well. Bringing this result back to the theoretical model developed earlier in this study, this suggests that as a team's competitors increase their prices, the team's indifferent fan moves further away allowing the team to increase its ticket price as well.

#### Strategic Firm Relocation

The results discussed in the previous subsection all indicate that professional sports teams spatially compete in choosing their ticket prices so as to maximize profits. As was discussed earlier, these same teams may choose to relocate to a more "friendly" competitive environment in the long run so as to maximize profits. Specifically, based on the results in table 2, firms may wish to relocate from an area where the spatially weighted average ticket prices are low to an area where these prices are higher, from an area with low population to an area with higher population, from an area with low per capita income to an area with higher per capita income and/or from a Canadian city to a city in the U.S. (in the NBA). Note that if they could accurately predict future attendance

percentages, this may also lead the team to strategically relocate, but the focus here is going to remain on variables which the team has prior information about.

From the period 1995 to 2005, the four professional sports in question had ten individual team relocations. Of these relocations, four were in the NFL (the Raiders moved from Los Angeles to Oakland in 1995, the Rams moved from Los Angeles to St. Louis in 1995, the Ravens moved from Cleveland where they were known as the Browns to Baltimore in 1996 and the Titans moved from Houston where they were known as the Oilers to Tennessee in 1997), three were in the NHL (the Avalanche moved from Quebec where they were known as the Nordiques to Denver in 1995, the Coyotes moved from Winnipeg where they were known as the Jets in 1996 and the Hurricanes moved from Hartford where they were known as the Whalers in 1997), two were in the NBA (the Grizzlies moved from Vancouver to Memphis in 2001 and the Hornets moved from Charlotte to New Orleans in 2002) and one in MLB (the Nationals moved from Montreal where they were known as the Expos to Washington D.C. in 2005). These moves can be seen visually in figure 3 which is useful in depicting the spatial environment in both the origin and destination city for each of these moves.

The results presented in table 2 allow for the examination of these moves in terms of the predicted impact of the move on ticket prices. Table 3 presents both the changes to the spatial variables because of the team relocation (population, per capita income, and the spatially weighted average ticket price) and the predicted impact of these changes on ticket prices for each of these franchise moves.<sup>16</sup> Notice that while many of the team

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<sup>16</sup> The change in the average attendance percentage for the team is also included. This is measured as the change in the average attendance percentage comparing the two years prior to the move and the two years following the move so as to reduce any impact of the move itself on attendance. As was mentioned

relocations were to areas with lower population bases, lower per capita incomes and/or lower spatially weighted average ticket prices, nine of the ten moves were to locations where the cumulative effect of these variables was predicted to allow the team to increase its ticket prices.<sup>17</sup>

In the NFL, the Raiders move in 1995 from Los Angeles, CA to Oakland, CA is predicted to have allowed the Raiders to increase their ticket prices by 49% holding all non-spatial variables constant at their 1994 levels. Likewise, the Rams move in the same year from Los Angeles, CA to Oakland, CA is predicted to have allowed them to increase their ticket prices by 27%. In later years, the Ravens moved from Cleveland, OH to Baltimore, MD which is associated with a 31% increase in predicted ticket prices while the Titans moved from Houston, TX to Nashville, TN which is predicted to have allowed them to increase ticket prices by 31%.

In the NBA, the move of the Grizzlies in 2001 from Vancouver, BC to Memphis, TN is associated with a 26% increase in predicted ticket prices while the move of the Hornets from Charlotte, NC to New Orleans, LA is predicted to have allowed them to increase their ticket prices by 23%. The relocation of the Avalanche from Quebec to Denver, CO is predicted to have allowed them to increase ticket prices by 8% with a similar increase of 6% for the Coyotes when they moved from Winnipeg to Phoenix, AZ. The move of the Hurricanes from Hartford, CT to Raleigh, NC is the only one of the ten moves which is associated with a decrease in the predicted ticket prices based on spatial characteristics. While this results predicts only a modest 1% decrease in prices, this

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previously, if the teams could predict this change it would provide them with another reason for moving. However, in the estimated impact of the relocation on ticket prices this impact is excluded.

<sup>17</sup> The one move where the predicted impact was to lower ticket prices had a negligible predicted impact on ticket prices.

particular movement was associated with a fight over funding for a new stadium in Hartford which lead the owner to move the team. The only relocation in professional baseball, the move of the Nationals from Montreal to Washington D.C. is predicted to have allowed the National's owners to increase ticket prices by 69%.

These calculations are intended to isolate the effect of the origin and destination markets on the predicted ticket prices, and thus hold constant non-spatial factors that do change over time. As such, the actual change in ticket prices differs from those predicted above in many cases. With this in mind, it should be noted that the predicted changes above are actually quite similar to the actual changes following the movements for many of these franchises.

## **5. Conclusions**

The focus of this study has been on spatial competition and strategic firm relocation. Using a theoretical model of spatial pricing, it is predicted that firms price is partly determined by the level of spatial competition present. In particular, each firm's profit maximizing price is, in part, determined by the price of its competitors such that the firm is the utility maximizing seller. This framework implies that, in the long run, firms may strategically relocate to regions where the pricing pressure from competitors is lessened allowing the firm to increase its price.

Employing pricing data from the four major professional sports leagues (Major League Baseball, the National Basketball Association, the National Football League and the National Hockey League) over the period 1995-2005, a spatial autoregressive model of pricing is estimated. The results of this model indicate that professional sports teams do spatially compete in prices. These estimates are then used to examine the predicted

impact on ticket prices of the ten team relocations during the period 1995-2005. This analysis indicates that nine of the ten team moves were strategic in nature moving to areas which allow the team to charge higher ticket prices.

These results make a significant contribution to the literature in that they provide an empirical link between the spatial pricing and location literatures. An interesting extension of this study would be to examine the choice of expansion cities in professional sports from a spatial competition point of view. This was not done in this study as the choice of location cities is determined by the current team owners who are attempting to maximize their profits and the focus of strategic relocation in this study has been on owners moving their own teams to maximize their profits.

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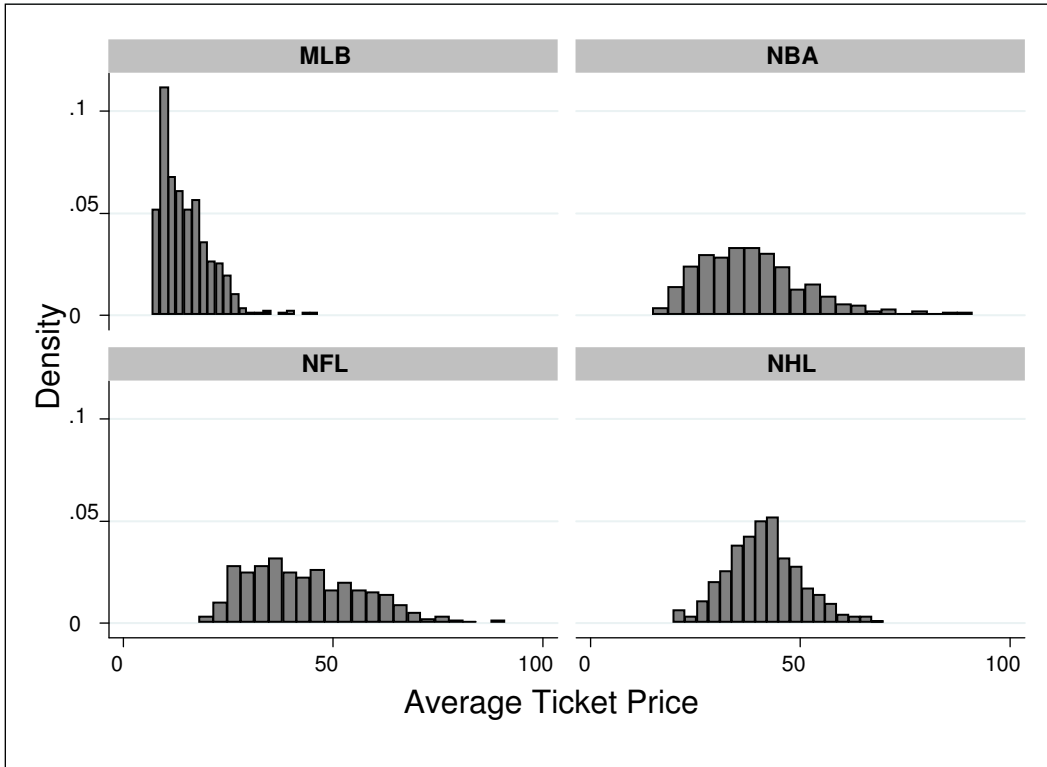
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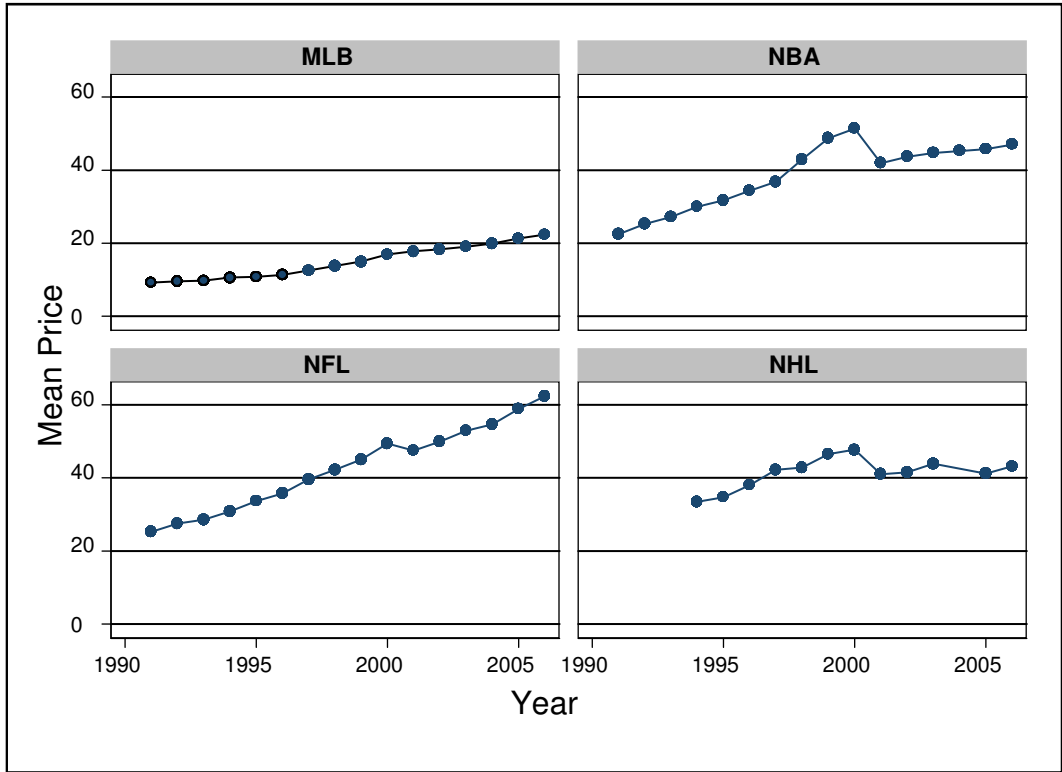
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**Figure 1: The Distribution of Ticket Prices by League**



**Figure 2: Average Ticket Prices by League 1991-2006**

**Table 1: Summary Statistics**

<b>Variable</b>	<b>Mean (MLB)</b>	<b>Mean (NBA)</b>	<b>Mean (NFL)</b>	<b>Mean (NHL)</b>
Average Ticket Price	\$14.04	\$37.51	\$40.79	\$37.48
Previous Year's Attendance	2,215,312	664,380	500,595	636,496
Previous Year's Attendance Percentage	0.599	0.866	0.894	0.888
Payroll	\$47,100,000	\$40,500,000	\$55,300,000	\$29,000,000
Per Capita Income	\$32,923	\$32,247	\$32,724	\$31,551
Population	5,440,235	4,998,014	4,120,225	5,433,104
Work Stoppage	0.086	0.090	0	0.199
Playoffs	0.247	0.548	0.387	0.564
Champion	0.031	0.034	0.032	0.035
Expansion	0.006	0.009	0.012	0.014
New Stadium	0.031	0.050	0.038	0.053
New City	0.003	0.006	0.015	0.011
Canada	0.065	0.053	0	0.216
Trend	5.074	5.028	5.082	4.777

**Table 2: OLS & Spatial Autoregression Results**

Variable	MLB		NBA		NFL		NHL	
	OLS	Spatial Lag	OLS	Spatial Lag	OLS	Spatial Lag	OLS	Spatial Lag
Log Prev. Year's Attendance Percentage	0.289*** (0.035)	0.313*** (0.033)	0.521*** (0.090)	0.548*** (0.087)	0.233*** (0.071)	0.281*** (0.070)	0.258*** (0.084)	0.295*** (0.077)
Log Payroll	0.215*** (0.032)	0.202*** (0.030)	0.367*** (0.047)	0.351*** (0.045)	-0.031 (0.051)	-0.031 (0.049)	0.110*** (0.040)	0.097** (0.037)
Log Per Capita Income	0.470*** (0.084)	0.434*** (0.079)	-0.094 (0.093)	-0.131 (0.091)	0.468*** (0.075)	0.414*** (0.075)	0.178** (0.081)	0.150** (0.074)
Log Population	0.031* (0.016)	0.029* (0.015)	0.125*** (0.015)	0.123*** (0.015)	-0.015 (0.013)	-0.013 (0.012)	0.070*** (0.013)	0.063*** (0.012)
Work Stoppage	-0.067* (0.039)	-0.068* (0.036)	0.085** (0.036)	0.070** (0.035)			-0.099*** (0.027)	-0.062** (0.025)
Playoffs	-0.018 (0.025)	-0.020 (0.023)	0.008 (0.024)	0.013 (0.024)	0.017 (0.018)	0.012 (0.018)	0.073*** (0.022)	0.067*** (0.020)
Champion	0.040 (0.056)	0.035 (0.052)	0.031 (0.058)	0.032 (0.055)	0.047 (0.047)	0.045 (0.046)	0.008 (0.053)	0.022 (0.049)
Expansion	0.133 (0.120)	0.114 (0.112)	0.075 (0.114)	0.088 (0.110)	0.069 (0.078)	0.074 (0.075)	0.311*** (0.088)	0.263*** (0.081)
New Stadium	0.248*** (0.053)	0.251*** (0.050)	0.177*** (0.047)	0.168*** (0.045)	0.173*** (0.042)	0.171*** (0.041)	0.066 (0.045)	0.067* (0.041)
New City	0.347** (0.169)	0.353** (0.157)	0.204 (0.134)	0.214* (0.129)	0.204*** (0.072)	0.227*** (0.070)	-0.014 (0.097)	0.005 (0.088)
Canada	0.121*** (0.043)	0.076* (0.041)	-0.153*** (0.051)	-0.181*** (0.050)			-0.032 (0.031)	-0.003 (0.029)
Trend	0.002 (0.005)	-0.010** (0.005)	-0.014** (0.005)	-0.013** (0.005)	0.009** (0.005)	0.004 (0.005)	-0.020*** (0.005)	-0.014*** (0.004)
Constant	-6.381*** (0.935)	-6.517*** (0.874)	-3.596*** (1.079)	-3.570*** (1.038)	-0.439 (1.116)	-0.755 (1.083)	-1.068 (0.960)	-1.690* (0.884)
Spatially Weighted Average Ticket Price		0.319*** (0.062)		0.183*** (0.059)		0.242*** (0.078)		0.331*** (0.058)
Observations	324	324	321	321	341	341	282	282
Adjusted R <sup>2</sup>	.68		.47		.39		.42	
Log Likelihood		147.27		105.22		174.54		135.16

Note: the dependant variable, Log Real Average Ticket Price is the weighted average ticket price adjusted for inflation. Standard errors are in parentheses. \* significant at 10%, \*\* significant at 5% and \*\*\* significant at 1%.



**Table 3: Origin and Destination Location Characteristics for Firm Relocations**

<b>Firm Movement</b>	<b>Change in Population Base</b>	<b>Change in Per Capita Income</b>	<b>Change in Weighted Average Ticket Price of Competitors</b>	<b>Change in Average Attendance Percentage</b>	<b>Predicted Change in Ticket Price due to Change in Location</b>
Raiders from Los Angeles to Oakland (1995)	- 7,779,313	+ \$8,592	+ \$6.61	+ 30%	+ 49%
Rams from Los Angeles to St. Louis (1995)	- 9,011,988	+ \$1,037	- \$1.31	+ 36%	+ 27%
Nordiques/Avalanche from Quebec to Denver (1995)	+ 1,231,414	+ \$12,096	- \$7.14	+ 14%	+ 8%
Browns/Ravens from Cleveland to Baltimore 1996	+ 351,250	+ \$1,017	+ \$2.71	+ 1%	+ 31%
Jets/Coyotes from Winnipeg to Phoenix (1996)	+ 2,176,089	+ \$12.5	- \$1.89	+ 16.5%	+ 6%
Oilers/Titans from Houston to Tennessee (1997)	- 3,063,440	+ 1,562	+ \$1.91	+ 31.5%	+ 31%
Whalers/Hurricanes from Hartford to Raleigh (1997)	- 404,868	- \$762	+ \$3.09	- 41.5%	- 1%
Grizzlies from Vancouver to Memphis (2001)	- 824,638	+ \$4,944	- \$21.51	+ 1%	+ 26%
Hornets from Charlotte to New Orleans (2002)	+ 31,814	+ \$588	+ \$2.07	+ 20.4%	+ 23%
Expos/Nationals from Montreal to D.C. (2005)	+ 1,641,868	+ \$23,161	- \$2.18	+ 45%	+ 69%