

Ticket Prices, Concessions and Attendance at Professional Sporting Events

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Abstract

This paper explores the demand for attendance at professional sporting events using a data set that includes ticket prices and a price index reflecting prices for ancillary goods associated with attendance. Previous research has focused on attendance at Major League Baseball games, but this study also includes attendance at NBA and NFL contests. The analysis largely confirms existing findings that attendance demand is price inelastic, a result that is often thought to be at odds with the monopoly status of professional sports franchises. The analysis shows that ticket pricing in the inelastic portion of the demand curve is consistent with revenue maximization by monopoly teams that also set prices for related goods and services like concessions and parking closer to the elastic portion of the demand curve.

Keywords: professional sports, demand analysis

Introduction and Motivation

The demand for attendance at major league sporting events has been the subject of a great deal of empirical research over the years. An important barrier to much of this research has been the lack of a long time series of ticket price data, especially for professional football and basketball. Since the early 1990s, Team Marketing Report has published a Fan Cost Index. As part of this index, they collect data on tickets, but also on concessions and parking so that the index measures the full dollar cost of attending a game. The index and its components are available for each of the NFL, NBA, and MLB franchises over the period.

These data make it possible to estimate empirical demand models for the NFL, NBA, and MLB, something that has been difficult since Noll's (1974) seminal paper. Moreover, the Fan Cost Index data makes it possible to assess the effect of the prices of complementary goods like concessions, parking, and programs on attendance. The Fan Cost Index attempts to paint a complete picture of the cost of attending a sporting event. The addition of the prices of the ancillary purchases related to attendance enables researchers to assess the role of these other prices in the determination of attendance.

Knowing the effects of these other prices is quite important for public policy reasons. Fort (2004) has

argued that many researchers find inelastic demand for attendance in professional baseball, despite franchise monopolies, because multiple products—most notably, local TV broadcasts—are being sold. Once the multiple product nature of the franchises is correctly addressed through fuller specification of the revenue functions, then inelastic ticket pricing is implied by profit maximization.

The problem for empirical work is that time-series data sets of local television contract revenues covering many years is not available in any of the sports. Indeed, for the NFL, teams are not able to individually negotiate television contracts. However, with the Fan Cost Index data on concession, parking, and program prices, the analysis of demand can occur while accounting for greater richness in the revenue function of the franchises in all three sports.

This paper uses the Fan Cost Index, and the ticket price component of this index, to estimate the demand for attendance at professional baseball, basketball, and football games from 1991 through 2001. We analyze demand in each of these sports at the franchise level using a time series cross section data set. Price and income elasticities are estimated for each sport, controlling for demand shifters such as the age of the facility in which the franchise plays, the length of time the franchise has been in the city, the size of the city, and the success of the franchise on the field. Because ticket prices are potentially endogenous, we use a generalized method of moments (GMM) estimator. This approach also enables us to assess the validity of the instruments we use for the endogenous price variables.

The results confirm findings in the literature that demand for tickets is inelastic with respect to price. However, there are differences between sports. For example, while demand is inelastic in both the NBA and MLB, the ticket price elasticities are not generally the same size. The evidence here is that demand for tickets to NFL games is quite unlike demand for tickets to baseball or basketball games. The instruments used to identify the endogenous variables in the MLB and NBA demand equations are not found to be valid in the NFL equations. Coefficient estimates from the NFL equations are, generally, much less likely to accord with demand theory than

are the estimates from the MLB and NBA equations. This can be partially attributed to differences in the likelihood of a contest selling out all the seats in the stadium. Sell-outs are much less frequent in baseball and basketball than in football.

Using the Fan Cost Index, which includes prices of concessions and other ancillaries like parking, the analysis also provides some insight into the profit-maximizing behavior of the franchises. For example, based on a simple model of revenue maximization presented below, we show that the difference in the ticket price elasticity and the Fan Cost Index elasticity is consistent with concession price being set at the concession-revenue maximizing level. The finding that attendance is in the inelastic portion of the demand is, according to the theory, consistent with concession demand falling as ticket prices rise. This also supports the implication that franchises set ticket prices to maximize concessions' revenues.

The Attendance Demand Literature

Because attendance is a major source of revenue for all sports teams, theoretical and empirical research on the demand for attendance has been an integral part of sports economics. The two earliest empirical studies of the determinants of attendance were done in the 1970s by Noll (1974) and Demmert (1973). Each study carefully accounted for a variety of factors that might shift demand by including control variables for income of the local population, stadium age, the availability of substitutes, franchise success, and the population in the local market. Each of these studies also found the effect of ticket prices on attendance to be problematic—imprecisely estimated or having the wrong sign.

The attendance models published since Demmert's and Noll's seminal papers have generally included similar control variables to capture demand shifts—population characteristics, stadium characteristics, team quality variables, and the availability of substitutes - as well as price data. They have, however, taken very different approaches in other respects. For example, some researchers have used aggregate time series data (Schmidt & Berri, 2001, 2002, 2004), others have used panel data sets containing annual average attendance by team for a number of sea-

sons (Coates & Harrison, 2005) or game-by-game attendance during a particular season (Bruggink & Eaton, 1996). Studies also have focused on specific issues affecting attendance, such as the impact of roster turnover (Kahane & Schmanske, 1997), the impact of the designated hitter rule (Domazlicky & Kerr, 1990), the impact of labor unrest (Coffin, 1996; Schmidt & Berri, 2002, 2004; Coates & Harrison, 2005), and the impact of the relative strengths of the contestants (Knowles et al., 1992; Schmidt & Berri, 2001).

None of these papers developed an explicit model of the price-setting decision of the franchise, and none included the prices of complementary goods like concessions, parking, and programs as explanatory variables. Bruggink and Eaton (1996) address the impact of special promotions, finding that promotions have positive and significant effects on attendance.¹

A general finding in these studies is that attendance demand is price inelastic. Fort (2004) shows that this is not inconsistent with the idea that professional sports franchises are monopolies, so long as the franchises have other sources of revenue. His analysis builds upon that of El Hodiri and Quirk (1974) and Heilman and Wendling (1976) by extending sources of revenue to include sales unrelated to attendance. Heilman and Wendling (1976) show that franchises may set ticket prices in the inelastic portion of attendance demand to raise revenues from other sources.

Finally, some recent literature examines the relationship between concessions and attendance at professional sports. Krautmann and Berri (2007) develop a model of ticket pricing, concession pricing, broadcasting revenue, and revenue sharing in a professional sports league. They use this model to motivate an unconditional analysis of ticket and concession prices that supports the idea that revenue maximizing teams price tickets in the inelastic portion of the demand curve in order to maximize total revenues by increasing revenues from other sources like concessions. Chupp, Stephenson, and Taylor (2007) found that the availability of alcohol had no effect on attendance at minor league baseball games, based on a natural experiment that resulted from a change in regulation of Sunday alcohol sales.

In the next section, we extend the models of Heilman and Wendling (1976) and Fort (2004) to include the determination of the price of complementary goods like concessions, parking, and programs, as well as ticket prices. We emphasize the development of empirically testable predictions in this model.

A Model of Monopoly Price Determination

Consider a monopoly sports franchise that is able to set prices for tickets and ancillary goods and services like concessions and parking. Suppose that costs to the franchise are independent of attendance and sales of these ancillaries. In these circumstances the objective of the franchises is to set ticket and concession prices to maximize revenues, given the constraint that attendance is limited by the seating capacity of the stadium or arena. Subject to these circumstances, this section derives implications for the attendance demand equation.

Let $A = A(P_T; P_C)$ be the demand function for tickets. Ticket demand is a function of both the ticket price, P_T , and the price of other ancillary goods and services, P_C . We will refer to these ancillary goods and services as “concessions,” but this could include parking, programs, and other non-food items. Let $C = C(P_C; P_T)$ be the concessions demand function. Concessions demand is a function of ticket and concessions prices. $A_T < 0$ is the first partial derivative of the demand for tickets with respect to ticket prices, and A_C is the partial derivative of the demand for tickets with respect to concessions prices; this partial derivative cannot be signed *a priori*, though intuitively it is likely that this derivative is negative, implying that concessions and tickets are (gross) complements in demand. Indeed, it is impossible to buy concessions without having first purchased a ticket. Likewise, $C_C < 0$ is the partial derivative of concessions demand with respect to concessions prices and C_T is the partial derivative of concessions demand with respect to ticket prices. Again, it is probable that this cross price derivative is negative, though from a purely theoretical standpoint it may be positive or 0.

Let X , $A(P_T; P_C)$ be the capacity constraint on attendance. This constraint says that the number of seats in the

stadium or arena must be at least as large as the number of tickets sold for the contest.

The franchise's optimization problem is to maximize total revenues subject to the capacity constraint. That is:

$$\text{Max } L = P_t A(P_t; P_c) + P_c C(P_c; P_t) + \lambda (X - A(P_t; P_c)) \quad (1)$$

The franchise chooses the ticket and concession prices and the LaGrange multiplier λ to maximize revenues. The first order conditions for this problem are:

$$P_t A_t + A(P_t; P_c) + P_c C_t - \lambda A_t = 0 \quad (2)$$

$$P_t A_c + P_c + P_c C_c - \lambda A_c = 0 \quad (3)$$

$$\lambda (X - A(P_t; P_c)) = 0; \lambda \geq 0; X - A(P_t; P_c) \geq 0 \quad (4)$$

The last condition simply requires that the marginal revenue from additional seating capacity be 0 if there is unused capacity, but if the facility sells out, then relaxing the capacity constraint allows the franchise to raise revenues by selling tickets for the additional seats.

Consider first the implications for pricing if the facility does not sell out ($\lambda = 0$). By manipulating equations 2 and 3, one can obtain the following expressions for price elasticities

$$1 + \varepsilon_{tt} = -(A_c/A_t)\varepsilon_{ct} \quad (5)$$

$$1 + \varepsilon_{cc} = -(A_t/A_c)\varepsilon_{tc} \quad (6)$$

where ε_{ij} is the elasticity of demand for i with respect to a change in price j . Note that $\hat{A}_{ct} \neq \hat{A}_{tc}$ as the former is the effect of ticket prices on concessions demand and the latter is the effect of concessions prices on ticket demand. The sign of these elasticities indicates whether concessions and tickets are gross substitutes or gross complements in demand, while the size of the elasticities indicates the strength of the relationship.

Above, we suggested that the cross-price elasticities between concession prices and ticket demand would likely be negative, indicating that concessions and tickets are gross complements. If tickets and concessions are, in fact, complements, then the model predicts that a revenue maximizing franchise with monopoly power will set both ticket and concession prices in the inelastic portion of the

respective demand curves. That is, $-1 \leq \varepsilon_{tt} \leq 0$ and $-1 \leq \varepsilon_{cc} \leq 0$. This is simply the Heilmann and Wendling (1976) result alluded to by Fort (2004). Additionally, note that the stronger the degree of complementarity between concessions and tickets, the lower the own-price elasticity of demand for tickets that satisfies equation 5. In other words, if high ticket prices have a strong negative effect on concessions purchases, a revenue maximizing franchise will price tickets in the inelastic portion of the demand curve—and forego some revenue from ticket sales—but make up for it in increased revenues from concession sales.

As noted, the cross price elasticities need not be equal. From consumer theory, recall that the gross price elasticities can be decomposed into a substitution effect and an income effect. Because the gross price elasticities depend on the relevant expenditure shares and income elasticities of demand for these goods, the gross price elasticities, ε_{tc} and ε_{ct} , need not be equal. For example, suppose that $\varepsilon_{tc} = 0$. In this case, equation 6 is satisfied only if $\varepsilon_{cc} = -1$, which is the condition for maximizing concession revenues. In other words, the model predicts that franchises set concessions prices at their revenue maximizing levels—in the elastic portion of the demand curve—when facilities have excess capacity.

The analysis is only slightly changed under the condition that franchises sell out their facilities. In this case, $\lambda \geq 0$, so the first order conditions do not simplify in such a straight-forward manner. Instead, the first order conditions become:

$$1 + \varepsilon_{tt}(P_t - \lambda)/P_t = -(A_c/A_t)\varepsilon_{ct} \quad (7)$$

$$1 + \varepsilon_{cc} = -(A_t/A_c)\varepsilon_{tc}(P_t - \lambda)/P_t \quad (8)$$

$(P_t - \lambda)/P_t$ can be thought of as the ticket “mark-up.” This mark-up depends upon the current ticket price, at which the stadium sells out, and the marginal revenue from expanding the capacity of the facility, λ . Suppose the constraint is binding, but that there is a large excess demand for tickets. Such a situation would arise, for example, in the presence of waiting lists for season tickets. In this case, $\lambda = P_t$, the mark-up is 0, and the left hand side of equation 7 will simply be 1, regardless of the size

of ε_{tt} ; for the right hand side of equation 7 to be 1, the elasticity ε_{ct} must equal $-A_t/A_c$. Because A_i is the share of total spending devoted to good i , if tickets are a larger share of spending than concessions, the elasticity of concessions demand with respect to ticket prices must be larger than 1 in absolute value. Additionally, in this case, concession prices are set so as to maximize revenues from concessions without regard to their impact on ticket sales. When $\lambda = P_t$, the right hand side of equation 8 is 0 for any value of the cross price elasticity, ε_{tc} .

Consider the situation when the capacity constraint is binding with no excess demand for tickets. In this case, in order to raise revenues by selling an additional ticket, and assuming capacity expands, the ticket price must be reduced. This is because we have assumed that at the existing price, the tickets demanded exactly equal the stadium capacity; if there were an additional seat, it would not sell at the current price. In other words, λ is marginal revenue, which is less than price for a monopolist. Therefore, $(P_t - \lambda)/P_t$ is positive, but less than 1. Now, $\varepsilon_{ct} = 0$ implies that ticket prices are set above the ticket revenue maximizing level. In this situation, $-\varepsilon_{tt} = P_t/(P_t - \lambda) > 1$.

As before, no complementarity between concessions and tickets $\varepsilon_{tc} = 0$ implies concessions prices set to maximize concessions revenues. However, with the stadium sold out, a stronger relationship between concession prices and ticket demand may still be nearly consistent with revenue maximizing prices of concessions because the “mark-up” factor reduces the right hand side of equation 8. In other words, concession prices may be set near to the revenue maximizing level despite the dampening effect of those prices on ticket demand.

The model of price determination by a monopoly sports franchise developed in this section contains a number of empirically testable predictions about the own- and cross-price elasticities of ticket demand. First, if the attendance demand is inelastic with respect to ticket prices, then $\varepsilon_{ct} < 0$, or an increase in ticket prices reduces demand for concessions. Second, concession prices that do not affect ticket demand imply concession prices are set at revenue maximizing levels. Third, clubs whose attendance is constrained by stadium capacity or that have waiting lists for tickets may be able to approximate

the concessions’ revenue maximizing prices even if increased concession prices reduce attendance.

In the next section, we estimate empirical demand models and use the estimated own- and cross-price elasticities of demand to assess the predictions of this model of price determination by monopoly sports franchises.

Empirical Approach

Empirical estimates of price elasticities of demand can be generated from a simple reduced form model of demand for tickets to sporting events. The extensive literature on estimation of demand for tickets to sporting events, reviewed above, largely relies upon reduced form models. Here, we employ a model similar to those used in this literature that also accounts for the panel structure of our data. The basic demand model is:

$$A_{it} = \alpha_i + \pi P_{it} + \gamma S_{it} + e_{it}. \quad (9)$$

The terms in this empirical demand model are:

- A_{it} The log of average annual attendance at sports facility i in season t
- P_{it} A vector of the log of the average price of good j in sports facility i in season t
- S_{it} A vector of variables that proxy for factors that shift either demand or supply
- e_{it} An observable random error term distributed $N(0; \sigma^2_e)$
- α_i A vector of parameters capturing unobservable fixed-effects associated with sports facility i
- π A vector of parameters reflecting price elasticities of demand
- γ A vector of parameters capturing the effects of the demand and supply shifters on attendance

As the attendance and price variables are expressed in logs, the vector of parameters π can be interpreted as estimates of the price elasticities discussed above. The elements of S_{it} will be discussed in detail below, but in general this vector may contain variables that vary across facilities and time, and may also contain variables expressed in both logs and levels.

The primary econometric problem inherent in estimating equation 9 is that the price variables are not statistically exogenous. According to the model above, prices are

decision variables for sports franchises that have monopoly power, so they are likely to be correlated with the equation error term e_{it} in the regression model. The Ordinary Least Squares estimator is biased and inconsistent under this condition, making inference based on the estimated standard errors and parameters inappropriate. The standard solution to this problem is to use an instrumental variables (IV) estimator to generate a vector of price variables that are, by construction, uncorrelated with the equation error term. However, the panel structure of our data and the presence of unobservable facility-specific effects rules out a simple two-step IV estimator in this case.

Instead, we apply a Generalized Method of Moments (GMM) estimator to equation 9. The GMM estimator we employ yields efficient estimates of the coefficients as well as consistent estimates of the standard errors. This efficient, feasible GMM estimator is a two-step procedure that minimizes a criterion function

$$J(\beta) = n g(\beta)' W g(\beta)$$

where n is the sample size, β is the vector of parameters estimated, and $g(\cdot)$ represents the orthogonality or moment conditions. These moment conditions simply ensure that all of the exogenous variables and instruments are uncorrelated with the equation error term in equation 9. W is a weighting matrix, which is equal to the inverse of the estimated variance-covariance matrix of the orthogonality conditions. The GMM estimator

$$\beta_{\text{GMM}} = (X'ZWZ'X)^{-1}X'ZWZ'A$$

where Z is a vector of instruments and X a vector of variables formed from all right hand side variables in equation 9, is described in Baum, Schaffer, and Stillman (2003). The instruments in the first stage of this two-stage feasible efficient GMM estimator are a variable reflecting the capacity of each facility in each year and an individual time trend for each team playing in the facility. The GMM estimator controls for heteroscedasticity in the error term, and the parameter estimates are robust to any correlation between the explanatory variables on the right hand side of equation 9 and the error term.

Data Description

We draw data from a variety of sources. The attendance and team performance variables (won-loss records) for

MLB, NBA, and NFL teams come from a number of web archives. NBA data come from the Association for Pro Basketball Research website (www.apbr.org); NFL attendance data come from the Kenn sports attendance database (www.kenn.com/sports/index.html) and won-loss data come from the official NFL web site (www2.nfl.com/history). MLB data come from the Baseball Archive (www.baseball1.com).

Stadium-related data come from the stadium archive (www.ballparks.com) maintained by Munsey and Suppes. The age of each franchise is measured from the date the team begins playing in the city; the stadium age is the current year minus the date of construction. The variables in the regressions are the natural logarithms of these ages. Some researchers have hypothesized that attendance receives a boost in the last year a stadium is in operation, as fans return for the sake of nostalgia. To capture this effect, the analysis includes a variable that takes value 1 in the last year a stadium is in service and takes value 0 otherwise.

Economic and demographic characteristic variables—personal income, population, and other variables for the Standard Metropolitan Statistical Areas (SMSAs) for each sports facility—come from the Regional Economic Information System website maintained by the Census Bureau of Economic Analysis (www.bea.doc.gov/bea/regional/data.htm).

The ticket and Fan Cost Index (FCI) variables are collected and published by Team Marketing Reports. The FCI is created by assuming that consumers make a specific basket of purchases when attending a sporting event. These purchases are: four average-price tickets, four small soft drinks, two small beers, four hot dogs, two game programs, parking, and two adult-size caps. How Team Marketing Report developed this combination is not clear, but the combination is only intended to give some sense of the full cost of attending a ball game for a family of four, and it probably does a reasonable job of that. It clearly includes both ticket prices and concession prices. All price and income variables were deflated using the CPI for All Urban Consumers (CPI-U) and are expressed in natural logarithms. Likewise, the attendance variables are expressed as the natural logarithm of per game attendance. Table 1 contains the means and stan-

Table 1: Descriptive Statistics

	MLB		NBA		NFL	
	Mean	StdDev.	Mean	Std. Dev.	Mean	Std. Dev.
Attendance	28,089	8429	16,671	2936	61,522	9787
FCI	107.84	25.86	211.55	61.45	216	51.92
Winning %	0.504	0.068	0.507	0.16	0.498	0.187
Made playoffs	0.22	0.41	0.58	0.49	0.3	0.46
Team age	59	33	31	14	39	21
Stadium age	32	24	15	13	28	17
Population (000s)	4,084	2,573	3,540	2,543	3,279	2,360
Income per capita	18,555	2645	17,562	2601	17,872	2949
N	264	—	298	—	308	—

dard deviations for each of the variables used in the empirical work, by sport.

The mean values are what one would expect for these three sports. Average attendance is largest at NFL games, and smallest at NBA games. The FCI is highest for NFL games and lowest for MLB games. More NBA teams make the playoffs than do NFL or MLB teams. NFL franchises are located in smaller cities, on average, while NBA and MLB franchises are located in larger cities. The stadium and franchise age variable means are also as expected. MLB teams are older and play in older stadiums. NBA teams play in newer facilities. MLB teams play in cities with higher income per capita. NFL teams, because of the greater revenue sharing and revenues from national television broadcasting contracts in that league, play in smaller cities and in cities with lower income per capita.

Empirical Results

Table 2 shows the GMM instrumental variables regression results from equation 9 for the NFL, NBA, and MLB. The empirical model also contained year dummy variables to control for unobservable factors that affect attendance in each year in the sample. The estimation results for these variables, and the first stage regression results for the instrumental variables procedure are available by request from the authors. Instruments are a nonlinear time trend and the natural log of the stadium capacity. A Hansen test of instrument validity cannot reject the null

hypothesis that the instruments are independent of the regression errors.

The ticket price variable is significant for both the NBA and MLB; the Fan Cost Index variable is significant in the NBA and nearly significant in MLB.² The signs on these variables are negative, as expected, indicating that higher prices are associated with lower attendance, all else equal. Because the estimated price elasticities are all less than one in absolute value, the evidence suggests that teams set prices in the inelastic portion of the demand curves in the NBA and MLB.

In both baseball and basketball, the ticket price elasticity is smaller than the Fan Cost Index price elasticity. The Fan Cost Index contains ticket, concession, and other related good prices. Because the FCI elasticity is higher than the ticket price elasticity, the elasticity of the non-ticket components of the FCI may be larger than the ticket price elasticity. This result is consistent with the prediction that emerges from the model developed above, when attendance is less than capacity. It implies that revenue maximizing teams price concessions and other goods closer to the revenue maximizing elastic portion of the demand curve and trade off these revenues by pricing tickets in the inelastic portion of the demand curve. This result is consistent with the unconditional results reported by Krautmann and Berri (2007).

The team's winning percentage and the previous year's attendance in the metropolitan area in which the team

Table 2: GMM Estimation Results and Asymptotic Standard Errors

	MLB		NBA		NFL	
Fan Cost Index	-0.584	———	-0.160*	———	0.061	———
	0.319	———	0.063	———	0.061	———
Ticket price	———	-0.269*	———	-0.119*	———	0.028
	———	0.158	———	0.046	———	0.052
Win %	1.675*	1.661*	0.308*	0.313*	0.184*	0.184*
	0.177	0.179	0.041	0.041	0.031	0.031
Playoffs	0.01	0.007	-0.008	-0.009	0.002	0.003
	0.03	0.029	0.014	0.014	0.014	0.014
Lagged win %	-0.274	-0.339	0.013	0.012	-0.019	-0.016
	0.211	0.196	0.05	0.049	0.042	0.042
Stadium age	-0.008	-0.011	-0.045*	-0.044*	-0.017	-0.018
	0.014	0.014	0.008	0.008	0.007	0.008
Team age	-0.003	0.002	0.015	0.014	0.018	0.017
	0.017	0.018	0.008	0.008	0.009	0.009
Income per capita	0.092	0.005	0.153*	0.143	0.005	0.021
	0.138	0.102	0.048	0.046	0.047	0.046
Lagged attendance	0.849*	0.837*	0.748*	0.749*	0.774*	0.782*
	0.065	0.063	0.038	0.038	0.038	0.038
Population	0.062*	0.054*	0.021*	0.015	0.005	0.006
	0.024	0.021	0.01	0.008	0.006	0.006
Final season	0.075	0.059	0.075	0.075	-0.01	-0.009
	0.063	0.062	0.153	0.151	0.028	0.028
R ²	0.82	0.83	0.78	0.78	0.71	0.7
N	217	217	296	296	305	305
Hansen	1.36	2.42	0.52	0.41	6.7	7.14
(p-value)	0.24	0.12	0.47	0.52	0.01	0.01

* Significant at the 5% level.

plays are both significant at the 5% level and correctly signed in all model specifications. The population of the metropolitan area is significant and positive for MLB and NBA teams, but not for the NFL. All specifications explain between 70% and 80% of the observed variation in attendance in the sample. In the NBA, aging arenas reduce attendance, perhaps explaining why NBA teams replace their facilities so frequently. Each 10% increase in the age of a basketball arena reduces attendance by about 0.5%, based on these estimates.

The results for the National Football League are quite different from those for MLB and the NBA. The price and Fan Cost Index variables are not significant, suggesting that attendance at NFL games is not very sensitive to changes in the FCI or the ticket price. Of the other explanatory variables, only the lagged attendance and current winning percentage variables are significant in the NFL models. Average attendance at NFL games is typically much closer to the capacity of the facility than in MLB or the NBA. Many NFL teams have average attendance near stadium capacity in every season. This result

is also consistent with the predictions of the revenue maximization model developed above, when the capacity constraint is binding.

Hansen's J statistic can be used to test the null hypothesis that the instruments are not correlated with the equation error term. The statistic has a chi-square distribution. The estimated Hansen's J statistics indicate that the instruments are valid for the NBA and MLB, but not for the NFL, where the null of instrument independence is rejected.

If one splits the Fan Cost Index into its components, it is possible to estimate the attendance demand equations including the prices of other goods. Coefficients on those other prices are the \hat{A}_{tc} from above. We estimated attendance equations for each league using the ticket price as well as the prices of hot dogs, beers, sodas, programs, and parking. These prices are all treated as endogenous in the regressions. Instruments include log of stadium or arena capacity, a nonlinear time trend, and lagged values of the prices. For the NFL, the instruments are never found valid using the Hansen test. For the NBA and MLB, the vector of prices is never jointly significant, though some are individually so at the 10%. For example, the elasticity of demand for attendance with respect to soda prices is about -0.23 in the NBA equation, with a p-value of 0.055. The full set of results is available upon request.

The weakness of these results makes drawing inferences from them suspect. Nonetheless, the lack of significance of concessions prices in the attendance demand equation strikes us as intuitively plausible. More interesting is the lack of significance these prices have in determining attendance, which is consistent with the implications of equations 6 and 8 that hold concession prices are set to maximize concessions' revenue.

Discussion and Conclusions

The evidence here suggests that demand for attendance at professional sporting events is quite inelastic with respect to the ticket price. This evidence appears to be at odds with the common idea that professional sports franchises are monopolists whose pricing behavior should be to set prices in the elastic portion of the demand. Following Fort (2004), who built on earlier analysis, we

devise a simple model of a multiproduct sports franchise and derive implications for the pricing of each of the products of the team. The precise predictions depend upon whether the team sells out its entire stadium or whether there is excess capacity. In the latter case, the profit maximization conditions imply that when concessions prices do not affect ticket demand, concession prices are set to maximize concessions' revenue. We find weak evidence that this is the case.

The results also indicate that demand for professional football differs fundamentally from that of basketball and baseball. Football far more frequently sells out its games, and the theory section shows that the comparative static effects of sell outs are more complicated than those of non-sell outs. Moreover, the football equations are not well-estimated in that they reject the validity of the instruments and few coefficients are significantly different from 0. Indeed, the price variable frequently has the wrong sign for the NFL, although the estimated parameters are not different from 0. Because the capacity constraint may be binding for the NFL, while it clearly does not bind for MLB and the NBA, the pattern of estimated parameters for the NFL may reflect this constraint.

The results in this paper support the idea that ticket price elasticities in the inelastic portion of the demand curve reported in the literature are due to the inter-related pricing decision on tickets, concessions, and other related goods made by revenue maximizing monopolists in the NBA and MLB. Because the estimator used here has superior properties to the commonly used OLS estimator when some explanatory variables may be correlated with the equation error term, these results also indicate that the widely reported small ticket price elasticities are not due to econometric problems with the OLS estimator. We also find that the determinants of demand for NFL tickets differ significantly from the determinants of NBA and MLB tickets.

These results suggest at least two future lines of inquiry in this area. First, more extensive research using the individual components of the Fan Cost Index, the individual price of beer, soda, parking, merchandise, and other goods, is necessary. These variables could be used to estimate cross-price elasticities in an attendance demand model. Collecting data on the purchases of these items at

sporting events would advance the study of pricing tickets, as well as allow verification of the implication that concessions are priced to maximize concession revenues. These estimated price elasticities would be of interest to policy makers who are attempting to raise tax revenues by taxing tickets and other game day goods to offset public subsidies for stadium construction and operation. Second, the clear difference between the determinants of demand for NFL tickets and the other two sports indicates that a thorough examination of the full dimensions of these differences would shed more light on the economic decisions made by professional sports teams.

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Endnotes

¹ Bruggink and Eaton actually use both the ticket price and the Fan Cost Index in their analysis. They find that both variables have the wrong sign in determining attendance at American League games, but both have the expected sign in attendance at National League games.

² If lagged values of concession prices are used as instruments, both the ticket and the fan cost index elasticities are significant in the MLB equation, and each is about half that reported in the table. Using lagged concession prices in the NBA equation makes the Fan Cost and the ticket price elasticities insignificant. Adding concessions prices as instruments in the NFL equations does not improve the NFL attendance model.

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