



Managerial Finance

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Article information:

To cite this document:

Yang-Ming Chang Joel M. Potter Shane Sanders , (2016), "Inelastic sports ticket pricing, marginal win revenue, and firm pricing strategy", *Managerial Finance*, Vol. 42 Iss 9 pp. 922 - 927

Permanent link to this document:

<http://dx.doi.org/10.1108/MF-02-2016-0047>

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Inelastic sports ticket pricing, marginal win revenue, and firm pricing strategy

A behavioral pricing model

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Abstract

Purpose – A standard result of firm theory is that a monopoly maximizes profit somewhere along the elastic portion of its demand curve. However, empirical studies of sports ticket pricing routinely find that (home) teams price along the inelastic portion of demand. Despite compelling theoretical explanations of this finding, at least one important factor remains unconsidered. A profit-maximizing team considers not only direct marginal revenue and direct marginal cost when setting a ticket price but also deferred, strategic benefit (revenue) from present game success. The paper aims to discuss these issues.

Design/methodology/approach – Prior literature finds that a given win is valued in that it generates additional future revenue and likelihood of home victory rises, *ceteris paribus*, in crowd density. The authors construct a firm profit maximization problem in which a sports team considers both present and future revenue when pricing home games in the present period.

Findings – If the deferred benefit is sufficiently large, a forward-looking, profit-maximizing team prices along the inelastic portion of its static demand curve. Importantly, this same price falls along the elastic portion of the firm's (empirically unobserved) dynamic demand curve.

Originality/value – This is the first model of sports ticket pricing to recognize the intertemporal nature of demand for a sports match.

Keywords Home advantage, Crowd factors, Firm pricing strategy, Inelastic sports ticket pricing

Paper type Research paper

I. Introduction

A standard result of firm theory states that a monopoly maximizes profit at a point along the elastic portion of its demand curve. This result can be explained intuitively: if the monopolist faces positive marginal cost, then it must stop raising price at a point where marginal revenue is still positive (and no less than marginal cost). However, empirical studies of sports ticket pricing generally find that sports (home) teams invariably price along the inelastic portion of their respective demand curves. In some cases, teams are found to price at very inelastic points. Krautmann and Berri (2007) provide a survey of 11 empirical findings of estimated price elasticities of demand for sporting events (Demmert, 1973; Noll, 1974; Siegfried and Eisenberg, 1980;



Bird, 1982; Scully, 1989; Coffin, 1996; Fort and Quirk, 1996; Depken, 2001; García and Rodríguez, 2002; Hadley and Poitras, 2002; Winfree *et al.*, 2004). The estimates, collectively representing five different sports leagues, range in value from highly inelastic (-0.06) to marginally inelastic (-0.93). A number of authors have provided plausible theories to explain these results. Fort (2004) shows that local TV revenue relationships between teams can explain inelastic pricing in Major League Baseball. Krautmann and Berri (2007) find that sports teams may price tickets in the inelastic portion of demand to sell more concessions. Kesenne (1996, 2000) shows that inelastic pricing may result from teams maximizing wins (subject to a profit constraint) rather than profits directly. Andersen and Nielsen (2013) show that inelastic pricing may result from team risk aversion under uncertainty.

These explanations are compelling and potentially complementary. However, it appears that at least one important factor remains unconsidered. For a given game, a profit-maximizing team considers not only direct marginal revenue and direct marginal cost when setting a ticket price but also deferred, strategic benefit (revenue) from present game success. It is established that a given win is valued in the sense that it generates additional future revenue for a team (see, e.g. Scully, 1974; Fort and Quirk, 1995; Vrooman, 1995; Krautmann, 1999; Szymanski, 2004; Szymanski and Kesenne, 2004). In another strand of literature, Schwartz and Barsky (1977) and Agnew and Carron (1994) show that a home win becomes more likely, *ceteris paribus*, as crowd density rises (i.e. as a larger supportive audience is present). These authors conclude that a supportive audience alters the relative performance productivity of home and away teams to improve home advantage. Similarly, Downward and Jones (2007) find that referee home bias increases in crowd size (pressure). Nevill *et al.* (2002) and Greer (1983) find that home advantage rises in crowd noise, *ceteris paribus*. Thus, a profit-maximizing, professional sports team must consider both immediate and deferred benefits in determining an optimal ticket price.

We construct a firm profit maximization problem in which a sports team considers both present and future revenue when pricing home games in the present period.

II. A model of the standard monopolistic home team

A profit-maximizing sports (home) team behaves as a monopolist in assigning ticket price. In the standard monopoly case, the team is subjected to the following profit maximization exercise:

$$\text{Max}_{\{q_H\}} \pi(q_H) = p(q_H)q_H - c(q_H) \quad (1)$$

where q_H represents ticket quantity supplied (exchanged), $\pi(q_H)$ represents profit level, $p(q_H)$ represents the team's inverse demand function, $c(q_H)$ represents the team's cost function, $p'(q_H) < 0$, and $c'(q_H) \geq 0$. We assume an interior solution (i.e. that the team operates in the present period and chooses a ticket price that results in positive attendance) and solve for the first order condition in (2):

$$p'(q_H)q_H + p(q_H) - c'(q_H) = 0 \quad (2)$$

We rearrange (2) such that marginal firm revenue is listed on the left side of (marginal firm cost is listed on the right side of) the following equation:

$$p'(q_H)q_H + p(q_H) = c'(q_H) \quad (3)$$

As marginal cost of production is positive, Equation (3) states that the monopolist chooses to price where marginal revenue is positive (i.e. along the elastic portion of demand).

III. A model of the monopolistic home team with intertemporal strategic considerations

A forward-looking home team realizes two components of marginal revenue for a given game: direct revenue from match ticket sales and deferred revenue from match performance. In that ticket prices influence crowd size, crowd size influences present game performance, and present game performance influences future home game revenues, deferred revenues are strategically endogenous. Such a firm is represented in profit maximization exercise (4), in which present price is set to maximize (dynamic) profit resulting from the present game:

$$\text{Max}_{(q_{H,1})} \pi(q_{H,1}, q_{H,2}) = p_{H,1}(q_{H,1})q_{H,1} + \delta p_{H,2}(w_{H,1}(q_{H,1}), q_{H,2})q_{H,2} - c(q_{H,1}) - \delta c(q_{H,2}) \tag{4}$$

where $\pi(q_{H,i})$ represents home game profit for the representative home team in period i ($i \in \{1, 2\}$), $q_{H,i}$ symbolizes attendance level for the home team in period i , $p(q_{H,i})$ represents the static (immediate) inverse demand curve for the home team in period i , $w_{H,1}(q_{H,1})$ represents the expected likelihood that the home team wins in period 1 given the attendance level in that period, δ ($0 < \delta \leq 1$) represents the depreciation rate, and $c(q_{H,i})$ represents the cost of providing attendance services in period i . Also, we have that $(\partial p_{H,2} / \partial w_{H,1}) > 0$, $(\partial w_{H,1} / \partial q_{H,1}) > 0$, $c'(q_{H,i}) \geq 0$, and $p'_{H,1}(q_{H,1}) < 0$.

In (4), the representative team ticket prices are set far in advance of a game (see, e.g. Andersen and Nielsen, 2013). Note that we do not consider a capacity constraint as influencing the team's ticket allocation in the first period (as in Fort and Quirk, 1995)[1]. Instead, we consider the marginal cost of supplying tickets as being positive and potentially rising (e.g. for various settings in which the capacity constraint does not bind). One can verify that these alternative assumptions provide qualitatively identical results. The first order condition is specified by the following equation:

$$\frac{\partial p_{H,1}}{\partial q_{H,1}} q_{H,1} + p_{H,1} + \delta q_{H,2} \frac{\partial p_{H,2}}{\partial w_{H,1}} \frac{\partial w_{H,1}}{\partial q_{H,1}} = c'(q_H) \tag{5}$$

At a given positive scale, the left hand side values of (5) are each greater than the left hand side value of (3). Thus, a forward-looking, profit-maximizing team will locate further down along its static demand curve than will a myopic, profit-maximizing team. If the deferred value of revenue is sufficiently large, each forward-looking team will locate along the inelastic portion of its static demand curve. To illustrate this point and develop conditions for its occurrence, we rearrange (5) to create Equation (6). The left hand side of the equation is marginal revenue from time period 1, $c'(q_{H,1})$ is the marginal cost of providing attendance services in period 1, and $\delta q_{H,2} (\partial p_{H,2} / \partial w_{H,1}) (\partial w_{H,1} / \partial q_{H,1})$ is the deferred marginal revenue from attendance in period 1[2]:

$$\frac{\partial p_{H,1}}{\partial q_{H,1}} q_{H,1} + p_{H,1} = c'(q_{H,1}) - \delta q_{H,2} \frac{\partial p_{H,2}}{\partial w_{H,1}} \frac{\partial w_{H,1}}{\partial q_{H,1}} \tag{6}$$

From condition (6), we construct the following proposition:

- PI. Each team chooses a point along the inelastic portion of its home game static demand curve iff the deferred marginal revenue from attendance is greater than the marginal cost of providing attendance services.

It is important to note that the teams depicted above locate along the elastic portion of their respective (empirically unobserved) dynamic demand curves. We also note that the deferred component of a team's marginal revenue function may be difficult to estimate empirically given the endogenous relationship between attendance and wins.

IV. An example of the standard monopolistic home team

In this section, we specify a profit function and solve for a team's ticket allocation in the standard monopoly case. The firm's objective function, first order conditions, and optimal ticket allocation are specified in the following equations, respectively:

$$\text{Max}_{\{q_H\}} \pi(q_H) = (a - bq_H)q_H - cq_H \tag{7}$$

$$(a - 2bq_H) = c \tag{8}$$

$$q_H^* = \frac{a - c}{2b} \tag{9}$$

Note from (7) that $(q_H^* = (a - c)/2b) < (a/2b)$. In other words, the monopolist facing a linear demand function and a positive marginal cost of production always chooses a production point above the midpoint of said function (i.e. in the elastic portion of the demand function).

V. An example of the monopolistic home team with intertemporal strategic considerations

In this section, we specify a profit function and solve for team (strategic) ticket allocation given that the team recognizes the deferred revenue associated with a given ticket price. The present value of future revenue associated with a given ticket allocation is specified in the following equation:

$$\delta p_{H,2}(w_{H,1}(q_{H,1}), q_{H,2}) = \delta(q_{H,1} - kq_{H,2}) \tag{10}$$

The following equation specifies each team's objective function in this case where k is the absolute value of the slope of the inverse static demand curve in period 2:

$$\pi(q_{H,1}, q_{H,2}) = (a - bq_{H,1})q_{H,1} + \delta(q_{H,1} - kq_{H,2})q_{H,2} - cq_{H,1} - \delta cq_{H,2} \tag{11}$$

First order conditions and optimal ticket allocation are calculated in the following equations:

$$(a - 2bq_{H,1}) + \delta q_{H,2} = c \tag{12}$$

$$q_{H,1}^* = \frac{a + \delta q_{H,2} - c}{2b} \tag{13}$$

Note that each additional present spectator in period 1 brings the home team a present value of $\delta q_{H,2}$ dollars in additional revenue from the future home game[3]. This effect is generated from each spectator's effect upon the present game outcome and the subsequent effect on the price of the future home game. Note further that $(q_{H,i}^* = (a + \delta q_{H,2} - c)/2b) > (a/2b)$ iff $c < \delta q_{H,2}$. That is to say, each team chooses a point

along the inelastic portion of its home game static demand curve iff the deferred marginal revenue from attendance is greater than the marginal cost of attendance. This finding is consistent with the general proposition derived earlier.

VI. Conclusion

We have shown that sports ticket pricing along the inelastic portion of static demand is consistent with the consideration of deferred revenue from present game success. A profit-maximizing home team considers not only direct marginal revenue and direct marginal cost when setting a ticket price but also the deferred, strategic marginal benefit of present game success, where present game success is positively related to attendance. Within a pricing model, we find conditions under which a representative team (optimally) prices along the inelastic portion of static demand. Importantly, this same price falls along the elastic portion of the firm's (empirically unobserved) dynamic demand curve. An important area for future research would be to endogenize the second period quantity and solve for a similar problem using backwards induction.

Notes

1. In the present analysis we assume that $q_{H,2}$ is set to a binding constraint and is exogenous to $p_{H,1}$ and $q_{H,1}$.
2. $\delta q_{H,2}(\partial p_{H,2}/\partial w_{H,1})(\partial w_{H,1}/\partial q_{H,1})$ can be explained intuitively as follows: in response to taking this deferred revenue into account, the team decreases the period 1 price which in turn increases $q_{H,1}$, $w_{H,1}$, and $p_{H,2}$. Thus, the increase in expected price of the period 2 home game is discounted (by δ) and multiplied by the actual number of attendees (in period 2) to obtain the total current value of deferred revenue.
3. Once again we assume that $q_{H,2}$ is set to a binding constraint and is exogenous to $p_{H,1}$ and $q_{H,1}$.

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