Economics Letters 114 (2012) 304–307

Contents lists available at SciVerse ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

A test of monopoly price dispersion under demand uncertainty

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ARTICLE INFO

Article history:
Received 2 September 2010
Received in revised form
11 October 2011
Accepted 20 October 2011
Available online 3 November 2011

JEL classification:
D42
L12
L83

Keywords:
Price dispersion
Demand uncertainty
Sports

ABSTRACT

A test of the predictions of Dana's (2001) model of monopoly price dispersion under demand uncertainty using ticket price data from Major League Baseball shows that ticket price dispersion changes systematically with demand uncertainty, verifying the predictions of the model.

1. Motivation

Price dispersion exists for many reasons. Stigler (1961) identified three sources: costs of determining prices of rival producers, supply and demand instability, and knowledge obsolescence from entry and exit. Dana Jr. (2001) developed a model of monopoly price dispersion under uncertain demand with prices set in advance of sales that predicted profits increased when the monopolist offered multiple prices if the *ex post* monopoly price increased with demand. Intuitively, different demand states have different price elasticities; monopolists exploit these in the face of demand uncertainty by offering goods at different prices.

Major League Baseball (MLB) teams are monopolists, or duopolists in cities with two MLB teams, and they set ticket prices in advance. Ticket sales represent the largest source of revenues for MLB teams. Dana Jr's (2001) model applies to MLB; ticket price setting in sports motivated his model.

Price dispersion can also result from attempts to capture consumer surplus. Salop and Stiglitz (1982) showed that, when entry costs exist, "the *only* possible equilibria in the market involve price dispersion" (p. 1121). Changes in market structure may also generate price dispersion. Dana Jr (1999) developed a model of price dispersion and market structure in which price dispersion increased with competition. Stahl II (1989) developed a model of price dispersion and market structure in which price dispersion decreased with competition. The difference was that Dana Jr (1999) assumed uncertain demand and price setting before demand was known while Stahl II (1989) assumed costly consumer search and information asymmetries.

Not all observed differences in professional sport ticket prices represent price dispersion. Each seat in a baseball stadium provides spectators with a different view and experience. There are important quality differences between seats, and some observed price differences can be attributed to heterogeneity. Differential pricing based on heterogenous seat quality can be found in sports, theater, concerts, and other markets (Courty, 2003). However, all spectators attending a baseball game observe the same game. Dana Jr's (2001) model explained how observed price dispersion in MLB can be interpreted as a monopolist charging different prices for similar goods in the face of uncertain demand. Fort (2004) summarized the existing literature on price setting in professional sports.

We analyze ticket price dispersion in MLB using a unique data set. MLB annually produces the *Red Book* for the American League and the *Green Book* for the National League. These publications contain a wealth of data, including player statistics, locations of team hotels in various cities, and front office personnel contact information. They also contain lists of all ticket price levels set

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0165-1765/$ – see front matter
doi:10.1016/j.econlet.2011.10.021

Table 1
Ticket price summary statistics, 1975–2008.

Team name	Average # of Prices Offered	Largest # of Prices Offered	Smallest # of Prices Offered	Average Price Offered	Mininimun Price Offered	Maximum Price Offered	Median Price Offered	Stand. Dev. of Prices
Arizona	13.55	15	8	37.46	1.07	215.00	23.40	32.22
Atlanta	5.82	10	4	16.92	1.04	70.00	15.59	9.52
Baltimore	7.97	13	4	18.25	3.22	80.00	13.81	8.09
Boston	5.91	7	4	25.18	4.46	125.00	20.85	12.29
California	6.71	12	3	16.71	4.79	150.00	11.96	8.76
Chicago Cubs	5.79	10	4	17.77	4.45	58.15	14.08	7.06
Chicago White Sox	5.38	8	3	18.06	5.93	51.92	16.29	6.34
Cincinnati	6.29	11	4	15.62	3.96	77.88	13.05	7.11
Cleveland	6.06	12	4	16.22	3.30	66.15	11.78	8.88
Colorado	12.25	15	8	17.21	1.22	48.80	13.39	11.18
Detroit	5.62	11	4	17.10	5.00	93.77	13.73	9.62
Florida	7.69	10	4	24.50	2.50	103.84	20.85	15.50
Houston	7.38	12	5	16.35	1.04	52.00	13.61	8.19
Kansas City	5.76	9	4	16.36	3.35	167.55	15.01	8.62
Los Angeles	4.97	13	3	16.72	4.00	207.68	11.74	8.28
Milwaukee	7.59	11	5	17.25	1.07	88.26	15.53	8.44
Minnesota	5.03	9	2	16.08	4.74	106.00	15.22	7.73
New York Mets	4.38	6	3	20.01	3.92	74.76	17.05	8.04
New York Yankees	5.94	14	3	28.05	3.00	415.36	18.27	16.96
Oakland	5.65	9	4	20.08	4.32	213.59	16.19	14.78
Philadelphia	4.94	9	4	16.22	4.46	50.00	14.36	5.84
Pittsburgh	5.71	12	3	15.25	4.74	54.00	13.06	6.41
San Diego	6.26	12	3	15.38	5.00	62.69	13.11	6.97
San Francisco	6.32	13	4	19.10	2.37	95.00	15.00	9.56
Seattle	5.94	12	4	17.98	3.11	62.69	13.66	8.86
St. Louis	6.24	13	4	17.99	4.79	88.26	11.69	8.34
Tampa	9.91	11	9	52.36	1.94	257.57	29.25	61.82
Texas	6.76	13	4	18.07	2.39	88.19	14.81	9.34

by each club in advance of the season. The price data from these publications provide detailed information about pricing decisions, and price dispersion, over time, providing a unique setting in which to analyze monopoly price dispersion. MLB operates as a legal monopoly, variation in on-field performance gives us an measure of demand uncertainty, and the total number of tickets sold, an output proxy, is observable.[3]

2. Data

We collected detailed single game ticket price data from the 1975 through 2008 *Red* and *Green* books. These are ticket prices available to fans who purchase single game tickets; season tickets and group discount tickets may have different prices. The *Red* and *Green* books contain ticket prices for each section in each stadium. In 2008, MLB made the *Red* and *Green* books available only as PDFs. In 2009 and 2010, MLB denied us access to the PDFs. The sample, an unbalanced panel due to the presence of expansion teams, contains 994 team–season observations. Table 1 shows summary statistics of the number of distinct prices offered, including general admission tickets. The minimum and maximum ticket prices are in 2008 US Dollars, deflated by the CPI. We omit data for Montreal and Toronto because of a lack of metropolitan area population data for Canadian cities before 1987 and other data inconsistencies for Canadian MLB teams.

Table 1 reveals significant variation in price setting. The maximum number of price points offered by teams is more than ten, suggesting that price dispersion is relatively high. Considerable dispersion in the minimum and maximum ticket prices offered exists, with some teams offering maximum prices four times higher than other teams. A number of teams offer $1 general admission tickets throughout the sample. The standard deviation of ticket prices offered by Tampa (61.82) is more than 10 times Philadelphia's (5.84). Most teams offer a skewed distribution of prices, as the average ticket price is higher than the median. Recent expansion teams offer tickets at more price points than older franchises.[4]

Table 2 contains team summary statistics for on-field performance, market, and stadium characteristics. Table 2 shows quite a bit of variation in market size, stadium size, and on-field performance. The market size variable exhibits considerable variation even when accounting for the fact that the four largest markets have two teams.

3. Empirical analysis and discussion

We estimate a reduced-form linear regression model of the price dispersion chosen by each team:

$$PD_{it} = \alpha_{1i} + \alpha_{2t} year_t + \beta_1 DU_{it} + \beta_2 M_{it} + \epsilon_{it}, \quad (1)$$

where PD_{it} is the standard deviation of ticket prices set by MLB team i in season t, α_{1i} a team fixed effect, $year_t$ a vector of indicator variables for each year in the sample, DU_{it} a measure of demand uncertainty, M_{it} a vector of variables reflecting market and stadium conditions, and α_{2t}, β_1, and β_2 unknown parameters to be

[3] No publicly available data exist on the number of tickets sold or the number of seats available at each price point listed in the *Red* and the *Green* books.

[4] The data reflect the fact that better performing teams raise prices and worse performing teams lower prices. In a regression model with average ticket price as the dependent variable and lagged winning percentage as an explanatory variable, controlling for other factors, the parameter on lagged winning percentage is positive and significant. Better teams charge higher prices and worse teams charge lower the next season.