

Neighborhood Spillovers: The Demand for Cubs Game Parking in Wrigleyville

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Abstract

We examine the market for parking spaces during Cubs games, focusing on primary data from parking at two residential locations near Wrigley Field in 2008. We describe the price setting process in a theoretical and applied context. Renting six spaces to Cubs game patrons yielded nearly \$14,000 during the 2008 baseball season. Parking revenues were higher when attendance was higher, during night games, during weekday games, and especially when the White Sox were the opponent. We suggest opportunities for increased efficiency in price setting for the building owners. We estimate the real estate value of each parking space at about \$8,250.

I. Introduction

Wrigley Field, home of Major League Baseball's Chicago Cubs, is unique in many ways. Part of the charm of Wrigley Field is its symbiotic relationship with the local neighborhood known as Wrigleyville. Fans come from far and wide to pack not only the ballpark, but the dozens of taverns and restaurants surrounding it. They even fill the rooftops of the apartment buildings across the street to watch the games.

While the taverns, restaurants, rooftop spectators and resident Cub fans clearly receive some benefit from sharing their neighborhood with the Chicago Cubs, the relationship between the ballpark and the neighborhood residents and landlords has sometimes been contentious. Local activist group Citizens United for Baseball in the Sunshine was successful in keeping lights and night games out of Wrigley for years. In 2002 in *Chicago National League Ball Club, Inc. v. Skybox on Waveland, L.L.C.*, the Cubs sued eleven rooftop owners for selling the view to their baseball games. Most recently, the neighborhood unsuccessfully resisted an expansion of the bleachers. The residents' concerns extend to crime, noise, congestion, traffic, and of course parking.

In this paper, we examine the market for parking near Wrigley Field during Cubs games. Parking spaces represent a perishable, non-renewable resource with stochastic demand, and prices fluctuate each day as information about current market conditions is updated. We obtained data on daily parking space rentals during the 2008 baseball season for two residences located approximately two blocks from the ballpark. We apply a revenue management model to discuss the factors that influenced daily demand for parking and discuss how Wrigley Field and the on-field performance of the Cubs might influence revenues and property values. Our results suggest that the parking entrepreneurs in our study could improve profitability by pricing less aggressively during weekend games. We also estimate the value of a parking space to the building owner of about \$8,250.

II. Market Dynamics

This study focuses on the efforts of two local entrepreneurs, Mary and Paul, who reside in two neighboring buildings with three parking spaces each approximately two blocks from

Wrigley Field. They parked cars and collected data on 80 of 81¹⁵ home dates during the 2008 season, with Paul on the street holding a sign to attract potential parkers and Mary collecting money and guiding cars into the parking spaces in the alley behind their two buildings. Occasionally a third parker helps out in the alley.

Surrounding these six parking spaces is a densely populated residential neighborhood made up primarily of three story buildings inhabited by renters. There are a number of bars and restaurants in the area that are busy through the year, and even more so during baseball season. Parking is at a premium on all days, but especially on game days. The Cubs and Wrigley Field, unlike nearly all other baseball teams, do not provide parking facilities for fans. Many areas around the ballpark have street parking restrictions, and this particular street requires a local residential parking permit after 6 p.m. or two hours before night games, whichever occurs earliest. Also in the vicinity are some small commercially owned parking lots (between 10 and 50 parking spots) that rent spaces on game days. These locations typically announce a price each day, post it on a sign, and attempt to rent all the spaces in their lot at that price. In contrast, Paul and Mary continuously update their price based on changing market conditions.

A typical parking day has three distinct stages. About one hour before game time, Mary and Paul choose a starting price. Then they adjust this price as volume builds in the period immediately before the first pitch, and finally, the game begins and the market dynamics change in somewhat unpredictable fashion. The starting offer price is an educated guess at what the market will bear. Potential customers driving by roll down their windows and are individually quoted a price. As conditions change and spaces are filled, Paul adjusts the offer price accordingly. Because customers negotiate separately, it is not uncommon for cars parking right next to each other to pay different prices. Prices may rise as much as \$15 in a ten-minute span. The trickiest time of day is immediately before game time. Sometimes, the first pitch results in traffic drying up almost instantaneously, but on other days, it results in a customer panic. In the former case, Paul and Mary may fail to sell all six spaces. In the latter case, however, panicked customers stop asking "How much?" and start asking "Where?" These customers end up paying a high price.

The economic problem reduces to maximizing revenues in the face of uncertain demand; once Mary and Paul show up to park cars, they face essentially zero marginal cost. There has been little work on the pricing mechanism for parking at non-stadium controlled facilities during sporting events, though some work has been done on the importance of parking accessibility as part of the fan experience (Hill & Green, 2000, Wakefield & Sloan, 1995). A significant amount of work has been done on this type of pricing problem in general. Bitran and Caldentey (2003) survey the literature and present a review of revenue management models and derive the basic optimization conditions for dynamic pricing of a perishable resource. Following their model, let $V(C,t)$ represent the value of a parking space as a function of the remaining capacity C at time t . Let $F(r,t)$ be the distribution function for a random variable representing the reservation price of the potential customer arriving at time t and p_t represent the price offered for the space at time t . The customer purchases the space only if $r > p_t$. Customers are assumed to arrive independently of each other. This results in a Poisson demand process with optimality condition given by the Bellman equation

¹⁵ No attempt was made to park cars on one date (6/26/08, vs. Baltimore).

$$\frac{dV(C_t)}{dt} = \max_{p \geq 0} \{ \lambda (1 - F(p, t)) [p - (V(C_t) - V(C_t - 1))] \} \quad (1)$$

where λ is a level parameter representing the intensity of demand¹⁶. Note that $V(C_t) - V(C_t - 1)$ represents the change in the value function that results from reducing capacity by one space, or the opportunity cost of selling the parking space at time t . Bitran and Caldentey use this equation to show that under some reasonable assumptions the optimal price is decreasing in t and increasing in C_t . In other words, the asking price should fall as it gets closer to game time, but rise as more spaces are sold.

Much of the literature is concerned with the implications of different functional forms for F , but in practice, F is understood in real time as Paul gathers information about drivers each day. Paul describes the process by which he chooses his offer price:

[T]he information regarding pricing change prior to game time is based primarily on the interplay between Capacity Utilization Analysis, Potential Customer Feedback Analysis and Cubs Event Analysis which is basically further refinement of supply/demand analysis. Capacity Utilization Analysis relates to how much supply the immediate competition (one or two block radius) has left. More supply equals flexibility and give-up on pricing. Customer feedback analysis is somewhat related to supply but basically analyzes the traffic flow. More cars and roll-downs equal more demand opportunity. A couple key clues are if a potential customer initially rejects the offer but then comes back later and accepts; this is a bullish market structure. Also bullish is seeing previous turn-downs circling the neighborhood. Another bullish clue is if increasing numbers of individuals are inclined to attempt and negotiate a parking price; this typically indicates that supply is tight. Cubs Event Analysis basically incorporates statistics like tickets sold, the competition and the event day and time of the week. Cubs Event Analysis basically provides a feel for an estimate of what the underlying demand should be. If the underlying demand should be strong, then holding the line and moving up pricing is more likely.

In the notation of Bitran and Caldentey, Capacity Utilization Analysis and Cubs Event Analysis refers to the factors that influence λ , while Customer Feedback Analysis refers to the factors that influence F in equation (1).

III. Data and Empirical Analysis

For each game, Paul and Mary provided data on total revenue, number of cars, per car price, and average price. We did not obtain data on the time or order in which the cars were parked. In addition, we matched this with data on game attendance, weather conditions, game time, day of week, opponent, and the Cubs' position in the standings.¹⁷ The average price for a parking space was \$31.15 and the average number of cars parked was 5.56, resulting in \$13,788 in revenue over the season. All six spaces were filled on 61 of 80 days, and five cars were parked on 9 days. Seven of the remaining ten days were weekends. The three games against the cross-town Chicago White Sox averaged \$50.55 per space.

¹⁶ Bitran and Caldentey (2003) examine the case and present first order conditions for the optimal price in the case where λ is constant over time. Other research (Zhao & Zheng, 2000) derive similar results in a model with time-varying demand intensity as might be expected in the case of Cubs game parking.

¹⁷ Source: Chicago Cubs website. (Chicago Cubs, 2009)

We examine two empirical models. First, we estimate daily revenue as a function of demand conditions using ordinary least squares. Equation (1) is a reduced form expressing the value of parking spaces in terms of both price and capacity, so both can be treated as exogenous in the revenue management equation. In the second model, we note that price and quantity (or capacity utilization) are determined jointly. We create a structural model and use two stage least squares to decompose the effects of the various regressors on revenues into their price and quantity components.

We begin by estimating the following equation using ordinary least squares:

$$\text{DailyRevenue} = b_0 + b_1(\text{Attendance}) + b_2(\text{Weekend}) + b_3(\text{DayGame}) + b_4(\text{Rain}) + b_5(\text{WhiteSox}) + b_6(\text{GA}) + b_7(\text{ExtraHelp}) + \varepsilon \quad (2)$$

Attendance measures the announced number of tickets sold to that day's Cubs game; Weekend is a dummy variable indicating the game was played on a weekend; DayGame indicates that the game started at 3:05 or earlier (no games started between 3:05 and 6:05); Rain indicates whether it was raining at game time; WhiteSox is a dummy variable representing whether the opponent was the Chicago White Sox; and GA represents how many games the Cubs currently were ahead in their division standings. ExtraHelp indicates that a third parker was present on that day. The results of this regression are presented in Table I.

The Cubs sold between 37,812 and 41,730 tickets per game. Our model estimates suggest that an additional 100 tickets sold translates into an extra \$2.64 in total revenue. Weekday starts generated an extra \$41.19 in revenues compared to weekends. Weekend days were especially likely to be the days where demand dried up suddenly after the first pitch, and this information will be useful for Paul and Mary next year. Day games reduce revenues by \$25.37 versus night games. This is probably due in large part to parking regulations. Street parking on nights of game days without a residential permit is prohibited in Wrigleyville, making demand for private spaces higher. Revenues fall by \$10.62 on rainy days, though the effect was statistically insignificant.

When the White Sox come to Wrigley, daily revenues rise by \$129.76. One possible explanation is that White Sox fans displace some Cubs fans, and that they are more likely to drive to the game than walk or use public transportation. Another explanation is that the Cubs-Sox games draw non-spectators to the neighborhood to participate in the revelry. It is also possible that the higher prices for Cubs tickets on these days attract wealthier people who are more inclined to pay for private, relatively close parking spaces.

Our estimated coefficient on the Cubs' position in the standings indicates an increase in revenues by \$0.74 for each game they lead their division, though the result was not statistically significant. The Cubs averaged 2.7 games ahead over the course of the season. Playing .500 baseball would have meant an average of 8 games behind. Without placing an undue level of confidence on this result, these estimates suggest that a fall from the Cubs' actual .602 winning percentage to .500 would cost approximately \$800 in revenue over the course of the season.

Next, we estimate the following system of equations using two stage least squares.

$$\text{AvgPrice} = b_0 + b_1(\text{Attendance}) + b_2(\text{Weekend}) + b_3(\text{DayGame}) + b_4(\text{Rain}) + b_5(\text{WhiteSox}) + b_6(\text{GA}) + b_7(\text{CarsParked}) + \varepsilon \quad (3)$$

$$\text{AvgPrice} = d_0 + d_1(\text{CarsParked}) + d_2(\text{ExtraHelp}) + \gamma \quad (4)$$

The need for two stage least squares arises because the number of cars parked and the price charged are jointly determined as seen from Equation (1) above. Equation (3) captures the factors that influence demand intensity— λ in equation 1, or Capacity Utilization Analysis and Cubs Event Analysis in Paul's terminology. Equation (4) measures the ability to accurately read market conditions— F in equation (1), or Potential Customer Feedback Analysis. Intuitively, equation (3) can be thought of as the demand equation, while equation (4) can be thought of as the supply or production equation. Demand depends on the characteristics of the particular game's crowd. Supply depends at least in part at how efficiently Mary, Paul, and sometimes a third parker, are able to park cars. The presence of a third parker is random and does not depend on the things that influence demand intensity, so the presence of the extra parker provides a useful instrument in identifying this system of equations. The third parker assisted on 23 days. On days without help, a queue of two or three cars may build as some other potential parkers would simply drive by rather than block traffic on the street. Additionally, without the third person, Paul has to walk a short distance each time he sells a parking space to point them to Mary, taking time that could be spent negotiating with potential customers or observing market conditions. In the mad rush around the time of the first pitch, the extra parker may make the difference between parking six cars or parking four.

Two stage least squares results are presented in Table II. The endogenous explanatory variable is the number of cars parked. The dependent variable is the average price per car. These results allow us to examine whether the revenue effects identified above are due to changes in price per car or in the number of cars parked. The first thing to note is that the number of cars parked does not significantly influence the average price of a car through the demand equation, but increases the price charged through the supply equation. This suggests that the demand curve facing Paul and Mary is highly elastic, as would be expected in this competitive market, but that there are gains to be made by parking cars more efficiently. In the language of equation (1), λ is determined exogenously, while the extra parker does in fact aid in the ability to understand the day's distribution of reservation prices, F .

These results allow us to break down the influences of the covariates on revenues into their price and quantity components. Above, we showed that an increase in attendance of 100 fans leads to a \$2.64 increase in revenues. From Table II, we see that an increase of 100 fans leads to a \$0.33 increase in the average price paid. If the average (5.56) number of cars is parked, the \$2.64 increase can be decomposed into \$1.81 in higher pricing and \$0.83 in increased quantity. Weekend games lowered prices by an estimated \$2.03 per car, which explains \$11.17 of the \$41.19 revenue decline. The vast majority of the lower revenues from weekend games come from an inability to fill all six spaces. There does not seem to be a post-first-pitch panic on weekends. This will be of great practical interest to Paul and Mary in future seasons. Nearly all of the \$129.76 increase in revenues on White Sox game days comes from higher prices. The White Sox push up prices by \$18.60 on average, and six cars were parked at each White Sox game. For day games, prices fell by \$2.84 per car, which explains about \$15.64 of the \$25.37 decline in revenues. The position in the standings drove up the price by a statistically significant \$0.35 per game ahead, though this did not translate into a statistically significant increase in revenues. Rain also had a statistically significant impact on prices, lowering them by \$2.75 per car, but this did not translate into a statistically significant decline in

revenues. The presence of the third parker added \$4.09 to the average price, but this led to a statistically insignificant increase in revenues of \$9.36.

During 2008, the Cubs drew a record 3,299,840 fans. Our estimates above suggest a point elasticity of price with respect to attendance of 4.2. In other words, a 10% drop in attendance would lead to a 42% drop in price, or a fall from \$31.15 to about \$18 per space. As an admittedly imperfect check on our results and lacking concrete data, we asked Paul to provide his recollections about prices and capacity utilization over this period. Table III presents pricing estimates based on the model-estimated elasticity and Paul's estimate, scaled for capacity utilization. Paul overestimated 2008, but only slightly. He estimated 95% capacity utilization and about \$35/space, versus actual results of 93% and \$31.15. His recollections track reasonably well with our model. Note that Paul's 2002 estimate of \$20.25 exceeds the model-predicted price of \$11.76. This is consistent with the notion that if prices fall below the opportunity cost of the parker's time, parking entrepreneurs will exit the market. The model predicts a lower price in 2003 than Paul recalls, and a higher price in 2004. The Cubs in 2003 began with low expectations and went on to win a division title, while the 2004 squad started well but collapsed as the year went on. There was likely high variation in demand over the course of those two seasons. From 2005-2008, the Cubs' on-field performance was reasonably consistent from the beginning of the season to the end, and the two sets of pricing estimates are close.

IV. Conclusions

Competition for parking spaces near Wrigley Field during Chicago Cubs baseball games is fierce. This provides an opportunity for enterprising building owners to earn a substantial amount of revenue by meeting this demand. One important practical finding for Mary and Paul that comes out of this study is the relatively high frequency with which unsold parking spaces occurred on weekends. Rather than seeing the post-first-pitch panic, weekends were more likely to dry up quickly. Increasing the average number of cars parked from 5.0 per weekend day to 5.83 cars, the weekday average, on the 26 weekend game days would have added about \$650 to the yearly total. This information should prove useful in future seasons.

We can construct some back of the envelope estimates of the impact of variation of Cubs attendance on parking prices and extend this to consider the value of a parking space. Shutdown costs for entrepreneurial building owners are essentially zero, and the marginal cost of parking is only the value of the entrepreneur's time, so parkers will leave the market when prices fall below this level. Paul's ten years of parking experience and the authors' own anecdotal evidence gathered from attending many games over the years suggests a lower bound on parking prices of about \$15. Any premium over this lower bound represents economic profit and adds value to the property. The last column of Table III translates the model-predicted price of a parking space into a measure of annualized economic profit per space. Average economic profits over the period based on the results of our model are estimated to be \$3,964 per year. Area capitalization rates for properties in the area are between 5% and 8% (Real Estate Capital Institute, 2008). At 8% cap rates, the returns to parking translate into about \$49,500 in property values, or about \$8,250 per space.

Further study is needed to extend one year's results to past and future seasons, but the analysis of the parking market in 2008 supports the conclusion that there are positive economic returns accruing to owners of parking spaces near Wrigley Field. The evidence presented here also suggests that the performance of the Cubs, through its effects on game attendance, affects the size of these profits. At least in this way, good baseball is good for the neighborhood.

Table I. Regression Estimates on Total Revenue

Dependent Variable	Total Revenue
	Parameter Estimate (Standard Error)
Intercept	-877.67** (227.41)
Attendance	0.0265** (0.01)
Weekend	-41.19** (9.53)
DayGame	-25.38** (8.82)
Rain	-10.62 (8.52)
WhiteSox	129.76** (21.20)
Div_Position	0.74 (1.48)
ExtraHelp	9.36 (9.22)
N	80
R-Squared	.5848

*Statistically significant at a 95% confidence level.
 **Statistically significant at a 99% confidence level.

Table II. Two Stage Least Squares Estimates on Average Price

Dependent Variable	Average Price	Average Price
	Parameter Estimate (Standard Error)	Parameter Estimate (Standard Error)
Intercept	-105.37** (23.91)	21.90** (3.99)
Attendance	.0033** (.0006)	
CarsParked	.331 (.48)	1.45* (.70)
Weekend	-2.03* (1.09)	
Rain	-2.75** (.89)	
White Sox	18.60** (2.19)	
Div_Position	.358* (.16)	
Day Game	-2.85** (.94)	
Extra Help		4.09** (1.46)
N	80	80
R-Squared	.6960	.1280

*Statistically significant at a 95% confidence level.

**Statistically significant at a 99% confidence level.

Table III. Estimated Impacts of Cubs Attendance on Parking Returns

Year	Per Game Attendance	Model-Predicted Price	Paul-Estimated Price	Economic Profit
2002	34,627	\$11.52	\$20.25	\$ 0.00
2003	36,575	17.78	24.30	1,252.24
2004	39,138	26.01	21.25	4,959.18
2005	38,276	23.24	22.95	3,712.45
2006	38,559	24.15	24.65	4,121.76
2007	40,153	29.27	30.40	6,427.21
2008	40,738	31.15	33.25	7,273.31

Source: Ballparks of Baseball (2008).

Model-Predicted Price_t = P₂₀₀₈ * (1 - (A_t - A₂₀₀₈) / A₂₀₀₈) * 4.2; A=Attendance, 4.2=Elasticity of Price With Respect to Cubs Attendance from Table II Coefficient

Paul-Estimated Price is the per-space average price times capacity utilization rate based on Paul's recollection of market conditions at those times.

Economic Profit is based on the model predicted price; Economic Profit = 0 if P_t < \$15; Economic Profit = (P_t - 15) * 81 games * 5.56 cars parked per game

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