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Dynamic ticket pricing and the impact of time – an analysis of price paths of the English soccer club Derby County

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ABSTRACT

Research question: Empirical studies about dynamic ticket pricing (DTP) in sports to date have focused exclusively on the Major League Baseball and on analyzing dynamic ticket prices based on a limited number of points in time. The current study extends the literature by examining the impact of time over the whole selling period. Furthermore, the presented study is the first to analyze a dynamic pricing system of a football club in Europe.

Research methods: Ticket prices for selected games of the English football club Derby County were collected daily during the 2013/2014 season. A data set of 5862 price points was analyzed by means of a hedonic pricing regression.

Results and findings: The model suggests that time has a significant effect on dynamic ticket prices. Ticket prices increased monotonously over time. This finding is consistent with previous research on dynamic pricing in sports. However, the pricing system can be differentiated from models applied in the airline or the hotel industry.

Implications: The current study extends the existing literature by analyzing the effect of time in the context of DTP. Sport managers can apply these findings concerning the specification of a more sophisticated pricing approach.

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Dynamic ticket pricing; sport demand; professional team sports; hedonic pricing model

The English football team Derby County currently plays in the second tier of English Soccer, the Championship, and seemed to be the first football club in Europe to apply a dynamic pricing system for sport events. Since the introduction in the 2012/2013 season the ticket prices today fluctuate on a daily basis depending on the current demand (http://www.dcfc.co.uk, 2012).

Throughout the twentieth-century sport managers applied either a *one-size-fits-all* approach, in which all ticket prices for the whole stadium were the same, or a *seat-location* approach, in which prices correlated with the distance to the field (Drayer, Shapiro, & Lee, 2012). In order to increase revenue streams for their 1999 season, the Colorado Rockies were the first team in professional sports to implement variable ticket pricing (VTP) (Drayer et al., 2012; Rovell, 2002). By applying VTP, prices are differentiated by factors

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such as opponent and day of the week (Drayer et al., 2012). However, ticket prices are fixed at the beginning of the season and are not supposed to change during that season. Several other teams adopted VTP in the following years and at the beginning of 2003 about one-third of Major League Baseball (MLB) organizations applied some form of VTP (Mondello & Rishe, 2005). Rascher, McEvoy, Nagel, and Brown (2007) evaluated the revenue potential of variable pricing for MLB. They estimated that every team could have been yielding approximately 2.8% additional revenues in 1996, if VTP had been applied.

In 2009 the San Francisco Giants were the first professional sports club to experiment with a new form of ticket pricing called dynamic ticket pricing (DTP). Revenue increases accounted for $450,000 (Moore, 2010), although they applied DTP for only 5% of the stadium capacity. Consequently, in the following season all seats in the stadium were priced dynamically, resulting in a ticket revenue increase of 7% (Kahn, 2011). Due to the financial results, three additional MLB teams adopted DTP for the 2011 season: the St. Louis Cardinals, Chicago White Sox, and Houston Astros (Paul & Weinbach, 2013). In fact, in the 2012 Season, 30 teams and other organizations in the MLB, National Basketball Association, National Hockey League, Major League Soccer, and National Association for Stock Car Auto Racing had started working together with Qcue, the company which had designed the dynamic pricing software (Dunne, 2012).

Previous research about DTP in sport focused exclusively on the MLB (Paul & Weinbach, 2013; Shapiro & Drayer, 2012, 2014). Shapiro and Drayer (2014) as well as Shapiro and Drayer (2012) reported that ticket prices increased continuously towards the day of the match with the application of a DTP system. Yet, a study about consumer expectations revealed that sport fans expected lower ticket prices as the time before the event decreased (Dwyer, Drayer, & Shapiro, 2013). These expectations would correspond to DTP models applied in the hotel or the airline industry, in which last-minute discounts are quite common.

However, the studies of Shapiro and Drayer (2012, 2014) are limited concerning the impact of time as they examined ticket prices at only five and four points in time, respectively. Therefore, the current study focusses on the impact of time more thoroughly by analyzing dynamic ticket prices over the whole selling period. Furthermore, the current study adds to the literature by analyzing for the first time a DTP system of a football club in Europe. A theoretical contribution is made as well since the current study is the first to analyze DTP data of a sports club based on the theoretical framework of dynamic pricing. Additionally, the study at hand is the first to relate its findings to studies about other industries which analyzed dynamic pricing data concerning the impact of time.

The paper is organized as follows: first, the theoretical principles of dynamic pricing are explained. Second, relevant literature is reviewed. Due to the focus of the current paper, the ticket pricing structure of Derby County is presented in a third step. Fourth, the data model is presented. Fifth, the data collection process is explained. Sixth, the results are illustrated followed by a discussion of the results. The paper ends with a conclusion, a presentation of limitations as well as a deduction of further research questions.

Theoretical framework

The theoretical foundation of this paper is the theory of dynamic pricing. This is based on neoclassical demand theory, according to which a consumer is assumed to choose a consumption bundle to maximize utility based on his or her preferences and is subject to a budget constraint. Thus, the demanded quantity of a good depends upon the price of the good in question. Studies on sport demand, understood as attendance at sport events, are generally in favor of this neoclassical perspective and found that sport demand and the admission price are negatively correlated (Andreff & Szymanski, 2009).

Due to the lively development in the research field of dynamic pricing models (Gönsch, Klein, & Steinhardt, 2009), there is no standard definition of dynamic pricing. Generally, the term refers to a strategy of price setting by which a seller sets non-negotiable prices and varies the price dynamically over time (Gönsch et al., 2009). Two examples are provided to help define the concept of dynamic pricing: one example follows a theoretical-methodical approach and a second one is taken from an overview paper.

Gallego and van Ryzin (1994), describe dynamic pricing as follows: 'Given an initial inventory of items and a finite horizon over which sales are allowed, we are concerned with the tactical problem of dynamically pricing the items to maximize the total expected revenue' (p. 999). According to Bitran and Caldentey (2003), dynamic pricing concerns: ' … a seller who owns a fixed and perishable set of resources that are sold to a price sensitive population of buyers. … [and is] interested in finding an optimal pricing strategy that maximizes the revenue collected over the selling horizon' (p. 203). While discussing the concept of dynamic pricing, the term *revenue* or *yield management* has to be considered as well. However, a clear distinction between dynamic pricing and revenue management is not possible (Gönsch et al., 2009). Some authors argue that dynamic pricing and revenue management are alternative concepts but of equal quality (Boyd & Bilegan, 2003, p. 1378f.). Others such as Bitran and Caldentey (2003) see revenue management as a subsection of the more general concept of dynamic pricing, in contrast to Tscheulin and Lindenmeier (2003), Tallury and van Ryzin (2004) and Gönsch et al. (2009), who argue for a classification the other way round. They distinguish between *quantity-based* revenue management, which refers to the classic revenue management, and *price-based* revenue management, which refers to dynamic pricing; and classify dynamic pricing as an additional version of the more generalized concept of revenue management. This last point of view is also followed by the current paper.

The theoretic principles of the general dynamic pricing model (Bitran & Mondschein, 1993; Bitran & Wadhwa, 1996; Gönsch et al., 2009; Klein & Steinhardt, 2008) assume that a monopolist sells a single product to an indefinite population of time homogenous and myopic[1] customers. The demand is regarded as price sensitive. At the end of the selling period the value of the residual items accounts for 0. The price can be varied continuously at the beginning of each time period and can take any nonnegative value. Thus, at the beginning of the selling period a fixed number of items C of a product is available, which can be sold over a discrete period of time $t = T, \dots ,1$, starting with period T and ending with period 1. At the beginning of every period a price p_t has to be set, which influences the demand for the product based on a stochastic demand function $D_t(p_t)$. The objective of the dynamic pricing problem is to determine a price policy which maximizes the expected revenues $V(c,t)$ over all periods. The Bellman-equation specifies the mathematical functionality:

$$V(c,t) = \max_{p_t} E(p_t \times \min\{D_t(p_t),c\} + V(c - \min\{D_t(p_t),c\},t-1)) \qquad (1)$$

$$\text{for all } 0 \leq c \leq C \quad \text{and} \quad t = T, \ldots, 1.$$

with boundary conditions:

$$V(c,0) = 0 \text{ for all } c \geq 0 \text{ and} \tag{2}$$

$$V(0,t) = 0 \text{ for all } t = T, \ldots, 1. \tag{3}$$

The equation consists of two summands:

- the revenues which can be yielded directly in a certain period of time based on the chosen price p_t and the sold quantity in that period $\min\{D_t(p_t), c\}$;
- the expected revenues of the remaining periods of time $V(c - \min\{D_t(p_t), c\}, t - 1)$.

The boundary conditions (2) and (3) ensure that no additional revenues are yielded either at the end of the selling period (2) or in the case that all items are sold (3). Concerning the mathematical modelling of dynamic pricing approaches there exist two characteristics. First, in phases during which no purchases occur, the ticket price decreases steadily. However, if a ticket is sold, the price for the next period increases abruptly. The second characteristic states that the ticket price for a lower remaining capacity is higher than for a higher remaining capacity (Gönsch et al., 2009; Klein & Steinhardt, 2008).

Review of related literature

Relevant literature stems from three sources. First, studies about sport demand and stadium attendance are reviewed. Second, the literature about dynamic pricing in general is explored, followed by a review of literature on dynamic pricing with a special focus on the sports industry.

Sport demand

Sport demand is a primary field of research amongst sport economists. Therefore, there exist numerous studies that have focused on the topic of sport demand in terms of stadium attendance and factors that influence stadium attendance [overviews can be found in Borland and MacDonald (2003); Cairns, Jennett, and Sloane (1986); Downward and Dawson (2000); Villar and Guerrero (2009)]. These studies suggest that ticket prices of sport events are negatively correlated with stadium attendance and that ticket prices are set in the inelastic portion of the demand curve (e.g. Borland & MacDonald, 2003; Villar & Guerrero, 2009). Therefore, it seems that ticket prices could be increased without a proportional loss of ticket sales. However, Coates and Humphreys (2007) as well as Krautmann and Berri (2007) argue that sport managers also take ancillary revenues like concessions and parking into account while optimizing overall revenues.

Dynamic pricing

In recent years, dynamic pricing has been established as one of the most methodologically sophisticated research topics at the intersection between operations research, marketing, economics, and e-commerce and a lot of studies about different applications has been published (Gönsch et al., 2009). Tallury and van Ryzin (2004) wrote the standard text book in the field of dynamic pricing. Overviews of the current state-of-the-art can be found in Bitran and Caldentey (2003), Chan, Shen, Simchi-Levi, and Swann (2004), Elmaghraby and Keskinocak (2003), Tscheulin and Lindenmeier (2003), and Gönsch et al. (2009). The first paper about dynamic pricing was published by Kincaid and Darling (1963). The first practical applications were implemented in the airline industry, due to the Airline Deregulation Act of 1978 (Tallury & van Ryzin, 2004, p. 6ff). Since then, other industries such as hotel, car rental, and tourism have transferred the mathematical principles of dynamic pricing to their specific situations (for an overview see Klein & Steinhardt, 2008, p. 38). Most recently, dynamic pricing models were developed for restaurants (Heo & Lee, 2011), cruise lines (Maddah, Moussawi-Haidai, El-Taha, & Rida, 2010), golf courses (Kimes & Schruben, 2002), spas (Kimes & Singh, 2009) and theme parks (Heo & Lee, 2009).

Dynamic pricing in sports

It seems that only a few studies on dynamic pricing in sports have been published to date. Either the topic was addressed on a managerial level or determinants of dynamic ticket prices were evaluated.

Drayer et al. (2012) examined the applicability of a dynamic pricing strategy for the sports industry from a managerial point of view. The authors based their analysis on the conceptual framework of Kimes (1989) and Kimes, Chase, Choi, Lee, and Ngonzi (1998) in order to evaluate the applicability of a dynamic pricing approach for a sports club. The conceptual framework includes seven prerequisites characteristics: the ability to segment markets, the sale of perishable inventory, in advance sale of the product, low marginal sales costs, high marginal production costs, and fluctuating demand. Since all characteristics are true for the sports industry Drayer et al. (2012) concluded that dynamic pricing can be regarded as an appropriate pricing strategy for sport events. Nufer and Fischer (2013) came to the same conclusion based on an analysis of European Football Leagues and stated that it is only a matter of time before dynamic pricing would be used by major football clubs in Europe.

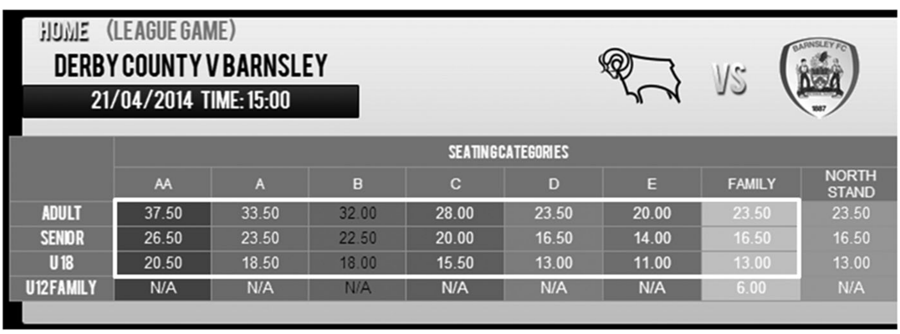
Three empirical studies were contributed by Paul and Weinbach (2013) and Shapiro and Drayer (2012, 2014), who analyzed pricing data from MLB clubs applying DTP. Shapiro and Drayer (2012) analyzed ticket prices for 12 selected games of the San Francisco Giants in the 2010 season, the first ever year in which a whole sport stadium has been priced dynamically. They reported significant effects for both time and seating category. Also, as the day of the match approached, the price through dynamic pricing continuously increased. Further, they showed that better seats within the stadium were priced higher. Paul and Weinbach (2013) extended the study of Shapiro and Drayer (2012) by analyzing a data set of ticket prices for the San Francisco Giants, St. Louis Cardinals, Chicago White Sox, and Houston Astros – the four American Baseball Teams that had implemented dynamic pricing during the 2011 season. They found significant effects for the variables: day of the week, months of the year, home team's winning percentage, opponent, promotions, starting pitcher, and weather conditions on the ticket price. However, results varied widely depending on the teams. Weather conditions, in particular, were found to be mixed. Shapiro and Drayer (2014) conducted the third study about determinants of DTP in sport. Of 29 initially considered variables, 10 were included in the final model. Significant factors included ticket-related variables (seat location), team performance (whether the opponent reached the playoffs during the previous year, home team's winning percentage in the last 10 games), individual performance (whether Tim Lincecum was scheduled to pitch, starting pitcher's Earned Run Average, number of all-stars on opponent's roster), time-related variables (start time for the game, part of the season, and number of days before the game), and game-related variables (whether the opponent is from the same division).

However, Drayer et al. (2012) pointed out that a more comprehensive analysis of this new pricing approach required a lot of additional research. Therefore, the current study extends the existing literature by focusing on the impact of time in a dynamic pricing model, using the example of the soccer club Derby County.

The pricing system of Derby County

Derby County provides detailed information about their pricing system on their homepage. In general, ticket prices are differentiated by seating category and age band. Six seating categories ranging from AA to E are used as well as an additional family category and a North Stand category. Four age bands are implemented: Adults, Senior, U18, and U12. (http://www.dcfc.co.uk, 2012). Figure 1 provides an example of Derby County's ticket prices. Furthermore, Derby County applies four categories to classify the quality of the opponent. The first category refers to rival games and is priced highest. Initial prices for the other three opponent categories decrease gradually. Figure 2 provides an overview of the initial price ranges. For example, initial prices for the opponent category 2 ranged between £11 for U18 and seat category E tickets and £37.50 for adults and seat category AA tickets.

The concept of dynamic pricing, which is called *demand based pricing* by Derby County, is applied to the seating categories AA to E as well as to family tickets. The North Stand is excluded from the dynamic pricing system. Age bands Adult, Senior, and U18 tickets are priced dynamically. U12 tickets are not subject to the dynamic pricing approach (http://www.dcfc.co.uk, 2012).



	AA	A	B	C	D	E	FAMILY	NORTH STAND
ADULT	37.50	33.50	32.00	28.00	23.50	20.00	23.50	23.50
SENIOR	26.50	23.50	22.50	20.00	16.50	14.00	16.50	16.50
U18	20.50	18.50	18.00	15.50	13.00	11.00	13.00	13.00
U12FAMILY	N/A	N/A	N/A	N/A	N/A	N/A	6.00	N/A

Figure 1. Derby County's ticket pricing structure.

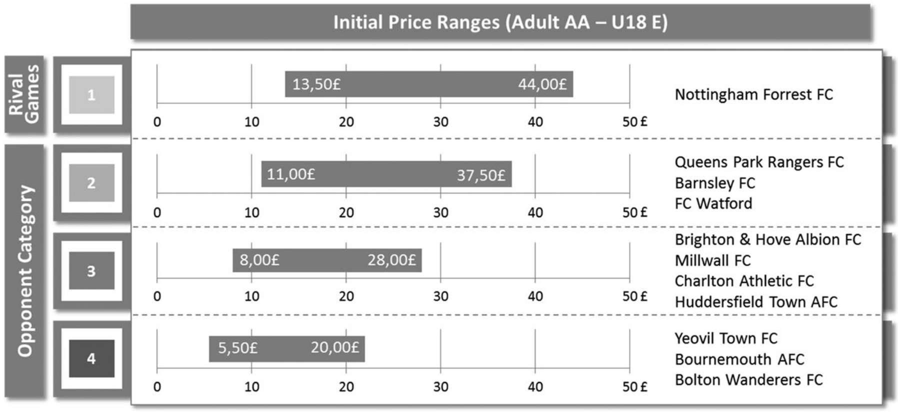


Figure 2. Initial price ranges of Derby County's ticket pricing structure.

Ticket prices can change on a daily basis based on real-time market conditions. Only home league fixtures are subject to the demand based pricing system, as away games are charged by the competitive club. When fixtures go on sale, the starting price will be the lowest price for a single match ticket. If a price is going to change, it will change at midnight. There is the possibility that the price of a ticket may go up and then drop down back to the starting price, but the price will never drop below the starting price. This means that supporters who choose to purchase their individual tickets early will get the best possible pricing deal before any potential fluctuation in prices might occur. In contrast to the implemented lower price threshold, there will be no limit on how high prices can go. Price changes are unique to fixtures, seating categories, and age bands. Upgrades or downgrades are still possible, but are subject to the current demand based price and not the price paid when the ticket was purchased. In order to protect season ticket holders, the system guarantees that single match buyers always pay more for tickets than season ticket holders or 12- and 6-game plan holders (http://www.dcfc.co.uk, 2012).

Data model

In order to analyze the impact of time on the dynamic ticket price of Derby County we specify a hedonic posted price model. This approach has been widely used in environmental economics and primarily in the field of evaluating house prices (e.g. Mahan, Polasky, & Adams, 2000; or Zabel & Kiel, 2000). The hedonic pricing approach is based on the recognition that a complex commodity can be considered as a bundle of different characteristics and originates in Lancaster's characteristics theory of consumer demand (Lancaster, 1966). Similar approaches to valuing sporting intangible assets has been applied by Gerrard, Parent, and Slack (2007) to the case of stadium naming rights, by Gerrard and Dobson (2000) to analyze the transfer value of professional soccer players, or by Stewart and Jones (1998) to evaluate the attributes of MLB players. Harrington and Treber (2014) applied a hedonic pricing model to analyze the impact of time on ticket prices in the secondary market. Hence, we adapt the approach of Harrington and

Treber (2014) and specify the following model:

$$\ln(\text{DAILY\_PRICE})_i = \alpha + \sum_{j=1}^{27} \beta_j \text{DAYSBEFORE}_{j,i} + \sum_{k=1}^{5} \gamma_k \text{SEAT\_CAT}_{k,i} + \sum_{l=1}^{2} \delta_l \text{AGE\_BAND}_{l,i} + \sum_{m=1}^{3} \theta_m \text{OPPONENT\_CAT}_{m,i} + \omega \text{SOLD\_PERC}_i + \tau \text{CUR\_LEAGUE\_POS\_DC}_i + \varphi \text{CUR\_LEAGUE\_POS\_OPP}_i + \varepsilon_i. \quad (4)$$

Dependent variable

The logarithm of the daily ticket price as displayed on Derby County's homepage was used as the dependent variable: ln (DAILY_PRICE). This approach was applied because Harrington and Treber (2014) specified a similar model and it offered the advantage to interpret the estimated coefficient as percentage changes of the daily ticket price.

Explanatory variables

The primary explanatory variable is the time before the day of the match (DAYSBEFORE). This variable was categorized in order to evaluate the corresponding price path. The reference category is the match day itself. Prices have been collected daily since tickets were available to the public. Seat category (SEAT_CAT), age band (AGE_BAND) opponent category (OPPONENT_CAT), current league position of Derby County (CUR_LEAGUE_POS_DC), current league position of the opponent (CUR_LEAGUE_POS_OPP), and the percentage of the sold stadium capacity (SOLD_PERC) were used as control variables. Unfortunately, Derby County was not willing to provide us with the corresponding daily sales data over the selling period. Therefore, we had to use the sold number of tickets at match day to calculate a proxy for the sold stadium capacity. In the estimated model, the best seat category was used as the reference category. Similarly, the regular tickets for adults were used as the reference category for age band and the highest opponent category was excluded as the reference category. The current league position of Derby County and the current league position of the opponent were included into the model in order to account for the performance of the teams throughout the season because previous studies reported significant effects of the current team performance (Paul & Weinbach, 2013; Shapiro & Drayer, 2014). The variable α is the intercept of the model and ε represents the error term.

Data collection

Data were collected between 18th December 2013 and 26th April 2014, covering the whole second half of the 2013/2014 season of the English Championship. This time period was chosen because it offered a broad variety of opponents ranging from rival games to opponents from category 4. Furthermore, the opponents were distributed over the whole league table at the end of the previous season. Due to the focus of the current study, only the home games of Derby County were taken into account. Ticket prices were tracked from the first day that the purchase of tickets on Derby County's homepage was possible. The considered selling periods ranged between 19 and 27 days prior to match day. In total, data were analyzed for 11 games, including 5862 price points. Other studies about DTP in sports like Shapiro and Drayer (2012, 2014) each evaluated 12 selected games and are therefore comparable to the current study in terms of the number of analyzed games, although these two studies evaluated significant fewer data points. Ticket prices were considered for the age bands Adult, Senior, and U18. Tickets for the fourth age band U12 were not subject to dynamic pricing. The seating category North Stand was also excluded because tickets for this category were fixed price. Game and ticket price information was collected every day directly from the official homepage of Derby County (http://www.tickets.wearederby.com/match-tickets/buy-tickets/#). The number of sold tickets was obtained from http://www.worldfootball.net.

Results

The results are present in two steps. First, general descriptive results are shown, then the results of the hedonic posted price model are presented.

Descriptive results

The dependent variable – the daily ticket price – ranged between £5.5 and £45.5 and averaged out at £17 with a standard deviation of £7.5. Concerning the stadium occupancy rate only the game against Nottingham Forest can be regarded as a sellout. 98% of the seats were sold. The occupancy rate of the other games only ranged between 68% for the game against Millwall and 81% for the game against Bournemouth. The league position of Derby County ranged between the second and the fourth place. The league position of the opponent teams varied between the second and 24th place. A summary of the percentages for the categorical variables is displayed in Table 1. The results show that the variables days before the game, seat category, age band, and opponent category are relatively equally distributed among the categories. Since only the game against Nottingham Forrest was classified as a rival game, this opponent category had fewer observations.

The allocation of the opponents to the opponent category can be seen in Figure 2. Based on the combination of seat category, age band, and opponent category Derby County applies 84 initial price points. However, all of these initial prices could fluctuate freely resulting in 228 different price paths for the analyzed data set.

Figure 3 shows an example of the price paths for adult tickets for the game against Watford. While ticket prices for the seat categories AA, A, and B remained stable over the whole selling period, ticket prices for the seat categories C, D, and E increased by 4%, 15%, and 25%, respectively. Ticket prices for the seat category C only changed one time – at seven days before the game took place. Ticket prices for the seat category D and E, however, increased three times over the selling period – at ten and seven days before the game and on match day itself. Therefore, it seems that ticket prices of the considered price paths change independently from each other.

The distribution of the total price increase concerning all price paths is presented in Figure 4. It can be seen that 35 of the 228 price paths did not increase at all over the whole selling period, while the mark up for the other 193 price paths ranged between 2% and 75%.

Table 1. Descriptive results for the categorical variables.

Variable	Categories	*N*	Percentage (%)
SEAT_CAT	AA	849	14.5
	A	849	14.5
	B	849	14.5
	C	849	14.5
	D	849	14.5
	E	849	14.5
	Family	768	13.1
AGE_BAND	Adult	1954	33.3
	Senior	1954	33.3
	U18	1954	33.3
OPPONENT_CAT	1	486	8.3
	2	1512	25.8
	3	2163	36.9
	4	1701	29.0
DAYSBEFORE	0	228	3.8
	1	228	3.8
	2	228	3.8
	3	228	3.8
	4	228	3.8
	5	228	3.8
	6	228	3.8
	7	228	3.8
	8	228	3.8
	9	228	3.8
	10	228	3.8
	11	228	3.8
	12	228	3.8
	13	228	3.8
	14	228	3.8
	15	228	3.8
	16	228	3.8
	17	228	3.8
	18	228	3.8
	19	228	3.8
	20	207	3.5
	21	207	3.5
	22	207	3.5
	23	207	3.5
	24	207	3.5
	25	102	1.7
	26	102	1.7
	27	63	1.1

An interesting finding, however, is that over the whole selling period not one single price reduction could be detected: for all 228 of the analyzed price paths, the price only either increased over time or stayed at the same level. This can be seen in Figure 5, which visualizes the number of price increases and price decreases over the selling period. The vast majority of price increases occurred on match day itself and on the days leading up to match day. Hence, the last week prior to match day has a decisive impact on ticket prices.

Regression analysis

The results of the estimated regression model are shown in Table 2. The model was estimated using ordinary least squares (OLS) corrected for heteroscedasticity and autocorrelation using heteroscedasticity-and-autocorrelation standard errors (HACSE) as proposed by

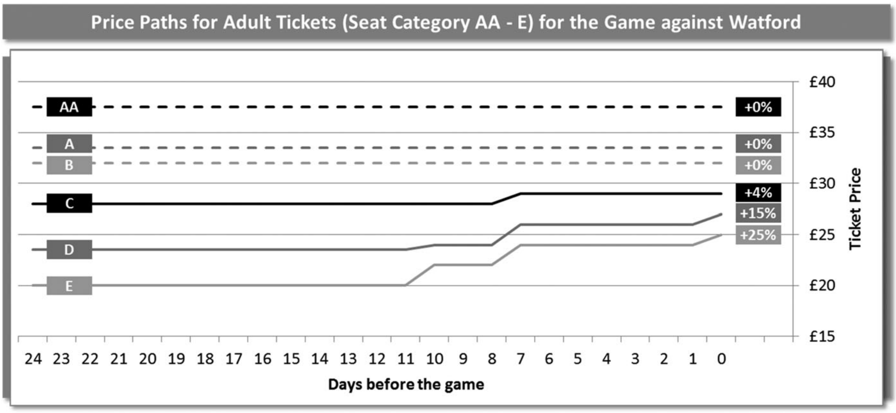


Figure 3. Example of price paths.

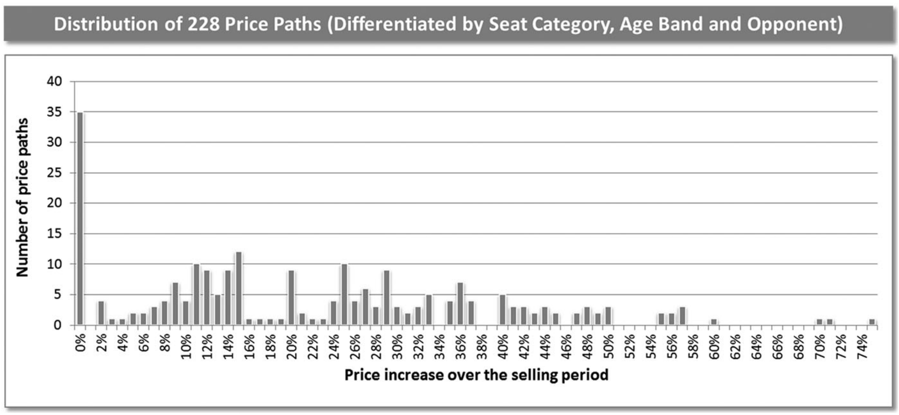


Figure 4. Distribution of the price paths' total price increase over the selling period.

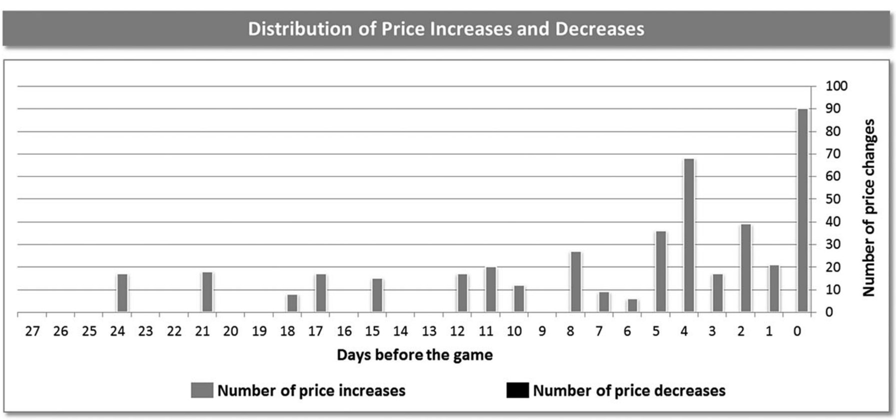


Figure 5. Number of price increases and decrease over the selling period.

Table 2. Estimates of the OLS regression and HAC standard errors.

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value	Sig.
Constant	3.589	0.180	19.937	<.001	***
SEAT_CAT AA vs. A	−0.097	0.005	−18.479	<.001	***
SEAT_CAT AA vs. B	−0.155	0.003	−50.315	<.001	***
SEAT_CAT AA vs. C	−0.271	0.010	−27.593	<.001	***
SEAT_CAT AA vs. D	−0.425	0.017	−25.178	<.001	***
SEAT_CAT AA vs. E	−0.611	0.027	−22.633	<.001	***
SEAT_CAT AA vs. Family	−0.460	0.015	−30.192	<.001	***
AGE_BAND Adults vs. Senior	−0.345	0.002	−229.504	<.001	***
AGE_BAND Adults vs. U18	−0.583	0.003	−171.695	<.001	***
OPPONENT_CAT 1 vs. 2	−0.142	0.074	−1.916	.055	.
OPPONENT_CAT 1 vs. 3	−0.389	0.080	−4.884	<.001	***
OPPONENT_CAT 1 vs. 4	−0.668	0.082	−8.113	<.001	***
SOLD_PERC	0.005	0.002	2.870	.004	**
CUR_LEAGUE_POS_DC	−0.021	0.012	−1.689	.091	.
CUR_LEAGUE_POS_OPP	−0.002	0.001	−1.703	.089	.
DAYSBEFORE 0 vs. 1	−0.048	0.015	−3.119	.002	**
DAYSBEFORE 0 vs. 2	−0.056	0.018	−3.065	.002	**
DAYSBEFORE 0 vs. 3	−0.068	0.019	−3.532	<.001	***
DAYSBEFORE 0 vs. 4	−0.076	0.019	−3.995	<.001	***
DAYSBEFORE 0 vs. 5	−0.100	0.026	−3.829	<.001	***
DAYSBEFORE 0 vs. 6	−0.117	0.025	−4.646	<.001	***
DAYSBEFORE 0 vs. 7	−0.119	0.025	−4.714	<.001	***
DAYSBEFORE 0 vs. 8	−0.122	0.025	−4.902	<.001	***
DAYSBEFORE 0 vs. 9	−0.132	0.024	−5.495	<.001	***
DAYSBEFORE 0 vs. 10	−0.132	0.024	−5.473	<.001	***
DAYSBEFORE 0 vs. 11	−0.137	0.025	−5.546	<.001	***
DAYSBEFORE 0 vs. 12	−0.152	0.025	−6.034	<.001	***
DAYSBEFORE 0 vs. 13	−0.155	0.027	−5.835	<.001	***
DAYSBEFORE 0 vs. 14	−0.155	0.026	−5.852	<.001	***
DAYSBEFORE 0 vs. 15	−0.155	0.027	−5.813	<.001	***
DAYSBEFORE 0 vs. 16	−0.159	0.026	−6.206	<.001	***
DAYSBEFORE 0 vs. 17	−0.162	0.026	−6.222	<.001	***
DAYSBEFORE 0 vs. 18	−0.164	0.028	−5.850	<.001	***
DAYSBEFORE 0 vs. 19	−0.167	0.029	−5.745	<.001	***
DAYSBEFORE 0 vs. 20	−0.167	0.029	−5.823	<.001	***
DAYSBEFORE 0 vs. 21	−0.167	0.029	−5.761	<.001	***
DAYSBEFORE 0 vs. 22	−0.174	0.031	−5.663	<.001	***
DAYSBEFORE 0 vs. 23	−0.174	0.031	−5.648	<.001	***
DAYSBEFORE 0 vs. 24	−0.174	0.031	−5.643	<.001	***
DAYSBEFORE 0 vs. 25	−0.190	0.029	−6.511	<.001	***
DAYSBEFORE 0 vs. 26	−0.190	0.029	−6.515	<.001	***
DAYSBEFORE 0 vs. 27	−0.205	0.022	−9.402	<.001	***
DF	5820			.Significance: 10% level	
R^2	0.973			*Significance: 5% level	
R^2_{adj}	0.973			**Significance: 1% level	
F-Statistic	558.39***			***Significance: 0.1% level	

Lumley and Heagerty (1999). This approach was chosen because we had to deal with heteroscedasticity and autocorrelation. A Breusch–Godfrey test and a Durbin–Watson test were applied to test for autocorrelation and both showed significant effects ($p < .001$). A Breusch–Pagan test suggested heteroscedasticity ($p < .001$), while a Goldfeld–Quandt test was not significant ($p = .331$). Consequently, HACSE are reported. Multicollinearity was not a serious issue. All variance inflation factors (VIF) were far below 10, which is the most commonly recommended maximum level of the VIF (e.g. Hair, Anderson, Tatham, & Black, 1995; Kennedy, 1992; Neter, Wasserman, & Kutner, 1989; O'Brian, 2007).

The calculated R^2 and R^2_{adj} for the model accounted for 97.3% each. All variables showed a significant effect on a 1%-level, except for the second opponent category, the

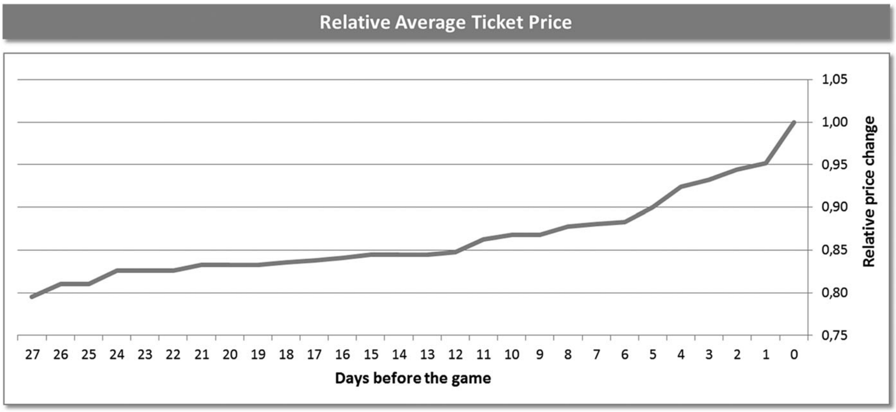


Figure 6. Relative average price path adjusted by control variables.

current league position of Derby County and the current league position of the opponent team, which were only significant on a 10%-level. Most variables even were significant on a 0.1%-level. The overall F-test for the model showed a significant effect on a 0.1%-level.

The control variables seat category, age band, and opponent showed the expected signs. Better seats and opponents of higher quality were priced higher. For example, tickets for the second highest seat category A were on average 9.7% cheaper than the tickets for the highest seat category AA. Similarly, tickets for the second opponent category were on average 14.2% less expensive than tickets for the first opponent category, which corresponds to rival games. Senior and U18 tickets were sold at a discount of 34.5% and 58.3%, respectively, compared to adult tickets. Also the variable sold stadium capacity showed the expected positive effect. On average, an increase of the stadium occupancy rate by 1% resulted in a price increase of 0.5%. The control variables current league position of Derby County and of the opponent team showed the expected effects as well, although the effects were only slightly significant. An improvement in the table of Derby County or the opponent team by one position resulted in higher ticket prices by 2% and 0.2%, respectively.

The evaluation of the variable of primary interest revealed that ticket prices of Derby County continuously increased as the match day approached. All dummy variables concerning the selling period were negative and statistically significant. Controlling for the other variables, ticket prices increased monotonously over the whole selling period. For example, ticket prices were 20% cheaper 27 days prior to the game compared to ticket prices on match day. A major price increase could be observed on match day itself. The difference in ticket prices between one day before match day and on match itself amounted to 4.8%. The relative development of the average ticket price is visualized in Figure 6.

Discussion

The presented study is the first to evaluate the impact of time on dynamic ticket prices for a sport clubs on a daily basis. While other studies about determinants of dynamic ticket prices, like Shapiro and Drayer (2012) or Shapiro and Drayer (2014), analyzed a data set of 1316 and 811 observations, respectively, the current study extends the data basis by analyzing 5862 price points. The overall fit of the model based on the adjusted R^2 accounted for 97.3%. This can be regarded as a very high value. The discussion of the results is orientated on the conceptual framework regarding general managerial considerations about DTP in sport outlined by Drayer et al. (2012). The framework includes the following five critical factors: time, price ceilings and floors, season ticket holders, price transparency, and face value of the ticket.

Time

Derby County chose to change ticket prices on a daily basis like the San Francisco Giants do. Other options would have been to adapt prices in real time, by minute, hour, or other time intervals. However, even if sudden changes in weather forecasts or player injuries could not be accounted for, more frequent price adjustments may lead to customer confusion and the perception of price unfairness (Drayer et al., 2012). As many studies have shown, perceived price fairness is one important psychological factor that influences consumers' satisfaction and subsequent behavior (Bei & Chiao, 2001; Etzioni, 1988; Kahnemann, Knetsch, & Thaler, 1986a, 1986b; Oliver & Swan, 1989). Therefore, it seems a reasonable approach to change prices not more than once a day.

Shapiro and Drayer (2012, 2014) showed that ticket prices prior to the game increased continuously over time with the application of a DTP system. The current study reveals that this also applies for ticket prices of Derby County. However, in contrast to Shapiro and Drayer (2012), which examined four time points (20, 10, or 5 days in advance of the game and on match day itself) and to Shapiro and Drayer (2014), which examined five time points (30, 20, 10, or 5 days in advance to the game and on match day itself), the current study analyzed daily pricing data over a period of 27 days prior to match day. Therefore, the findings of Shapiro and Drayer (2012, 2014) can be generalized. Shapiro and Drayer (2012) reported that dynamic ticket prices at 20 days before match day were 13% lower compared to ticket prices on match day. In the current study, the difference accounted for 17% and was, therefore, slightly larger.

Contrary to the development of ticket prices in the primary market, studies about ticket prices in the secondary market reported that prices decrease towards the day of the match (Drayer & Shapiro, 2009; Shapiro & Drayer, 2012). Therefore, the ticket price development in the primary and secondary market seems to follow complete different patterns. However, Shapiro and Drayer (2012) found that ticket prices in the secondary market are on average roughly 50% higher than in the primary market. However, the difference in ticket prices between the primary and secondary market decreases towards the day of the match. Hence, this observation relativizes the general oppositional development of ticket prices in the two markets. Dwyer et al. (2013) further analyzed the impact of time in advanced ticket purchase decisions based on an online questionnaire. The authors found that as time before the event decreased the consumer expected a higher ticket availability and a lower ticket price – both for the primary and secondary market. Based on the current study, however, these customer's expectations concerning the future price development in the primary market might be disappointed. Dwyer et al. (2013) speculate about the reasons for these expectations, e.g. a general consumer's lack of awareness of DTP in sports. However, the authors point out that additional research is needed in order to evaluate this question. Therefore, it is a potential field for future research to explore how these expectations might be related to concepts like fans' willingness to pay or loss aversion.

The study at hand, furthermore, shows that ticket prices increased continuously over the whole selling period. Consequently, fans of Derby County should be encouraged to buy tickets as soon as possible to get the best possible deal. A detailed analysis of all price paths revealed that ticket prices actually never decreased. Therefore, the pricing system of Derby County can be differentiated from dynamic pricing models applied in the hotel industry, by which room rates first increase over time and then drop towards the day of accommodation (Kimes, 2010). Derby County's dynamic pricing system, however, does not offer last-minute deals. Quite the contrary seems to be true, as ticket prices on match day increased significantly. Like the hotel industry, traditional airlines commonly apply last-minute discounts. Only in the case of low-fare airlines a clear upward trend in the price charged could be observed (Koeningsberg, Muller, & Vilcassom, 2008). Yet, Koeningsberg et al. (2008) further found that ticket prices of low-fare airlines do not increase monotonously and that prices actually decrease at certain points in time. Hence, this can be regarded as a clear difference to the pricing system of Derby County. Additionally, the observation that ticket prices never decreased is surprising, in the respect that this pattern violates the characteristics of the general model of dynamic pricing, exposed in the theoretical framework section. The theoretical model predicts that prices decline over time when no purchase occurs. Of course, the possibility exists that prices only increase over time due to high demand, but in the current case only the game against Nottingham Forest showed really high attendance figures, whereas the stadium attendance rate of the other games ranged between 68% and 81%. However, the current study could only incorporate the attendance rate on match day rather than the actual sales data on a daily basis, which might have biased the results. Therefore, future studies should further investigate into the impact of the actual number of sold tickets on dynamic ticket prices. Nevertheless, by the incorporating the attendance rate on match day into the data analysis the current study could extend the literature about DTP, since previous studies neglected the number of sold tickets at all (Paul & Weinbach, 2013; Shapiro & Drayer, 2012) or merely considered whether the game was a sellout or not (Shapiro & Drayer, 2014). Therefore, although the data analysis might be improved, it seems likely that Derby County prevents prices from dropping generally by the implementation of price floors.

Price ceilings and floors

According to Zeithaml (1988) a low price point can devalue the product in the eyes of the customer. Therefore, it seems reasonable to implement price floors to prevent tickets being priced too low. According to Derby County's homepage, the starting price will be the lowest price for a single match ticket, when fixtures first go on sale. This was also supported by our data analysis. Furthermore, Derby County's homepage states that prices may go up and then drop down back to the starting price, but will never drop below it. Although our data analyses suggest that Derby County uses price floors, we could not detect a single case in which prices declined at all. Hence, Derby County seems to have implemented not a static but some kind of dynamic price floor, preventing prices from dropping generally. The long phases of constant prices further support this conclusion. Therefore, the lack of falling prices might suggest that Derby County highly controls the ticket price and that these results might not be indicative of what would happen in other marketplaces where soccer tickets are priced dynamically. However, only future research might be able to answer this question.

Apart from price floors, no price ceilings could be detected in our analyses. This corresponds to the statement of Derby County. The absence of price ceilings should ensure a higher optimal price and an increase of revenues. An anodyne to the lack of price ceilings is to give consumers with low or medium household income an opportunity to attend truly high demand games. This is generally considered an important part of building a passionate and loyal fan base (Drayer et al., 2012). Another argument against price ceilings is the risk of ticket overpricing and hence a decreasing stadium attendance which, e.g. in the NFL, might lead to media blackouts (Drayer et al., 2012). However, media blackouts are not applied in English soccer. Hence, a dynamic pricing system without price ceilings can be regarded as reasonable strategy for Derby County to maximize ticket revenues.

Season ticket holder

The implementation of price floors further serves the purpose of protecting season ticket holders. To prevent a season ticket holder sitting next to a single game attendant who paid less for his ticket, Derby County established price floors to guarantee that season ticket holders as well as 12- and 6-game plan holders always pay less than single match buyers; this information is clearly emphasized on the Derby County webpage (http://www.dcfc.co.uk, 2012). Season ticket holders are often considered a team's most valuable asset. They generate a fixed income stream prior to the season, and generally are the most dedicated fans (Drayer et al., 2012). Barry Kahn, CEO of the dynamic pricing software company Qcue, stated that he would rather not have implemented price floors, but it was more important to protect season ticket holders than to establish a true dynamic pricing system (Moore, 2010).

Price transparency

Another point concerning the implementation of a pricing system refers to the amount of information provided. In this respect, Derby County chose to offer detailed information about their pricing strategy on their webpage, although they do not provide information about all determinants that influence the ticket price (http://www.dcfc.co.uk, 2012). In contrast, the San Francisco Giants provide no information on their homepage about the specifications of the pricing system. A study on vacation packages (Tanford, Erdem, & Baloglu, 2011) found that the amount of provided information correlates positively with the customers' perception of price fairness; and this same effect has also been found in the context of hotel rooms (Choi & Mattila, 2005). Therefore, it seems advisable to inform fans and potential stadium attendants about the characteristics of the pricing strategy as Derby County does. However, the current study puts into question whether ticket prices can actually drop under the configuration of Derby County's DTP system. From a managerial point of view, customers' perception of price unfairness should be avoided – otherwise lower shopping intentions may be the result (Campbell, 1999).

Face value

Due to the high frequency of price changes in a dynamic pricing system, the need for a printed face value comes into question. According to Drayer and Shapiro (2011), a printed price influences consumer perception of ticket value, because the consumer relates her or his perception to the actual price of the ticket. Omitting the printed price on the ticket reduces the risk that two patrons in adjacent seats compare prices, which may lead to one of them feeling gouged (Drayer et al., 2012). Nevertheless, Derby County decided to print tickets showing the prices that customers actually paid (Digonex Ticket Office, e-mail contact, December, 2013), thereby emphasizing the value of the ticket in terms of price paid.

Control variables

Apart from adapting ticket prices on a daily basis Derby County implemented three classical determinants to differentiate ticket prices: seat category, age band, and opponent category. These determinants have been widely used in the sports industry since the introduction of VTP in order to capitalize on the fans' willingness to pay. Therefore, it is not surprising that all three variables showed the expected effects. Better seats were priced higher, senior and U18 tickets were priced lower in comparison to adult tickets, and games against better opponents were charged with a markup. Nevertheless, it was necessary to control for these variables while analyzing the impact of time on the dynamic ticket price.

In the context of analyzing DTP the studies of Paul and Weinbach (2013) and Shapiro and Drayer (2014) took seat category into account and reported similar results. However, those two studies differentiated between only three seat categories, whereas the current study analyzed ticket prices for all seven of Derby County's regular seat categories. The control variable age band was unique to the current study. Although such price discrimination is quite common in VTP (e.g. Drayer et al., 2012), it has not previously been taken into account while analyzing dynamic ticket prices. Hence, the study at hand extends the existing literature in this respect. The third VTP component refers to the quality of the opponent. In this respect, Derby County classified their opponents into four categories. Games against opponents of higher quality were priced higher. Similarly, Shapiro and Drayer (2014) reported that matches against divisional opponents and games against opponents who reached the playoffs the previous season are priced with a mark-up and also Paul and Weinbach (2013) found that ticket prices of the San Francisco Giants highly depend on the opponent. Since the opponent category was determined prior to the season, two additional variables were incorporated into the model to account for the current season performance of the home and away team. Although these two variables showed the expected effects, they were only slightly significant. Paul and Weinbach (2013) reported a strong influence of the home team's performance on the dynamic ticket price. Shapiro and Drayer (2014) found a significant effect of the home team's performance as well, whereas the performance of the away team was not integrated into their final model. Therefore, future studies should further investigate into this direction.

Although these control variables have not been the primary focus of the current study, they extend the knowledge in the field of dynamic sport ticket pricing and add to the literature in this new area of scientific interest.

Conclusion and limitations

The current study is original in the field of DTP in multiple aspects. First, it is the first study to analyze the impact of time on dynamic ticket prices for a sports clubs on a daily basis. Previous studies in this field like Shapiro and Drayer (2012, 2014) were limited in terms of the number of analyzed points in time. Second, the current study adds to the literature with respect to the analyzed sports league. Previous research focused exclusively on the MLB (Paul & Weinbach, 2013; Shapiro & Drayer, 2012, 2014). The study at hand extends the knowledge concerning the specification of DTP models in sports by evaluation a European soccer club.

Based on a hedonic pricing model it could be shown that ticket prices increased monotonously over the whole selling period. Hence, the findings of Shapiro and Drayer (2012, 2014) concerning the impact of time on dynamic ticket prices in sports could be generalized. However, it was surprising that not a single price reduction could be detected. Therefore, the analyzed pricing system can be differentiated from dynamic pricing systems of low-fare airlines, whose prices actually increase and decrease over time. Furthermore, unlike DTP models in the hotel or the airline industry, in which last-minute discounts are quite common, the opposite was observed in the current study, as prices increased significantly on the day of the match. Hence, it seems that sports clubs use a different approach to calculate their dynamic ticket prices compared to other industries which apply a dynamic pricing strategy.

Of course, the current study is not free of limitations. First, only a selection of games of the English football club Derby County could be analyzed. Hence, factors that might influence ticket prices for other teams and other games of Derby County could not be evaluated. Therefore, future research about DTP in soccer should track pricing data over a longer period of time in order to verify the results of this study. Second, the current study was only able to incorporate the final amount of sold tickets. Hence, a potential field for future research is to incorporate daily sales volumes in the analysis, since the number of sold tickets can be regarded as an important factor concerning the determination of dynamic ticket prices. However, relevant data might be difficult to obtain. Third, future studies could focus more thoroughly on the timing of price changes in order to evaluate whether or not the ticket price will change the next day. Of course, from a consumer perspective this a crucial issue concerning his purchase behavior. Fourth, additional research should evaluate if the impact of time might be different in other sport leagues and in other countries. Yet, that cannot be accomplished until applications of DTP systems extend beyond North American and English sport leagues. However, as Nufer and Fischer (2013) have pointed out, that should only be a matter of time.

Note

1. Here "myopic" means that the customer does not anticipate price changes in the future. Hence, she or he does not show strategic customer behavior.

Disclosure statement

No potential conflict of interest was reported by the authors.

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