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Major League Baseball and other professional sports leagues have long been concerned with competitive imbalances caused by differences in local revenues. The fear is that in the absence of salary caps or other regulatory mechanisms, smaller-market teams will be unable to remain competitive. This research uses a structural dynamic programming model to analyze ownership's payroll investment decisions. This model estimates the relationship between optimal payrolls and local-market populations and the influence of long-term customer equity dynamics on payroll investments. In addition, the author analyzes the impact of a recent policy intervention that implemented revenue transfers from high-local-revenue markets to low-local-revenue markets. The statistical results indicate that market population has a significant impact on the value of a team's payroll investments. For example, optimal payrolls double as the population increases from 2.5 million to 7.5 million. Furthermore, rather than improving competitive balance, the adoption of revenue sharing has decreased the incentives for small-market teams to remain competitive. The author uses the estimation results to evaluate alternative approaches to managing competitive balance. Specifically, the results suggest that basing revenue-sharing payments on local-market population and (higher) attendance rates reduces payroll dispersion.

*Keywords*: customer equity, sports marketing, dynamic programming, alliance management

# Individual Team Incentives and Managing Competitive Balance in Sports Leagues: An Empirical Analysis of Major League Baseball

Over the past two decades, Major League Baseball (MLB) has experienced substantial growth in revenues as attendance has grown from 55.5 million in 1980 to more than 70 million in 2005.[1] However, despite this growth, there are significant concerns that increasing disparities in local revenues are reducing small-market teams' abilities to invest in talent and remain competitive (Levin et al. 2000; Zimbalist 2003). As competitive balance among teams diminishes, the fear is that small-market teams will become unviable and overall consumer demand will decrease (Rottenberg 1956). Concern about competitive balance and MLB's future prospects has driven significant changes in the collective bargaining agreements between owners and the players' association. Since the late 1990s, collective bargaining agreements have included revenue-sharing provisions that transfer funds from high-local-revenue clubs to low-local-revenue clubs.[2] The stated intent of the revenue-

[1]The level of attendance growth is notable in that price increases for professional baseball have far exceeded the general level of inflation. For example, the average cost of attendance grew by 107% from 1991 to 2005, whereas the Consumer Price Index increased by 42%. Attendance figures are from the Statistical Abstract of the United States, and revenues are from "The Report of the Independent Members of the Commissioner's Blue Ribbon Panel on Baseball Economics" (as cited in Levin et al. 2000).

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[2]Revenue sharing is based on a team's local receipts net of stadium expenses. These revenues include gate, local media, and other revenues (e.g., concessions, parking) (*USA Today* 2008).


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sharing plans is to increase the ability of small-market teams to field competitive teams. However, the structure of the agreement—revenue-sharing payments increase as the team's local revenues decrease—may also reduce the incentive of small-market teams to compete. This article examines how ownership's payroll investment decisions are affected by population levels, characteristics of the collective bargaining agreement, and marketing goals (e.g., customer equity management).

The analysis is conducted by estimating a dynamic programming model (Erdem, Imai, and Keane 2003; Erdem and Keane 1996; Gonul and Shi 1998; Gonul and Srinivasan 1996; Lewis 2004; Sun, Neslin, and Srinivasan 2003) of owners' payroll decisions as a function of market size. The analysis is dynamic in that decisions are modeled as a function of expectations regarding consumer loyalty. The analysis is also explicitly strategic because it acknowledges that payoffs to success are dependent on the fixed resource differences, in terms of market potential, among clubs.

The results show that market size has a significant effect on return on investment. For example, a team in a market with a population of 10 million receives a return of approximately $1.2 million for each victory, whereas each victory is worth approximately $625,000 for a team in a market with a population of 2.5 million. Furthermore, the move to a revenue-sharing structure has had a substantial negative effect on small-market franchises' incentives to invest. After the adoption of revenue sharing, a typical small-market team in a market with a population of 2.5 million began to invest in talent as if each victory returned only $315,000. This latter finding is salient for thinking about how future collective bargaining agreements should be designed. If the goal is to maintain competitive balance among teams, any revenue-sharing system should be designed to equalize the returns to investment in payroll (winning rates). Along these lines, this article demonstrates how the results can be used to design a revenue-sharing scheme that better aligns team and league incentives. Specifically, it is shown how basing revenue sharing on a combination of market size and higher attendance rates would moderate payroll imbalances.

In addition to the results being salient to the specific context of professional sports, the analysis is related to several established lines of research in strategy and marketing. In terms of the strategy literature, the analysis is motivated by previous work that considers issues of firm resource and strategy heterogeneity. In particular, the analysis is related to work that adopts an evolutionary perspective for studying the sustainability of industries comprised of firms with heterogeneous strategies. From a marketing perspective, the analysis is related to research pertaining to customer equity management. In this regard, it is determined that optimal payroll levels are greater when the model includes dynamic customer management factors. The results are also relevant to work focused on alliance management. Sports leagues are prototypical examples of alliances in which firms simultaneously compete and cooperate, and collective bargaining agreements represent means for managing this type of tension. The article also highlights the interface between human resources and marketing by explicitly linking compensation policies to marketing outcomes.

The article is organized as follows: The next section discusses issues related to competitive balance, customer management, and firm resource heterogeneity. Then, the empirical context and the data are described. The model is then presented, followed by the estimation results. The proposed method for managing competitive balance through attendance-based incentives is then described. The article concludes with a discussion of key issues, model limitations, and areas for further research.

## *LITERATURE*

Before the data and analysis methodology are described, several relevant streams of research are briefly discussed. First, the economics literature focuses on competitive balance issues in sports. Second, the strategy literature pertaining to how resource and strategy heterogeneity can lead to instability is salient, given the feared consequences of competitive imbalances. Third, the marketing literature on customer equity (Blattberg and Deighton 1996; Blattberg, Getz, and Thomas 2001; Rust, Lemon, and Zeithaml 2004) is applicable because the detrimental effects of competitive imbalances are due to reductions in consumer demand. Finally, several studies in the marketing literature focus on coordination and compensation issues.

### *Competitive Balance*

The economics literature has a long history of empirical and theoretical analyses of professional sports (Fort and Quirk 1995; Neale 1964; Rottenberg 1956). Unease about competitive imbalances can be traced to the "uncertainty of outcome hypothesis" proposed by Rottenberg (1956). Rottenberg's concern was that in the absence of restrictive labor policies, teams located in larger markets would acquire the most capable players, and contests would become too predictable, potentially driving fans away. Neale (1964) adds to this literature by describing how the importance of competition leads leagues to prefer parity among clubs, whereas individual teams have incentives to pursue consistent on-field success. Neale refers to this dichotomy as "the peculiar economics of professional sports." Fort and Quirk (1995) stress the importance of competitive balance and discuss how cross-subsidization methods, such as revenue sharing, can be used to create a sustainable balance between contradictory league and team incentives.

Recently, increasing disparities in local television revenues have refocused attention on competitive imbalance issues (Zimbalist 2003). In response to these concerns, MLB formed a Blue Ribbon Panel (BRP) of political and economic experts to assess the effects of competitive imbalances on the health of the league. The BRP's report concluded that small-market teams are at a significant disadvantage because of the larger revenue bases of teams in more populous areas (Levin et al. 2000). However, the BRP's results have been challenged. Schmidt and Berri (2002) consider the market-size issue raised by the BRP and find that market size is not consistently related to on-field success. Furthermore, the hypothesis that free agency has harmed competitive balance is unresolved; some studies find that free agency has reduced competitive balance (Depken 1999), whereas others find that it has not (Chatterjee and Yilmaz 1991; Horowitz 1997; Schmidt and Berri 2003).

An important element in the ongoing management of competitive balance is the collective bargaining agreement between team owners and the players' association. The negotiations of collective bargaining agreements have been consistently contentious; every basic agreement between owners and players has been marked by either a strike or a lockout (Zimbalist 2003). Of special relevance for the purpose of this study is the adoption of revenue sharing beginning in 1997. An important aspect of the revenue-sharing structure is that revenues are allocated in proportion to how far the team's local revenues were below the league average. For example, in 2001, the Florida Marlins had local revenues of $36 million and received $18.5 million in revenue-sharing funds, whereas the New York Mets had local revenues of approximately $160 million and contributed more than $18 million.

Although the intent of revenue sharing is to provide incremental funds to clubs in smaller markets, the structure also has the potential to create perverse incentives for small-market teams. Specifically, the creation of a negative link between local revenues and revenue-sharing payments means that teams can acquire revenues in two conflicting ways. In addition to on-field success creating consumer demand, teams may also be able to collect revenue-sharing payments by pursuing strategies, such as lower payroll investments, that reduce winning rates and local revenues. Nonetheless, professional sports is a business in which noneconomic benefits, such as psychic rewards of championships and winning, may influence investment levels. Therefore, even if the collective bargaining agreement changed the economic incentive structure of small-market teams, it is open to question how ownership behavior may change. For the purposes of this study, the shift to a revenue-sharing structure that transfers funds from teams with high local revenues to teams with low local revenues represents a natural experiment. The salient empirical question is, How did the implementation of revenue sharing alter the decisions of small-market teams?

### *Heterogeneous Resources and League Sustainability*

The issue of competitive balance is related to notions of firm resources (Barney 1991; Wernerfelt 1984) and heterogeneity in the strategy literature. In professional sports, the location of franchises in markets of different sizes leads to considerable heterogeneity in terms of revenue potential. The different revenue bases may lead to heterogeneous strategies as teams in more lucrative markets make greater investments in payrolls. Therefore, disparate revenue bases may lead franchises to adopt divergent strategies (Lee 2003). For example, the different revenue bases may lead to heterogeneous strategies in which some teams use high-price talent to compete for championships, whereas other teams attempt to use relatively low payrolls while attracting enough customers to remain viable. The fixed nature of teams' regions represents permanent advantages of scale if winning in a large market creates more revenues than winning in a small market.

The strategy literature also includes work that adopts an evolutionary perspective (Gavetti and Levinthal 2004; Nelson and Winter 1982) to consider how variation in capabilities and selection forces can lead to changes in industry structure. This viewpoint incorporates factors such as feedback effects (Rumelt 1984) and path dependencies (Hunt and Morgan 1995; Levinthal 1997). The evolutionary perspective is useful for explaining persistent heterogeneity in terms of different survival strategies (Caves and Porter 1977). If firms can identify sustainable niches, resource disparities may not lead to instability.

The fundamental question related to competitive balance in MLB is whether imbalances are likely to cause destructive feedback effects (Levinthal and Myatt 1994) and whether rules that regulate spending can mitigate structural imbalances. Feedback effects that reduce the financial viability of underperforming clubs are important because of the structure of sports leagues. Because sports leagues are alliances, successful firms require the survival of their less successful on-field competitors. In other words, professional sports represent a case in which firms simultaneously collaborate and compete (Amaldoss et al. 2000). If advantages of scale are self-reinforcing, in the absence of some regulatory mechanism, the tendency is often for feedback effects to amplify firm heterogeneity (Levinthal and Myatt 1994).

Elements of collective bargaining agreements, such as revenue sharing and payroll constraints, are mechanisms for preserving disadvantaged members of the alliance. For example, payroll constraints (salary caps) can be used to reduce competitive imbalances by limiting the spending of larger market teams. As such, payroll constraints are intended to enhance the overall league but can have adverse or indeterminate effects on specific teams. Revenue-sharing mechanisms address how league members should share in total revenues. Revenue-sharing plans tacitly acknowledge that though franchises have different revenue bases, the league itself is a cooperative endeavor. Payroll constraints and revenue-sharing interventions represent attempts to jointly manage and allocate the rewards achieved by the overall league (Jap 2001). Through these types of mechanisms, collective bargaining agreements can manage evolutionary trends that could harm the overall alliance (De Rond and Bouchikhi 2004; Van de Ven and Poole 1995).

### *Customer Equity*

Although there is limited marketing literature that is specifically focused on professional sports (e.g., Holt 1995; McDonald and Rascher 2000), a growing body of work that is relevant to this study has focused on the concept of customer equity (e.g., Blattberg and Deighton 1996; Gupta and Lehmann 2005; Gupta, Lehmann, and Stuart 2004; Rust, Lemon, and Zeithaml 2004). The main idea of the customer equity literature is that because customers are the ultimate source of revenues and profits, a firm's customer base should be viewed and managed as an economic asset. The idea of managing customer equity is a useful perspective for considering dynamic aspects of team strategy. In the case of professional sports, investments in payroll represent a means to manage the customer base by investing in the quality of the on-field product. The view that competitive imbalances can be harmful to overall league performance is related to concerns about the "customer equity" of small-market teams.

Aggregate consumer demand is likely to be influenced by factors such as local-market size, product quality, and consumer loyalty. Multiple researchers have identified a positive link between winning rates and attendance levels (Pan et al. 1999; Scully 1974). Research examining the relationship between team payroll characteristics and winning rates has also found that payrolls are correlated with winning percentage (Levin et al. 2000; Wiseman and Chatterjee 2003). In general, customer loyalty is often theorized as a function of quality, and researchers have found a positive correlation between service quality and repurchase intentions (Boulding et al. 1993). In the context of professional sports, this finding implies that winning may enhance customer retention. If so, future attendance may be larger, and more dollars may be available to invest in future quality. Through this type of process, investments in payroll represent a means for managing the customer base by controlling the quality of the team's talent.

This market-level view of managing customer equity is somewhat nontraditional because customer equity research has often focused on using individual-level customer information from customer relationship management systems to set marketing policy (Gonul and Shi 1998; Lewis 2005). In the current application, the concept of customer equity is a useful abstraction for viewing the need to invest in talent to maintain long-term consumer demand. In addition to managing the customer base as an asset, another salient sports marketing issue is that inventory (seats) for each contest is fixed and perishable. These inventory characteristics make the consumer demand management problem similar to the yield management problems typically encountered in the travel industry (Desiraju and Shugan 1999; Talluri and Van Ryzin 2005).

### *Compensation and Coordination Issues*

Although the context of the current research is a nontraditional marketing application, the literature on sales force management and that on franchising considers compensation issues that are somewhat analogous to those faced in sports league management. In the context of sales territory allocations, Zoltners and Sinha (2005) provide a discussion of how territory alignment decisions affect salespeople, customers, and the firm. In some respects, allocating heterogeneous territories across salespeople is similar to a sports league distributing franchises across a diverse set of markets. The firm's decisions on territory allocation are motivated by a desire to maximize overall profits or revenues. For individual salespeople, inequity in territories can be problematic because relative rewards may be viewed as unfair, and morale may suffer. Territory size and salesperson capabilities can also affect customers' satisfaction levels. These considerations are similar to a league wanting to maximize total consumer demand, to teams desiring a level playing field, and to fans wanting their team to provide a comparable level of service (winning rates) as other customers receive.

The sales force and franchising literature streams have also addressed questions of compensation mechanisms that are relevant to the current discussions of competitive balance and collective bargaining agreements. In the sales force compensation literature, research has examined mechanisms for controlling sales force effort (Anderson and Oliver 1987; Jaworski 1988). Basu, Srinivasan, and Staelin (1985), Lal and Staelin (1986), and Raju and Srinivasan (1994) all consider the problem of compensation scheme design using agency theory. Gaba and Kalra (1999) examine the role of risk on salesperson response to incentive schemes, and Rao (1990) develops optimal compensation structure when the members of a sales force possess heterogeneous sales skills. This literature includes many of the themes under consideration here because collective bargaining agreements are analogous to control mechanisms, and revenue-sharing plans may alter the incentive structures of individual teams.

The franchising literature also addresses similar coordination issues. Jeuland and Shugan (1983), Shugan (1985), and Moorthy (1987) address questions of how incentive structures influence channel coordination. Lal (1990) focuses on the use of royalties and monitoring costs in scenarios in which the franchisor is concerned about local service levels. Sports leagues often refer to teams as franchises, and it can be argued that a purpose of the collective bargaining agreements is coordination. Nault and Dexter (1994) consider the case in which franchises are given exclusive territories and own their customers. This article draws on this stream of research because a consequence of customer ownership is that teams invest to maintain customer equity.

Bendapudi and Leone (2002) also consider customer ownership in the context of employee turnover. Although this specific issue is somewhat removed from the current context, there is a similar underlying theme of a link between compensation policies and marketing outcomes. The linkage between the design of compensation systems and consumer demand is likely to become more critical as the service sector continues to grow in importance.

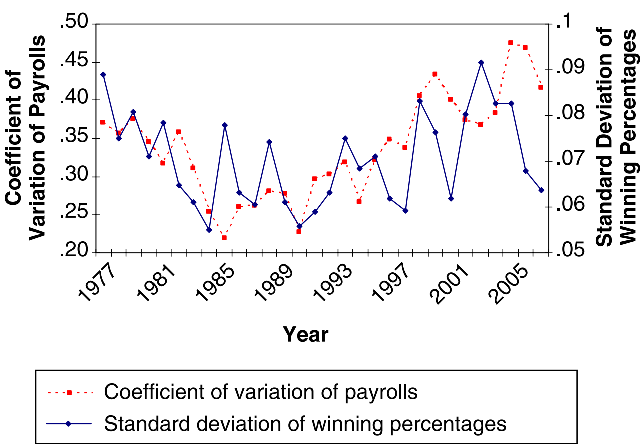
## *DATA*

An aspect of MLB that facilitates this study is that data on winning rates and attendance are widely available, and data on player salaries are increasingly accessible. Winning rates provide an objective measure of the quality of each team's product, and attendance provides an indication of the condition of each team's customer base. These two measures correspond to team objectives related to customer demand and on-field success. The primary way to manage these outcomes is through investment in payrolls. An initial assumption for the model in the next section is that observed payrolls represent each team's best level of investment in terms of expected on-field success and management of long-term consumer demand.

Figure 1 shows the trends for payroll dispersion and competitive balance levels since the advent of free agency. There has been a striking growth in salaries: Average payrolls have grown from less than $2 million in 1977 to more than $77.5 million in 2006. However, the trend in terms of dispersion is less straightforward. The plot of the coefficient of variation of payrolls reveals a decreasing trend from 1977 to the mid-1980s but an increasing trend over the past two decades. The second series shows how the standard deviation of winning percentages (a common measure of competitive balance level) varied from 1977 to 2006. The data on competitive balance levels do not show a clear directional trend. However, there is some evidence that increasing payroll dispersion increases imbalance levels. A simple regression of the standard deviation of winning percentages ($\sigma_{win\%}$) versus the coefficient of variation

Figure 1

COMPETITIVE BALANCES LEVELS TRACK PAYROLL DISPERSION

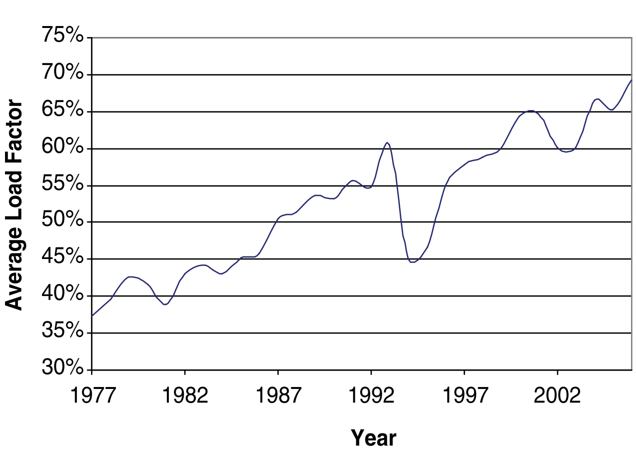



of payrolls yields the following equation: $\sigma_{win\%} = .047 + .067 \times$ (coefficient of variation of payrolls). The R-square for this model is .19, and the t-statistic for the payroll dispersion term is 2.59.

In the empirical analyses that follow, the key state variable regarding consumer demand is the percentage of seats filled each season. The term "load factor" is used to acknowledge that sports franchises share a similarity to other firms with perishable inventories, such as airlines and hotels. Figure 2 shows the attendance rates over the 1977–2006 period. The ratio of attendance divided by capacity has increased from approximately 40% in the late 1970s to approximately 60% over the past decade. In terms of the capacities and attendance, average home attendance has grown from 1.5 million in 1977 to 2.5 million in 2006, whereas stadium capacity has shrunk from 51,000 to 45,600 over the same time span.[3] Note also that fan attendance levels tend to adjust slowly over time. An ordinary least squares regression of load factor, $LF_t$, on lagged load factor, $LF_{t-1}$, yields an R-square of .76 and the following relationship: $LF_t = .10 + .81LF_{t-1}$.

Figure 2

PERCENTAGE OF SEATS FILLED OVER TIME




In addition to payroll decisions, on-field success, and load factor outcomes, market size is of great importance to understanding ownership decisions. Disparities in market potential are at the heart of concerns about the sustainability of underperforming teams. For example, in the 2000 census, the Milwaukee metropolitan area's population of approximately 1.5 million was less than one-tenth of New York's population of more than 18 million. In 2001, the local television and radio revenues for the Montreal Expos were just $500,000, compared with $57 million for the New York Yankees (Moores 2002). The importance of these disparities is illustrated by the relative payrolls of the four teams located in Milwaukee, Montreal, and New York. In 2000, Milwaukee's payroll was $30.5 million, and Montreal's was $28 million. In comparison, the Yankees and Mets had payrolls of $94.3 and $81.6 million, respectively.

Table 1 presents the correlations among market size, payroll investments, attendance factors, and winning rates. The data show a correlation of .48 between salary investments and winning rates and a correlation of .43 between winning percentage and attendance. This pattern is intuitive and suggests that salary investments increase quality on a dimension that influences consumer demand. More salient for this investigation, the correlation structure also reveals a significant, positive correlation of .44 between market population and payroll level.

## MODEL DEVELOPMENT

In this section, a structural dynamic programming model of owner behavior is developed to investigate the relationship between spending and market size and to understand the role of customer equity dynamics. The starting point for the model is the notion that team owners make decisions in the face of uncertainty and incorporate dynamic concerns into their decision making. The first element in the model is a single-season reward function. The reward function for season t is denoted as $R_t(D_t, S_t)$ and is specified as a function of the team's decisions, $D_t$, and a vector of variables that describes the team's particular environment, $S_t$. The current application uses the team's decisions of how much to invest in payroll each year. To control for growth in the absolute levels of payrolls, decisions related to payroll

[3]Much of the change in capacity is due to the construction of baseball-only stadiums from 1990 onward. These newer ballparks often have lower capacity than the dual-use baseball and football stadiums being replaced.

Table 1

CORRELATIONS

| | *Population* | *Salary Percentage* | *Load Factor* | *Win Percentage* |
|---|---|---|---|---|
| Population | 1.0 | | | |
| Salary percentage | .44 | 1.0 | | |
| Load factor | .13 | .50 | 1.0 | |
| Win percentage | .15 | .48 | .43 | 1.0 |

investments relative to the league average each year are considered. Relative payroll decisions are then treated as discrete choices by establishing ranges of relative payroll levels.[4] A series of J indicator variables $d_j$, such that $d_j$ is equal to 1 if category j is selected and 0 if otherwise, are also defined.

The state variables, $S_t$, include measures that reflect prior attendance, previous divisional finish, and market size. The primary dynamic aspect of the model is the maintenance of a club's customer equity as reflected by attendance rates. Because consumer demand in a given season is likely to be related to both past demand and current on-field success, the ownership investment decisions are appropriately modeled as a dynamic decision process. The inclusion of expectations regarding the evolution of the team's customer base necessitates a shift from a single-period choice framework to a dynamic model. Therefore, a dynamic programming structure is used to replicate the decision-making process when future considerations are important. The objective of a dynamically oriented team making sequential payroll decisions in response to a changing environment is as follows:

$$(1) \qquad \max E\left[\sum_{t=1}^{T} \alpha^{t-1} R_t(D_t, S_t)\right],$$

where $S_t$ is a vector of information about the environment relevant to the customer's dynamic optimization problem, $\alpha$ is a single-period discount factor, and T is the planning horizon.

The owner's decision problem involves selecting the payroll in each period that maximizes the expected utility for the remainder of the relevant time horizon. In dynamic programming terminology, the value function, V, is defined as the maximum value of discounted expected utility over the decision horizon. The alternative specific value functions, $V_j(S_t)$, are the expected values of investing in a payroll of level j at time t when the state space is $S_t$ and selecting optimal actions thereafter. The form of the alternative specific value functions is given in Equation 2 and underscores that decisions are based on both the immediate reward provided by an alternative and the expected future utility from the next period onward:

$$(2) \qquad V_D(S_t) = E\left[R_t|S_t, D_t\right] + \alpha E\left[V(S_{t+1})|S_t, D_t\right].$$

The first term is the expected current-period benefit conditional on the team's current state, $S_t$, and payroll, $D_t$. The second term represents the value function of a process beginning one period in the future. A significant detail is that future benefits can depend on the alternative selected because the evolution of the state from $S_t$ to $S_{t+1}$ may be conditional on the team's decision, $D_t$. The relationship between the evolution of a team's decisions and consumer demand is at the heart of the modeling approach. The model is constructed under an assumption that consumer demand is affected by both winning rates, which are related to payroll investments, and past levels of demand. The structure of the model is designed to reflect a context in which the firm continually invests in quality to profit in the current period and also to maintain a significant customer base over time. As such, the implementation of the model requires a single-period reward function that describes environment at a given time and a set of relationships that describe how the system is expected to evolve as a result of the firm's decisions. Therefore, interpretation of the model requires the simultaneous consideration of the reward function and the dynamic structure implied by the expectations equations.

*Single-Period Rewards*

The reward function is specified to reflect the costs and benefits of operating a team as a function of the team's environment (state) and selected investment in payroll (control). The single-period reward function defined in Equation 3 includes the relative payroll ($Pay_t$) in year t, the team's previous attendance load factor ($LF_{t-1}$), the team's previous divisional finish ($Fin_{t-1}$), local-market population (Pop),[5] and a binary variable ($RS_t$) that indicates when revenue sharing is in place. Detailed descriptions of the covariates appear in Table 2.

The form of the reward expression is designed to account for the relationship between investments in payroll and the characteristics of the market. The relative payroll is included to account for the direct financial costs of invest-

[4]The treatment of relative payroll decisions as discrete choices may be controversial. However, note that the substantial nature of player salaries means that payroll investment levels increase and decrease more as step than continuous functions. A large number of payroll categories is also used to mitigate concerns about the appropriateness of different range classification schemes.

[5]Metropolitan area population is used as a proxy for the economic attractiveness of a given market. There are several possible enhancements to this definition of market size, such as the metropolitan area's relative affluence or the scope of a team's broadcast distribution. These additional considerations would require nonpublic data and assumptions, such as the value of having broadcast coverage in a nonlocal market.

Table 2
STATE AND CONTROL VARIABLES

| | *Definition* |
|---|---|
| *State Variables* | |
| Previous relative salary level: $Pay_{t-1}$ | Team salary in year t – 1 divided by the league average payroll in year t – 1. |
| Attendance load factor: $LF_t$ | Percentage of available capacity filled in year t, discretized into 10% increments. |
| Divisional finish: $Fin_t$ | |
| Market size: Pop | Metropolitan area population from the U.S. Census and Stats Canada. |
| Market size quartile indicators: {$MKQ1_t$, $MKQ2_t$, $MKQ3_t$, $MKQ4_t$} | Market size quartile indicator variables, set to 1 if a team is in a given quartile and to 0 if otherwise. |
| Revenue-sharing indicator: $RS_t$ | Binary variable, set to 1 if revenue sharing takes place in year t and to 0 if otherwise. |
| *Control Variables* | |
| Relative payroll level: $Pay_t$ | Team salary in year t divided by the league average payroll in year t, discretized into 10% increments. |

ing in player talent. The previous season's load factor, $LF_{t-1}$, provides a measure of the active customer base. Divisional finish is included to acknowledge that sports franchises often operate with goals beyond simply maximizing economic returns. Including finish in the reward function allows for the relative measurement of the psychic value of on-field success. Previous finish is included directly and also as a quadratic term, $Fin_{t-1} \times Fin_{t-1}$. The quadratic term is included to account for nonlinear effects because, for example, there may be a large benefit to championships.

Because a primary goal of the study is to understand the relationship between market size and return on investment, the reward expression also includes interactions between investment levels and market demand, Pop × Pay and Pop × $Pay^2$. These terms are intended to capture how market and customer base size moderate returns to investment. The quadratic term is included to provide flexibility to the measurement of these moderating effects.

The reward expression also includes terms intended to capture the influence of revenue sharing on investment decisions. The revenue-sharing elements in the model are designed to measure the relative effects on teams in different quartiles. The MQ terms are binary variables that indicate each team's population quartile (MQ1 indicates the smallest market quartile). This use of quartiles instead of a continuous function is chosen to make the results more relevant to the findings presented in the BRP's report. A particularly salient question is whether the adoption of revenue sharing has changed the incentives for small-market (Quartile 1) teams to invest in talent. The expression for the reward in season t is given as follows:

$$(3)\quad \begin{aligned} R_t = {} & \beta_0 + \beta_{Pay}Pay_t + \beta_{LF}LF_{t-1} + \beta_{Fin}Fin_{t-1} \\ & + \beta_{Fin2}(Fin_{t-1} \times Fin_{t-1}) + \beta_{Pop \times Pay}Pop_t \times Pay_t \\ & + \beta_{Pop \times Pay2}Pop_t \times Pay_t^2 \\ & + RS_t \times Pay_t \times [\beta_{Q1}MQ1 + \beta_{Q23}(MQ2 + MQ3) \\ & + \beta_{Q4}MQ4]. \end{aligned}$$

*Expectations*

The reward function represents the expected benefits and costs of choices made in the current season. In addition to current-season factors, management of a baseball team (and most other firms) involves consideration of longer-term effects. A critical factor in most marketing settings is maintenance of the firm's customer base. To evaluate the influence of customer base management on investment decisions, the model also includes expectations of the relationship between current decisions and the future customer base state.

The expectations terms are important because they establish the link between current actions and long-term management of customer equity. The desire to manage customer equity necessitates the adoption of a dynamically oriented investment strategy. The structure of the dynamic policy is estimated by assuming that a team's history of investment decisions represents an effort to dynamically optimize outcomes over time.

The approach to modeling expectations of customer demand uses an ordered logit framework that involves the probabilities of different load factor categories. This approach allows for consumer demand to be viewed as a probabilistic outcome. For implementation, seven categories of load factor that encompass 10% ranges are defined. The categories are centered at 35%, 45%, and so on, up to 95% attendance. It is assumed that expectations of demand levels are formed according to the payroll decisions and state variables a team would expect to affect future attendance rates. For this application, these covariates include lagged load factor, relative payroll, and population. The specification used is given as follows:

$$(4)\quad \alpha X_t = \alpha_{LF}LF_{t-1} + \alpha_{Pay}Pay_t + \alpha_{Pay2}Pay_t^2 + \alpha_{Pop}Pop_t.$$

With the results from Equation 4 and a set of intercepts $\{\alpha_1, \alpha_2, \ldots, \alpha_7\}$, the probabilities of each load factor category are computed in Equations 5, 6, and 7. The structures of the equations for categories centered at load factors of 55%–85% are similar to Equation 6.

$$(5)\quad Pr(LF_{t+1} = LF_{CAT\_35\%}) = \frac{\exp(\alpha_1 + \alpha X_t)}{[1 + \exp(\alpha_1 + \alpha X_t)]},$$

$$(6)\quad Pr(LF_{t+1} = LF_{CAT\_45\%}) = \frac{\exp(\alpha_1 + \alpha_2 + \alpha X_t)}{[1 + \exp(\alpha_1 + \alpha_2 + \alpha X_t)]} - \frac{\exp(\alpha_1 + \alpha X_t)}{[1 + \exp(\alpha_1 + \alpha X_t)]},$$

...

$$(7)\quad Pr(LF_{t+1} = LF_{CAT\_95\%}) = 1 - \frac{\exp(\theta_1 + \theta_2 + \alpha_3 + \alpha_4 + \alpha_5 + \alpha_6 + \alpha X_t)}{[1 + \exp(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5 + \alpha_6 + \alpha X_t)]}.$$

The model also includes terms that capture expectations regarding a team's on-field success. Specifically, expectations of a team's divisional finish are included. In this case, the categories correspond directly to the discrete finish positions. The specification used in this set of expectations is given in Equation 8 and includes relative payroll, payroll squared, and previous finish.

$$(8)\quad \gamma Y = \gamma_{Pay}Pay_t + \gamma_{Pay2}Pay_t^2 + \gamma_{Fin}Fin_{t-1}.$$

Equations 9, 10, and 11 provide the probabilities for finishing first, second, and fifth place or worse. The expressions for third- and fourth-place finishes are similar to Equation 10.

$$(9)\quad Pr(Fin_t = 1st) = \frac{\exp(\gamma_1 + \gamma Y_t)}{[1 + \exp(\gamma_1 + \gamma Y_t)]},$$

$$(10)\quad Pr(Fin_t = 2nd) = \frac{\exp(\gamma_1 + \gamma_2 + \alpha Y_t)}{[1 + \exp(\gamma_1 + \gamma_2 + \gamma Y_t)]} - \frac{\exp(\gamma_1 + \gamma Y_t)}{[1 + \exp(\gamma_1 + \gamma Y_t)]},$$

...

$$(11)\quad Pr(Fin_t = 5th) = 1 - \frac{\exp(\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4 + \gamma Y_t)}{[1 + \exp(\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4 + \gamma Y_t)]}.$$

In terms of computational aspects of the model, the expectations of divisional finish and load factor are used to calculate the expected value function from the next period onward.

*Estimation*

Model parameters are estimated using an analogous approach to that used in static choice models because the likelihood of observed choices is based on a comparison of the benefits provided by the various alternatives. The key distinction in dynamic programming models is that the utility of an alternative involves both immediate rewards and expected future benefits. The reward equation detailed in Equation 3 is used to calculate immediate utility, and the expectation equations describe the evolutionary structure that is used in the dynamic optimization procedure. As such, choices are assumed to be the alternatives that maximize utility over the remaining horizon. If the error terms are extreme value i.i.d., the probabilities of observed choices are given in Equation 12, where $v_j$ is the deterministic portion of the alternative specific value functions (Rust 1994).

$$(12) \qquad \Pr[d_j(t) = 1|S(t)] = \frac{\exp\{v_j[S(t), \beta, \gamma, \alpha]\}}{\sum_{j'=1}^{J} \exp\{v_{j'}[S(t), \beta, \gamma, \alpha]\}}.$$

The likelihood function evaluated in the maximum likelihood routine is the sum of the logarithms of the choice probabilities defined in Equation 12. Therefore, estimation requires the repeated solution of a dynamic programming model to calculate the value functions. The estimation procedure involves nesting a dynamic programming algorithm within a maximum likelihood routine (see Rust 1994). For this analysis, it is assumed that each team operates with a rolling four-year planning horizon and uses a 5% annual discount rate.[6]

[6]The four-year horizon was determined on the basis of model fit (see the Web Appendix at http://www.marketingpower.com/jmroct08). There is also anecdotal evidence that franchises tend to operate on three- to five-year planning cycles (Cashman et al. 2004).

## *RESULTS*

In addition to the model described in the previous section, several alternative specifications were evaluated. Descriptions of each specification and fit statistics appear in Table 3. The alternative specifications represent restricted versions of the baseline reward function given in Equation 3. For example, the first restricted model drops the divisional finish terms from the reward function. The Bayesian information criteria indicates that it is important to include the finish, attendance, revenue sharing, population, and the population and payroll interactions in the model. The Web Appendix includes additional details regarding the performance of the various specifications in terms of out-of-sample fit as well as the model's dynamic structure (see http://www.marketingpower.com/jmroct08).

*Estimation Results*

The estimation results for the complete dynamic model appear in Table 4. The table is structured to first present the results for the single-period reward function, then for the revenue-sharing factors, and finally for the expectation terms. The coefficients for the single-period reward function are all significant, with the exception of the intercept. As expected, the sign for the salary term is negative, and the effect of the lagged load factor is positive. The finish effects indicate that divisional championships create a large amount of positive utility, but the effect of place finish quickly diminishes.

The terms that interact payroll spending with population speak to the incremental benefits of investing in talent in larger markets. The positive sign on the Pop × Pay term suggests that as market size and fan interest increase, the returns to payroll investments increase. The negative sign on the Pop × $\text{Pay}^2$ term indicates that as spending increases, there are diminishing returns.

The revenue-sharing terms indicate that the subsidization system that increases transfers based on lower local revenues may be problematic. The interaction between the revenue-sharing indicator and payroll for the smallest market size shows that the incentive structure has changed so that smaller teams are better served by investing less in pay-

Table 3
FIT STATISTICS

| *Model* | *Description* | *Observations* | *Parameters* | *Log-Likelihood* | *Bayesian Information Criteria* |
|---|---|---|---|---|---|
| *Main Model* | Detailed in Equation 3. | 822 | 27 | –3783.5 | 7748.2 |
| *Restricted Models* | | | | | |
| Finish | Divisional finish and finish squared are dropped from the reward function. | 822 | 25 | –3793.1 | 7754.0 |
| Load factor | Load factor is dropped from the reward function. | 822 | 26 | –3792.7 | 7759.9 |
| Revenue sharing | The revenue-sharing adjustment terms are set to zero for all market size categories. | 822 | 24 | –3797.0 | 7755.0 |
| Salary × population | The interactions between payrolls and population are set to zero. | 822 | 25 | –3862.9 | 7893.5 |
| Population | All terms involving population (revenue sharing and payroll interactions) are set to zero. | 822 | 23 | –3894.4 | 7943.2 |

Table 4
ESTIMATION RESULTS

| | *Coefficient* | *SE* |
|---|---|---|
| *Reward* | | |
| Intercept: $\beta_0$ | .04 | .06 |
| Relative payroll: $\beta_{Pay}$ | –3.21*** | .43 |
| Load factor (t – 1): $\beta_{LF}$ | 2.78*** | .70 |
| Finish (t – 1): $\beta_{Fin}$ | –.69** | .35 |
| Finish squared: $\beta_{Fin2}$ | .18** | .076 |
| POP × Pay: $\beta_{P \times P}$ | 1.18*** | .12 |
| POP × Pay²: $\beta_{P \times P2}$ | –.41*** | .042 |
| *Revenue Sharing* | | |
| MKQ1 × Pay × RS: $\beta_{Q1}$ | –.73** | .30 |
| MKQ2&3 × Pay × RS: $\beta_{Q23}$ | –.22 | .27 |
| MKQ4 × Pay × RS: $\beta_{Q4}$ | .99** | .45 |
| *Expectations* | | |
| *Load Factor* | | |
| Intercept 1: $\alpha_{LF,1}$ | 5.86** | 2.23 |
| Intercept 2: $\alpha_{LF,2}$ | 1.48** | .78 |
| Intercept 3: $\alpha_{LF,3}$ | 1.39** | .62 |
| Intercept 4: $\alpha_{LF,4}$ | 1.45** | .63 |
| Intercept 5: $\alpha_{LF,5}$ | 1.46** | .72 |
| Intercept 6: $\alpha_{LF,6}$ | 1.24** | .61 |
| Population: $\alpha_{pop}$ | .0097 | .017 |
| Previous LF: $\alpha_{LF}$ | –11.69*** | .43 |
| Relative payroll: $\alpha_{Pay}$ | –1.88** | .87 |
| Relative payroll squared: $\alpha_{Pay2}$ | .22 | .47 |
| *Division Finish* | | |
| Intercept 1: $\delta_{Fin,1}$ | –2.17*** | .59 |
| Intercept 2: $\delta_{Fin,2}$ | 1.14** | .51 |
| Intercept 3: $\delta_{Fin,3}$ | .87** | .41 |
| Intercept 4: $\delta_{Fin,4}$ | .90* | .50 |
| Relative payroll: $\gamma_{Pay}$ | 1.20* | .62 |
| Relative payroll squared: $\gamma_{Pay2}$ | .27 | .34 |
| Previous finish: $\gamma_{Fin}$ | –.33*** | .05 |

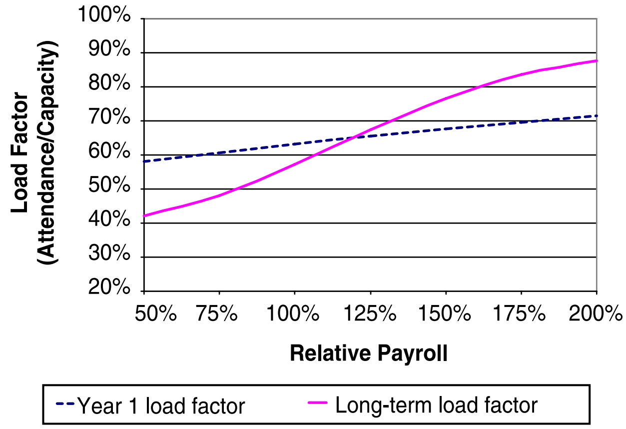
*$p < .1$.
**$p < .05$.
***$p < .01$.

rolls. The other coefficients indicate that revenue sharing has not significantly changed the incentives of teams in Quartiles 2 and 3, but there has been an increase in the return on investment for Quartile 4.

Figures 3 and 4 illustrate the roles of expectations. Figure 3 shows the next-year load factor and the long-term load factor for a range of payroll levels for a team that begins with an average payroll, has a local population of 5 million, and sells 65% of available capacity in year zero. The figure shows the expected change in attendance levels as the team immediately shifts to and then maintains the alternative payroll level. For example, a shift to a 50% payroll results in a one-year drop in attendance rate to 58%. However, the long-term attendance rate drops to 42%. This difference highlights the dynamic nature of customer base management.

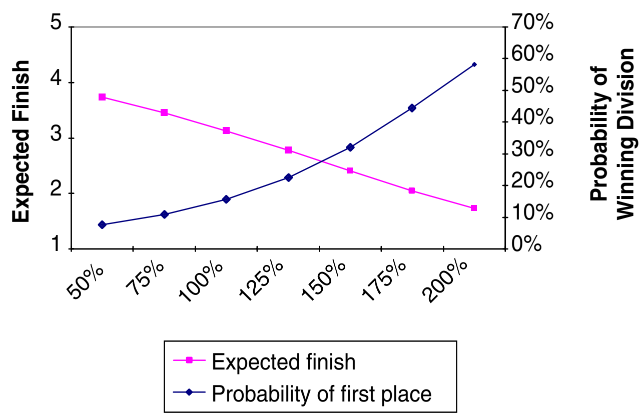
Figure 4 shows the relationship between relative payroll and two measures of on-field success. The first series uses the left axis to define the relationship between payroll and expected finish. The expected finish, computed using the probabilities of each finishing position, is 3.75, or about fourth place when the payroll is 50% of the average. In contrast, a payroll of 175% of the average leads to an expected

Figure 3
THE SHORT- AND LONG-TERM EFFECTS OF PAYROLL INVESTMENTS ON PERCENTAGE OF SEATS FILLED




Notes: Population = 5 million, and previous load factor = 65%.

Figure 4
EXPECTED FINISH AND PROBABILITY OF DIVISIONAL CHAMPIONSHIP FOR PAYROLL LEVELS




finish of second place. The second series plots the relationship between payroll and probability of winning the division. A 200% payroll is expected to win the division approximately 60% of the time, whereas a 50% payroll is expected to win at less than a 10% rate.

*Payroll Policies*

Given the dynamic elements and interaction terms in the model, many aspects of the results cannot be appreciated by simply considering the marginal effects implied by the estimated reward function parameters. As such, the estimation results are interpreted in terms of the investment policies they suggest for teams in different markets. To accomplish this, we solve dynamic programming problems using the estimated parameters for a range of population levels. Table

5 lists the optimal myopic and long-term payrolls for teams in population centers ranging from 2.5 million to 15 million. The optimal payrolls increase as market size grows but at a diminishing rate. The payrolls range from approximately 60% of the league average for a market with 2.5 million people to 131% of the average for a market with a population of 15 million.

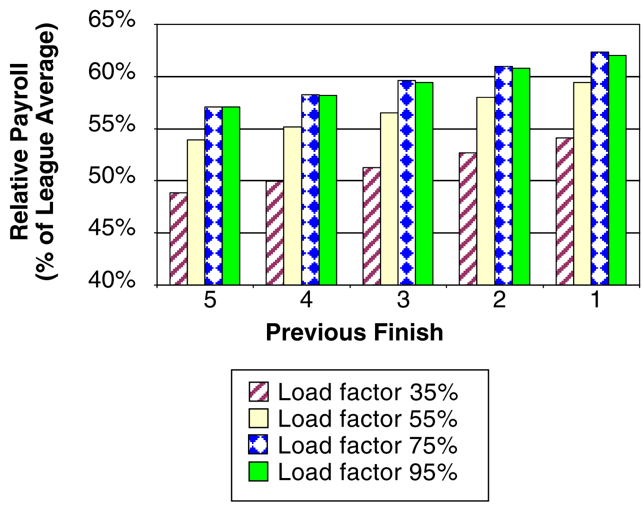
The importance of maintaining the customer base is highlighted by the differences between the dynamic and the static policies. At each population level, the dynamically optimal payroll exceeds the optimal myopic payroll. In 2006 dollars, the static optimization suggests a payroll of $40 million, whereas the dynamically optimal payroll is $47 million for a market with a population of 2.5 million. For a market population of 15 million, the dynamic policy is for a payroll of $102 million versus a payroll of $97 million for the static case. These incremental investments are due to the importance of maintaining the customer base. The importance of investing to maintain customer equity is especially apparent in the smaller market because the incremental investment is more than 17% greater.

Figure 5 illustrates the complexity and dynamics imbedded in the model. The preceding results are all computed assuming a starting point of an average payroll, a third-place finish, and a 65% load factor. However, optimal payroll policies are sensitive to the starting conditions. The first notable aspect of the figure is that optimal investments are higher when teams have better previous finishes. With market size and previous attendance held constant, teams that have previously won their division have optimal payrolls that are approximately 10% higher than teams that previously finished fifth or worse. These results highlight the importance of maintaining quality levels to maintain the customer base. The second notable result is that optimal investment is a nonlinear function of previous load factor. Investments increase as load factor increases from 35% to 75%, but then they slightly decrease as load factor reaches 95%. This indicates that there may be some diminishing returns to payroll investments.

Table 6 reveals the consequences of the revenue-sharing policy that transfers funds from high-local-revenue markets to low-local-revenue markets for a range of population levels. These results are calculated in the same way as the previous optimal payroll levels, except that the revenue-sharing interactions are included in the reward function. For a small-market team, the optimal action under revenue sharing is to shrink payroll investment dramatically from a level of 60% of the league average to just 27% of the average. These results suggest that revenue sharing has led small-market teams to operate as if they could do better financially by performing poorly and collecting revenue transfers than by attempting to be competitive.

Figure 5

EFFECT OF PREVIOUS FINISH AND LOAD FACTOR ON OPTIMAL PAYROLL




Notes: Population = 2.5 million.

*Returns to Winning*

This section combines the results from the previous section with information on the relationship between spending and winning to translate the results to a measure of the dollar returns to winning for different market sizes. This analysis is particularly germane because it connects the notion of competitive balance with the economic disparities due to market size effects. The relationship between winning per-

Table 5

DYNAMIC AND STATIC OPTIMAL PAYROLLS BY MARKET POPULATION

| *Population* | *2.5 Million* | *5 Million* | *7.5 Million* | *10 Million* | *15 Million* |
|---|---|---|---|---|---|
| Dynamic | 60% | 98% | 117% | 124% | 131% |
| Static | 52% | 84% | 106% | 116% | 126% |

Table 6

IMPACT OF OPTIMAL SALARIES OF REVENUE SHARING BY MARKET SIZE

| *Population* | *2.5 Million* | *5 Million* | *7.5 Million* | *10 Million* | *15 Million* |
|---|---|---|---|---|---|
| No sharing | 60% | 98% | 117% | 124% | 131% |
| Revenue sharing | 27% | 80% | 107% | 132% | 140% |

centage and investment level is estimated with an ordinary least squares regression of winning rates as a function of relative payroll and relative payroll squared using the data from 1977 to 2006. The model yields an R-square of .23 and the formula in Equation 13. The t-statistics for the payroll and payroll squared terms are 5.89 and –1.72, respectively.

$$\text{(13)} \qquad \text{Win\%}_t = .38 + .14 \times \text{Pay}_t - .019 \times \text{Pay}_t^2.$$

To compute the dollars per expected win, the recommended payrolls are multiplied by the average payroll in 2006, and this quantity is divided by the number of wins from Equation 13. This conversion is presented in Equation 14 and is labeled ROW (return on wins).

$$\text{(14)} \qquad \text{ROW} = \frac{\text{Pay} \times \$77{,}500{,}000}{162 \times (.38 + .14 \times \text{Pay} - .019 \times \text{Pay}^2)}.$$

The output from this translation is the dollar value of a regular-season win. Contrasting the ROW for different market sizes quantifies the differences in returns based on local populations.

Table 7 lists the implied dollars per win for market sizes ranging from 2.5 million to 15 million. In the pre-revenue-sharing era, the returns to winning range from approximately $1.2 million per game for a large market with a population of 15 million to less than $625,000 for a market with a population of 2.5 million. This analysis suggests that the return to winning for the smaller markets is about half that of the largest markets. The ROWs following the adoption of revenue sharing are also instructive. For the market size of 2.5 million, the ROW drops from $625,000 to $314,000. This is striking because it suggests that though the intent of revenue sharing was to make small-market teams more competitive, it has reduced the returns to winning for small-market teams from about one-half to one-quarter of the ROW for the largest markets.

Table 8 more fully illustrates the relationships among investment levels, winning rates, and revenue sharing for a small-market club. The first two columns of the table list the optimal payrolls both in relative terms and in 2006 dollars for a team in a market of 2.5 million. The third column uses Equation 13 to predict the expected winning percentage for the given payroll policy. The fourth column uses the ROW to compute the implied return. In the pre-revenue-sharing environment, the team uses a $46.5 million payroll and wins 45.7% of the games for a return of $46.3 million. Under revenue sharing, the team drops its payroll to $22.3 million, wins 41.7% of its games, and has a return of $21.2 million. Given the reduced payroll investment and revenue-sharing payments that may exceed $20 or $30 million, the shift to a lower payroll is a rational and potentially profitable strategy.[7]

The conversion of the estimation results to dollars per win may be useful for guiding efforts to ensure competitive balance. Ensuring that teams put forth equal effort toward winning requires a mechanism that mitigates the disparities in returns on winning. The next section discusses issues related to managing competitive balance and proposes an approach that would provide revenue sharing to smaller markets while creating incentives for these teams to invest in payroll.

## *COMPETITIVE BALANCE MANAGEMENT*

The statistical results and subsequent analyses illuminate why it is difficult to manage competitive balance levels when franchises are tied to unequal local markets. The findings related to the value of winning suggest that local-market differences lead to large differences in incentives. When payroll investments are considered in terms of each team's incentive structure, it is not surprising that the implementation of revenue sharing may have exacerbated payroll disparities. By linking higher revenue-sharing payments to lower local revenues, the first generation of revenue-sharing plans tended to magnify rather than reduce incentive differences. This section considers approaches to managing competitive balance levels.

The structure of the reward function (Equation 3) speaks directly to the relationship between incentives and market size. In particular, the terms involving payroll and population describe disparity in incentives. A revenue-sharing intervention that eliminates the parameters for the interactions between payroll and population would equalize incentives across the disparate market sizes. In practice, this type of intervention would require revenue-sharing pay-

[7]Examples of recent revenue-sharing payments are given in the next section.

Table 7

RETURN TO WINNING BY MARKET SIZE

| *Population* | *2.5 Million* | *5 Million* | *7.5 Million* | *10 Million* | *15 Million* |
|---|---|---|---|---|---|
| No sharing | $625,507 | $941,139 | $1,077,680 | $1,132,447 | $1,179,225 |
| Revenue sharing | $314,309 | $797,040 | $1,007,191 | $1,187,184 | $1,232,703 |

Table 8

RETURNS TO WINNING FOR A 2.5 MILLION MARKET

| | *Relative Payroll* | *Payroll* | *Winning Percentage* | *Implied Return* |
|---|---|---|---|---|
| Pre–revenue sharing | 60.0% | $46.5 million | 45.7% | $46.3 million |
| Revenue sharing | 27.5% | $22.3 million | 41.7% | $21.2 million |
| Difference | | | | $25.1 million |

ments to be a negative function of local-market size and a positive function of team payroll. However, there are at least two problems with this approach.

First, the amount of revenue sharing required may not be realistic. Given that MLB's revenue-sharing transfers are less than $350 million whereas league revenues exceed $5 billion and that hard salary caps have been rejected, it seems unlikely that large-market teams would be willing to forgo their structural advantages completely. The second problem with this approach pertains to the nature of the behavioral model. The econometric model is estimated under an assumption that owners are solving a dynamic decision problem. Although this assumption is necessary for computational tractability and may be satisfactory given the number of teams in the league, the lack of a true game-theoretic structure limits confidence in the ability to assess drastic changes to the competitive environment.

The logic of creating positive incentives suggests several mechanisms for improving competitive balance. A potential approach would be to base revenue sharing on a combination of market size and higher attendance rates. This type of approach may encourage greater investment on the part of small-market teams and is consistent with the league's overall desire to grow its fan base. How the estimation results can be used to develop this type of revenue-sharing approach is now described.

The first step in this approach involves inserting an element into the reward expression that will link population and load factor to utility. As a demonstration, Equation 15 is inserted into the reward equation (Equation 3). Equation 15 involves load factor, $LF_t$, divided by the square of the local-market population, Pop. The parameter $\beta_{RS}$ is a positive quantity that defines the degree of revenue sharing and can be set on the basis of the level of competitive balance desired.

$$\beta_{RS} \times \frac{LF_t}{Pop^2}. \tag{15}$$

For a given value of $\beta_{RS}$, the new expression for single-period rewards and the expectation structure can then be used to estimate optimal payroll policies. The logic of the approach is that the value of attendance is increased for all teams, but the benefits are much less for teams with larger local populations. To develop actual dollar-based revenue-sharing policies, the utility measures would then be converted into a dollar scale.

Table 9 provides optimal payroll policies without revenue sharing and for a scheme that uses the procedure sketched previously with a value of $\beta_{RS}$ equal to 10. The proposed approach leads to significantly higher payroll investments in the small markets. For example, optimal payrolls grow by 79%—from 34% to 60% of the league average—for a market size of 2 million. In contrast, optimal spending is slightly lower for larger markets. This occurs because the revenue-sharing scheme provides a small source of revenue for the largest markets. The change in incentives is predicted to reduce spending by approximately 2% for the largest markets.

Table 10 illustrates the financial implications of the proposed revenue-sharing scheme for several small-market teams. The table lists the revenue-sharing payments and attendance rates for 2006 for Tampa Bay, Minnesota, Pittsburgh, San Diego, and Kansas City. The column labeled "RS Plan" reports the revenue-sharing payments under the proposed plan given the team's achieved attendance rate. The columns labeled "RS 70% LF" and "RS 80% LF" report the revenue-sharing payments if the teams had achieved attendance rates of 70% and 80%, respectively. For example, under the existing revenue-sharing approach, Kansas City received $32 million and achieved a load factor of 42%. Under the proposed mechanism, this load factor would have earned Kansas City a payment of $26.3 million. In contrast, if Kansas City had achieved a 70% attendance rate, the payment would be $44.1 million, and an 80% attendance rate would push payment to $50.4 million.

The preceding proposal to make revenue sharing a function of attendance and population can be debated on several dimensions. For example, the use of load factor as the primary criteria could influence team decisions regarding capacity and pricing. Teams may have incentives to reduce capacity or even to build relatively small stadiums. On the pricing dimension, the linkage of revenue-sharing payments to attendance would create incentives for clubs to use pric-

Table 9

OPTIMAL PAYROLL POLICIES UNDER EXISTING AND PROPOSED REVENUE-SHARING SCHEMES

| *Population* | *2 Million* | *2.5 Million* | *5 Million* | *7.5 Million* | *10 Million* | *12.5 Million* | *15 Million* |
|---|---|---|---|---|---|---|---|
| No revenue sharing | 33.5% | 59.9% | 98.4% | 116.7% | 124.4% | 128.7% | 131.0% |
| Proposed revenue sharing | 60.1% | 72.2% | 95.4% | 112.9% | 121.2% | 126.1% | 129.3% |

Table 10

PROPOSED REVENUE-SHARING EXAMPLES

| *Team* | *2006 Revenue Sharing (RS)* | *2006 Load Factor (LF)* | *RS Plan* | *RS 70% LF* | *RS 80% LF* |
|---|---|---|---|---|---|
| Tampa Bay | $33 million | 37% | $13.4 million | $25.1 million | $28.7 million |
| Minnesota | $22 million | 50% | $13.4 million | $16.2 million | $18.5 million |
| Pittsburgh | $25 million | 60% | $24.8 million | $29.1 million | $33.2 million |
| San Diego | $6 million | 77% | $20.7 million | $18.7 million | $21.3 million |
| Kansas City | $32 million | 42% | $26.3 million | $44.1 million | $50.4 million |

ing and promotion aggressively to fill seats. Given the perishable nature of seat inventory in sports, the proposed revenue-sharing approach would make it advantageous to discount deeply or give away unsold tickets. It may be necessary to add conditions to avoid practices that violate the spirit of the approach. The important point about the proposed approach is that the incentives created by revenue sharing should encourage investment in payroll and improve the alignment between league and team goals.

## *DISCUSSION*

The key results from the preceding analyses are the estimation of the value-to-winning rates for different market sizes, the findings related to the effects of revenue sharing on small-market teams, and the demonstration of an approach for using positive attendance-based incentives to manage competitive balance levels. The estimation results for the pre-revenue-sharing environment suggest that market size exerts a significant effect on teams' returns to payroll investments. This is intuitive because winning would be expected to yield larger returns as a result of increased media revenues. Less intuitive is the finding that the current revenue-sharing plan has exacerbated matters. The current approach to revenue sharing is problematic because these types of plans lessen the incentives for producing local revenues through winning because revenues can also be obtained through revenue-sharing distributions.

The evidence that revenue sharing changes small-market teams' incentives combined with the relationship between returns to winning and market size suggests that an alternative approach for managing competitive balance levels is needed. Specifically, revenue sharing should be designed to reduce the disparities in the returns to winning. This would require the adoption of a system that bases revenue-sharing payouts on local-market size and some factor that encourages investments in payroll. The approach proposed herein rewards teams for achieving higher attendance rates. The key point about this approach is that it better aligns the incentives of teams with the goals of the overall league.

Beyond the specific context of managing professional sports leagues, this study provides several contributions to the broader marketing literature. The first is the linkage of dynamic investment strategies to the marketing concept of customer equity. This is an important linkage in that the sustainability of different strategies is ultimately based on firms' abilities to maintain sufficient customer bases. The importance of dynamic concerns is highlighted by the differences in the recommended dynamic and myopic payroll strategies. When dynamic customer equity concerns are included in the model, payroll investments are several million dollars higher. The second contribution is to the literature focused on alliance management. As noted previously, the results suggest that the key to maintaining the commitment of heterogeneous alliance members is to equalize returns rather than to subsidize inherently weaker members. In general, this article provides a link between marketing outcomes and compensation policies. Although the causal links among payroll investments, winning, and consumer demand levels are straightforward in the context of professional sports, compensation policies may exert strong effects on service quality levels and customer equity in various circumstances (Bendapudi and Leone 2002).

It may also be useful to discuss the relative merits of the analysis methodology. For example, there may be concerns related to the treatment of payroll investments as discrete decisions that are made at a single point in time. The treatment of investments as discrete levels is justified because the magnitude of player salaries means that payrolls tend to grow by jumps of millions of dollars rather than continuously. For example, in the 2005 off-season, the Chicago White Sox signed Paul Konerko to a contract that paid $12 million per season, and the Toronto Blue Jays signed Rob Burnett to a deal that paid $11 million per season. These types of player acquisitions highlight how incremental investments in talent result in large, discrete jumps in payrolls. As such, the approximation to discrete ranges is likely adequate. The assumption of a single investment decision could also be relaxed to allow for salary adjustments within a season. However, this type of extension would require additional data and modeling assumptions regarding the timing of decisions to adjust payroll. Additional data on team-specific revenue sources, such as concession contracts or adjustments to account for the value of large media networks (e.g., WGN, TBS), might also be useful for refining the reward functions.

Note also that the model assumes that owners make independent decisions, thus neglecting the role of competitive forces in payroll decisions. Although a game-theoretic approach is naturally appealing, the large number of teams and the dynamic structure of competition result in a difficult and currently intractable empirical problem. As such, the development of appropriate game-theoretic analyses is left for further research; it is hoped that the results are useful for guiding the construction of such models. In a similar vein, the model also makes several assumptions regarding which variables can be treated as exogenous. For example, if local populations are influenced by the presence and success of a local team, it may be useful to relax this assumption and treat population levels as endogenous.

Another potential area for further research involves the development of models that account for unobserved heterogeneity. Specifically, it seems likely that ownership preferences for economic and on-field success vary. The psychic benefits of winning may be of utmost importance to some segment of owners, whereas other clubs may emphasize economic returns. For example, it has been reported that the team with the perennially highest payroll also tends to lose money each season.[8] This type of heterogeneity suggests that it would be useful to examine alternative state variables, such as absolute payroll, and decision variables, such as payroll change. There are also opportunities for further research in terms of competitive balance issues. The proposed method of basing revenue sharing on population and attendance is only one potential approach. It might be useful to evaluate policies that link revenue sharing to team finish or payroll investments. Another unsettled but fairly fundamental issue pertains to the ideal level of competitive balance. The proposed regulatory mechanism is predicted to raise payrolls for small-market teams from approximately 60% to approximately 72% of the league average.

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[8]*Forbes.com* (2007) estimates that the New York Yankees lost approximately $25 million in 2006.

This closes the gap, but it does not completely level the playing field. Finally, although the richness of available data and the relative lack of interventions make MLB an attractive setting for empirical work, it would be useful to analyze data from other professional leagues.

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