The Impact of Revenue Sharing on Club Objectives in Professional Sports

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Abstract

This paper presents an n-club sporting contest model in which each club consists of an owner and its manager. It is demonstrated that sports clubs behave as if they are maximizing a utility function which is a linear combination of profits and wins, while keeping the profit maximizing objective at the level of owners. It is also demonstrated that revenue sharing arrangements by the leagues play an essential role in formulating the club objectives. The results imply that club objectives and revenue sharing arrangements are endogenous.

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1 Introduction

The purpose of this paper is to show that the objectives of sports clubs can be explained by revenue sharing arrangements which a league uses. We present an n-club sporting contest model which each club consists of an owner and its manager, which is closely related to the strategic delegation literature (Fershtman and Judd 1987; Sklibas, 1987): Profit maximizing owners set goals for managers to pursue, and managers compete for the given goals. The present model will first show that sports clubs will behave as if they are maximizing a utility function which is a linear combination of profits and wins (Sloane, 1971; Rascher, 1997). Then, we will show that as the league intensifies revenue sharing, club objectives become more profit oriented; on the other hand, if the league lacks a redistribution mechanism, club objectives are more win oriented. This result is quite consistent with the relation between existing empirical observations of club objectives described below and a system of revenue sharing in real-world sports leagues.

Since pioneering works of Rottenberg (1956) and Sloane (1971), the general perception is that professional sports clubs in the U.S. traditional leagues, such as Major League Baseball (MLB) and the National Football League (NFL), are more commercially oriented and have become more businesslike companies than in European football. Some empirical evidence from the U.S. traditional leagues confirms the hypothesis that clubs' main objective is profit maximization (Ferguson *et al.*, 1991; Alexander, 2001).[1] On the other hand, it has been widely held that European football clubs are primarily interested in sporting objectives, such as win maximization subject to a budget constraint; see Késenne (1996, 2000). However, Andreff and Staudohar (2000) argue that European football clubs are evolving toward the American sports clubs' financial structure because of recent revenue growth, especially from broadcasting, and the conversion of many clubs to joint stock companies. This might be expected to lead to a great emphasis on profits and thus behavior more akin to the North American model (Hoehn and Szymanski, 1999; Fort, 2000). Yet, Garcia-del-Barrio and Szymanski (2009) empirically find that behavior of clubs in English and Spanish leagues over the period 1994-2004 seem to closely approximate win maximization subject to a financial constraint. They suggest that football club executives may find it in their best interest to maximize wins.

This paper is motivated by these observations above: Although, in the past few years, financial models in European professional sports came closer to the U.S. professional sports model, club objectives in Europe and the U.S. leagues are different. Our investigation demonstrates that objectives of clubs may be affected by the organization of sports leagues, while keeping the profit maximizing objective at the level of owners. In the past, most owners were individuals; more recently, the form of sports club ownership has become diversified, such as corporations and limited partnerships, due to the costs of purchasing and operating a club. These owners usually invest a sum of money, hoping for a profitable

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[1]However, for several reasons, these results are not entirely convincing. See Zimbalist (2003) for details.

return, but do not take an active part in the management of the club. Thus, when we say an "owner", we mean a decision-maker whose objective is to maximize the profits of the club. A "manager" refers to an agent that the owner hires to delegate all player personnel decisions and decides on an investment level in playing talent. What has to be emphasized is that we define club objective as an objective function for the manager.

Although there are substantial differences in the organizational framework of North American and European sports leagues, the principal difference that this paper focuses on is the revenue sharing rules used by the leagues.[2] Revenue sharing arrangements are typically more extensive in the U.S. sports than in European football. In Europe, there are almost no gate-sharing arrangements. There are no arrangements for the sharing of income from merchandising such as exist in the U.S. sports leagues. While collective selling of media rights exists in most European football leagues, the distribution formulas tend to favor the strong clubs; this is known as performance-based reward schemes. So, with these institutional differences of revenue sharing arrangements in mind, the present paper shows why professional sports clubs in European football are more win oriented than in the U.S. sports leagues.

The intuition behind our results can be explained using the club-objective function which is a linear combination of profits and wins. If revenue sharing arrangements are limited and/or the league authorities choose a performance-based reward scheme, then potential revenue of the club would be closely correlated with the success of the club. Under such organizational framework of sports leagues, the more weight a club puts on wins, the more it invests in playing talent; consequently, the club will be more successful and attractive to fans or broadcasters. Thus, profit maximizing owners give an incentive to and put pressure on managers of clubs to win. On the other hand, if the leagues engage in the leveling of club revenues via revenue sharing arrangements, then the relation between improvements in club performance and increases in club revenue is weak; hence, owners will force managers to strive for profit maximization. As mentioned above, there is a much lower incidence of revenue sharing in Europe. Then, in view of our results, this means that professional sports clubs in European football are more win oriented than in the U.S. sports leagues.

Our analysis also can shed some light on the effect of revenue sharing policy. In theory, there seems to be an emerging consensus that the nature of clubs in a league as profit or win maximizers may affect the success of policies to promote competitive balance, such as revenue sharing and salary caps (see e.g., Zimbalist, 2003; Késenne, 2007; Vrooman, 2007).[3] However, our results suggest that club objectives may alter after a

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[2]Other differences are league system (e.g. promotion and relegation), league functions (e.g. centralized marketing), player market (e.g. rookie draft) and so on.

[3]To put it more concretely, revenue sharing has no positive impact on competitive balance in a profit maximization league where clubs are profit maximizers (e.g., U.S. sports leagues); on the contrary, if all clubs are win maximizers (e.g., European football leagues), revenue sharing is effective in establishing a more balanced distribution of talent among clubs.

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change of revenue sharing arrangements. Therefore, league authorities should recognize that competitive-balance rules may affect not only clubs' investment level in playing talent but also their objectives.

The remainder of the paper is organized as follows. Section 2 presents an n-club sporting contest model. In Section 3, we present our main results and show some important features of our model. Concluding remarks are given in Section 4.

2   Sporting Contest with Revenue Sharing

We consider a professional sports league. A league is made up of $n(n \geq 2)$ clubs in which each club consists of an owner and its manager who are both risk neutral. Our analysis of the sports league is formulated as a dynamic game with complete and perfect information and the concept of equilibrium is defined as the subgame perfect equilibrium. At the first stage, each owner i simultaneously has to decide on an incentive scheme for his manager i. At the second stage, each manager i observes all chosen incentive schemes. After that, the managers simultaneously choose their clubs' investment level in playing talent.

To simplify our expositions and to proceed with the analysis, we specify the revenue function of a club as follows:

$$R_i(s_i) = s_i R, \quad i = 1, \cdots, n, \tag{1}$$

where $R > 0$ is the total market volume of a given league sport, which is exogenously determined (e.g., by sales of tickets, TV rights revenues, merchandising, revenues from advertising and sponsorship etc.)[4]; s_i is the share of talent of the club or the relative quality of the club. We assume that the relative quality of the club is characterized by the contests success function (CSF) and depends on the proportion of playing talent hired by each club. We use the typical logit CSF, which is the most widely used functional form of a CSF in sporting contests.[5] The share of talent of the club can be defined as

$$s_i(t_1, \cdots, t_n) = \begin{cases} \frac{t_i}{\sum_{j=1}^{n} t_j} & \text{if} \quad \sum_{j=1}^{n} t_j > 0 \\ \frac{1}{n} & \text{otherwise}, \quad i = 1, \cdots, n, \end{cases} \tag{2}$$

where $t_i \geq 0$ is investment in playing talents of a club. In view of (1) and (2), the revenue function of a club means that with an increase in a club's share of playing talent, the clubs will be more successful and attractive to fans or broadcasters, and thus generate a higher revenue through the sale of tickets, broadcasting rights, sponsorship money etc.

We now present the simplest revenue sharing arrangement in order to investigate the impact of interventions by a league on club objectives. In real-world sports leagues, there

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[4]Exogeneity of R is assumed for simplicity. If the total market size R is endogenously determined, different results may be obtained. However, here it is left to future research to investigate these extensions.

[5]See the excellent survey by Szymanski (2003) and the references therein.

are several arrangements for sharing revenue: Gate revenue sharing, pool revenue sharing, sharing broadcasting revenues and a complex combination of these.

In theory, it has been recognized that different revenue sharing arrangements can have a different impact on competitive balance (see e.g. Késenne, 2007). However, apart from any impact on competitive balance, another consequence of revenue sharing is the leveling of club finances. So, from this point of view, a model of revenue sharing is formulated as follows:[6]

$$R_i(s_i; \alpha) = \alpha s_i R + \frac{1-\alpha}{n} R = R\Big(\alpha s_i + \frac{1-\alpha}{n}\Big), \quad 0 < \alpha \le 1, \qquad i = 1, \cdots, n, \qquad (3)$$

where α measures the level of revenue sharing chosen by sports leagues. This parameter gives the share of a club's revenue that depends on the relative quality of the club. Then equation (3) shows that club i's revenue can be decomposed into two components. The first revenue component is the variable part $s_i R$. It follows from (1) and (2) that this term describes club i's revenue under the condition of no revenue sharing arrangement ($\alpha = 1$). The second component is the fixed part $(\frac{1-\alpha}{n})R$. Independent of on-field success, this part will always bring in a part of club i's revenue as long as revenue sharing takes place ($\alpha < 1$). Therefore, as α is close to zero, an egalitarian sharing rule is introduced or intensified by the league; consequently, the relationship between improvements in the relative quality of the club and increases in club revenue becomes weak.[7] Note that the assumption of a positive real number for α reflects the fact that no European football leagues and the U.S. traditional leagues share all revenues.[8]

On the cost side, in line with most of the existing literature, we assume that talent can be hired in the players' labor market at a constant marginal cost $c > 0$, so that the cost function can be written as:

$$C_i(t_i) = ct_i, \quad i = 1, 2, \cdots, n. \qquad (4)$$

Under the conventional hypothesis of a perfectly competitive labor market, clubs are wage takers, so that the unit cost of talent is the same for every club.

It follows from (2),(3) and (4) that with revenue sharing, the profit function for club

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[6]Typically, revenue sharing as a distribution or redistribution means that revenue that is earned by one club is given to other clubs. For the purpose of this paper and analytical tractability, here we omit the tax on clubs' local-revenue from revenue sharing system.

[7]A similar after-sharing revenue function can be found in Dietl *et al.* (2008). Note that as in Tullock (1980), they have used the logit CSF for n clubs as the probability of winning the championship in order to model revenue sharing arrangements. However, the logit-form approach is also used to describe market share so that we have no uncertainty and no winner-take-all situation in our model (see e.g. Schmalensee 1976; Kräkel and Sliwka, 2006).

[8]Single-entity leagues, such as Major League Soccer (MLS), the Women's National Basketball Association (WNBA) and the Women's United Soccer Association (WUSA), share all revenues and expenses equally, regardless of the size of the market. In this paper, however, we are not concerned with the single-entity league.

i is described by

$$\pi_i(t_1, \cdots, t_n; \alpha) = R\left(\alpha s_i + \frac{1-\alpha}{n}\right) - ct_i = R\left(\alpha \frac{t_i}{\sum_{j=1}^{n} t_j} + \frac{1-\alpha}{n}\right) - ct_i, \quad i = 1, \cdots, n. \quad (5)$$

The owner's objective is to maximize these profits.

Next, in the spirit of Fershtman and Judd (1987), Sklibas(1987) and Rascher (1997), it is assumed that club i's manager is motivated to choose t_i to maximize a linear combination of profits and wins, which can be written as:[9]

$$O_i(t_1, \cdots, t_n; \theta_i, \alpha) = \pi_i + \theta_i w_i, \quad \theta_i \geq 0, \quad i = 1, \cdots, n. \quad (6)$$

where θ_i is the incentive parameter chosen by owner i in order to maximize his profits; following the existing literature, w_i represents the winning percentage for each club and is written as:[10]

$$w_i(t_1, \cdots, t_n) = \frac{n}{2} \frac{t_i}{\sum_{j=1}^{n} t_j}, \quad i = 1, \cdots, n. \quad (7)$$

As already mentioned in the Introduction, we define club objective as an objective function for the manager in equation (6). Then, it allows clubs to be more profit oriented or more win oriented because the weight parameter θ_i can be different for every club. Note that $\theta_i = 0$ means that owner i forces the manager to maximize profit only.[11]

As in Fershtman and Judd (1987), the managers' compensation contracts are publicly observable and linear in the objective function:

$$U_i = A_i + B_i O_i \geq \bar{U},$$

where A_i and B_i are constants, and U_i and $\bar{U}$ are the manager's wage and reservation utility respectively. It is assumed that this reservation utility is zero so that it will always pay for an owner to delegate decisions. Note that in equilibrium, the owner will earn the whole surplus π_i as a manager's participation constraint will always be binding. Hence, in the following we only have to care about the effect of θ_i on the managers' choice of t_i.

Finally, in the analysis of sports league, it is conventionally assumed that the total supply of talent is fixed. Authors who have made this assumption have used a non-Nash conjecture $\frac{\partial t_i}{\partial t_j} = \frac{-1}{n-1} \neq 0$ for all $i \neq j$ to reflect this scarcity in each club's first-order condition (Fort and Quirk, 1995; Vrooman, 1995): The loss of playing talent, caused by an increase of playing talent in one club, is spread evenly among the rival clubs. However,

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[9]Fershtman and Judd (1987) and Skilvas (1987) use a combination of profits and revenues. On the other hand, Rascher (1997) assumed that sports clubs are maximizing a linear combination of profits and wins. However, note that in Rascher (1997), an owner and a manager were modeled as a single entity.

[10]As long as every club plays the same number of games, it can be shown that the sum of win percentages of all clubs is not equal to 100% but equals half the number of clubs in the league (see e.g. Fort and Quirk, 1995; Késenne, 2007).

[11]We shall take the owners' delegation decisions as exogenous, though it can be interpreted another way: There is no delegation at all and the owner also serves as the manager of the club.

in view of game theoretic approach and a distinctive feature of European football players' labor market, Szymanski and Késenne (2004) choose to apply a Nash conjecture $\frac{\partial t_j}{\partial t_i} = 0$ in the determination of theoretical sports league equilibrium.[12] Indeed, opinion is divided among sports economists on this subject, but we use the Nash conjecture in this paper.[13] The main reason is that we would like to compare the North American and European sports leagues on the basis of the same theoretical assumptions. Moreover, as Szymanski (2004) acutely pointed out, as far as modeling the game is concerned, there is no inconsistency between the use of Nash conjecture and the assumption that supply of talent is fixed . A game involving a fixed supply is simply a type of zero-sum game, and zero-sum games can have Nash equilibria.

3   Club Objectives and Revenue Sharing

To solve our two-stage game, we rely on backward induction. Consider first the game played among the managers at the second stage given their respective objective functions (6). For simplicity, the following definitions are useful:

$$T = \sum_j t_j, \quad T_{-i} = \sum_{j \neq i} t_j, \quad z_i = \alpha R + \frac{n\theta_i}{2},$$

where T and T_{-i} are total investments in playing talent within a league and the aggregate investments in playing talent by all competitors of club i respectively. It follows from (5), (6), (7) and the above definitions that we can rewrite the objective function for manager i as

$$
\begin{aligned}
O_i &= R\Big(\alpha \frac{t_i}{\sum_{j=1}^n t_j} + \frac{1-\alpha}{n}\Big) - ct_i + \theta_i w_i = R\Big(\alpha \frac{t_i}{\sum_{j=1}^n t_j} + \frac{1-\alpha}{n}\Big) - ct_i + \theta_i \Big(\frac{n}{2} \frac{t_i}{\sum_{j=1}^n t_j}\Big) \\
&= \frac{1-\alpha}{n} R + \Big(\alpha R + \frac{n\theta_i}{2}\Big) \frac{t_i}{\sum_{j=1}^n t_j} - ct_i = \frac{1-\alpha}{n} R + z_i \frac{t_i}{T} - ct_i, \quad i = 1, \cdots, n. \qquad (8)
\end{aligned}
$$

The objective of each manager is to maximize O_i subject to $t_i \geq 0$. By using the Kuhn-Tucker conditions for a maximum, subject to inequality constraints, we obtain:

$$
\begin{aligned}
t_i &= 0 \quad \text{if } z_i \leq cT_{-i}, \\
z_i \frac{T_{-i}}{(t_i + T_{-i})^2} - c &= 0, \quad \text{if } z_i > cT_{-i}.
\end{aligned}
\qquad (9)
$$

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[12]A theoretical reason is that if each club makes a single choice, simultaneously and independently of the choices of others, its rivals will have no opportunity to respond; hence it makes no sense to talk of any conjectural variation other than zero. Another reason is that after the liberalisation of football players' labor market by the Bosman verdict (1995), an extra talent in one club does not necessarily imply a loss of talent in another club in the same league.

[13]See Szymanski (2004), Eckard's (2006) comment and Szymanski's (2006) reply for details.

We can solve these equalities for t_i to obtain manager i's reaction function:

$$t_i = \max\left(\sqrt{\frac{z_i}{c}T_{-i}} - T_{-i}, \ 0\right) \quad i = 1, \cdots, n.$$

To find an equilibrium we must solve this system of n equations. Note that not all managers invest strictly positive amounts in playing talent. Let H denote the set of active clubs whose managers invest strictly positive amounts in playing talent. For notational simplicity, we now use the new definitions:

$$\Theta \equiv \sum_{i \in H}\left(\frac{1}{z_i}\right), \quad \Theta_{-i} \equiv \sum_{j \in H \setminus \{i\}}\left(\frac{1}{z_j}\right).$$

For a given vector of incentive parameters $(\theta_1, \cdots, \theta_n)$ the following result characterizes the Nash equilibrium of the second stage.

Lemma 1. *A unique Nash equilibrium exists at the second stage, which has the following properties: There is a subset $H \subseteq \{1, \cdots, n\}$ of all managers who invest positive amounts in playing talent. The managers contained in this subset are those that have the $m = \sharp H$ highest θ_i values. The investment level of each manager in the subset is*

$$t_i = \frac{(m-1)\left(\Theta_{-i} - (m-2)\frac{1}{z_i}\right)}{c\Theta^2}. \tag{10}$$

The managers with the $n - m$ lowest θ_i do not spend any resources on playing talent. For the $\theta_i s$ of the managers contributing positive amounts on playing talent the following condition holds:

$$\Theta_{-i} > \frac{m-2}{z_i}. \tag{11}$$

All managers with $\Theta_{-i} \leq \frac{m-2}{z_i}$ choose $t_i = 0$. The managers with the two highest θ_i always contribute a strictly positive amount on playing talent.

Proof. First, we will show uniqueness of the Nash equilibrium at the second stage by following the approach in Cornes and Hartley (2005). Suppose we have an equilibrium $(t_1, \cdots, t_n)$. Recall that $T \equiv \sum_j t_j$. If $t_i > 0$, we must have from (9) that

$$z_i \frac{(T - t_i)}{T^2} - c = 0, \Rightarrow \ t_i = T - \frac{cT^2}{z_i}.$$

Then we define

$$t_i(T) = \max\left\{T - \frac{cT^2}{z_i}, \ 0\right\}, \tag{12}$$

which is referred to by Cornes and Hartley as the manager i's *replacement function*. The replacement function gives the unique value (possibly an equilibrium) of t_i given that the total investments in playing talent is T. Furthermore, rather than use the replacement

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function directly, it proves convenient to divide both sides of (12) by $T > 0$. The resulting function

$$s_i(T) = \max\left\{1 - \frac{cT}{z_i},\ 0\right\},\tag{13}$$

which is called the manager i's *share function* by Cornes and Hartley. Nash equilibrium values of T occur where the aggregate share function, $\sum_i s_i(T)$, equals unity. In our model, it follows from (13) that this gives T satisfying

$$\sum_{i=1}^{n} s_i(T) = \sum_{i=1}^{n}\left(\max\left\{1 - \frac{cT}{z_i},\ 0\right\}\right) = 1.$$

The aggregate share function is monotonically decreasing, and has a value $n(> 1)$ if $T = 0$ but tends to 0 if T becomes large. Hence, a unique T and therefore a unique equilibrium must exist. In fact, solving this equation for active clubs, Nash equilibrium total investments in playing talent level yields

$$T = \frac{m-1}{c\Theta}.\tag{14}$$

Substituting this into active clubs' replacement function (12), we have

$$\begin{aligned}
t_i &= T - \frac{cT^2}{z_i} = \frac{m-1}{c\Theta} - \frac{c}{z_i}\left(\frac{m-1}{c\Theta}\right)^2 \\
&= \frac{(m-1)\big(z_i\Theta - (n-1)\big)}{cz_i\Theta^2}.
\end{aligned}$$

Using $\Theta_{-i} \equiv \sum_{j \in H\setminus\{i\}}\left(\frac{1}{z_j}\right)$ and $z_i\Theta = 1 + z_i\Theta_{-i}$, this can be rearranged as

$$t_i = \frac{(m-1)\big(\Theta_{-i} - (m-2)\frac{1}{z_i}\big)}{c\Theta^2},$$

which is the Nash equilibrium investment of each manager in the subset H. Note that the existence of the equilibrium is guaranteed because the manager's objective function in (8) satisfies the second-order conditions. In fact, it follows from (8) that the second-order condition of the ith manager is given by

$$\frac{\partial^2 O_i}{\partial t_i^2} = -z_i \frac{2T_{-i}}{(t_i + T_{-i})^3} = -\left(\alpha R + \frac{n\theta_i}{2}\right)\frac{2T_{-i}}{(t_i + T_{-i})^3} < 0,\ \text{for } \theta_i \geq 0,$$

where the inequality comes from the assumption that α is a positive real number.

To obtain the condition for positive investment level for club i just check that $t_i > 0$ is equivalent to $\frac{(m-1)\big(\Theta_{-i}-(m-2)\frac{1}{z_i}\big)}{c\Theta^2} > 0$ and this is equivalent to

$$\Theta_{-i} > \frac{m-2}{z_i} = \frac{2(m-2)}{2\alpha R + n\theta_i}.$$

If this condition does not hold, the club's manager will stay out of the players' labor market and choose $t_i = 0$. Now we suppose without loss of generality that $\theta_1 \geq \theta_2 \geq \cdots \geq \theta_n \geq 0$

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holds. It follows from the inequality condition above that clubs with higher values of $\theta_i (i \in H)$ will make positive expenditures whereas those with sufficiently low values will choose to incur no expenditure.

To see that in equilibrium at least the two managers with the two highest θ_is will spend positive amounts on playing talent, simply note that if the manager with the second highest θ_i does not choose a positive t_i, the manager with the highest θ_i can always reduce his own investment level and be better off. Hence, there is no equilibrium with only one manager investing a positive amount in playing talent. □

The results of *Lemma 1* show that the owners can not only directly influence the behavior of their managers, but also the behavior of the other clubs' managers. In particular, a weight on winning percentage has an effect of increasing the investment in talent. In fact, the derivative of (10) with respect to a change in θ_i can be written as

$$\frac{\partial t_i}{\partial \theta_i} = \frac{n(m-1)}{2cz_i^2\Theta^3}\left(m\Theta_{-i} - \frac{m-2}{z_i}\right) > 0, \tag{15}$$

where the inequality sign comes from (11). Thus, delegation opens up to the option to future actions. However, as will be shown later, whether or not clubs with larger weights on wins via delegation earn more profit than those with smaller weights is a different question.

Now we can go back to the first stage of the game where the owners simultaneously choose incentive schemes for their respective managers. In view of (5), owner i's profits are given by

$$\pi_i = R\left(\alpha\frac{t_i}{\sum_{j=1}^n t_j} + \frac{1-\alpha}{n}\right) - ct_i = R\left(\alpha\frac{t_i}{T} + \frac{1-\alpha}{n}\right) - ct_i, \quad i = 1, \cdots, n.$$

where the Nash equilibrium level $(t_1, \cdots, t_n)$ of talent investments are determined by the results of *Lemma 1* for given incentive parameters $(\theta_1, \cdots, \theta_n)$. Each owner i chooses θ_i to maximize his profits by taking into account the incentive parameters set by his competitors and the resulting Nash equilibrium in the second stage. Indeed, in the following result we show that a symmetric subgame perfect equilibrium exists. Note that an asterisk denotes the equilibrium outcome.

Lemma 2. *For $n \geq 2$, a unique subgame perfect equilibrium exists which is symmetric. At the first stage, each owner chooses an incentive variable:*

$$\theta^* = \frac{2(n-2)\alpha R}{(n^2 - 2n + 2)n}.$$

At the second stage, each manager invests t^* in playing talent:

$$t^* = \frac{(n-1)^2\alpha R}{(n^2 - 2n + 2)cn}.$$

Each owner's equilibrium profits from this investment are given by

$$\pi^* = \frac{\big((n^2 - 2n + 2) - \alpha(n^2 - 2n + 1)\big)R}{(n^2 - 2n + 2)n}.$$

Proof. The proof proceeds as follows: In the first step, we analyze necessary conditions for the existence of a subgame perfect equilibrium. After this, we show existence of the characterized equilibrium in step 2.

Step 1: Necessary conditions

Suppose there is some equilibrium with m active clubs in the set H such that m managers choose $t_i > 0$ according to (10). In view of (5), (10) and (14), owner i's profits are given by

$$
\begin{aligned}
\pi_i &= \frac{1-\alpha}{n}R + \Big(\alpha R\frac{1}{T} - c\Big)t_i = \frac{1-\alpha}{n}R + \frac{(m-1)\big(\Theta_{-i} - (m-2)\frac{1}{z_i}\big)}{c\Theta^2}\Big(\alpha R\frac{c\Theta}{m-1} - c\Big) \\
&= \frac{1-\alpha}{n}R + \frac{\big(\Theta_{-i} - (m-2)\frac{1}{z_i}\big)\big(\alpha R\Theta - (m-1)\big)}{\Theta^2}. \quad (16)
\end{aligned}
$$

Each owner i is to maximize profits (16) with incentive parameters. It follows from (16) that

$$\frac{\partial \pi_i}{\partial \theta_i} = \frac{\partial}{\partial \theta_i}\Big(\frac{1-\alpha}{n}R + \frac{\big(\Theta_{-i} - (m-2)\frac{1}{z_i}\big)\big(\alpha R\Theta - (m-1)\big)}{\Theta^2}\Big) = 0,$$

which can be rearranged so that we obtain

$$\theta_i(\alpha R\Theta - m) = \frac{4(1-m)}{n\Theta} + \frac{2\alpha R(1 + m - \alpha R\Theta)}{n}. \quad (17)$$

Then, we encounter two cases depending upon whether $(\alpha R\Theta - m)$ is a zero or not:

1. First, suppose that $\alpha R\Theta - m = 0$ which is equivalent to $\Theta = \frac{m}{\alpha R}$. Then, we get from (17) that $\frac{2(2-m)\alpha R}{nm} = 0$ which can only hold if $m = 2$, i.e., there are only two active clubs. Hence, in this case we have a continuum of equilibria as follows:

$$-\frac{2}{\Theta} + \alpha R(3 - \alpha R\Theta) = 0 \Rightarrow \theta_i = -\frac{\alpha R\theta_j}{2\theta_j + \alpha R}, \quad i,j = 1,2; \ i \neq j.$$

   However, since $\theta_i(i = 1,2)$ is restricted to being non-negative in this paper, we must have $\theta_1 = \theta_2 = 0$ in this case.

2. Second, we must consider the case where

$$\alpha R\Theta - m \neq 0. \quad (18)$$

   Note that (17) here directly implies that the incentive parameter θ_i must be the same for all active clubs. Hence

$$\theta_i = \theta = \frac{(1 - m + \alpha R\Theta)(2 - \alpha R\Theta)}{(\alpha R\Theta - m)n\Theta}.$$

As $\Theta = \frac{m}{\alpha R + \frac{n\theta}{2}}$ we can conclude that

$$\theta = \frac{2\big((m-2)\alpha R - n\Theta\big)\big(2\alpha R + (1-m)n\Theta\big)}{m^2 n^2 \theta} \Rightarrow \theta = \theta_m^* = \frac{2(m-2)\alpha R}{\big(2 + (m-2)m\big)n}$$

when m clubs are active. It is easy to check that (18) indeed then holds for $m > 2$. Hence, if there is any pure-strategy perfect equilibrium when $m > 2$ then it will be the one where m active clubs all choose θ_m^*.

We now have to show that there is no equilibrium in which less than n clubs are active. To do this, first suppose that there is an equilibrium with $m(< n)$ active clubs. In that case, there must be at least one club j with $t_j = 0$ which can only be the case if condition (11) is violated for j, i.e., $\Theta_{-j} \le \frac{m-2}{z_j}$. Note that $\Theta_{-j} = \Theta$ as club j is inactive. Furthermore, in view of (5), this club j earns profits $\pi_j = \frac{(1-\alpha)R}{n}$ in such an equilibrium.

Again we have to differentiate two cases. If $m > 2$ then all active clubs in equilibrium choose θ_m^* and we must have that $\theta_j \le \frac{(m-2)(\alpha R + \theta_m^*)}{m} - \alpha R$ for club j to be inactive. Suppose now that, j deviates and chooses a small value $\theta_j = \theta_m^*$. Note that any manager of a "previously" inactive club $k \notin H \cup \{j\}$ will stay inactive after such a deviation. In that case, stage 2 is reached with $m+1$ clubs which have chosen θ_m^*. The investment level in playing talent of the $m+1$ active managers can then be computed from (10) as

$$t = \frac{m\left(\frac{m}{\alpha R + \frac{n\theta_m^*}{2}} - \frac{(m-1)}{\alpha R + \frac{n\theta_m^*}{2}}\right)}{c\left(\frac{m+1}{\alpha R + \frac{n\theta_m^*}{2}}\right)^2} = \frac{m(2\alpha R + n\theta_m^*)}{2c(1+m)^2}.$$

Then, in view of (5), each active club's profits are

$$\begin{aligned}
\pi &= R\left(\alpha \frac{t}{T} + \frac{1-\alpha}{n}\right) - ct = R\left(\alpha \frac{1}{1+m} + \frac{1-\alpha}{n}\right) - ct \\
&= \frac{(1-\alpha)R}{n} + \frac{2\alpha R - mn\theta_m^*}{2(1+m)^2}.
\end{aligned}$$

These profits are positive if $\theta_m^* < \frac{2(1-\alpha)(1+m)^2 R}{mn^2} + \frac{2\alpha R}{mn}$. It follows from θ_m^* above that this will be the case if

$$\frac{2(m-2)\alpha R}{\big(2 + (m-2)m\big)n} < \frac{2(1-\alpha)(1+m)^2 R}{mn^2} + \frac{2\alpha R}{mn}$$
$$\Leftrightarrow (1-\alpha)\big(m^2(m^2 - 1) + 2m + 2\big) + 2n\alpha > 0,$$

which is always the case. Therefore, the difference between each active club's profits and the inactive club j's profits is

$$\pi - \pi_j = \frac{(1-\alpha)R}{n} + \frac{2\alpha R - mn\theta_m^*}{2(1+m)^2} - \frac{(1-\alpha)R}{n} = \frac{2\alpha R - mn\theta_m^*}{2(1+m)^2},$$

which will be positive if

$$\theta_m^* < \frac{2\alpha R}{mn}.$$

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As $\theta_m^* = \frac{2(m-2)\alpha R}{\left(2+(m-2)m\right)n}$, this will be the case if

$$\frac{2(m-2)\alpha R}{\left(2+(m-2)m\right)n} < \frac{2\alpha R}{mn}$$

$$\Leftrightarrow \frac{4\alpha R}{(m^2-2m+2)mn} > 0$$

which is always the case, as the left-hand side is always positive. If only $m(<n)$ clubs are active and $m > 2$, then it is always beneficial for an inactive club to deviate to a smaller value of θ and get into the players' labor market.

If, however, $m = 2$ and $n > 2$ we know already that $\Theta = \frac{2}{\alpha R}$ under the condition $\theta_i(i = 1,2) = 0$. If there is an inactive club k, we must have that $\Theta = \Theta_{-k} \le \frac{m-2}{z_k}$ which is equivalent to $\Theta \le 0$, yielding a contradiction.

To sum up, if $n > 2$, at most a unique subgame perfect equilibrium in pure strategies exists in which all owners choose

$$\theta^* = \theta_n^* = \frac{2(n-2)\alpha R}{(n^2-2n+2)n}.$$

Note that for $n = 2$ the value for the incentive parameter θ corresponds to θ^* given above.

Step 2: Sufficient conditions for existence

To prove that this equilibrium indeed exists, we need consider only two cases, namely $n > 2$ and $n = 2$.

1. For $n > 2$, we can proceed analogously to the computation of (17) to ensure that equilibrium investments $(\theta_1^*, \cdots, \theta_n^*)$ in playing talent satisfy the second-order conditions. It follows from (17) that the sufficient second-order conditions are

$$\frac{\partial^2 \pi_i}{\partial \theta_i^2} = \alpha R\Theta - n + \frac{\partial \Theta}{\partial \theta_i}\left(\alpha R\theta_i + \frac{4(1-n)}{n\Theta^2} + \frac{2\alpha^2 R^2}{n}\right), \quad i = 1, \cdots, n.$$

Since the equilibrium investment level for club i is symmetric, Θ and $\frac{\partial \Theta}{\partial \theta_i}$ are expressed as

$$\Theta \equiv \sum_i \left(\frac{1}{z_i}\right) \equiv \sum_i \left(\frac{1}{\alpha R + \frac{n\theta_i}{2}}\right) = \frac{n}{\alpha R + \frac{n\theta^*}{2}}, \quad \frac{\partial \Theta}{\partial \theta_i} = -\frac{2n^2}{(2\alpha R + n\theta^*)^2},$$

from which the second-order conditions reduce to

$$\frac{\partial^2 \pi_i}{\partial \theta_i^2} = -\frac{n^2 - 2n + 2}{n}$$

and are obviously negative.

2. If $n = 2$, in view of (17), $\alpha R\Theta - m = 0$ and $m = n = 2$, the second-order conditions are expressed as

$$\frac{\partial^2 \pi_i}{\partial \theta_i^2} = \frac{\partial}{\partial \theta_i}\left(\frac{2}{\Theta} - 3\alpha R + (\alpha R)^2\Theta\right)$$

$$= \frac{2\theta_i^2\theta_j^2 - 2\alpha^4 R^4 + 4\alpha R\theta_i\theta_j(\theta_i + \theta_j) + \alpha^2 R^2(\theta_i^2 + 6\theta_i\theta_j + \theta_j^2)}{(\alpha R + \theta_i)^2(2\alpha R + \theta_i + \theta_j)^2}, \quad i,j = 1,2; \ i \ne j.$$

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Substituting $\theta_i = -\frac{\alpha R \theta_j}{2\theta_j + \alpha R}$ into equation above, the second-order conditions reduce to

$$\frac{\partial^2 \pi_i}{\partial \theta_i^2} = -\frac{(2\theta_j + \alpha R)^2}{2(\theta_j + \alpha R)^2} < 0.$$

Therefore, the sufficient second-order conditions are satisfied.

As the next step, we can apply the incentive parameter θ^* for all values of $n (\geq 2)$ in the derivation of the equilibrium profits and investment level for each club. First, it follows from θ^* and (10) that the equilibrium investment level for each club is given by

$$t^* = \frac{(m-1)\big(\Theta^*_{-i} - (m-2)\frac{1}{z_i^*}\big)}{c(\Theta^*)^2} = \frac{(n-1)^2 \alpha R}{(n^2 - 2n + 2)cn}.$$

Finally, it follows from θ^* and (16) that

$$
\begin{aligned}
\pi^* &= \frac{1-\alpha}{n}R + \frac{\big(\Theta^*_{-i} - (m-2)\frac{1}{z_i^*}\big)\big(\alpha R \Theta^* - (m-1)\big)}{(\Theta^*)^2} \\
&= \frac{\big((n^2 - 2n + 2) - \alpha(n^2 - 2n + 1)\big)R}{n(n^2 - 2n + 2)},
\end{aligned}
$$

which is positive for α, R, and n within their permissible ranges. $\qquad\square$

It follows from *Lemma 2* that the number of clubs plays an essential role in the determination of the optimal choice of incentive parameters by the owners. It follows from the properties of θ^* that when $n > 2$ the equilibrium incentive variable is positive, while when $n = 2$ it is equal to zero. Thus, each owner puts more weight on winning percentage rather than profit in sporting contests with more than two clubs, while in two-club contests each owner forces the manager to maximize profit only. The logic behind this result is roughly as follows: When $n = 2$ there may be no advantage in precommitment, while when $n > 2$ there is an advantage. In view of (15), delegating decisions to managers in a strategic situation may be useful for owners as a kind of self-commitment device. Therefore, if each club's objective is to maximize profit only, then no owners gain from the opportunity for precommitment to set non-profit objectives, such as the winning percentage, for their managers.

We now turn to the formal statement of these arguments about precommitment in our model. The following lemma is a particular case of a result in Dixit (1987) where asymmetric contests are also allowed.

Lemma 3. *In symmetric n-player sporting contests with payoff function (5), if one club can commit to an observable action before other clubs,*

1. *When $n = 2$, there is no strategic advantage in precommitment to affect future competition.*

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2. *When $n > 2$, there is a strategic advantage in overcommitment to affect future competition.*

Proof. Without loss of generality, suppose that club 1 can commit to an action t_1, observable by all other clubs who then choose their action simultaneously. Then, given t_1, club $i(i = 2, \cdots, n)$ wants to maximize its profits (5). The first-order condition for this requirement is simply

$$\frac{\partial \pi_i(t_1, \cdots, t_n)}{\partial t_i} = 0, \quad i = 2, \cdots, n. \tag{19}$$

We can use these equations to derive the reaction function of club i, $r_i(t_1)$. Then club 1's calculation of the rate of change of profit with respect to precommitment is

$$\frac{d\pi_1}{dt_1} = \frac{\partial \pi_1}{\partial t_1} + \left(\frac{\partial \pi_1}{\partial t_2} \frac{dr_2}{dt_1} + \cdots + \frac{\partial \pi_1}{\partial t_n} \frac{dr_n}{dt_1} \right) \tag{20}$$

At the equilibrium, reaction functions $r_i(t_1)$ for $i \neq 1$ are given implicitly by the first-order conditions (19). Hence, to find the right-hand side of equation of (20), differentiate the first-order conditions (19) with respect to t_1 to obtain

$$\frac{\partial^2 \pi_i}{\partial t_i \partial t_1} + \frac{\partial^2 \pi_i}{\partial t_i \partial t_2} \frac{dr_2}{dt_1} + \cdots + \frac{\partial^2 \pi_i}{\partial t_i \partial t_n} \frac{dr_n}{dt_1} = 0, \quad i = 2, \cdots, n. \tag{21}$$

At the symmetric interior Nash equilibrium $(t_1^n, t_2^n \cdots, t_n^n)$, it follows from (5) that the derivatives of the profit function are:

$$\frac{\partial^2 \pi_i}{\partial t_i^2} = \frac{-2\alpha R T_{-i}}{T^3} = \frac{-2(n-1)\alpha R}{n^3 (t^n)^2}, \quad i = 2, \cdots, n$$

$$\frac{\partial^2 \pi_i}{\partial t_i \partial t_j} = \frac{T - 2T_{-i}}{T^3} \alpha R = \frac{(2-n)\alpha R}{n^3 (t^n)^2}, \quad i, j = 1, \cdots, n; \; i \neq j,$$

Using equations above, and summing up the $n - 1$ equations (21) gives

$$(n-1)\frac{\partial^2 \pi_i}{\partial t_i \partial t_j} + \left(\frac{\partial^2 \pi_i}{\partial t_i^2} + (n-2)\frac{\partial^2 \pi_i}{\partial t_i \partial t_j} \right) \left(\frac{dr_2}{dt_1} + \cdots + \frac{dr_n}{dt_1} \right) = 0$$

$$\Rightarrow \left(\frac{dr_2}{dt_1} + \cdots + \frac{dr_n}{dt_1} \right) = -\frac{(n-1)\partial^2 \pi_i / \partial t_i \partial t_j}{\partial^2 \pi_i / \partial t_i^2 + (n-2)\partial^2 \pi_i / \partial t_i \partial t_j} = -\frac{(n-1)(n-2)}{n^2 - 2n + 2}$$

Moreover, since at symmetric Nash equilibrium $\frac{\partial \pi_1}{\partial t_i} = \frac{-\alpha R}{n^2 t^n} < 0$ for all $i \neq 1$, and $\frac{\partial \pi_1}{\partial t_1} = 0$, equation (20) evaluated at the symmetric Nash equilibrium $(t_1^n, t_2^n, \cdots, t_n^n)$ is given by

$$\left. \frac{d\pi_1}{dt_1} \right|_{t_i = t^n} = \frac{\partial \pi_1}{\partial t_i} \left(\frac{dr_2}{dt_1} + \cdots + \frac{dr_n}{dt_1} \right) = \frac{\alpha R}{n^2 t^n} \left(\frac{(n-1)(n-2)}{n^2 - 2n + 2} \right)$$

It then follows from this that if $n = 2$, the right-hand side is zero at symmetric Nash equilibrium. Thus, in this case, neither club gains from the opportunity for club to precommit itself. On the other hand, if $n > 2$, the right-hand side is positive. Therefore, the symmetric Nash equilibrium cannot be a part of subgame perfect equilibrium when club 1 can commit to an action. That is, there is strategic advantage in commitment to overexertion when $n > 2$.

This completes the proof. ☐

It follows from (15) and *Lemma* 3 that with the exception of the two-club case the club i with positive weights on wins earns more profit than the one with profit maximization objective provided that all clubs but i are profit maximizers. However, as shown in *Lemma* 2, when all clubs have equal opportunities to commit themselves to managerial contracts, each owner puts a positive weight on winning percentage in sporting contests with more than two clubs; consequently, it leads to more competition and lower profits. In fact, in view of (10), if each club's objective is to maximize profit only (i.e., $\theta_i = 0$ for all i), the investment level in playing talent of each club is given by

$$\hat{t} = \frac{(n-1)\alpha R}{cn^2}.$$

Substituting $\hat{t}$ into (5), the profits of each club are given by

$$\hat{\pi} = \frac{(n - \alpha(n-1))R}{n^2}.$$

Therefore, it follows from *Lemma* 2 that the difference between profit $\hat{\pi}$ and profit π^* is

$$\hat{\pi} - \pi^* = \frac{(n-1)(n-2)\alpha R}{(2 + (n-2)n)n^2} > 0, \quad \text{for } n > 2.$$

Hence, if all clubs jointly adopt the profit maximizing objective, then the clubs would be better off. However, in view of (15) and *Lemma* 3, when $n > 2$ the profit maximization objective is not incentive compatible from each club's point of view.

Thus, we can summarize these arguments as follows.

Proposition 1. *Suppose that the league is made up of $n(n \geq 2)$ clubs in which each club consists of an owner and its manager who are both risk neutral. Then the profit maximizing owners set sporting objectives other than profits, such as the winning percentage, for their managers in the league with more than two clubs, while in the two-club case the profit maximizing owners set the profit maximization objective for their managers.*

It follows from *Proposition* 1 that sports clubs are maximizing a linear combination of profits and wins in order to maximize clubs' profits for $n > 2$; on the other hand for $n = 2$, they maximize profit only. Thus, our discussion of this proposition shows that sports clubs will behave as utility maximizers, while keeping the profit maximizing objective at the level of owners. Put differently, owners may find that the best way to maximize profit is to set sporting objectives at the club level. To give a further argument about the characteristic of club objectives, we concentrate on not two clubs but $n(> 2)$ clubs in what follows.

In the theoretical literature that addresses the performance of sporting leagues and the impact of different regulations, most studies start from a model with each club's hypothesized mode of behavior being *constant*: Clubs are supposed to maximize either their profits, winning percentage or a linear combination of profits and wins. However, it follows from *Lemma 2* that each club's optimal mode of behavior will depend on revenue sharing arrangements, α, chosen by the league, because varying the revenue sharing system

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influences the objectives of sports clubs. In view of (3), an increase in α means that revenue sharing arrangements are limited and/or the league authorities choose a performance-based reward scheme, such as sharing broadcasting revenues, in the league. In contrast, as α decreases, the leagues engage in the leveling of club revenues via revenue sharing arrangements.

From the optimal incentive parameters given by *Lemma* 2, it is easily shown that $\frac{\partial \theta^*}{\partial \alpha} > 0$ for $n > 2$. Therefore, as α increases, owners give an incentive to and put pressure on managers of clubs to win; hence club objectives will be more win oriented. On the other hand, reducing α via revenue sharing leads clubs to be more profit oriented. The intuition behind this result is the following. If the leagues lack a redistribution mechanism that might lead to equalization of club finances, club's playing success and club's revenues are much more closely related. Then, owners may find that the best way to maximize profits is to win at the club level. In contrast, as a league engages in revenue sharing, the relationship between improvements in club performance and increases in club revenue is weak; consequently, club owners do not have direct financial incentive to win.

Thus, we can summarize these arguments as follows:

Proposition 2. *Suppose that the league is made up of $n(n > 2)$ clubs in which each club consists of an owner and its manager who are both risk neutral. Revenue sharing arrangements used by the leagues have the impact on club objectives or club manager's incentives as follows:*

1. *As the league intensifies the leveling of club finances via revenue sharing, club owners will force managers to strive for profits in order to maximize profits.*

2. *As the league strengthens the correlation between the success of clubs and club revenues by weakening the revenue sharing and/or implementing performance-based reward schemes, club owners will force managers to strive for wins in order to maximize profits.*

It follows from *Proposition* 2 that revenue sharing arrangements by the leagues play an essential role in the club objectives. As already mentioned in the Introduction, revenue sharing arrangements are typically more extensive in the U.S. sports than in European football. For example, broadcasting revenues typically include a performance-related element and a fixed share in Europe. In contrast, in the U.S. traditional leagues, national TV rights are evenly split among the clubs in the leagues without regards to the performance of particular clubs. Therefore, in view of *Proposition* 2, professional sports clubs in European football are more win oriented than in the U.S. sports leagues. This result is quite consistent with empirical observations by Garcua-del-Barrio and Szymanski (2009); that is, behavior of European football clubs seem to closely approximate win maximization. Moreover, this proposition shows why European football clubs are win oriented, even though recent TV revenue growth and the entry of corporations into the sports business

might be expected to lead to a great emphasis on profits. It is reasonable to conjecture that objectives of a club may be affected by the organization of sports leagues, while keeping the profit maximizing objective at the level of owners.

It is interesting to note that, in view of *Lemma* 2, as the league strengthens the correlation between the success of clubs and club revenues by removing the arrangements for revenue sharing and/or implementing performance-based reward schemes, the clubs have a strong incentive for higher talent investments, that is, $\frac{\partial t^*}{\partial \alpha} > 0$; on the contrary, the equilibrium profits for each club decline, that is, $\frac{\partial \pi^*}{\partial \alpha} < 0$. This result explains why European football clubs still struggle to balance the books, despite the influx of broadcasting income.

It follows from these arguments that our results seem to have validated the conventional sports clubs' behavioral assumptions: Professional sports clubs in the U.S. major leagues are more profit oriented than in European football. However, we should note that the use of revenue sharing schemes by the league can affect the objectives of sports clubs. Thus, if the league changes revenue sharing arrangements, then club objectives may also alter.

4   Conclusions

This paper is intented as a preliminary step in the analysis of the impact of differences in the organization of sports leagues on objectives of professional sports clubs. It presents an n-club sporting contest model in which each club consists of an owner and its manager. We have shown that sports clubs behave as if they are maximizing a utility function which is a linear combination of profits and wins, while keeping the profit maximizing objective at the level of owners. It is also demonstrated that revenue sharing arrangements by the leagues may affect the club objectives. If a league engages in revenue sharing (e.g. U.S. sports leagues), then club objectives are more profit oriented. On the other hand, if a league lacks a redistribution mechanism (e.g. European football leagues), then club objectives are more win oriented even if club owners are profit maximizers. These results seem to be quite consistent with existing empirical observations of club objectives.

Moreover, our analysis can shed some light on the effects of revenue sharing policy. The relation between revenue sharing and competitive balance has been the subject of controversy in the economics of team sports. In theory, it has been recognized that club objectives may affect the success of revenue sharing policy to promote competitive balance. However, in view of our results, league authorities should recognize that revenue sharing arrangements also have an influence on club objectives.

Further research may take the following directions. First, our model has assumed that given the separation of management from ownership in professional sports clubs, the profit maximizing owners set goals for managers to pursue, and its managers pursue the given goal by choosing their clubs' investment level in playing talent. These enable us to simplify our analysis and to derive interesting results. As mentioned in the Introduction,

profit maximization hypothesis will be plausible as a first approximation of the objective of club owner in recent years. However, the ownership of football clubs is more complex. For example, Real Madrid in Spain is mutually owned by $50,000$ members, most of them ordinary supporters who elect a president to run the club. Under this structure of ownership, it may be reasonable to suppose that regardless of the revenue sharing scheme, the committee of a club is willing to sacrifice profit for the prestige of winning. Hence, firstly we would like to extend our analysis in the presence of this different type of ownership structure of clubs. Second, the present model does not consider the difference in the size of the market in which a club operates. When we try to extend our model to include the difference of the size of the market among the big clubs and the small clubs, different results may be obtained. Although this extension will be of interest, an analysis of this problem will form the basis of our future research.

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