REVENUE SHARING, CONJECTURES AND SCARCE TALENT IN A SPORTS LEAGUE MODEL

Stephen T. Easton

and

Duane W. Rockerbie

October 2002

JEL: L83

Abstract

We develop a model of a representative professional sports club operating in a league that has the option of adopting one of two different forms of revenue sharing: traditional revenue sharing and central-pool type revenue sharing. To adopt either form of revenue sharing, the league requires that a majority of clubs increase profit with adoption of the plan. We derive necessary conditions for either plan to garner enough support for a majority vote. The likelihood of forming a majority also depends on the conjectures on acquiring talent that clubs possess. Competitive conjectures make revenue sharing more likely, while cartel conjectures make revenue sharing less likely. Empirical results provide evidence in favor of the model for four North American professional sports leagues.

Steve Easton: Department of Economics, Simon Fraser University, Burnaby, B.C. V5A 1S6, easton@sfu.ca

Duane Rockerbie: Department of Economics, University of Lethbridge, 4401 University Drive, Lethbridge, AB T1K 3M4 rockerbie@uleth.ca

I. INTRODUCTION

The expansion of professional sport has been a hallmark of the latter half of the twentieth century. Professional leagues of baseball, football, basketball, and hockey bear scant resemblance to those same leagues prior to World War II. In North America the sheer scale and daily media coverage of Major League Baseball (MLB), the National Football League (NFL), the National Basketball Association (NBA), or the National Hockey League (NHL) today is a testimony to the success of the business.

And successful they have been. For those clubs that have survived, franchise values have increased dramatically. Among major North American sports, in the last decade of the century the value of franchises increased by an average annual rate of 10.7 percent in the NHL to 17.7 percent in the NBA (Quirk and Fort, 1999.) Entry into these leagues has also become expensive. During the 'nineties, the cheapest expansion into the NHL cost $35.5 million while a new team in the NBA reached a high of nearly $200 million. In the same period the franchise fees grew at an average annual rate of 18.3 percent for the NHL and an impressive 70.2 percent for the NBA (Quirk and Fort, 1999.) Around the world, football (soccer) has shared in the explosion of interest. One club alone, Manchester United, turned down a $1 billion purchase offer. The 1998 World Cup reached 33.4 billion viewers: five times the world's population. Television rights for the 2006 World Cup matches in Germanys sold for 1.5 billion Swiss Francs ($1 billion US).

Part of the price of rapid growth is increased scrutiny. In North America professional sports leagues share a number of characteristics that distinguish their structure, conduct and performance from any other industry.[1] We take a league as composed of individual firms that maximize their own profits. Each firm does so through local ticket pricing and by selling local broadcasting rights. These firms are members of the league cartel, so they also undertake actions to maximize league profits without jeopardizing their own local profits[2]. The cartel is allowed to sell national broadcasting and merchandising rights with the proceeds divided evenly among the cartel members. The cartel typically enforces a player draft system, revenue sharing and other activities in which all clubs participate. Finally, firms within the cartel cannot be sold or relocated without permission of a majority of the cartel members, nor can new firms join the cartel without

---

[1] Although many of these characteristics are also shared by non North American leagues, this paper focuses explicitly on North American leagues for which data although sparse are more readily available than for the others.

[2] Atkinson, Stanley and Tschirhart (1988) suggest that team owners maximize utility since they may prefer winning to higher profits if given a tradeoff. This may be true, but we have chosen to exploit the more simple profit maximization approach, particularly since there may be no tradeoff between winning and profits.

a majority vote. These cartel policies clearly are designed to restrict entry of new firms and maintain the profits of the existing firms and the league, but are protected from antitrust legislation by the decision in *Federal League vs. Baseball* (1922).

One particular phenomenon that has arisen in the context of leagues is that of revenue sharing. It is a controversial financial tool that is currently used in MLB and the NFL. It is controversial because owners argue that it increases the economic viability of marginal small market clubs that would otherwise fold, and that it also increases parity in play so that large revenue clubs cannot persistently dominate small market clubs on the playing field (Levin et al. (2000)), while players believe that revenue sharing drives down salaries[3]. The latter assertion may be of interest to fans and has occasioned much professional discussion (El Hodiri and Quirk (1971), Quirk and Fort (1992, 1995), Vrooman (1995), Marburger (1997), Rascher (1997) and Késenne (2000) are representative papers), but in our view it has more to do with the fairness of play and skips over the broader issue of addressing disparities in revenue. A recent panel established to study the financial health of MLB concluded that

> "Large and growing revenue disparities exist and are causing problems of chronic competitive imbalance." – Levin et al. (2000), p. 1

> "In recent years, there has been a rapidly accelerating disparity in revenues and, consequently, payrolls between clubs in high and low-revenue markets. There also has been a stronger correlation between club revenues/payrolls and on-field competitiveness in the years since the issue of competitive balance was studied by the Joint Economic Study Committee which issued its report in 1992. – Ibid., p. 12

The report goes on to discuss means by which revenue sharing and other policies can be used to address revenue and payroll disparities, through which disparities in team performance can be affected. In our view, if revenue sharing is profit increasing, economic analysis should reveal the conditions under which this is likely to be the case, and this is the focus of our paper.

II. REVENUE SHARING

In its most simple form, a revenue sharing system requires that the home club gives the visiting club a share of the gate revenue for each game played. We call this "traditional revenue sharing". The share is adjusted periodically with each collective agreement with the players.

[3] Major league baseball owners and players agreed on a new collective bargaining agreement just hours before a strike deadline of September 1, 2002. The most hotly debated issue was the owner's insistence to increase revenue sharing.

MLB adopted a 50-50 split in the 1903 National Agreement that was reduced to 80-20 and 95-5 for the American and National Leagues respectively by the early 1990s. The NFL used a 66-34 split in the early nineties that was increased to a 60-40 split by the late nineties. Revenue from luxury boxes, concessions and parking are exempt from sharing. Clubs also receive an equal share of television, apparel and licensing revenues from league central funds.

MLB adopted three new forms of revenue sharing in their 1996 collective agreement. We call this "central-pool revenue sharing" in its general form. The *straight-pool plan* requires each club to contribute 39% of its net local revenue to a central pool, which is then divided evenly among all participating clubs. Net local revenue is a club's local revenue less its actual stadium expenses. The *split-pool plan* requires each club to contribute 20% of its net local revenue to a central pool; 75% of that pool is then divided equally among all participating clubs; the remaining 25% of the pool is divided only among participating clubs (side payments) whose net local revenue is below the league average[4]. The *hybrid plan* computes the amount of net revenue each club will be rebated under the straight-pool and split-pool plan, and then awards the greater of the two. This can result in a shortfall of money in the pool that is made up by luxury taxes and monies transferred from the central fund. Estimated net payments from the pool are paid out four times a year, starting on May 25, with a final adjustment payment on June 7 of the following year.

MLB implemented its new revenue sharing system in a number of phases. For 1996, the hybrid plan was adopted on a 60% basis, *i.e.* participating clubs received only 60% of the estimated net payment owed from the pool. This remained unchanged until 1998 when the split-pool plan was implemented on an 80% basis. In 2000, the split-pool plan was operating on a 100% basis. Currently MLB's collective agreement with the players has expired, however the intent is to continue with the split-pool plan. The NFL will adopt central-pool revenue sharing at the start of the 2002 season.

Table 1 provides a summary of local net revenues and net receipts from the central pool for MLB's 2001 season. Fourteen of the thirty clubs received net payments from the central pool. The largest net receiver was the Montreal Expos ($28.5 million) and the largest net payer was the New York Yankees ($26.5 million). Quite rightly, owners argue that the system is doing what it was designed to do: redistribute revenues from rich to poor clubs in order to maintain parity and a financially healthy league. Yet one must wonder why the New York Yankees would voluntarily give away just over 12% of their local operating revenue to help poor clubs? Clubs that earn the majority of their revenue from revenue sharing (like the Expos) could be allowed to fail, yielding

[4] The exact amount received is increasing in the distance below the league average.

greater amounts of revenue from the central fund for all remaining clubs. This is the argument for contraction that is currently being debated in the press and in the courts. If central-pool revenue sharing is just a zero-sum gain with an equal number of net payers and net receivers, why would a majority of clubs support it?

One possibility is central fund revenues (TV, apparel and licensing rights) are positively related to league parity and stability. In this case, revenue sharing might be financially beneficial even for the Yankees. However, we suggest that there is another motive for revenue sharing: with central-pool revenue sharing, profits can increase *for all clubs* over and above what profit would have been without revenue sharing. Hence all clubs will vote to adopt it. With traditional revenue sharing, some clubs gain and some lose according to a specific condition derived below. As a result, revenue sharing will be adopted if a majority of clubs gain from its use. While revenue sharing is a zero-sum gain for the league, the league may benefit from the consequent reductions in payroll costs that revenue sharing promotes (Quirk and Fort (1995)). The movement of the NFL and MLB from traditional revenue sharing to central-pool revenue sharing may be profit maximizing in our framework.

III. A MODEL OF REVENUE SHARING

Fundamental work by Quirk and Fort (1992, 1995) followed by Vrooman (1995), Rascher (1997), and Késenne (2000) shows that, while revenue sharing has no effect on league parity, it unambiguously raises profit for every team in the league. Although these authors arrive at this result using different assumptions concerning the supply of talent to the teams, in these models, revenue sharing reduces the cost of talent. Winning teams participate in the losing team's losses and consequently reduce the league wide demand for talent. The approach of this paper is to build a more general model of a league to investigate revenue sharing. To keep a tight focus, we do not explicitly address parity, salary caps, utility of winning, and a host of other important issues.

Conjectures play a key role in determining how team owners perceive the supply curve of talent and the subsequent effect of revenue sharing on profit. Quirk and Fort (1995) utilize a revenue function that is increasing in the home club's output (winning percentage). Conjectures are necessarily competitive in the club's output. However, talent is available in infinite supply at constant marginal cost implying that talent conjectures are not competitive. Later in the paper we show that profits always increase in the Quirk and Fort framework if talent conjectures are

Cournot[5]. Vrooman (1995) makes no assumptions concerning conjectures. Rascher (1997) and Késenne (1997) assume competitive talent conjectures and find that profit is increasing with revenue sharing. Marburger (1997) implicitly assumes Cournot conjectures but utilizes a more general revenue function so that revenue sharing has uncertain effects on parity and revenues.

In this paper we argue that conjectures about talent, the perceived response by team j to a change in talent of team i, is central to an understanding of revenue sharing. We investigate the supply curve of talent and the talent conjecture of each club in a general way by deriving an indirect profit function from profit maximizing behavior. What we show is that revenue sharing has very different effects on team and league profit depending both on the nature of the revenue sharing formula and the talent conjectures of all clubs.

Traditional revenue sharing

The purpose of this section is to derive necessary conditions for revenue sharing to increase team profit using a simple model of a representative team[6]. We assume a league with n teams using the traditional revenue sharing system where the profit function, π_1, for team 1 is given by

$$p_1(t_1, \boldsymbol{t_j}) = a \sum_{j=2}^{n} R_{1j} + (1-a) \sum_{j=2}^{n} R_{j1} - C(t_1) \tag{1}$$

where t_i is the talent used by team i, $\mathbf{t_j}$ is the vector of all other teams talent a is the share of revenue retained by the home team, 1, from home park revenues when playing against team every other team j. With traditional revenue sharing, total revenue for team 1 is an a-weighted sum of

---

[5] Although Quirk and Fort (1995) do not explicitly state their assumption of the talent conjecture, implicitly they utilize a Cournot conjecture. In their notation, home revenue for team i is an increasing function of the "closeness" of the contest when playing team j, given by $R^{ij}(Z^{ij})$ and $Z^{ij} = w_i(t) - w_j(t)$ where t is a vector of league talent and w_i is the winning percentage of team i. Maximizing revenue with respect to own talent gives $\frac{\partial Z^{ij}}{\partial t_i} = \left(\frac{\partial w_i}{\partial t_i} + \frac{\partial w_i}{\partial t_j}\frac{\partial t_j}{\partial t_i}\right) - \left(\frac{\partial w_j}{\partial t_i} + \frac{\partial w_j}{\partial t_j}\frac{\partial t_j}{\partial t_i}\right) = 0$. Assuming Cournot conjectures, $\frac{\partial t_j}{\partial t_i} = 0$ and Quirk and Fort's equation (3) is obtained.

[6] We assume clubs act so as to maximize their own profit. An alternative setup is for clubs to maximize joint profits, such as in Atkinson, Stanley and Tschirhart (1988). When maximizing national broadcast revenues, apparel revenues and other central fund revenues, a cartel model is appropriate. However, to maximize cartel profit using only gate revenue, as considered here, would require clubs to have the ability to shift attendance demand to the most profitable clubs. It seems unlikely that clubs would have the ability to do this, hence we assume clubs maximize their own profit from gate revenue.

home revenues that team 1 receives when playing the visiting team j in team 1's stadium, R_{1j}, and the revenues club j receives when team 1 plays in team j's stadium, R_{j1}. C(.) is the cost function that depends on the level of player talent for each team in the league; in this case, team 1.

League talent enters a production function that determines game attendance for team 1. Per home-game revenue for team 1, R_{1j}, is determined by the product of game attendance A_{1j} and average ticket price P_1. Attendance depends on the level of talent of the home team, t_1 and the visiting team, t_j.

$$R_{1j} = P_1 A_{1j} = P_1(\gamma_1 t_1 + \gamma_{1j} t_j) \tag{2a}$$

The terms γ_1 and γ_{1j} represent the return to attendance from home talent and the talent of team j respectively and are assumed to be positive. This approach is similar to Marburger (1997)[7], but differs from Pallomino and Rigotti (2000) who also add a specific valuation for "closeness" of each contest. Total home-game revenue for team 1 is the sum of all home game revenues as in 2b:

$$\sum_{j=2}^{n} R_{1j} = \gamma_1 (n-1) t_1 + \sum_{j=2}^{n} \gamma_{1j} t_j \tag{2b}$$

In (2), since t_1 is the talent of the home team 1 and t_j is the talent of each visiting club, the γ's measure a linearized return to talent in the form of attendance and are assumed to be positive.

The revenue team 1 generates in team j's stadium when team 1 plays on the road is R_{j1}. Total revenue generated by team 1's appearances on the road is the sum of each of the other n-1 club's revenues:

$$\sum_{j=2}^{n} R_{j1} = P_j \sum_{j=2}^{n} A_{j1} = P_j \left(\sum_{j=2}^{n} \gamma_j t_j + t_1 \sum_{j=2}^{n} \gamma_{j1} \right) \tag{3}$$

The production functions in (2) and (3) are simplistic in that they assume no cross-effects, i.e. the marginal product of t_1 does not depend on the level of t_j and vice-versa. Further, a ceiling on talent and a ceiling on attendance are treated as essentially the same thing. For now we

---

[7] Marburger (1997) does not specify an average ticket price in the revenue function. Note that we do not write $P_1 = P_1(A_{1j})$ since more talent increases home attendance at a given average ticket price. Hence an increase in talent acts to shift the demand for home attendance to the right.

place no ceiling on either although we return to this issue shortly. With a revenue function that is linear in talent, a cost function that is quadratic in talent proves to be a convenient specification.

$$C(t_1) = qt_1^2 \tag{4}$$

Maximizing (1) with respect to t_1, subject to (2), (3) and (4) gives the first order condition

$$\frac{\partial p_1}{\partial t_1} = a\left(g_1(n-1)P_1 + P_1\sum_{j=2}^{n} g_{1j} z_j \right) + (1-a)\left(\sum_{j=2}^{n} g_j P_j z_j + \sum_{j=2}^{n} g_{j1} P_j \right) - 2qt_1 = 0 \tag{5}$$

where $z_j = \partial t_j / \partial t_1$ is the conjecture of team 1 regarding the reactions through talent acquisition of each of the other clubs, j, to team 1's changes in talent. We assume all clubs possess identical conjectures[8]. The first two large-bracketed terms in (5) give the (conjectured) marginal revenue of team 1. That is, an increase in talent for team 1 raises both its attendance at home and the attendance of its road games as long as z_j is not "too" negative. With revenue sharing, team 1 shares the revenue from both sources. The final term is the marginal cost of talent. Solving (5) for the optimal talent for team 1, t_1^*, gives

$$t_1^* = \frac{a\left(g_1(n-1)P_1 + \sum_{j=2}^{n} g_{1j} P_1 z_j \right) + (1-a)\left(\sum_{j=2}^{n} g_j P_j z_j + \sum_{j=2}^{n} g_{j1} P_j \right)}{2q} \tag{6}$$

The solution for t_1 is more easily manipulated if some of its terms are converted to averages, represented by a bar over the variable(s), by multiplying and dividing by n-1. After all, the owner of team 1 does not really care about the individual game effects on attendance and revenue at the end of the season, rather only the average effect per game. Thus t_1^* may be rewritten as:

$$t_1^* = \frac{aP_1(n-1)\left(g_1 + \overline{g_{1j} z_j}\right) + (1-a)(n-1)\left(\overline{g_j z_j P_j} + \overline{g_{j1} P_j}\right)}{2q} \tag{7}$$

---

[8] This is overly strong, but is a useful simplification. We will not consider all conjectures but instead treat three common specifications: Cournot, competitive and cartel.

Maximizing Profits using Revenue Sharing

To solve for profits as a function of both talent and the degree of revenue sharing, we need to develop an expression for changes in the optimal level of talent as revenue sharing, a, changes. The standard procedure in QF (1992, 1995), Vrooman (1995), Marburger (1997), Rascher (1997) and Késenne (2000) is to differentiate the marginal revenue, the first two terms in (5), with respect to α to determine how marginal revenue shifts with revenue sharing. In the context of their models, the sign of this derivative indicates how revenue sharing affects parity. Since marginal revenue is also the numerator of (7), we differentiate (7) with respect to α, but not because we are interested in saying something about parity, but because this derivative is useful when the optimized profit function is differentiated

Differentiating (7) with respect to the revenue share, a, retained by the home team yields:

$$\frac{\partial t_1^*}{\partial a} = \frac{P_1(n-1)\left(g_1 + \overline{g_{1j} z_j}\right) - (n-1)\left(\overline{g_j z_j P_j} + \overline{g_{j1} P_j}\right)}{2q} \tag{8}$$

where the “bar” over a variable or set of variables again refers to the mean of the products.

The sign of this derivative is not obvious. If clubs possess Cournot conjectures then $z_j = 0$ for all clubs. If team 1’s talent has a larger effect on its own attendance than its road attendance ($g_1 > g_{j1}$) then the derivative is positive and marginal revenue shifts down with greater revenue sharing. This is the “normal” case found in the literature and drives the parity invariance result of revenue sharing. That is, an increase in revenue sharing, a *lower* a, leads to a decrease in talent and no change in parity[9]. Marburger (1997) points out that the derivative could be negative even with Cournot conjectures if the club plays in a small home market. In this case revenue sharing will also move the league towards parity.

If conjectures are competitive then $z_j = -1$ for all clubs. This is equivalent to a talent constraint since it means that team 1 conjectures that the talent it acquires will be entirely at the expense of the other (n-1) teams in the league. The derivative is still positive if $g_1 > g_{1j}$ for all clubs, which is not unreasonable.

Cartel conjectures imply that $z_j = 1$ so that each club matches the acquisition of talent by team 1 per game. Team 1 then anticipates that all other clubs will react to talent acquisition so as to maintain their market shares. The derivative in (8) then depends simply on the difference

[9] The decrease in talent will also shift in the demand curve for tickets by reducing attendance.

between the home game marginal revenue for team 1 and the average of the home game marginal revenues for all other home clubs when they play team 1. This could be positive (above) or negative (below) depending on where the home club average revenue lies in the distribution of all average home revenues. However unlikely the cartel conjecture seems, we retain it as illustrative of the range of consequences that conjectures have on revenue sharing outcomes[10]. Our point is that the sign of (8) depends on the magnitudes of the γ's and the nature of the conjectures.

The optimized profit function can be found by substituting (7) into (1) and simplifying by converting some of the terms to averages.

$$\pi_1^* = \alpha P_1 (n-1)\left(\gamma_1 t_1^* + \overline{\gamma_{1j} t_j}\right) + (1-\alpha)(n-1)\left(\overline{P_j \gamma_j t_j} + t_1^* \overline{P_j \gamma_{j1}}\right) - \theta t_1^{*2} \tag{9}$$

Taking the derivative of (9) with respect to α and requiring that it be negative means that revenue sharing has a positive effect on profit for team 1. This solution implies inequality (10)

$$\begin{aligned}\frac{\partial \pi_1^*}{\partial \alpha} &= P_1 (n-1)\left(\gamma_1 t_1^* + \overline{\gamma_{1j} t_j}\right) + \alpha P_1 (n-1)\gamma_1 \frac{\partial t_1^*}{\partial \alpha} + (1-\alpha)(n-1)\overline{\gamma_{j1} P_j}\frac{\partial t_1^*}{\partial \alpha} \\ &\quad - (n-1)\left(\overline{P_j \gamma_j t_j} + t_1^* \overline{\gamma_{j1} P_j}\right) - 2\theta t_1^* \frac{\partial t_1^*}{\partial \alpha} < 0 \\ &= (n-1)\left(AR_1^* - AR_{j1}^*\right) + \frac{\partial t_1^*}{\partial \alpha}\left(\alpha P_1 (n-1)\gamma_1 + (1-\alpha)(n-1)\overline{\gamma_{j1} P_j} - 2\theta t_1^*\right) < 0\end{aligned} \tag{10}$$

where AR_{j1} is the average of the per game revenue of the other j clubs when they play team 1 in their own parks, AR_1 is the per game revenue of team 1 in its own park[11]. Utilizing (5) and rearranging, (10) reduces to

---

[10] If all clubs maintain the same talent shares every season, relative attendances and revenues would not be expected to change (given no price changes) and the expectation of league standings would be the same every season. Of course actual results could differ due to differences in revenue and cost conditions. The analysis would be complicated since the derivative in (5) would have to include additional terms for the effect of a change in t_1 on the conjectures.

[11] Note that AR_1 is not average revenue per unit of talent. AR_1^* is the optimized per game revenue for team 1, given by $AR_1^* = P_1\left(\gamma_1 t_1^* + \overline{\gamma_{1j} t_j}\right)$. The average per game revenue for the other j teams is given by $AR_{j1}^* = \overline{P_j \gamma_j t_j} + \overline{P_j \gamma_j} t_1^*$.

$$AR_1^* < AR_{j1}^* - \frac{\partial t_1^*}{\partial a}\left(P_1\overline{g_{1j}z_j} + \overline{P_j g_j z_j}\right) < 0 \text{ or}$$
$$AR_1^* < AR_{j1}^* - \left(\frac{t_1^*}{a}\right)h_a\left(P_1\overline{g_{1j}z_j} + \overline{P_j g_j z_j}\right) < 0 \tag{11}$$

The elasticity h_a measures the percentage reduction in talent for team 1 (or percentage increase in talent for the visiting team j) in response to a reduction in α. Condition (11) neatly decomposes the decision for team 1 to support greater revenue sharing[12]. As α is reduced, the optimal talent level of team 1 falls since $\partial t_1^* / \partial a > 0$ by assumption, and consequently $h_a > 0$. This lowers home gate revenue for team 1 and all other j teams through (2b) and (3). If talent levels for the other j teams do not change in response, then lowering α simply exchanges team 1's home gate revenue for all other team's home gate revenue. If the average revenue of the other clubs is greater than the average home gate revenue for team 1, revenue sharing raises net revenue for team 1. This is the essence of condition (11) when z = 0 for all clubs (Cournot conjecture). Each club faces its own unique value for condition (11). Since marginal revenue shifts down for all clubs (through the assumption of $\partial t_1^* / \partial a > 0$ for all clubs and α falls with increased revenue sharing), the marginal cost of talent will also be driven down for all clubs. This is why marginal cost does not appear in (11).

With competitive conjectures in talent, z = -1 for all clubs and condition (11) becomes

$$AR_1^* < AR_{j1}^* + \left(\frac{t_1^*}{a}\right)h_a\left(P_1\overline{g_{1j}} + \overline{P_j g_j}\right) \tag{12}$$

The reduction in talent for team 1 from greater revenue sharing is now acquired by all other j clubs[13], raising their home gate revenues on the margin. The last term in (12) measures the increase in net revenue for team 1 through increased sharing of the home revenues of the j other clubs. The last bracketed term is just the value of the marginal product of team j's own talent. Hence the last term in (12) is a bonus revenue that team 1 receives from greater revenue sharing due to the competitive conjecture in talent. Revenue sharing will be more attractive to clubs

---

[12] Moving from (10) to (11), the fact that we are only considering increased revenue sharing, and a subsequent fall in the value of α, gives rise to $\partial a < 0$ and the subtraction on the RHS of (11).

[13] That is, if team 1 gives up one unit of talent per game, the visiting club acquires that one unit of talent. Since team 1 plays each club only once at home, the total reduction in talent by team 1 is distributed evenly around the league.

whose average home gate revenue is very close to the average home gate revenue for all other j clubs that it plays on the road.

With cartel conjectures in talent, z = 1 for all clubs, the argument is just the reverse of the competitive conjecture case. With greater revenue sharing, the reduction in talent for team 1 is just matched by all other clubs, reducing their home gate revenues. Team 1 would then prefer not to share more in these lower club j revenues. The sign of the last term in (12) is reversed and revenue sharing is less attractive to clubs near the average gate revenue of all other j clubs.

Clubs that operate in large markets (large AR_1) will not support revenue sharing. For a league to adopt revenue sharing, condition (11) must hold for a majority of clubs, regardless of the talent conjecture, implying that there must be a non-uniform league distribution for average per game revenues, and thus the values of marginal products of talent.[14].

Figure 1 aids depicts the different conjecture regimes by plotting α, the share of revenue retained by the home club, against per game revenue. In each conjecture regime, the revenue sharing is an all or nothing decision for the club. Reducing α increases the degree of revenue sharing and slides the club along the revenue line to the left. If condition (11) holds, the relevant revenue line is downward sloping and the club would optimally choose the value $\alpha = 0$, essentially trading its own revenue for the average revenue of the other clubs[15]. If condition (11) does not hold, the club would optimally choose $\alpha = 1$ and keep all of its own revenue. There is no middle ground for the optimal α. Only a bang-bang solution results. If a majority of clubs satisfy (11), revenue sharing will be adopted.

The base case revenue line is drawn in Figure 1 with Cournot conjectures. For small revenue clubs ($AR_1 < AR_{j1}$), the revenue line under competitive conjectures in Figure 1 is steeper than the line with Cournot conjectures (the line pivots around R_1 since a club could always choose to keep its own revenue by choosing $\alpha = 1$). Revenue sharing becomes more attractive with competitive conjectures since reductions in team 1's talent are matched by increases in talent of all other clubs, from which team 1 benefits. Revenue sharing becomes less attractive with cartel conjectures as reductions in talent for team 1 are matched by equal talent reductions for all other clubs. Team 1 must then share in their lower revenues.

[14] Technically the average revenue and value of marginal product of talent would both have to be above or below the league average for each club in addition to the league distributions being uniform. In this case, the vote to adopt revenue sharing could be split 50-50.
[15] Since marginal cost falls as α is reduced, we can couch the discussion in terms of revenue rather than profit.

<u>Perverse effects of revenue sharing on talent</u>

Obviously if $\partial t_1^* / \partial a$ = 0 in (12), then $\partial p_1^* / \partial a$ = 0 since the marginal revenue is unaffected by revenue sharing. The demand for talent will not change and parity is left unaffected. Condition (12) does not change if $\partial t_1^* / \partial a$ < 0 with Cournot conjectures. This would be an unusual case since each club captures a larger share of its revenues from road games. The Cournot revenue line in Figure 1 is unaffected, however the revenue line with competitive conjectures becomes flatter than the Cournot revenue line. The revenue line with cartel conjectures becomes steeper than the Cournot revenue line. With competitive conjectures and $\partial t_1^* / \partial a$ < 0, greater revenue sharing increases the demand for talent for each club, who must bid talent away from all other clubs, reducing the revenues of all other clubs. Clubs would then prefer to share less in the reduced revenues of all other clubs. With cartel conjectures, the argument is just the opposite.

In the perverse case, greater revenue sharing shifts marginal revenue upward for every club, increasing the demand for talent and raising payroll costs. Clubs who will support revenue sharing play in large home markets and face low marginal talent costs. This would appear to be counter-intuitive based on casual empirical observations of club market size and payroll costs. Large market clubs tend to have high payroll costs and probably high marginal talent costs, all the while experiencing a larger return from their own talent at home than on the road. A small number of clubs may fit this description, but most would not making the likelihood of majority support for revenue sharing small.

<u>The QF model again</u>

The QF (1992, 1995) model finds that revenue sharing raises profits for all clubs. This result can be shown to rely on a restriction QF impose on condition (11). QF specify home revenue as a function of home winning percentage only, where winning percentage is determined by the relative talent of the home club. Thus increasing home talent will reduce the winning percentage of the other club in their two team model. In our framework, the QF model imposes the restrictions $\overline{g_{1j}} = -t_1 / \hat{t}^2, g_1 = 1/\hat{t}$ and z_i = 0, where $\hat{t}$ is total talent across all n clubs. Maximizing (1) with respect to t_i, then solving for the equivalent form of (11) without taking means gives

$$P_1(n-1)\left(g_1\left(t_1^* + w_1\overline{t_j}\right)\right) - \left((n-1)\sum_{j\neq 1}^{n} P_j g_j\left(\overline{t_j} + t_1^*\overline{w_j}\right)\right) < 0 \tag{13}$$

Since the first term in (13) is of order (n-1) and the second term is of order $(n\text{-}1)^2$, the sign of (13) is negative and profits always rise with revenue sharing[16].

<u>Central pool revenue sharing</u>

We assume that a league operates with the straight-pool plan discussed in section 3; however the results are the same for a split-pool plan without the side payments to the poorer clubs. Despite its apparent simplicity, this form of revenue sharing is much more complicated to model. Profit for team 1 can be expressed as

$$\begin{aligned} p_1(t_1, \boldsymbol{t_j}) &= aR_1 + \frac{(1-a)}{n}\sum_{i=1}^{n} R_i - qt_1^2 \\ &= \left(a(n-1)\overline{R_1}\right) + \left(\frac{(1-a)(n-1)}{n}\overline{R_1}\right) + \left(\frac{(1-a)(n-1)^2}{n}\overline{R_{ROL}}\right) - qt_1^2 \end{aligned} \tag{14}$$

where ROL is the rest of the league other than team 1 and a bar over a variable means the average over all games and n clubs (where relevant). Converting all revenues to per game averages simplifies the exposition. In (14), the sources of revenue for team 1 have been extracted into separate bracketed components to emphasize the nature of the revenue sharing. The first term is simply the average revenue team 1 earns from its (n-1) home games that it does not contribute to the central fund. The second term is the share of its contributed home revenues to the fund that it will receive back at the end of the season. The third term is the share of central fund revenue that team 1 receives from the revenues of all other clubs. The revenues for each source are given by (15).

---

[16] Suppose (13) is just equal to zero so profits do not change with revenue sharing. Solving for the optimal t_1 then gives $t_1^* = \frac{\overline{P_j g_j t_j}(n-1)}{P_1 g_1} - \hat{t}$. If for any club, $P_1 g_1 > \overline{P_j g_j}$ then $t_1^* < 0$. An equilibrium could with no clubs in the league could result since as wealthy clubs exit, $\overline{P_j g_j}$ falls until for the last club, $t_1^* = 0$.

$$\begin{aligned} \overline{R_1} &= P_1\left(\gamma_1 t_1 + \overline{\gamma_{1j} t_j}\right) \\ \overline{R_{ROL}} &= \overline{P_j \gamma_j t_j} + \overline{\overline{P_j \gamma_{jk} t_k}} \end{aligned} \tag{15}$$

An interesting feature of (14) is the presence of the last bracketed term, which is the share of revenue team 1 receives from the central fund for games that it does *not* play. In our framework, an expansion franchise adds one more team contributing to the central fund. Generally the number of games each club plays over a season does not change with expansion, so the contribution of any one pre-expansion club to the central fund is left virtually unchanged, however pre-expansion clubs will receive a larger share payment if the revenues of the expansion club are above the league average. Leagues will always support expansion to large revenue clubs. Expansion clubs that play in small markets that earn below the league average revenue may still enter the league if the expansion fee can compensate for the loss of share revenue for the existing clubs from the central fund.

The subscript j does not include team 1 while the subscript k does include team 1. Team 1 maximizes its profit in (14) subject to (15) to give the optimal level of talent.

$$t_1^* = \frac{P_1\left(\gamma_1 + \overline{\gamma_{1j} z_j}\right)\left(\frac{n-1}{n}\right)\left(n\alpha + (1-\alpha)\right) + \left(\frac{(1-\alpha)(n-1)^2}{n}\right)\left(\overline{P_j \gamma_j z_j} + \overline{P_j \gamma_{jk} z_k}\right)}{2q} \tag{16}$$

As before, we take the derivative of (16) with respect to α to determine how talent demand changes under revenue sharing.

$$\frac{\partial t_1^*}{\partial \alpha} = \frac{(n-1)^2}{2qn}\left(P_1\left(\gamma_1 + \overline{\gamma_{1j} z_1}\right) - \left(\overline{P_j \gamma_j z_j} + \overline{P_j \gamma_{jk} z_k}\right)\right) \tag{17}$$

The sign of (17) will depend on the signs of the γ's and the assumption of the value of the conjecture z. With Cournot conjectures, $z = 0$ for all clubs and (17) is positive - the "normal" case. With competitive conjectures (talent constraint), $z_j = -1$ and, assuming the return to home talent is greater than the return to visiting talent, (17) is again positive. The sign of (17) cannot be determined if conjectures are collusive ($z_j = 1$), however it is likely that (17) will be positive if clubs are not too small.

The optimized profit function for team 1 is given by

$$p_1^* = a\overline{R_1^*}(n-1) + \frac{1-a}{n}\overline{R_1^*}(n-1) + \frac{1-a}{n}(n-1)^2\overline{R_{ROL}^*} - qt_1^{*2} \tag{18}$$

Maximizing (18) with respect to α gives, after some simplification

$$\frac{\partial t_1^*}{\partial a}\left(\frac{\partial\overline{R_1^*}}{\partial t_1^*}\left(a(n-1) + \frac{(1-a)(n-1)}{n}\right) + \frac{\partial\overline{R_{ROL}^*}}{\partial t_1^*}\frac{(1-a)(n-1)^2}{n} - 2qt_1^*\right) + \overline{R_1^*}\left((n-1) - \frac{n-1}{n}\right) - \frac{(n-1)^2}{n}\overline{R_{ROL}^*} < 0 \tag{19}$$

The derivative in (19) must be negative for revenue sharing to improve profit for any club. The first bracketed term in (19) can be simplified utilizing the first-order condition in (16). Rearranging gives

$$AR_1^* < AR_{ROL}^* - \left(\frac{t_1^*}{a}\right)h_a\left(\left(\left(\frac{(1-a)(n-1)}{n}\right)\overline{g_{1j}z_j}\right) + \left(\left(\frac{(1-a)(n-1)^2}{n}\right)\left(\overline{P_j g_j z_j} + \overline{P_j g_{jk} z_k}\right)\right)\right) \tag{20}$$

Condition (20) for central pool revenue sharing differs from condition (11) for traditional revenue sharing in several ways. In condition (11), home revenue per game must be less than road revenue per game only for the games in which team 1 participates. In condition (20), home revenue per game must be less than the average per game revenue *for all other teams in the league*. The second term on the RHS of (20) is the marginal increase in the net revenue of team 1 with increased sharing. Of course with Cournot conjectures in talent, other clubs do not respond to the reduction in talent of team 1 and the condition simplifies to an average revenue requirement. With competitive conjectures, the large RHS term is positive and thus makes revenue sharing more attractive to teams close to the average revenue of all other j clubs. With all other j clubs increasing their talent in response to the reduction in team 1's talent, team 1 reaps the benefit of higher home gate revenues, higher gate revenues for its road games, and higher revenues for *games in which it is not involved*. The cartel conjecture again gives the opposite result.

The club's decision to support a vote to revenue share is a bang-bang solution, analogous to the presentation in Figure 1 for the decision to vote for traditional revenue sharing. The effect of different conjectures on the slope of the revenue line is qualitatively the same. The presence of the number of clubs, n, in the RHS of (20), might lead one to conclude that expansion of the number of clubs would make revenue sharing more attractive with competitive conjectures. It is not hard to show that both of the relevant bracketed terms are increasing in n. However this is not a general result since we assume that team 1 plays each of the other j teams once. Expanding the league by one club adds one more home game and road game to team 1's schedule, as it also does for all other j clubs. Increasing revenue sharing and allowing expansion then allows team 1 (and all other j teams) to capture the increased revenue from one more home and away game when talent is absorbed by the rest of the league. In general, expansion *does not* increase the number of games that a club plays in a professional sports league.

IV. THE EVIDENCE

Professional sports clubs can achieve higher profits through revenue sharing if conditions are right. With traditional revenue sharing, a club will experience an increase in profit if condition (11) is met, regardless of whether conjectures in talent are Cournot, competitive (talent constraint) or cartel-like. A club's profit will increase with traditional revenue sharing in the "normal" case (greater revenue sharing decreases talent demand implying $\partial t_1^* / \partial a > 0$) if its home gate revenue is smaller than the average gate revenue for it's road games. Implicit in the derivation of condition (11) is the requirement that marginal talent cost decreases more than marginal revenue for clubs that support revenue sharing. Hence the decision to adopt revenue sharing is as much a decision to hold down player salaries as it is to correct inequities in the distribution of club revenues.

Major league baseball replaced its use of traditional revenue sharing with central-pool type revenue sharing in its 1996 collective bargaining agreement. The NFL did the same at the start of its 2002 season. Club profit can increase with central-pool revenue sharing if the club's revenue is less than the average of all other club's revenues, according to condition (20). Our model suggests that a larger number of clubs in each league must have satisfied condition (20) compared to condition (11). Was this the case? To test for condition (11), we estimated the average home gate revenue for each club in MLB, the NHL and the NFL for the 1999-2000 and 2000-2001 seasons. We also estimated the average road revenue for each club for the same seasons. A club should support traditional type revenue sharing if the ratio of average road revenue to average home revenue is greater than one. Tables 2, 3 and 4 provide the results. The NHL does not use traditional-type revenue sharing, yet a bare majority of owners (17/30 and 16/30) would have voted to adopt it given the results of Table 2. Support for traditional revenue sharing is slightly stronger in the NFL (16/31 and 19/31), but not overwhelming. Baseball would have found the least support for traditional revenue sharing (15/30 and 14/30) over the two seasons. The NHL and the NFL share very similar distributions for the revenue ratio with average ratios of away to home revenue and standard deviations of approximately 1.075 and 0.31. The average ratio and standard deviation is much higher for MLB at approximately 1.4 and 1.11 respectively. Baseball has some spectacular winners and losers from traditional revenue sharing: Montreal gained $6.56 for every dollar contributed in the 2001 season; Florida gained $2.45 for every dollar contributed; Boston and San Francisco gained only $0.57 for every dollar contributed. These revenue disparities account for the large mean and standard deviation of the MLB ratio distribution, however only a minority of clubs benefit under the plan.

To gain enough support for central-pool revenue sharing, the distribution of average home revenues must be heavily skewed to the right, so that the league will be composed of a majority of clubs earning below the average for all other clubs in the league. If more clubs satisfy condition (20) than condition (11), then central-pool type revenue sharing will more condition likely be adopted. We present results for the 1990 to 1996 seasons in Table 5 for MLB, the NFL and the NBA. Unfortunately we could not acquire NBA game by game attendance data for any of those seasons so the results only test evidence for central pool revenue sharing. Several results are quite striking. Baseball had the least support for central-pool revenue sharing over the sample period, but support would have been much stronger prior to 1996, strong enough to carry a majority vote. Support for central-pool revenue sharing has always been stronger in the NFL compared to MLB. The figures indicate that the majority of clubs in the NFL that would vote positively grew over the sample period to 70% by 1996. Surprisingly the NBA also demonstrates a clear majority for central-pool revenue sharing for every year in the sample, yet the NBA does not use revenue sharing. The driving force behind the voting results is the degree of skewness in the distributions of local revenue. The NFL local revenue distribution is much more skewed than the same for MLB, and is much more skewed than that for the NBA after 1992. With large skewness, more clubs will benefits from revenue sharing, which clearly confers with the predicted votes.

It could be that MLB voted to adopt central-pool type revenue sharing with contraction of the poorest teams in mind. This might explain the apparent deadlock in voting for the 2001 season in Table 5 If the two clubs designated for contraction (Minnesota and Montreal) are removed from the 2000 and 2001 season gate revenue estimates in Table 4, still only 14 out of 28 clubs benefit under the central-pool revenue sharing plan[17]. However our gate revenue estimates are not without some degree of error. If we include the clubs whose ratio for condition (20) is greater than 0.97, the number of clubs rises to 16 out of 28[18] for both seasons.

Either form of revenue sharing drives down the marginal cost of talent. It could be that payroll cost reductions (or a slowing of payroll increases) could move some MLB clubs on the margin of voting against revenue sharing to voting for revenue sharing. To test this hypothesis, we assumed two forms of payroll reductions. First, we reduced the payroll of each MLB club by 3%, 10% and 50% of the league average payroll using the data in Table 1 for the 2001 season. Only one club moved from non-support to support of revenue sharing. Second, we reduced the payroll of each MLB club by 3%, 10% and 50% successively of its own payroll. The result was the same. Our results again suggest that higher profits, whether achieved through payroll cost reductions or the redistributive effects on revenues, are not the driving force behind revenue sharing in MLB in recent years.

V. CONCLUSIONS

The basis of the theoretical model developed in this paper is that a club owner will vote to institute some form of revenue sharing if his or her profit increases as a result. We then derive a necessary condition for this to be the case under two different forms of revenue sharing. While striving for parity is another important motivation for revenue sharing that has been discussed in the literature, we abstract from analyzing the effects on parity in our framework.

This paper makes a number of contributions to literature, principally the explicit account of the voting requirement for revenue sharing, and the use of different conjectures on input (talent). The median voter problem with revenue sharing has not been addressed in the literature. If a majority of club owners satisfy our condition(s), revenue sharing should be adopted by the league. Positive skewness of the league revenue distribution is a necessary condition to obtain a majority voting result and obviously influences the number of clubs that satisfy our condition(s). Actual revenue distributions for the major North American sports leagues demonstrate marked positive skewness, justifying the use of the voting model.

[17] Gate revenues are used in place of local revenues here. In the NFL, the effect of contraction is much more pronounced than in MLB. Eliminating the two lowest revenue clubs, Arizona and Atlanta, increases the number of clubs who benefit under central-pool revenue sharing to 21 out of 29 for the 2000-2001 season. Oddly, contraction is not an issue for NFL owners.

[18] The effect is even greater for the NFL where 19 clubs satisfy condition (11) and 22 clubs satisfy condition (20) for the 2000-2001 season.

Input conjectures form a central feature of our model. We use Cournot conjectures as the base case for the voting model. Under normal effects of revenue sharing on talent demand, competitive input conjectures (equivalent to a perceived league talent constraint) make revenue sharing more attractive, perhaps explaining why salary caps and revenue sharing appear to go hand-in-hand in some professional leagues (NFL). Cartel input conjectures are shown to make revenue sharing less attractive relative to competitive or Cournot conjectures and could even cause a club owner to vote against it.

References

Atkinson, S., Stanley, L. and J. Tschirhart, "Revenue Sharing as an Incentive in an Agency Problem: an Example from the National Football League", *Rand Journal of Economics*, 19, 1988, 27-43.

Cairns, J., N. Jennett and P. Sloane, "The Economics of Professional Team Sports: A Survey of Theory and Evidence", *Journal of Economic Studies*, 13(1), 1986, 3-80.

Késenne, Stefan, "Revenue Sharing and Competitive Balance in Professional Team Sports", *Journal of Sports Economics*, 1(1), 2000, 56-65.

Levin, R., Mitchell, G., Volcker, P. and G. Will, The Report of the Independent Members Commissioner's Blue Ribbon Panel on Baseball Economics, Major League Baseball Commissioner's Office, July 2000.

Marburger, Daniel, "Gate Revenue Sharing and Luxury Taxes in Professional Sports", *Contemporary Economic Policy*, 15, April 1997, 114-123.

Pallomino, F. and L. Rigotti, "The Sports League's Dilemma: Competitive Balance versus Incentives to Win", *Institute of Business and Economic Research, Berkeley, Working Paper No. 292*, 2000.

Quirk, James and Rodney Fort, Pay Dirt: The Business of Professional Team Sports, Princeton University Press, 1992.

_________________, "Cross-Subsidization, Incentives, and Outcomes in Professional Teams Sports Leagues", *Journal of Economic Literature*, 33, 1995, 1265-99.

_________________, Hardball: The Abuse of Power in Pro Team Sports, Princeton University Press, 1999.

Rascher, Daniel, "A Model of a Professional Sports League", in Wallace Hendricks (ed.), Advances in the Economics of Sport, Volume 2, JAI Press, 1997, 27-76.

Vrooman, John, "A General Theory of a Professional Sports League", *Southern Economic Journal*, 61(4), April 1995, 971-990.

Table 1

Consolidated Financial Statement for Major League Baseball ($1,000's), 2001 season

Club	Regular season game receipts	Local television, radio and cable	All Other Local Operating Revenue	National Revenue	Total Operating Revenue	Revenue share net receipts	Operating expenses	Operating profit
Anaheim	30,208	10,927	26,195	24,401	91,731	9,594	101,300	25
Arizona	46,509	14,174	32,970	18,479	125,132	(4,432)	157,284	-36584
Atlanta	62,141	19,988	37,692	24,401	146,851	(10,647)	161,211	-25007
Baltimore	53,216	20,994	29,691	24,401	128,302	(6,807)	126,842	-5347
Boston	89,743	33,353	29,485	24,401	176,982	(16,438)	174,270	-13726
Chicago (NL)	51,189	23,559	30,642	24,401	129,774	(6,568)	124,977	-1771
Chicago (AL)	30,898	30,092	26,291	24,401	111,682	(4,201)	117,369	-9888
Cincinnati	32,102	7,861	6,523	24,401	70,887	13,404	81,943	2348
Cleveland	69,470	21,076	45,295	24,401	162,242	(13,254)	160,361	-11373
Colorado	54,015	18,200	35,197	24,401	131,813	(6,029)	135,228	-9444
Detroit	42,299	19,073	21,018	24,401	106,791	5,127	106,258	5660
Florida	16,756	15,353	4,037	24,401	60,547	18,561	88,288	-9180
Houston	49,161	13,722	36,826	24,401	124,629	(5,185)	125,843	-6399
Kansas City	19,520	6,505	13,270	24,401	63,696	15,997	79,830	-137
Los Angeles	50,764	27,342	41,100	24,401	143,607	(9,107)	188,950	-54450
Milwaukee	46,021	5,918	37,010	24,401	113,350	1,744	98,965	16129
Minnesota	17,605	7,273	6,987	24,401	56,266	19,069	74,799	536
Montreal	6,405	536	2,829	24,401	34,171	28,517	72,690	-10002
New York (NL)	73,971	46,251	38,162	24,401	182,631	(15,669)	174,339	-7377
New York (AL)	98,000	56,750	47,057	24,401	242,208	(26,540)	201,349	14319
Oakland	24,992	9,458	13,932	24,401	75,469	10,520	82,582	3407
Philadelphia	30,435	18,940	7,739	24,401	81,515	11,752	102,380	-9113
Pittsburgh	48,610	9,097	26,598	24,401	108,706	1,782	111,690	-1202
St. Louis	67,084	11,905	27,581	24,401	132,459	(8,229)	130,590	-6360
San Diego	34,381	12,436	8,504	24,401	79,722	8,668	95,873	-7483.14
San Francisco	67,173	17,197	61,524	24,401	170,295	(6,308)	151,295	12692
Seattle	76,570	37,860	56,211	24,401	202,434	(18,791)	168,168	15475
Tampa Bay	18,193	15,511	28,633	18,258	80,595	12,384	103,438	-10459
Texas	50,664	25,284	34,561	24,401	134,910	(8,744)	150,599	-24433
Toronto	25,363	14,460	14,255	24,401	78,479	9,830	131,406	-43097

Source: Accompanying documents to testimony by MLB Commissioner Bud Selig, December 6, 2001.

http://roadsidephotos.com/baseball/mlbsez.htm

Table 2

Ratio of average home gate revenue to average road gate revenue for NHL.

	2001-2001 season			2001-2002 season		
Club	Average home gate revenue (1)	Average road gate revenue (2)	Ratio (2/1)	Average home gate revenue (3)	Average road gate revenue (4)	Ratio (4/3)
Anaheim	$683873	$810254	1.185	$608027	$866357	1.425
Atlanta	782836	745145	0.952	683283	814703	1.192
Boston	764851	806138	1.054	806530	854481	1.059
Buffalo	720556	779690	1.082	724911	854690	1.179
Calgary	546225	806840	1.477	516516	822886	1.593
Carolina	551056	755328	1.371	600197	879641	1.466
Chicago	713405	786807	1.103	740612	856555	1.157
Colorado	1136422	818142	0.720	1176757	871205	0.740
Columbus	849284	764498	0.900	882316	821520	0.931
Dallas	959366	776253	0.809	1406431	831482	0.591
Detroit	1047538	859851	0.821	1075905	894194	0.831
Edmonton	544072	815625	1.499	572453	818422	1.430
Florida	694534	791867	1.140	767363	812644	1.059
LA	867564	800169	0.922	943874	837049	0.887
Minnesota	902861	784484	0.869	927217	800779	0.864
Montreal	771231	765258	0.992	782267	819471	1.048
Nashville	688044	771251	1.121	643024	831830	1.294
New Jersey	799641	804242	1.006	866840	864397	0.997
NY Islanders	384366	830892	2.162	504550	909925	1.803
NY Rangers	1197924	831646	0.694	1187300	887045	0.747
Ottawa	765991	793073	1.035	782171	816477	1.044
Philadelphia	1219749	806517	0.661	1219357	884174	0.725
Phoenix	550905	810760	1.472	522919	854654	1.634
Pittsburgh	788247	863468	1.095	833976	830087	0.995
San Jose	824848	770259	0.934	855517	825251	0.965
St. Louis	878789	825796	0.940	996019	859660	0.863
Tampa Bay	604614	775114	1.282	708914	787544	1.111
Toronto	1290461	782320	0.606	1355539	822115	0.606
Vancouver	796829	799121	1.003	864032	823195	0.953
Washington	596835	801527	1.343	771337	859501	1.114
Number of clubs with ratio > 1			17			16
Mean =			1.075			1.077
St. deviation =			0.314			0.302

Sources: Game attendance from sports.espn.go.com. Average ticket prices from www.teammarketing.com.

Table 3

Ratio of average home gate revenue to average road gate revenue for NFL.

	2001-2001 season			2001-2002 season		
Club	Average home gate revenue (1)	Average road gate revenue (2)	Ratio (2/1)	Average home gate revenue (3)	Average road gate revenue (4)	Ratio (4/3)
Arizona	$1782808	$3417874	1.917	$1444380	$3517235	2.435117
Atlanta	2102146	3188771	1.517	2123389	3236016	1.523986
Baltimore	2948120	3519195	1.194	3477753	3896810	1.120496
Buffalo	3228202	3340360	1.035	2906018	3379781	1.163028
Carolina	4224460	3337370	0.790	4364816	3457841	0.792208
Chicago	2805278	3355205	1.196	2858509	3693878	1.292239
Cincinnati	3302281	2985423	0.904	3183517	3565542	1.120001
Cleveland	3181046	2935056	0.923	3279904	3441041	1.049129
Dallas	3019856	3925226	1.300	3159381	3512869	1.111885
Denver	3503444	3302380	0.943	5808488	3297991	0.567788
Detroit	2963290	3309553	1.117	2937609	3228227	1.09893
Green Bay	2900010	3386648	1.168	3200119	3887627	1.214838
Indianapolis	2667988	3220873	1.207	3073524	3574164	1.162888
Jacksonville	3661045	3047346	0.832	3798827	3256218	0.857164
Kansas City	3642187	3023547	0.830	4027565	3856315	0.957481
Miami	3325612	3234620	0.973	4141462	3425530	0.827131
Minnesota	3097898	3076504	0.993	3378445	3417357	1.011518
New England	2880149	3092905	1.074	2880149	3571050	1.239884
New Orleans	2872074	2827184	0.984	3494543	3613802	1.034127
NY Giants	3580688	3293354	0.920	4390400	3833967	0.873261
NY Jets	4013580	3222228	0.803	4485688	3557959	0.79318
Oakland	2991316	3177477	1.062	3053249	3949740	1.293619
Philadelphia	2872222	3274262	1.140	3043881	3833051	1.259264
Pittsburgh	2243971	3540798	1.578	3871168	3830530	0.989502
San Diego	3172378	3239621	1.021	3475265	3479329	1.001169
San Francisco	3387275	3134698	0.925	3374100	3336685	0.988911
Seattle	2809363	3308050	1.178	2714041	4101436	1.511192
St. Louis	2829593	3592010	1.269	3278079	3388884	1.033802
Tampa Bay	4427133	3469764	0.784	4629086	3227354	0.69719
Tennessee	4060575	3631981	0.894	4192619	3505859	0.836198
Washington	6627194	2946059	0.445	6391248	3519060	0.550606
Number of clubs with ratio > 1			16			19
Mean =			1.062			1.077
St. deviation =			0.274			0.337

Sources: Game attendance from sports.espn.go.com. Average ticket prices from www.teammarketing.com.

Table 4

Ratio of average home gate revenue to average road gate revenue for MLB.

	2000 season			2001 season		
Club	Average home gate revenue (1)	Average road gate revenue (2)	Ratio (2/1)	Average home gate revenue (3)	Average road gate revenue (4)	Ratio (4/3)
Anaheim	336585.5	525923.6	1.563	282105	603770	2.140
Arizona	602307.8	504486.4	0.838	442143	551732	1.248
Atlanta	788533.9	555337.6	0.704	724009	529874	0.732
Baltimore	804882.6	485695.7	0.603	705237	595722	0.845
Boston	904424.8	586805.6	0.649	1116087	640387	0.574
Chicago (NL)	607476.8	553107.5	0.910	744826	613284	0.823
Chicago (AL)	348169.1	567260.4	1.629	413505	526939	1.274
Cincinnati	337278.7	660976.3	1.960	366672	596772	1.628
Cleveland	878150.6	540735.2	0.616	886368	533878	0.602
Colorado	669311.5	474525.8	0.709	594658	518584	0.872
Detroit	776704.5	483893.7	0.623	503142	534171	1.062
Florida	190820.3	488163.7	2.558	200535	490438	2.446
Houston	755734.1	496478.4	0.657	635355	523959	0.825
Kansas City	243608.4	565167.9	2.320	246199	539953	2.193
Los Angeles	573532.1	583743.5	1.018	577727	545574	0.944
Milwaukee	223302.1	442761	1.983	566373	550022	0.971
Minnesota	122063.5	559745.9	4.586	241364	551253	2.284
Montreal	117663.4	489457.2	4.160	72924	478432	6.561
N.Y. (NL)	881496.9	544090.8	0.617	739410	519857	0.703
N.Y. (AL)	1046568	673433.1	0.643	1058646	659622	0.623
Oakland	242257.8	616888.8	2.546	374244	528804	1.413
Philadelphia	274170.7	547702.1	1.998	327395	503431	1.538
Pittsburgh	255286.1	514622.6	2.016	599787	490398	0.818
San Diego	394884	511122	1.294	408443	533461	1.306
San Francisco	869353	524306	0.603	995041	568128	0.571
Seattle	910680	503443	0.553	780968	583249	0.747
St. Louis	723571	549913	0.760	822695	596174	0.725
Tampa Bay	247925	539316	2.175	258711	599988	2.319
Texas	688486	564473	0.820	630164	535085	0.849
Toronto	365325	532219	1.457	365825	593135	1.621
Number of clubs with ratio > 1			15			14
Mean =			1.452			1.375
St. deviation =			1.037			1.137

Sources: Game attendance from sports.espn.go.com. Average ticket prices from www.teammarketing.com

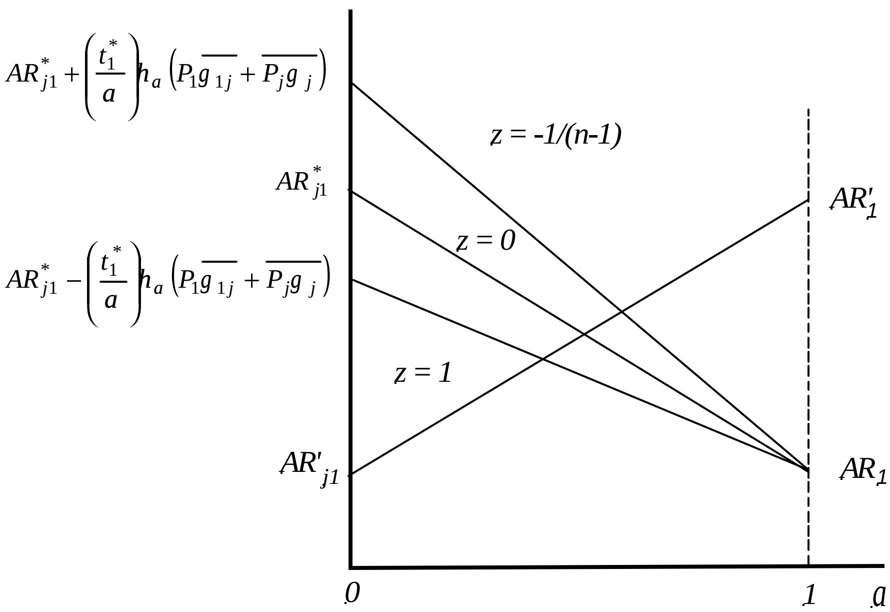
Table 5

Condition (21) for 1990-96 seasons

	Number of clubs supporting central pool plan			Skewness coefficient		
	MLB	NFL	NBA	MLB	NFL	NBA
1990	17/26	16/28	20/27	1.315	1.982	2.803
1991	16/26	17/28	17/27	0.893	1.266	1.911
1992	16/26	18/28	18/27	0.801	1.537	2.098
1993	17/28	18/28	17/27	0.835	2.776	1.163
1994	15/28	18/28	18/27	0.566	3.088	1.213
1995	17/28	19/30	16/27	0.526	2.979	0.928
1996	15/28	21/30	17/29	0.988	2.172	0.923
1998	16/30			0.612		
1999	17/30			0.627		
2001	15/30			0.551		

Source: Local revenues for 1990-96 taken from estimates by Michael Ozanian reported in various issues of Financial World (provided by Rod Fort). Local revenues for MLB for 1998-99 taken from Levin et al. (2000). Local revenues for MLB for 2001 taken from accompanying documents to testimony by MLB Commissioner Bud Selig, December 6, 2001, http://roadsidephotos.com/baseball/mlbsez.htm.

Figure 1


$AR^*_{j1} + \left(\frac{t^*_1}{a}\right) h_a \left(P_1\overline{g_{1j}} + \overline{P_j g_j}\right)$
$z = -1/(n-1)$
AR^*_{j1}
AR'_1
$z = 0$
$AR^*_{j1} - \left(\frac{t^*_1}{a}\right) h_a \left(P_1\overline{g_{1j}} + \overline{P_j g_j}\right)$
$z = 1$
AR'_{j1}
AR_1
0
1
a