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THE PRICING OF SPORTS EVENTS: DO TEAMS MAXIMIZE PROFIT?*

D. G. FERGUSON, KENNETH G. STEWART, J. C. H. JONES AND ANDRE LE DRESSAY

A model of price setting behaviour by National Hockey League teams based on the assumption of profit maximization is developed, estimated, and tested. The model implies parameter restrictions across equations of a two-equation simultaneous nonlinear econometric model, tested by a likelihood ratio test, and implies restrictions on the first and second derivatives of the revenue function, tested with Wald tests. The results in large measure support the hypothesis that hockey teams are profit maximizers, in contrast to some suggestions in the literature. The analysis provides an attractive example of the potential of sports data for testing behavioural hypotheses in economics.

> I bought the team out of love of the game and pride in the city
> and not for profit....
> You're kidding!
> You guessed, eh.
>
> Harv Antoine, *Apocryphal Northern Tales*

INTRODUCTION

THE LONGSTANDING debate over whether firms are profit maximizers has been given new life by recent evidence that both buyers and sellers are influenced by the perceived fairness of prices. Okun [1981], in particular, has argued that the threat of withdrawal of patronage can serve to punish firms who set prices in excess of those perceived by customers to be fair (warranted by costs). This enforces an implicit contract at prices below short run profit maximizing levels. Kahneman, Thaler and Knetsch [1986a, b], generalizing from the results of an extensive series of surveys, have gone further and argued that perceptions of fairness affect pricing on a much wider scale and do so even if the means of enforcement are not available. While this leads them to question the relevance and scope of profit maximization as a behavioural assumption, their case is far from conclusive.

Although buyers may express a dislike for profit maximizing prices and while suppliers may deny that they are motivated by profit maximization, it is not clear what this means for their actual behaviour. By their very nature, no number of surveys can resolve the issue. Consider the case of professional sports which is cited by both Okun and Kahneman *et al.* Despite their

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protestations will sports fans really deny themselves attendance at a game of a favoured (winning) team for this reason alone? Will teams really forego opportunities for more revenue? There is sufficient evidence—largely impressionistic but highly suggestive nevertheless—to indicate that the answer to both questions is no. For example, ticket prices in most North American professional sports leagues vary widely and seem to have more to do with the nature of the local market than they do with costs. Nor is it evident that attendance responds to price increases in a way that differs fundamentally from other goods. It is also apparent that, with respect to the pricing of different categories of seats or the pricing of season tickets and other ticket packages, teams engage in rather sophisticated practices that seem to be geared to extract surplus from their fans. In short it is not at all clear that teams have been inhibited from pricing so as to maximize profits.

Our intention in this paper is to shed some light on the issue of pricing motivation by examining the ticket pricing behaviour of teams in one particular sports league, the National Hockey League (NHL). This is of interest from two points of view. First, it provides a vehicle for introducing and implementing a number of procedures for testing price setting behaviour using firm level data. Sports leagues—and the NHL is a prime example[1]—provide one of the few instances of something close to an unregulated local monopoly for which data on price, sales, product attributes and market characteristics are available for individual agents (the teams). This allows us to extend the methods that have been developed for testing the optimizing behaviour of perfectly competitive agents and to overcome the aggregation problems that plague most of those studies (and which may partially explain their frequent rejection of the restrictions implied by optimizing behaviour).[2]

Second, professional team sports are industries in which there has been an active debate over the appropriateness of the profit maximization assumption[3]—not only by those concerned with general motivational issues, as discussed above, but also by those supporting and opposing changes in public policy toward the industry. Briefly, the argument is that if teams are not profit maximizers, and the suggested alternate motivations have ranged from 'satisficing' through 'love of the game' to 'civic pride', the application of standard economic policy models to sport is also inappropriate.[4] Hence, current public policy which might be justified by standard analysis—regulating monopoly, promoting entry, the application of antitrust laws in

[1] For a discussion of the particular features of the NHL see Jones [1969] and Jones and Ferguson [1988].

[2] See Nicol [1989], for example, for a discussion of some of the aggregation and conditioning problems that arise in applied demand analysis.

[3] See the survey in Cairns *et al.* [1986, 7–10].

[4] See, for example, the discussion of alternate motivations in Markham and Teplitz [1981, 25–31] for baseball (their study was commissioned by Major League Baseball) and the references in Jones [1969, note 3] for hockey.

general—may be ill-founded. Alternatively, if profit maximization holds, then standard analysis and the conventional nostrums presumably apply.

The central issue in our analysis is the narrow one of whether NHL teams act as profit maximizers in setting seat prices. In section I we outline a simple short run model of ticket pricing and introduce our method for testing whether prices are profit maximizing. The test procedure is based on the observation that if firms do act as profit maximizers then (i) the resulting price behaviour is restricted by the nature of the firms' demand and cost conditions and (ii) the appropriate first and second derivative conditions must be satisfied. The former is examined by testing cross-equation restrictions on parameters and the latter by numerically evaluating and testing the derivatives. The empirical implementation and results are presented in sections II and III. We find that, even in the context of this simple model, we fail to reject the hypothesis of profit maximization.

I. THE MODEL AND THE TEST METHOD

Our model of teams' ticket pricing is a simple one. We suppose that at the opening of a season each team considers their fans' willingness to pay for attendance at a representative game. It then maximizes its profits for the season by setting a single (average) seat price to maximize its gate receipts from the representative game. In making this choice it is constrained by the capacity of its arena and hence it may choose to price at a point at which the arena sells out.

Implicit in this approach are the assumptions that:

(i) costs which vary with attendance are small so that profit maximization coincides with revenue maximization,
(ii) games are sufficiently homogeneous that the depiction in terms of a representative game does not do undue violence to a team's actual calculations,
(iii) a single price is sufficient to describe a team's choice alternatives.

The first assumption does seem to be in accord with the facts—most costs of mounting a game are independent of how many people show up. However, the other two warrant more extended comment.

To some extent games do differ in their appeal to fans depending, for example, on the day of the week or the quality of the visiting team.[5] Although such variations can be treated as deviations about an average game, the principal difficulty in doing so is the existence of the capacity constraint imposed by arena size. If average attendance below capacity masks a large

[5] For a discussion of the significance of these factors for attendance in hockey see Jones [1984], and Jones and Ferguson [1988].

number of sellouts then our model would misrepresent the nature of the choice before such a team. Fortunately for us our sample is one in which teams can be clearly divided into those that sell out (or come quite close) for almost all games within a season and those that rarely (if ever) reach the capacity of their arena.[6]

With respect to the single price assumption, we can only express regret that despite repeated attempts we were unable to obtain data on pricing and sales by type of ticket.[7] As indicated in the introduction, it is our conjecture that teams use ticket bundling and the structure of seat prices to extract surplus from their fans and that they do so quite effectively. This limited our ability to deal with all of the relevant aspects of their behaviour and forced us to treat tickets as a composite good.

Given these assumptions we can now proceed with a more formal description of the model. The demand for attendance at the representative game of a team is described by an (inverse) demand function

$$(1) \qquad p = f(A, \mathbf{z}; \boldsymbol{\theta})$$

where p is the team's average ticket price, A is average attendance per home game within the season, $\mathbf{z}$ is a vector of attributes of the team and its home city and $\boldsymbol{\theta}$ is a vector of parameters. The team's ticket revenue is

$$(2) \qquad R(A, \mathbf{z}; \boldsymbol{\theta}) = Af(A, \mathbf{z}; \boldsymbol{\theta})$$

and, as described above, we suppose that they choose a level of attendance A and corresponding price so as to

$$(3) \qquad \max_A R(A, \mathbf{z}; \boldsymbol{\theta}) \quad \text{s.t. } A \leqslant C$$

where C is their arena capacity. The associated Kuhn–Tucker condition

$$(4) \qquad \frac{\partial R(A, \mathbf{z}; \boldsymbol{\theta})}{\partial A} \geqslant 0, \quad \frac{\partial R(A, \mathbf{z}; \boldsymbol{\theta})}{\partial A}(C - A) = 0, \quad C - A \geqslant 0$$

then characterizes the team's behaviour. In particular, if the revenue function is concave in A, then (4) is sufficient for A (and $p = f(A, \mathbf{z}; \boldsymbol{\theta})$) to be profit maximizing. More importantly, local concavity is necessary if the capacity constraint is not binding.

For the purpose of testing the hypothesis of profit maximization one critical point is that the parameters of the inverse demand function recur in

[6] See Table II for identification of the teams which sold out in each of the seasons. In general, this appears to reflect the dominance of fans' desire for a winning home team and in the Canadian case (note in Table II that only two of the Canadian teams failed to sell out) seems to reflect the significance of hockey in Canadian culture. For supporting evidence for an earlier period, see Jones [1984] and Jones and Ferguson [1988].

[7] The only price we could obtain was average price data for the three seasons 1981–1983 (see footnote 9).

(4). More specifically, the choice of a functional form for (1) also determines the form and prameterization of (4). The assumed behaviour imposes restrictions and a test of these restrictions can then be used to test the behavioural hypothesis.

Such tests are performed on restrictions across equations and consequently the first inequality in (4) cannot be represented directly. Our solution was to use

$$(5) \qquad \frac{\partial R(A;\mathbf{z};\boldsymbol{\theta})}{\partial A}(C-A)=0$$

as the equation representing the teams' choices. The estimation of a system consisting of (1) and (5) can then serve as the basis for a likelihood ratio test of the restrictions, and in addition numerical evaluation and testing of $\partial R/\partial A$ and of $\partial^2 R/\partial A^2$ can be used to determine if the conditions (4) are satisfied and whether the revenue function is concave in A for those teams that do not sell out.

Although we are concerned with a very specific instance here, this method is clearly linked to the broader literature on tests of behavioural hypotheses. The procedure is similar in form to the familiar parametric tests of the (cost minimizing or profit maximizing) behaviour of perfectly competitive firms, in so far as it uses tests of cross-equation restrictions and numerical checks on derivatives to determine if the implications of the assumed behaviour are satisfied.

II. EMPIRICAL IMPLEMENTATION

Estimation requires, of course, that the vector of home city and team attributes $\mathbf{z}$ be specified, as well as a functional form for the inverse demand function $f(A,\mathbf{z};\boldsymbol{\theta})$. The following list of attributes was used.[8]

- z_1 Population of the team's home city
- z_2 Per capita income of the team's home city
- z_3 Dummy $= 1$ if the home city is in Canada
- z_4 Number of 'superstars' on the team

[8] These attributes and variations on them have been used in virtually all demand studies of professional team sport using time series and/or cross section data. For specific examples see Noll [1974], Jones [1984], Jones and Ferguson [1988], and for overviews see Cairns *et al.* [1986, 12–27] and Schofield [1983]. The attribute z_1 is from the *Statistical Abstract of the United States*, 1985 for the US teams; and interpolated between the *Census of Canada* 1981 and 1986 for the Canadian teams. The attribute z_2 is from the US Department of Commerce, *Survey of Current Business*, April 1985 for US teams; and extrapolated from Statistics Canada, *Income Estimates for Sub-Provincial Areas*, 1983 for Canadian teams. The observations for z_4 were determined subjectively, by the authors. The attribute z_5 was computed from the daily standings of the teams during each of the three seasons as published in the *Victoria Daily Times*; and z_6 was obtained from the *NHL Guide*, 1981–1983.

z_5 The team's average rank in the League over the current season
z_6 The team's rank in the League at the end of the previous season

Data were collected for the 1981, 1982, and 1983 hockey seasons, the only ones for which data on ticket prices are available.[9] Since the NHL consisted of 21 teams at this time, our data set therefore contains 63 observations describing team behaviour.

As our theory does not suggest a functional form for the inverse demand function it seems desirable to choose as general a form as possible so as not to unduly restrict the demand relationship. For the most part we experimented with empirical models based on inverse demand functions of the form

$$f(A, \mathbf{z}; \boldsymbol{\alpha}, \boldsymbol{\beta}, \gamma) = a(\mathbf{z}; \boldsymbol{\alpha}) + b(\mathbf{z}; \boldsymbol{\beta}) A^{\gamma} \tag{6}$$

with a number of particular forms chosen for $a(\mathbf{z}; \boldsymbol{\alpha})$ and $b(\mathbf{z}; \boldsymbol{\beta})$. In addition, we experimented with alternate ways of representing the first derivative

$$\frac{\partial R}{\partial A} = a(\mathbf{z}; \boldsymbol{\alpha}) + (\gamma + 1) b(\mathbf{z}; \boldsymbol{\beta}) A^{\gamma} \tag{7}$$

Two issues governed our ultimate choice of specification—the computational problems that frequently arise in obtaining maximum likelihood estimators when using complicated nonlinear forms and the need to normalize (7) when substituted in (5). In estimation we considered linear, log-linear, and CES forms for $a(\mathbf{z}; \boldsymbol{\alpha})$ and $b(\mathbf{z}; \boldsymbol{\beta})$. It was found that nonlinear forms invariably led to intractable convergence problems in the application of nonlinear estimation procedures, and so in the end we settled on linear specifications. Normalization of the parameters in (7) was treated by substituting from (6) and representing (7) as

$$\frac{\partial R}{\partial A} = p + \gamma b(\mathbf{z}, \boldsymbol{\beta}) A^{\gamma} \tag{8}$$

The empirical model then consisted of[10]

$$p_i - \boldsymbol{\alpha} \cdot \mathbf{z}_i - (\boldsymbol{\beta} \cdot \mathbf{z}_i) A_i^{\gamma} = \varepsilon_{1i} \tag{9}$$

$$(p_i + \gamma (\boldsymbol{\beta} \cdot \mathbf{z}_i) A_i^{\gamma})(C_i - A_i) = \varepsilon_{2i} \tag{10}$$

where i refers to an observation for a particular team in a particular season.

This model represents a system of two stochastic simultaneous nonlinear equations. Although the equations have been derived in a deterministic setting, for all the usual reasons we do not expect that the data should fit them

[9] The ticket price data was obtained from the *Toronto Globe and Mail* (February 25, 1985, p. 20) and from information supplied by Mr Al Strachan of the *Toronto Globe and Mail*. The data was placed in real exchange rate adjusted terms.

[10] In the following, the first entry in each $\mathbf{z}_i$ is the number *one* so that the first terms in $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are intercepts.

exactly. This consideration has been treated in the usual way, by the introduction of additive random disturbances which we assume to be normally distributed. As the equations are derived from a common underlying behavioural model the disturbances are in part generated from common sources and so should be treated as being contemporaneously correlated. Accordingly the appropriate estimation methodology is nonlinear full information maximum likelihood, specifying price p and attendance A as endogenous and capacity C and the $\mathbf{z}$ variables as exogenous.[11] This is a standard estimation procedure available in a number of econometrics packages: our own implementation made use of the FIML routine of mainframe TSP.

III. THE RESULTS

The model was estimated both in the restricted form above, in which the cross-equation restrictions on γ and $\boldsymbol{\beta}$ are imposed, and in the unrestricted form consisting of (9) and

$$(11) \qquad (p_i + \lambda(\boldsymbol{\delta}\cdot\mathbf{z}_i)A_i^{\lambda})(C_i - A_i) = \varepsilon'_{2i}$$

Coefficient estimates for the restricted and unrestricted models are presented in Table I. Using the estimates from the restricted model the numerical values of $\partial R/\partial A$ and $\partial^2 R/\partial A^2$ were computed for each of the 63 observations and these are given in Table II. A discussion of the results of each table follows.

In Table I, although the coefficient standard errors are reported for completeness we regard them as being of comparatively little interest because the testable predictions of our theory are in terms of the cross-equation restrictions and the first and second order conditions rather than in terms of the coefficients individually. That is, we do not regard the individual coefficients of the model as having strong intuition associated with them with respect to magnitude or sign in the way that is common in many other econometric applications. Hence inferences with respect to the coefficients individually will not play a role in our statistical analysis of the model.

It is, however, notable that in both the restricted and unrestricted models many coefficients are statistically insignificant. In the context of the restricted model this is likely due in large measure to our specification (6) which allows both the intercept and slope of the inverse demand function to shift with our list of $\mathbf{z}$ variables. Given this specification it is hardly surprising that

[11] Although (10) is an implicit equation and cannot be normalized on any *single* variable, this does not represent any difficulty in estimation. The data on attendance was obtained from the individual game attendance figures published in the *Victoria Daily Times* over the three seasons. The stated capacity, as published in the *NHL Guide* for the respective seasons, was used for C in most instances. In some cases the average attendance exceeded the stated capacity and in those cases the observed average attendance was used for C. This was also done for those teams that attained or exceeded capacity for almost all games, but whose average attendance was slightly less than the stated capacity.

TABLE I
PARAMETER ESTIMATES

Restricted Model (Log of Likelihood Function = −952.95)					
α_0	−829.8283 (834.337)	β_0	1.1953 (5.4349)	γ	0.6893 (0.4311)
α_1	−0.1689 (0.08008)	β_1	0.2639e−3 (0.1152e−2)		
α_2	0.2231 (0.10023)	β_2	−0.1818e−3 (0.8674e−3)		
α_3	−213.0697 (261.168)	β_3	0.6129 (2.7321)		
α_4	31.8027 (119.699)	β_4	−0.4663e−1 (0.2146)		
α_5	36.8637 (22.2257)	β_5	−0.7746e−1 (0.3356)		
α_6	4.2888 (14.6054)	β_6	−0.1269e−1 (0.5641e−1)		

Unrestricted Model (Log of Likelihood Function = −946.29)							
α_0	−782.6429 (0.5038e−1)	β_0	0.8229 (41.875)	δ_0	0.6206 (35.031)	γ	0.7076 (385.11)
α_1	−0.2017 (100.06)	β_1	0.2333e−3 (92125.0)	δ_1	0.1438e−3 (50836.1)	λ	0.7328 (553.19)
α_2	0.2033 (699.99)	β_2	−0.1297e−3 (577630.0)	δ_2	−0.9855e−4 (462316.7)		
α_3	876.1851 (0.2953e−1)	β_3	−0.8490 (25.572)	δ_3	0.3942 (10.078)		
α_4	−69.3134 (0.9074e−1)	β_4	0.1228 (76.291)	δ_4	−0.4663e−1 (21.911)		
α_5	−7.4069 (0.6848)	β_5	0.2667e−2 (526.32)	δ_5	−0.4904e−1 (587.91)		
α_6	−6.3058 (0.7668)	β_6	0.5420e−2 (614.49)	δ_6	−0.7452e−2 (609.43)		

The standard errors are reported in parentheses.

the role of the variables is not well determined, as is reflected in some relatively large standard errors. As our interest is not with respect to the coefficients individually, however, this does not represent a difficulty; of much more importance and value is that the inverse demand function has been relatively generously parameterized so that the problem of implicit restrictions being placed on the demand relationship by an unduly restrictive functional form is mitigated.

An additional possible explanation for some large standard errors is that the inclusion of some variables may be unnecessary. As emphasized earlier, however, our variable set is well established in the literature. It is an elementary result in econometric theory that the inclusion of irrelevant explanatory variables is a far less serious specification error than the

TABLE II
THE DERIVATIVES OF THE REVENUE FUNCTIONS

	1981–1982		1982–1983		1983–1984	
	$\partial R/\partial A$	$\partial^2 R/\partial A^2$	$\partial R/\partial A$	$\partial^2 R/\partial A^2$	$\partial R/\partial A$	$\partial^2 R/\partial A^2$
*Calgary Flames**	1267.8 (0.000)	−0.150 (0.000)	1331.9 (0.000)	−0.164 (0.000)	138.3 (0.424)	−0.128 (0.000)
*Edmonton Oilers**	722.0 (0.047)	−0.056 (0.027)	566.6 (0.063)	−0.073 (0.005)	845.9 (0.033)	−0.067 (0.018)
*Montreal Canadiens**	1302.0 (0.000)	0.008 (0.848)	1257.7 (0.000)	−0.003 (0.929)	716.7 (0.009)	−0.044 (0.005)
*New York Islanders**	1504.3 (0.000)	0.030 (0.633)	1555.5 (0.000)	0.027 (0.682)	1339.2 (0.000)	−0.001 (0.999)
*New York Rangers**	849.9 (0.058)	−0.012 (0.762)	932.2 (0.055)	−0.015 (0.727)	1434.0 (0.044)	−0.008 (0.902)
*Quebec Nordiques**	624.0 (0.029)	−0.041 (0.131)	−88.4 (0.553)	−0.095 (0.007)	640.5 (0.005)	−0.055 (0.000)
*Toronto Maple Leafs**	356.1 (0.068)	−0.068 (0.000)	167.8 (0.350)	−0.090 (0.000)	456.3 (0.040)	−0.082 (0.000)
*Chicago Black Hawks***	415.8 (0.000)	−0.084 (0.000)	597.8 (0.073)	−0.046 (0.017)	101.1 (0.437)	−0.085 (0.000)
*Philadelphia Flyers***	245.1 (0.168)	−0.058 (0.000)	418.6 (0.087)	−0.055 (0.000)	340.2 (0.108)	−0.068 (0.000)
Boston Bruins	536.9 (0.000)	−0.083 (0.000)	540.1 (0.010)	−0.086 (0.000)	540.3 (0.020)	−0.096 (0.000)
Buffalo Sabres	238.2 (0.167)	−0.066 (0.000)	164.8 (0.990)	−0.097 (0.000)	292.5 (0.052)	−0.079 (0.000)
Detroit Red Wings	−155.1 (0.038)	−0.131 (0.000)	−286.2 (0.000)	−0.141 (0.000)	−615.5 (0.000)	−0.125 (0.010)
Hartford Whalers	−181.6 (0.000)	−0.169 (0.000)	−46.2 (0.596)	−0.197 (0.000)	−63.7 (0.420)	−0.185 (0.000)
Los Angeles Kings	443.2 (0.000)	−0.102 (0.000)	432.2 (0.000)	−0.097 (0.000)	357.0 (0.000)	−0.131 (0.000)
Minnesota North Stars	145.7 (0.251)	−0.088 (0.000)	385.6 (0.043)	−0.085 (0.000)	76.3 (0.571)	−0.120 (0.000)
Colorado Rockies	400.8 (0.000)	−0.202 (0.000)	−191.9 (0.008)	−0.168 (0.000)	−117.7 (0.166)	−0.202 (0.000)
Pittsburgh Penguins	182.7 (0.061)	−0.115 (0.000)	379.3 (0.000)	−0.168 (0.000)	550.6 (0.000)	−0.198 (0.000)
St. Louis Blues	−41.4 (0.771)	−0.100 (0.000)	−76.5 (0.209)	−0.133 (0.000)	−32.0 (0.678)	−0.132 (0.000)
Vancouver Canucks	602.5 (0.000)	−0.086 (0.000)	426.7 (0.015)	−0.098 (0.000)	476.5 (0.010)	−0.109 (0.000)
Washington Capitals	−78.4 (0.251)	−0.184 (0.000)	198.8 (0.142)	−0.150 (0.000)	362.5 (0.007)	−0.163 (0.000)
Winnipeg Jets	380.3 (0.029)	−0.082 (0.000)	539.2 (0.000)	−0.087 (0.000)	425.9 (0.000)	−0.118 (0.000)

* Sold out in all three seasons.
** Chicago sold out in 1982–1983 and Philadelphia sold out in all but 1983–1984.
Values in parentheses are the marginal significance levels of a Wald χ^2 test of the hypothesis that the derivative is equal to zero.

exclusion of relevant variables. Hence in our model we prefer to err on the side of the less serious specification error by using the full set of variables that are established in the literature, rather than to omit variables which other studies have found to be important and risk a more serious specification error.

For the unrestricted model standard errors are large in part simply because, once the restrictions are relaxed, we are estimating 23 parameters on the basis of 63 observations. It is therefore not at all surprising that the estimated coefficients are not well determined, and this is reflected in the large standard errors/low t-ratios. Again, this poses no difficulty for our analysis because nothing of importance rests on the coefficient estimates of the unrestricted model; only the loglikelihood function value for the unrestricted model is of interest, in connection with the likelihood ratio test of the cross-equation restrictions. Before turning to this test, however, let us consider our results on the first and second order conditions.

Table II offers valuable insights into the validity of our model because the model implies the following restrictions on the first and second order conditions for the individual teams.

(i) First order conditions:
  (a) $\partial R/\partial A = 0$ for non-sellout teams.
  (b) $\partial R/\partial A \geqslant 0$ for sellout teams.
(ii) Second order necessary conditions:
  (a) $\partial^2 R/\partial A^2 \leqslant 0$ for non-sellout teams.
  (b) $\partial^2 R/\partial A^2$ unrestricted for sellout teams.

Table II reports the numerical values of the first and second derivatives of the revenue function of each team in each season and, in parentheses, the marginal significance level of a Wald test for the hypothesis that each derivative is equal to zero.

The implications of the model for the *second order conditions* are very strongly supported by our estimation results. Numerical evaluation reveals that for *all* non-sellout teams the second derivative is negative. Furthermore the Wald test indicates that this negativity is statistically significant (at conventional significance levels) *in every case* for the non-sellout games. This regularity is so strong that it might lead one to wonder whether it doesn't represent some bias in the test statistic rather than a confirmation of the model; but this suspicion is dispelled by the fact that for sellout teams the second derivative is sometimes positive, and even when negative it is sometimes not significantly different from zero—often with a very large marginal significance level. Hence the second order condition results are entirely in accordance with the predictions of the model.

Results associated with the *first order condition* are somewhat more mixed. For non-sellout teams, where marginal revenue should not differ significantly from zero, there is in fact a fair incidence of rejection of this hypothesis, although in 16 of the 39 non-sellout cases marginal revenue is not significantly different from zero (at a 5% significance level). This leads us to some comments below on the general issue of the reliability of Wald tests. It is however notable that for sellout teams marginal revenue should be non-negative and this is violated in only a single instance (Quebec in 1982–83 and even here the violation is not statistically significant), whereas negative values for marginal revenue are more common for the non-sellout teams. This is supportive of the theory. Another encouraging aspect of the results is that rejection of the hypothesis that marginal revenue equals zero tends to be more common for sellout teams than for non-sellouts (although this result depends somewhat on the significance level chosen), as the model would lead one to expect.

Our inferences with respect to the first and second order conditions have been based on Wald test statistics. Wald tests are the natural ones to apply in this context because they are computed on the basis of the estimated model where the restrictions to be tested have not been imposed. Given that the first order condition is often rejected for non-sellout teams when the theory implies that it should not be, it may be useful to note that Wald test results must be qualified by a number of considerations generic to Wald testing.

(a) The three standard asymptotic test criteria are the Lagrange Multiplier (LM), Likelihood Ratio (LR), and Wald (W) test statistics. For linear restrictions these are related by the well known Berndt–Savin [1977] inequality.

$$\text{LM} < \text{LR} < \text{W}.$$

Although the first and second order conditions for our model represent nonlinear restrictions, the Berndt–Savin inequality nevertheless suggests strongly that Wald tests are the most likely to yield rejections of hypotheses. This feature of the Wald statistic may be reflected in the results of Table II; in particular, it is possible that the frequent rejections of the first order condition for the non-sellout teams is a statistical artifact rather than a deficiency of the model. This problem is most likely to be apparent, of course, in analyses such as ours which are based on comparatively limited samples, so that the small-sample behaviour of the statistic is not well approximated by its asymptotic distribution.

(b) Monte Carlo studies such as those of Gallant [1976, 1977] suggest that the finite sample distribution of the Wald statistic is less closely approximated by its asymptotic distribution than is the case for the Likelihood Ratio or Lagrange Multiplier statistics. Hence Wald test results are relatively unreliable.

(c) The Wald test statistic is not invariant to reparameterization of the model. "With the same data and an equivalent model and hypotheses, two investigators could obtain different values of the test statistic." (Burguete, Gallant, and Souza [1982, p. 185]) This element of arbitrariness is not present in the other two test statistics.

Given these deficiencies of Wald testing, it is desirable that not all our inferences with respect to our model make use of this procedure. Fortunately the other restrictions to be tested, the cross-equation restrictions, are most naturally tested with a likelihood ratio test, and it is to this that we now turn.

Returning to Table I, a likelihood ratio test of the cross-equation restrictions is based on a comparison of the loglikelihood function values associated with the restricted and unrestricted models. The computed value of the likelihood ratio test statistic is $2(-946.92-(-952.95)) = 13.32$, which for the eight cross-equation restrictions being tested does not represent a rejection at conventional significance levels. (For example $\chi^2_{.05} = 15.507$.)

In summary, to a very considerable extent our empirical results are consistent with the economic behaviour hypothesized by the model. This is especially noteworthy because of the simplicity of the model and the frequency with which similar tests of optimizing behaviour have failed. Our results are in striking contrast to the rejections of the restrictions implied by micro-theoretic models of agent behaviour which so often arise in the application of asymptotic test procedures in other areas of applied econometrics. For example, as documented by Deaton [1986], the homogeneity and symmetry restrictions of consumer theory are routinely rejected in applied demand analysis. It is also common to find that second derivative conditions, such as the negative semidefiniteness of the Slutsky matrix, are not satisfied. The comparative success of our results may be due, in part, to our use of data for individual agents rather than the aggregated data commonly employed in other studies.

IV. CONCLUSION

The above analysis is of interest both methodologically and from the point of view of substantive policy implications. Our econometric results, although based on a fairly simple model which abstracts from some of the complexities of actual team behaviour, offer considerable support for the profit maximizing behaviour hypothesized. These results have made use of both Wald and likelihood ratio tests and have involved the testing of cross-equation restrictions and hypotheses concerning the first and second order conditions for profit maximization, as well as the numerical evaluation of these first and second order conditions. Our results are particularly encouraging given the negative results which so often arise from analogous tests of agent behaviour in other areas of the application of econometrics to microeconomics, such as production and demand analysis. We have conjectured that one explanation for the comparative success of our results may be the availability of data on individual agents (the teams)—a level of disaggregation which is often not available in the industry or commodity data sets normally used to investigate hypotheses concerning microeconomic agent behaviour. Indeed it is not uncommon to find aggregation issues cited as a likely cause of the failure of such empirical work, and hence the increasing use of micro data by researchers.

It is evident from our results that ticket pricing by NHL teams may well be consistent with profit maximization so that, in contrast to the suggestions of Okun, Kahneman *et al.*, and others, the possibility that the behaviour of sports teams may be motivated by much the same considerations as are true for economic agents generally should not be dismissed. It follows that there may be no basis for an exception to the standard policy prescriptions.

Of at least as much interest as its implications for this latter issue, however, is that our analysis provides an attractive example of the potential of sports data for the implementation of tests of agent behaviour. In short, it is our view that sports data represents a potentially rich but previously unrecognized and little-tapped source of micro-level industry/firm/product data suitable for testing a wide range of hypotheses—a source which may compare favourably in cost and quality with other types of disaggregated data.

D. G. FERGUSON, KENNETH G. STEWART,
J. C. H. JONES AND ANDRE LE DRESSAY,
Department of Economics,
University of Victoria,
Victoria, B.C. V8W 3P5,
Canada.

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Cross-subsidization, Incentives, and Outcomes in Professional Team Sports Leagues

By RODNEY FORT
Washington State University
and
JAMES QUIRK
California Institute of Technology (Retired)

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I. *Introduction*

PROFESSIONAL TEAM SPORTS leagues are classic, even textbook, examples of business cartels (Quirk 1987). As Lance Davis (1974) points out for the history of organized baseball, these leagues are plagued by a host of incentive and enforcement problems that are identified in the conventional cartel literature. However, sports leagues differ from other cartels in one important and paradoxical respect. Sports leagues are in the business of selling competition on the playing field, leading to what Walter Neale (1964) termed "The Peculiar Economics of Professional Sports."

The special problem for sports leagues is the need to establish a degree of competitive balance on the field that is acceptable to fans. In the absence of cross-subsidies from strong teams, teams in weak-drawing cities lack the profit incentives to field teams that can compete at the level that would maximize league revenues. Moreover, as George Daly (1992) has emphasized, subsidies must be paid in ways that pass the test of preserving public confidence in the legitimacy of the competition on the playing field. These considerations are offered by team owners as the rationale for the most controversial practices of sports leagues.[1]

In all existing leagues, the member team franchises are located in cities of widely varying revenue potential. Leagues have developed a variety of de-

[1] This has special relevance in connection with syndication. While syndication, with all member teams sharing league-wide profits, is the simplest possible way to insure survival of league franchises, fans are understandably unhappy with it. Harold Seymour (1960) and Quirk and Fort (1992, p. 310) document the details of cross-ownership in the National (baseball) League in the 1890s and adverse fan reaction which helped pave the way for the emergence of the American League in 1901. Syndication also caused problems for the National Hockey League in the 1940s and 1950s. Currently, constitutions of all major American pro sports leagues forbid cross-ownership. However, with the popularity of World Cup soccer in the United States, at this writing a professional American soccer association is adopting a version of syndication by selling shares to generate capital, with all player hiring done by the centralized association.

IV. *Input Payment Issues*

Certain of the cross-subsidization devices employed by sports leagues operate by intervention in the labor market. We examine the impacts of the reserve-option clause, salary caps, and the rookie draft.

A. *The Reserve-Option Clause*

The reserve clause was introduced into baseball in the 1880 season as a way to control player salaries. Subsequently, it was incorporated into all other major American sports leagues. Although the details vary from league to league (Quirk and Fort 1992, ch. 5), the reserve, or option, clause in a player's contract essentially binds the player for his entire playing career to the owner of the contract. If the club signing him to his first contract trades or sells it, the receiving club acquires the remaining lifetime rights to the player. Over time, as the reserve clause faced court challenges, owners of sports teams developed the argument that, whatever the consequences of the reserve clause on players' salaries, it was needed to preserve competitive balance. Owners argued that free agency would allow the richest teams to acquire a disproportionate share of the playing talent in the league. Competitive balance would be destroyed, driving weaker franchises out of business.

In a seminal paper, Simon Rottenberg (1956) argued that profit incentives would limit the hiring of talent by any league team so that free agency would not have negative consequences for competitive balance in a league. El Hodiri and Quirk (1971) and Quirk and El Hodiri (1974) showed that the distribution of playing strengths (competitive balance) in a league allowing unrestricted sales of players for cash would be the same under free agency as under a reserve clause (a result that can be

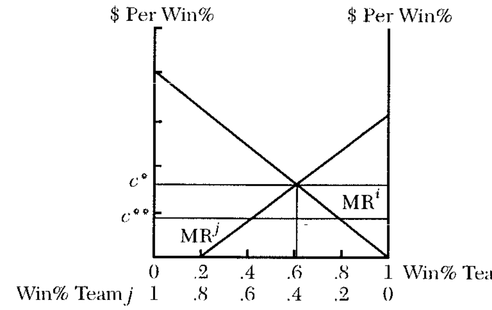

Figure 3. Reserve Clause, Two-Term League Equilibrium without Revenue Sharing

viewed as a version of the Coase Theorem). It should be noted that all three papers were written at a time when no league was operating under free agency, so that no empirical test of these authors' "invariance" result was available. In 1975, players won something approaching free agency for subsequent seasons, providing evidence for testing the invariance hypothesis (Quirk and Fort 1992, ch. 7).

We do not restate the formal invariance result here but, instead, illustrate it for the case of a two-team league without revenue sharing (the extension to revenue sharing is immediate). The case of a two-team league operating under a reserve clause is shown in Figure 3. It is assumed that all teams face the same cost of talent $c^{**} < c^{*}$, where c^{*} is the free agency equilibrium cost per unit of talent (c^{**} is the smaller of the two because the essence of the reserve clause is to drive the equilibrium cost of talent below what would prevail under free agency). Suppose that the initial distribution under a reserve clause provides more competitive balance than (w^{i*}, w^{j*}), the free agency distribution; that is, the initial distribution has $w^i < w^{i*}$, $w^j < w^{j*}$. With $MR^i > MR^j$, both i and j can increase profits by sales of talent from j to i. Team j should be willing to accept any price (for a season's unit of talent)

TABLE 3
WIN-PERCENT STANDARD DEVIATIONS AND FREE AGENCY IN MLB 1966–1975/1976–1985

Pre-Free Agency			Post-Free Agency		
Year	NL	AL	Year	NL	AL
1966	.064	.051	1976	.086	.062
1967	.071	.059	1977	.081	.099
1968	.058	.069	1978	.063	.087
1969	.092	.083	1979	.072	.091
1970	.049	.088	1980	.062	.080
1971	.060	.080	1981	.085	.076
1972	.078	.067	1982	.062	.069
1973	.062	.067	1983	.045	.073
1974	.075	.042	1984	.054	.058
1975	.067	.072	1985	.074	.055
Average	.068	.068	Average	.068	.075

Source: Standard deviations are calculated from win-percents reported in *The Baseball Encyclopedia Ninth Edition* (1993).

Estimating Equations:

(NL) SD = .060* + .008 AFTER + .021 EXPAN
(.006) (.008) (.018)
R^2 = .021, Adjusted R^2 = –.034.

(AL) SD = .071* + .001 AFTER –.003 EXPAN + .030 AFTEREXPAN
(.005) (.007) (.015) (.022)
R^2 = .180, Adjusted R^2 = .027.

Standard errors are in parentheses. * indicates statistical significance at the 5% level. SD = standard deviation of win-percent. AFTER equals one for years after free agency began. EXPAN equals 1 for expansion years and 0 else. AFTEREXPAN equals 1 for expansion year after free agency began and 0 else. (Expansion occurred in 1969 for both leagues and in 1977 for the AL only.)

cent from .400 in the reserve clause period to .392 in the free agency period. In the American (baseball) League, a larger ten percent fall from .415 to .372 occurred. We are unaware of any small sample statistical test for Gini coefficients but, intuitively, it appears that there was no significant change in either league, consistent with the invariance result. In particular, the Gini coefficients offer no evidence at all for the argument of owners that free agency would lead to a domination of the sport by strong-drawing teams or rich owners.

The evidence from baseball does not correspond to the predictions of the championship model. Dougan and Snyder (1994), using a championship model, shows that free agency can lead to a division of a league into "haves" and "have nots" that could impair competitive balance to the point where bankruptcy and exit could result for weak teams. As noted above, if anything, competitive balance has improved slightly under free agency in baseball. Further, the evidence on bankruptcy and team moves hardly supports this "instability" conclusion. Not a single major league baseball team has gone out of business (in either the reserve clause or free agency periods) since the National League shrank from 12 to eight teams in 1900. Further, no team has changed cities during the free agency period (the last move involved the Washington Senators leaving for Texas in 1971).

Neither is there any evidence from the franchise market that free agency is causing investors to discount the future profitability of weak-market teams. Quirk and Fort (1992, ch. 2) document the phenomenon more completely, but some examples are the San Diego Padres (1974 purchase price: $12 million; 1990 purchase price: $75 million), Baltimore Orioles (1979 purchase price: $13 million; 1988 purchase price: $70 million, 1993 purchase price: $185 million), Seattle Mariners (1981 purchase price: $13 million; 1989 purchase price: $76 million; 1992 purchase price: $110 million), and Texas Rangers (1970 purchase price: $11.1 million; 1989 purchase price: $80 million).

However, it should be pointed out that the move from a reserve clause system to free agency did eliminate a major source of subsidies to weak-drawing teams. It was a matter of historical accident that rising national TV revenues acted to offset this over the period from 1976 to 1993 (see below). Recently, the problem of developing other sources of subsidies has resurfaced in response to declining national TV revenues for baseball.

B. *Salary Cap Arrangements*

In 1980, a number of weak-drawing franchises in the NBA that were having financial problems suggested gate sharing as a way out of their difficulties (the home team takes all gate revenue in the NBA). This was rejected out of hand by a blocking coalition of the league's strong-drawing teams. Instead, the league adopted a truly innovative approach to its labor relations and financial problems by agreeing to share a fixed percentage of league revenues with players in exchange for a salary cap. The NBA has been a booming success under its "sharing-cap" and other leagues are following

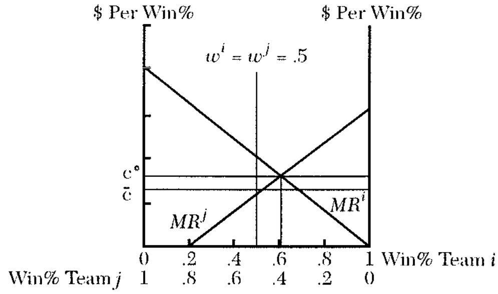

Figure 4. Two-Term League Equilibrium with a Salary cap

suit—the NFL adopted a similar arrangement in its labor agreement of 1993 and, at this writing, MLB is attempting to incorporate such an arrangement into its 1995 labor agreement with the Major League Baseball Players Association.

Under an NBA-style salary cap, the league agrees to set aside some fixed percentage β of total league-wide revenues $\bar{R}$ for player salaries and bonuses. Each league team is required to spend a specified minimum amount on salaries and is banned from spending more than a specified maximum amount, the "salary cap," subject to certain exceptions.[13]

The salary cap is set at the average of required league-wide payments to players, namely, $\beta\bar{R}/n$, where n is the number of teams in the league. Assuming that all teams actually spend the salary cap level, Figure 4 shows the equilibrium for a

[13]Under the NBA agreement, signed on April 1, 1983, the five top teams at the time in terms of salary expenditures—the Knicks, Nets, 76ers, Sonics, and Lakers—were allowed to continue to exceed the cap but their salary levels were frozen. Any team (including the top five) was allowed to exceed the cap to match another team's offer for one of its free agents. And, if a team is over the cap and one of its players retires, the team is allowed to replace him by paying someone 50 percent of the retiring player's salary, even if this leads to a violation of the cap. Finally, expansion franchises are allowed to spend less than the mandated minimum (roughly 81% of the cap) during their first years in the league.

two-team league. Again, c^* denotes the unrestricted free agency cost of talent and $\bar{c} < c^*$ denotes the cost per unit of talent under the cap.

Assuming a reverse-order-of-finish draft and a cap that equalizes spending on talent across all teams, and ignoring the role of coaches and general managers in a team's success, the long run equilibrium for the league would be equal win-percents for both teams. But even after teams i and j have adjusted their talent to the equal win-percent outcome, Figure 4 shows that $MR^i > \bar{c}$ and $MR^j < \bar{c}$. That is, the strong-drawing team i would like to buy more talent, the weak-drawing team j would like to spend less, and the league has an enforcement problem. Spending by the strong-drawing team has to be restrained and the weak-drawing team must be forced to spend its share of league-wide revenues (or be subsidized).

A natural assumption is that β will be chosen low enough so that total league-wide profits are larger than they would be under free agency. If R^* denotes revenue under free agency and $\bar{R}$ denotes revenue under the cap, then

$$\beta < 1 - \frac{R^* - \dfrac{nc^*}{2}}{\bar{R}}$$

is required in the n-team case for profits to be larger under the cap than under free agency. Otherwise, why would the league agree to the cap?

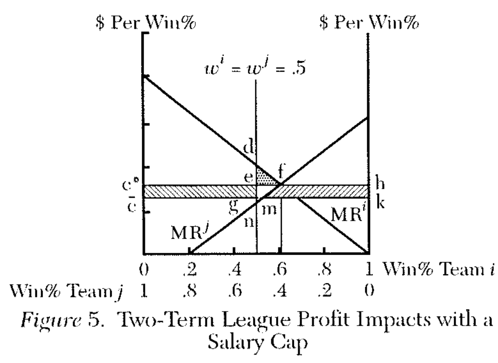

Figure 5. Two-Term League Profit Impacts with a Salary Cap

The distribution of profits under a cap is more complicated. Figure 5 shows the change in profits for teams i and j when moving from free agency to a cap. The free agency equilibrium is at point f, with w^{i*} slightly over .600 and w^{j*} slightly less than .400 at price of talent equal to c^*. The cap equilibrium is at $w^i = w^j = .500$ at per-unit talent cost of $\bar{c}$. In the case depicted, profits for the weak-drawing team j increase because the gain on the units in moving toward .500 (the cross-hatched area $fhmk$) exceeds the excess of $\bar{c}$, over MR^j on the rest of the win-percent units (the area of the triangle mgn). This result always holds as long as league-wide profits increase under the cap.

On the other hand, the strong-drawing team i loses profits on the win-percent it gives up on the way to the final .500 outcome (the shaded area of triangle def). This area is invariant to the choice of $\bar{c}$. The offset for team i is the lower cost of win-percent units between 0 and .500, that is, the cross-hatched rectangle $c^*eg\bar{c}$. The area of this rectangle increases with lower $\bar{c}$. Whether the area of the triangle exceeds the area of the rectangle depends upon the level of β. For β set low enough, profits for team i also rise. In an n-team league, profits for each team increase if and only if

$$\beta < n\left(\frac{\bar{R}^k - [R^{k*} - c^* w^{k*}]}{\bar{R}}\right), k = 1, \ldots, n.$$

And, as noted earlier, with consensus decision making on labor contracts by team owners, a reasonable assumption is that any cap agreed to by a league will satisfy this condition, that is, every team is better off under the cap.

These are the theoretical conclusions. What has been the experience of the NBA under the cap? Unfortunately,

TABLE 4
WIN-PERCENT STANDARD DEVIATIONS AND THE NBA SALARY CAP 1975–1976/1992–1993

Pre-Cap		Post-Cap	
Year	Std. Dev.	Year	Std. Dev.
1975/76	.105	1984/85	.146
1976/77	.098	1985/86	.144
1977/78	.111	1986/87	.154
1978/79	.103	1987/88	.157
1979/80	.152	1988/89	.162
1980/81	.161	1989/90	.168
1981/82	.153	1990/91	.159
1982/83	.161	1991/92	.160
1983/84	.115	1992/93	.158
Average	.128	Average	.156

Source: Standard deviations are calculated from win-percents reported in *The Official NBA Guide* (1993).
Estimating Equation:

$$SD = \underset{(.008)}{.132^{*}} + \underset{(.012)}{.022}\,AFTER - \underset{(.015)}{.008}\,EXPAN + \underset{(.022)}{.019}\,AFTEREXPAN$$

$R^2 = .385$, Adjusted $R^2 = .253$.

Standard errors in parentheses, * indicates statistical significance at the 5% level. SD = standard deviation of win-percent, AFTER equals 1 for years after the cap and 0 else; EXPAN equals 1 for expansion years and 0 else. AFTEREXPAN equals 1 for expansion years after the cap and 0 else.

profit data are not available so that the effect of the cap on the distribution of profits cannot be checked. But it is possible to examine the effect of the cap on competitive balance. The NBA salary cap became operational beginning with the 1984–1985 season. The Studentized Range test showed a deficiency of observations in the tails of the win-percent distribution for the 1989/1990 and 1990/1991 seasons (at the 5% level) but failed to reject that the distribution was normal in every other year (compared to a stable, non-normal alternative). Table 4 shows the standard deviations of win-percent in the NBA for the nine years before and after the cap was put in place. The win-percent model predicts a decrease in standard deviation following the introduction of the cap. But Table 4 shows that there was no significant change (at the 5% level) in the standard deviation during the nine-year period after the cap. Even after taking into account the effects of expansion, the predicted decrease certainly did not occur.

Looking at league championships, in the pre-cap period, Boston won three championships, Los Angeles (Lakers) two, and Portland, Golden State, Washington, Seattle, and Philadelphia each won one. In the post-cap period, the Lakers and Chicago won three championships each, while Boston and Detroit each won two. The pre-cap Gini coefficient is .772 and the post-cap figure is

TABLE 5
TEAM SALARY SPENDING IN THE NBA 1985–86 TO 1993–94, SELECTED YEARS ($MILLION)

Team	1985–86	1986–87	1987–88	1988–89	1991–92	1992–93	1993–94
Team Cap	$4.2	$4.9	$6.2	$7.2	$12.5	$14.0	$15.1
Atlanta	$3.6	$6.1	$6.5	$7.4	$13.0	$18.0	$22.5
Boston	$6.1	$8.0	$8.5	$8.5	$25.4	$25.0	$17.9
Charlotte	—	—	—	$4.8	$12.7	$14.2	$18.0
Chicago	$4.4	n.a.	$5.0	$6.9	$16.8	$18.5	$18.5
Cleveland	$3.6	$5.6	$4.3	$6.7	$16.7	$19.7	$23.7
Dallas	$3.9	$4.6	$4.9	$5.6	$13.2	$11.5	$14.3
Denver	$3.4	$6.0	$5.9	$7.5	$11.9	$13.8	$16.1
Detroit	$4.4	$5.3	$5.9	$7.5	$15.6	$14.0	$15.8
Golden State	$4.3	$5.5	$5.2	$6.0	$12.5	$15.5	$19.2
Houston	$4.3	$6.3	$7.0	$7.2	$13.3	$15.9	$16.8
Indiana	$3.8	$4.5	$5.0	$6.5	$15.2	$16.3	$17.2
L.A. Clippers	$4.3	$5.1	$6.1	$7.3	$12.9	$14.3	$20.2
L.A. Lakers	$8.6	$8.9	$9.1	$10.7	$15.8	$18.9	$23.5
Miami	—	—	—	$3.4	$10.7	$15.1	$17.8
Milwaukee	$3.3	$6.1	$6.6	$7.8	$13.1	$14.0	$14.9
Minnesota	—	—	—	—	$10.9	$13.7	$15.5
New Jersey	$5.8	$5.5	$6.6	$7.0	$12.6	$15.3	$20.1
New York	$6.7	$4.9	$7.4	$8.3	$12.4	$14.0	$22.1
Orlando	—	—	—	—	$12.3	$15.0	$19.9
Philadelphia	$6.9	$6.5	$6.2	$6.4	$14.1	$17.4	$15.5
Phoenix	$4.2	$4.5	$5.3	$6.4	$13.6	$14.3	$21.5
Portland	$4.0	$4.5	$5.2	$8.4	$12.7	$15.4	$23.5
Sacramento	$4.2	n.a.	$5.7	$6.1	$12.5	$14.0	$17.4
San Antonio	$4.1	$7.1	$4.9	$6.5	$11.9	$18.2	$19.3
Seattle	$5.4	$4.9	$5.1	$6.2	$13.3	$14.0	$16.0
Utah	$2.9	$5.2	$5.8	$6.2	$12.8	$14.5	$17.0
Washington	$4.2	$4.6	$6.4	$4.8	$12.6	$17.3	$16.2

Sources: *The Sporting News*, *New York Times*, and Fort data.
Caps for other years: 1984–85: $3.6, 1989–90: $9.8; 1990–91: $11.9.

.855; the inequality of the distribution of championships increased about eleven percent after the salary cap. The championship concentration data also conflict with the predictions of the win-percent model, and, presumably, also with those of the championship model.

The simplest explanation for the failure of the theory to predict the performance of the NBA under a salary cap is that the cap had not acted to equalize spending on talent in the NBA even into the early 1990s. As noted earlier, grandfather clauses exempted the highest-salary teams in the early years of the cap, and the rule permitting teams to match outside salary offers for players already under contact helped to maintain the disparity among teams although at less extreme levels. (Robert Tashjian, 1994, provides some details.) Because teams other than the highest-salaried were subject to the cap, in the early years of the cap this restricted their ability to compete for the best players, producing negative effects on competitive balance in the short run. Table 5 shows that the Lakers were spending 80 percent over the cap as late as 1986–87 and still were 50 percent over the cap in 1989.

There also might be problems with published salary figures because of creative accounting, deferred payments, and unreported payments. There have been several widely publicized cases involving disputes between teams and the NBA Commissioner concerning attempts by teams to find loopholes in the cap agreement. These include the signing of Ray Williams by Boston, Albert King by New York, the long-lingering salary and salary cap hassle among New York, the NBA, and Patrick Ewing, as well as the questions relating to the salary cap implications of the signing of Chris Dudley by Portland. The profit incentives for strong-drawing teams to violate the cap certainly exist, and there have reportedly been a dozen or more cases that have gone to arbitration since the cap was instituted, most involving strong-drawing teams.

Looking at the data in Table 4, it appears that there was a fundamental change in the league environment beginning in the 1979–80 season when the standard deviation rose almost 50 percent and, except for the 1983–84 season, stayed there. The 1979–80 season was when Larry Bird and Magic Johnson came on the scene, leading the Celtics and the Lakers to joint domination of the NBA for the next decade with historically high win-percents, followed by a comparable run with Michael Jordan and the Chicago Bulls. These occurrences may be what the data reflect. We have no information on changes in the business rules of the NBA to account for the observed decline in competitive balance from 1979–80 on.

There also is evidence that there have been enforcement problems with the cap from another direction as well. On December 19, 1991, the NBA Players' Association made public its charge that the NBA had failed to report substantial revenues to avoid having them included in player compensation. The league office said that this was "simply an accounting dispute." The "dispute" was settled in February, 1992, and Charles Grantham, lawyer for the players, said that the dispute involved \$50 to \$60 million per year. Commissioner Stern said, "I don't necessarily agree with the high end of Charles's figure, but it's larger than a bread basket" (*New York Times*, February 10, 1992). Recently, the reported settlement amount was about \$100 million (*Sports Illustrated*, April 28, 1994). However, this all is anecdotal. A reliable testing of the ability of the salary cap to improve competitive balance will have to wait until the grandfathering effects that distort the data into the 1990s have dissipated.

To the extent that an enforceable salary cap does lead to equal playing strengths, this result could lead to long-term revenue problems for a league such as the NBA. The league could begin to lose its TV audiences in strong-drawing cities (the Lakers in Los Angeles, the Celtics in Boston) as these traditionally powerful teams become just one of the bunch. Further, the reduction in strength of powerful teams could open the gate for rival leagues featuring strong teams in these centers of basketball interest. It is not simply a matter of theoretical interest that league-wide revenues are not maximized under a cap (because marginal revenue products of teams are not equalized), it is a matter of real-world interest to leagues and players as well.

Finally, one other aspect of enforceable caps should be mentioned. By imposing a rigid limit on the amount any team can spend on talent, the league protects itself from the threat, however slim, that some wealthy owners could bid salaries through the roof in their desire to field championship teams. While the historical evidence for this is weak, as noted earlier, with corporate ownership on the rise (including cable TV relationships between the Atlanta Braves and Hawks and the Turner Broadcasting System or the Chicago Cubs and WGN), the spill-over profits generated by championship team subsidiaries might provide greater incentives for such behavior in the future.

C. *The Rookie Draft*

The NFL was the first league to institute a rookie draft, beginning with the 1936 season, spurred by the bidding war that broke out between the Philadelphia Eagles and the Brooklyn Football Dodgers over Stan Kostka of the Minnesota Gophers at the end of the 1934 season.[14] The NBA originally had a territorial draft but switched to a reverse-order-of-finish draft in the 1950s. MLB began its rookie draft in 1965. The NHL's rookie draft came on-line a few years later.[15] As with the reserve clause, owners justify the rookie draft on competitive balance grounds, because it enables weak-drawing teams to acquire outstanding new talent at bargain prices.

The problem with the owners' argument is the same as that concerning the reserve clause. If the rookie draft changes the distribution of playing strengths in a league from the free agency distribution, there are profit incentives for weak-drawing teams to sell players to strong-drawing teams, until the revenue-maximizing distribution of talent is reestablished. Thus, with no restrictions on cash sales of players, including draft choices, the rookie draft should have no effect on competitive balance. Instead, by restricting competition for rookies, the draft lowers salaries paid to new players, raising league-wide profits but especially for the teams with high draft picks. On average, weak-drawing teams are weak teams on the field under either free agency or a reserve clause. Thus, it is usually weak-drawing teams that get preferential treatment in the draft. As a result, a disproportionate share of the added league-wide profits accrue to weak-drawing teams from lower costs of talent and from sales of such players to strong-drawing teams.

It has been pointed out by Daly (1992) that at least since the 1976 confrontation between Charley Finley of the Oakland A's and Commissioner Bowie Kuhn (Charles O. Finley v. Bowie Kuhn, 569 F. 2d 1193, 6th Circuit 1978), baseball has had an effective ban on sales of players for cash. In McNeil v. the NFL (D. Minn. 764 F. Supp. 1351, D. Minn. 777 F. Supp. 1475 1993), it was revealed that the NFL has had a rule prohibiting the sale of players for cash since the early 1960s. Daly sees the ban as an action taken by sports leagues to preserve the public's confidence in the integrity of competition on the playing field.

However, prior to these actions by baseball and the NFL, there was a long history of cash sales in all sports leagues. Table 6 summarizes the record of player transactions in the American (baseball) League between 1965 and 1974, showing that over half the transactions involved some cash, with 44 percent of the transactions being straight cash sales. It is

[14] The very first player chosen in the NFL draft was also the first recipient of the Heisman Trophy, Jay Berwanger of the University of Chicago. Philadelphia had the draft rights to Berwanger, but sold them for cash to Chicago (Bears) who, in turn, hoped to cash in on his home-town hero drawing appeal. Reportedly, however, Berwanger's asking price was $17,000 per season, three times what the Bears were paying Bronko Nagurski, and Berwanger never played in the NFL.

[15] The long delay in incorporating a rookie draft in baseball and hockey is due to the fact that, historically, these sports developed their new talent through a minor league system, rather than through the colleges. There were recruiting advantages for the primarily strong-drawing teams with extensive minor league systems. This held up league approval of a draft until rising bonus payments for talented rookies made a draft economically desirable, even to the dominant teams.

TABLE 6
AMERICAN LEAGUE PLAYER TRANSACTIONS 1965–1974

Year	Cash and Players	Cash Only	Total Transactions[a]	% Cash and Players	% Cash Only
1965	3	96	146	2%	66%
1966	23	45	95	24%	47%
1967	23	53	114	20%	46%
1968	13	42	103	13%	41%
1969	5	48	96[b]	5%	50%
1970	29	57	155	19%	37%
1971	19	59	178	11%	33%
1972	27	74	176	15%	42%
1973	15	71	173	9%	41%
1974	33	78	176	19%	44%
Ave.	16	62	141	11%	44%

Source: Fort data.
Notes:
[a] Individual players often were traded or sold more than once. Total Transactions includes all trades and sales that involved players on American League teams over the tabled period. All transactions involved a major league team.
[b] Seattle (Pilots) and Kansas City (Royals) transactions are not counted in the 1969 pre-expansion year totals (17 trades, 9 cash and players, and 79 cash only which would have raised the total to 201) in order to avoid over-counting of expansion purchases and trades.

something of a mystery why cash sales would raise concerns about the integrity of the sport only in the mid-1970s for baseball (and the early 1960s for the NFL), but not earlier.[16]

In any case, cash sales are not the only way in which strong-drawing teams can subsidize weak-drawing teams through player transactions. As pointed out by Noll in his testimony in the McNeil case, "unbalanced trades" can be close substitutes for cash transactions. In an unbalanced trade, weak-drawing teams send expensive (presumably high-talent) veterans to strong-drawing teams in exchange for lower-salaried, apprentice (presumably lower-talent) players or draft rights. While the trade is unbalanced in terms of talent, it can well be balanced in terms of value of the players to the two teams, with both teams ending up with higher profits than before the trade. A classic example is the trade of Kareem Jabbar from the Milwaukee Bucks to the Los Angeles Lakers in the early 1970s.

Another alternative to cash sales is the exchange of players for draft choices. Draft choices are valuable because draft-

[16] A more cynical view is that over the decades from the 1950s through the 1970s a major element of sports economics was the tax-sheltering benefits from team ownership (Benjamin Okner 1974; Davis and Quirk 1975; Quirk and Fort 1992, ch. 3). The tax shelter operates by assigning an artificially high value to the player contracts owned by a team in order to maximize depreciation write-offs. Data on the cash sales of players would provide the best possible evidence to the Internal Revenue Service of misrepresentation of the value of player contracts by owners. Several cases involving the tax shelter were tried beginning in the mid-1970s, including Laird v. the United States (391 F. Supp. N.D. Ga. 1975, First Northwest Industries of America, Inc. v. Commissioner of Internal Revenue (649 F. 2d 707 9th Cir. 1981), and Allen H. Selig v. the United States (565 F. Supp. 524 E.D. Wis. 1983, aff'd 740 F. 2d 572 7th Cir. 1984).

TABLE 7
WIN-PERCENT DISTRIBUTIONS AND THE NFL ROOKIE DRAFT 1930–1941

Pre-Draft		Post-Draft	
Year	Std. Dev.	Year	Std. Dev.
1930	.244	1936	.261
1931	.256	1937	.257
1932	.264	1938	.214
1933	.219	1939	.317
1934	.274	1940	.248
1935	.215	1941	.300
Average	.245	Average	.266

Source: Standard deviations are calculated from win-percents reported in Beau Riffenbrugh (1986).
Estimating Equation:

$$\underset{(.027)}{SD = .260^{*}} + \underset{(.029)}{.010}\,AFTER - \underset{(.032)}{.016}\,CONTRACT - \underset{(.029)}{.028}\,EXPAN$$

R^2 = .209, Adjusted R^2 = −.088.

Standard errors in parentheses, * indicates statistical significance at the 5% level. SD = standard deviation of win-percent, AFTER equals 1 for years after the cap and 0 else; CONTRACT is 1 in years in which the number of teams decreased and 0 else; EXPAN equals 1 for expansion years and 0 else.

ees are in weak bargaining positions relative to team owners. This has to do with limited back-up resources held by rookies, asymmetric information possibilities, and the fact that newly drafted players are under a reserve clause setting for their early years in the league (until the end of their fifth year in baseball, although arbitration eligibility in their third year mitigates part of this disadvantage).

The prediction of the win-percent model—that a rookie draft will have no effect on competitive balance—was examined for the NFL and MLB. The evidence from the same type of approach used earlier gives mixed results, with support for the theory in the case of the NFL draft (but based on very limited data), some support in the baseball draft case for the National (baseball) League, and rejection of the prediction in the case of the American (baseball) League.

Table 7 presents data for the NFL covering the period 1930 through 1941, centered about 1936, when the draft was introduced. The period for analysis was truncated in 1941 to avoid distortions due to World War II. The Studentized Range test detected deficient observations in the tails of the win-percent distribution for 1939, but all other years conform to normality. Tests fail to reject the hypothesis of equal variances before and after the introduction of the draft. Gini coefficients also are consistent with the prediction of no change in competitive balance.[17]

Table 8 shows data on standard devia-

[17] Prior to the draft, Green Bay and Chicago (Bears) won two championships each and New York (Giants) and Detroit won the other two. After the draft was instituted, Green Bay and Chicago (Bears) won two each and New York (Giants) and Washington won one each.

TABLE 8
WIN-PERCENT STANDARD DEVIATIONS AND THE MLB ROOKIE DRAFT 1952–1975

Pre-Draft			Post-Draft		
Year	NL	AL	Year	NL	AL
1952	.104	.088	1964	.083	.103
1953	.083	.103	1965	.084	.085
1954	.088	.115	1966	.064	.051
1955	.071	.098	1967	.071	.059
1956	.080	.091	1968	.058	.069
1957	.060	.087	1969	.092	.083
1958	.045	.053	1970	.049	.088
1959	.047	.062	1971	.060	.080
1960	.061	.079	1972	.078	.067
1961	.090	.100	1973	.062	.067
1962	.116	.061	1974	.075	.042
1963	.085	.082	1975	.067	.072
Average	.078	.084	Average	.069	.071

Source: Standard deviations are calculated from win-percents reported in *The Official Baseball Encylopedia Ninth Edition* (1993).
Estimating Equations:

(NL) SD = .072* – .001 AFTER + .044* EXPAN –.023 AFTEREXPAN
(.004) (.001) (.016) (.021)
R^2 = .353, Adjusted R^2 = .256.

(AL) SD = .087* – .018* AFTER –.026 EXPAN + .040 AFTEREXPAN
(.005) (.007) (.017) (.024)
R^2 = .275, Adjusted R^2 = .166.

Standard errors are in parentheses, * indicates statistical significance at the 5% level. SD = standard deviation of win-percent. AFTER equals 1 for years after the rookie draft began. EXPAN equals 1 for expansion years and 0 else. AFTEREXPAN equals 1 for expansion year after the rookie draft began and 0 else.

tions of win-percents in MLB for 12 years before and after the draft was introduced in 1964. The series was truncated at 1975 to avoid contamination by the introduction of free agency into baseball in 1976. Studentized Range tests do not reject normality for any year between 1952 and 1975. In the National League, there was a fall in the average standard deviation after the draft was introduced but, after taking into account expansion, there was no significant change from the pre-draft level. In the American League, the fall in the average standard deviation was significant at the five percent level. A part of this certainly is due to a change in management of the perennial powerhouse New York Yankees, purchased by CBS in 1964. The average win-percent of the Yankees fell from .624 (pre-draft) to .511 (post-draft) in the years covered by Table 8. But the other two leading teams during the pre-draft period, the Chicago White Sox and Cleveland, also witnessed substantial declines in average win-percent, from .565 to .494 for Chicago and from .553 to .468 for Cleveland. Turning to the concentration of championships, the Gini coefficient for the National League fell 20 percent from .710 to .571 while the decline was 22 percent, from .892 to .699, for the American League. Both appear to be significant increases in competitive balance, contradicting the predictions of the win-percent theory.[18]

V. *Revenue Distribution Issues*

An important source of cross-subsidization in sports involves gate and local TV revenue sharing among league teams.

A. *Gate and Local TV Revenue Sharing*

When the National (baseball) League began operations in 1876, gate receipts were split evenly between the home and visiting teams; each team received half of the 50 cent ticket price. Over time, the visiting gate share in MLB has declined. Currently, in the American League, visitors keep 20 percent of the gate with the home team taking 80 percent, while the home-visitor split in the NL is 95 percent-5 percent. In the NFL, the standard arrangement in the 1920s was a guarantee of $1,000 for the visiting team against 40 percent of the gate after deducting 15 percent for stadium expenses. The NFL now operates under a 60–40 (home-visitor) gate split on ticket sales, with luxury suite rentals excluded from the gate-sharing arrangement. The NBA and the NHL have no sharing with the visiting team, but the NBA does operate under its league-wide sharing of revenues with players. In early 1994, in the preliminaries leading up to labor negotiations in major league baseball, the owners proposed more equal gate and local TV revenue sharing to improve the finances of weak-drawing teams. The players' union was asked to accept a salary cap as its contribution to the future of baseball. As of June, 1995, no league has any provision for sharing local TV revenues among teams.

The win-percent model can be used to examine the effects of revenue sharing among teams on league profits and competitive balance. We look first at the simplified case of a two-team league with no local TV revenues, operating under free agency. With α denoting the home team's gate share percentage, profits for teams i and j are given by:

$$\begin{aligned} \pi^i &= \alpha R^i + (1-\alpha)R^j + \frac{N}{2} - cw^i, \\ \pi^j &= \alpha R^j + (1-\alpha)R^i + \frac{N}{2} - cw^j. \end{aligned} \qquad (15)$$

Because $\partial w^j/\partial w^i = -1$, the first order conditions for the two teams can be written as:

$$\begin{aligned} \alpha MR^i - (1-\alpha)MR^j - c &= 0, \\ \alpha MR^j - (1-\alpha)MR^i - c &= 0. \end{aligned} \qquad (16)$$

By inspection, for any α, equilibrium occurs at that distribution (w^i, w^j) such that $MR^i = MR^j$, that is, gate sharing has no

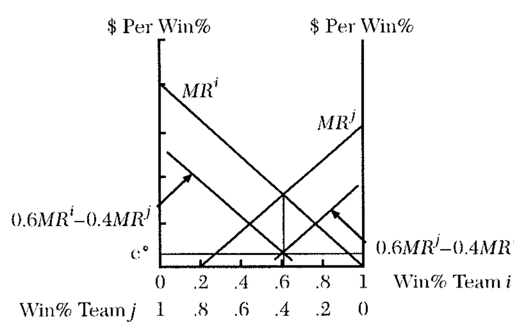

Figure 6. Two-Term League Free Agency Equilibrium with Revenue Sharing

[18] The championship breakdown prior to the draft: New York (Yankees) won ten of the twelve while Chicago (White Sox) and Cleveland (Indians) won the other two in the American League; Los Angeles won six, San Francisco and Milwaukee (Braves) won two each, and Pittsburgh and Cincinnati won the others. After the draft, in the American League it was four for Baltimore (Orioles), three for Oakland, two for Boston, and one each for New York and Detroit. In the National League, St. Louis, Los Angeles, and Cincinnati won three each, New York (Mets) won two, and Pittsburgh won one.

effect on competitive balance in a league.[19] Instead, a decrease in α (more liberal gate sharing) has the effect of lowering player salaries. Figure 6 illustrates this for the two-team league, for $\alpha = 0.6$, the NFL revenue sharing coefficient.

Intuitively, gate sharing lowers the value of an additional win-percent to a team because the team only captures a fraction of any increased revenue at home games. On the road, the team generally loses revenue because, on average, the win-percent of its opponent has fallen. Thus, the value of talent decreases with a decrease in α. Under free agency, this results in a decrease in player salaries; under a reserve clause system, a decrease in α lowers the market value of player contracts.

Consider now the case of an n-team league. The free agency equilibrium condition (12) can be rewritten as:

$$c^* = (2\alpha - 1)MRG^i + \alpha MRT^i + (1 - \alpha)AVE(MRT^{j \neq i}), i = 1, \ldots, n. \quad (17)$$

From (17), it follows immediately that gate revenue sharing has no effect on competitive balance in the absence of local TV. This is because, at equilibrium, $MR^i = MRG^i = MRG^j = MR^j = MR^*$ with all teams facing the same per-unit cost of talent c^*. And, as in the two-team case, a decrease in α, the home team's share, leads to a decrease in c^*: $c^* = (2\alpha - 1)MR^*$, with $dc^*/d\alpha = 2MR^* > 0$.

The presence of local TV revenues greatly complicates matters. Rewriting (17) yields:

$$c^* + \left(\frac{1-\alpha}{n-1}\right)\sum_{j=1}^{n} MRT^j = (2\alpha - 1)MRG^i + \left(\frac{n\alpha - 1}{n-1}\right)MRT^i, i = 1, \ldots, n. \quad (18)$$

League-wide revenue maximization occurs when:

$$MRG^i + MRT^i = MRG^j + MRT^j, i, j = 1, \ldots, n. \quad (19)$$

This condition is satisfied under either free agency or a reserve clause when either local TV revenues are zero or there is no gate sharing.[20] (Thus, for example, this condition is satisfied in the NHL and the NBA). In the general case, (18) implies:

$$(2\alpha - 1)MRG + \left(\frac{n\alpha - 1}{n-1}\right)MRT^i = (2\alpha - 1)MRG^j + \left(\frac{n\alpha - 1}{n-1}\right)MRT^j, i, j = 1, \ldots, n. \quad (20)$$

When $n = 2$, (20) implies (19) so that in a two-team league, league-wide revenue maximization is achieved under any choice of a gate-sharing arrangement even when there are local TV revenues. But this no longer is true for $n>2$. The coefficient on the MRT (marginal local TV revenue product) terms in (20) is an increasing function of n, with $\lim_{n\to\infty}\left(\frac{n\alpha - 1}{n-1}\right) = \alpha$. Also for $n > 2$, note that $2\alpha - 1 < (n\alpha - 1)/(n - 1)$, so that local TV marginal revenues are overweighted in (20) relative to the league-wide revenue maximizing condition in (19). Intuitively, the overweighting occurs because all local TV revenues are captured by the home team while gate revenues are shared with visitors. This immediately leads to the conclusion that

[19] This assumes $\alpha > .5$. For $\alpha \leq 5$, teams face the perverse incentive that they are better off losing than winning.

[20] Local TV and radio revenues in the NFL are minuscule relative to gate and national TV revenues. However, luxury box revenues, a nontrivial component of NFL revenues which are not shared with visiting teams, affect equilibrium outcomes in much the same way as (unshared) local TV revenues.

TABLE 9
AVERAGE LOCAL TV REVENUES AND ATTENDANCE IN MLB (U.S. CITIES) 1987–1991

Team	$\frac{\text{Pop.}}{\text{No. of Teams}}$ (000)[a]	Average Attendance 1987–1991 (000)	Average Local TV 1987–1991 ($000)
AL			
New York	9,692	2,200	$31,200
California	7,409	2,531	$7,100
Baltimore	6,830	2,200	$7,400
Boston	5,432	2,460	$13,525
Detroit	5,215	1,765	$6,900
Chicago	4,170	1,661	$9,750
Texas	4,135	1,949	$8,325
Oakland	3,166	2,449	$5,150
Seattle	3,064	1,241	$3,250
Cleveland	2,878	1,210	$4,500
Minnesota	2,583	2,287	$4,850
Milwaukee	1,622	1,807	$4,300
Kansas City	1,602	2,325	$4,050
NL			
New York	9,692	2,807	$20,525
Los Angeles	7,409	3,015	$8,100
Philadelphia	5,925	1,999	$15,375
Chicago	4,170	2,234	$7,250
Houston	3,850	1,637	$7,000
San Francisco	3,166	1,889	$6,050
Atlanta	3,051	1,229	$5,000
San Diego	2,549	1,726	$6,125
St. Louis	2,507	2,813	$9,375
Pittsburgh	2,404	1,703	$5,250
Cincinnati	1,843	2,202	$6,650

Sources: Population data are from *U.S. Bureau of the Census* (1992); attendance for the two leagues is from the *American League Red Book* and *National League Green Book*, each 1993; local TV revenues are from *Broadcasting and Cable* (*Broadcasting* to 1993), *various issues*.

Notes:

[a] $\frac{\text{Pop}}{\text{No. of Teams}}$ is population of the SMSA in which the city is located, divided by the number of teams in both leagues located in the same SMSA.

the rational choice for a league as a whole is to have the same rules for gate and local TV revenue sharing. This will lead to a distribution of playing strengths that maximizes league-wide revenues in the absence of a salary cap.

Evidence from local TV contracts in MLB indicates that *total* local TV revenues are more responsive to the drawing potential of cities than is attendance, as summarized in Table 9. If this also is true of local TV *marginal* revenues, then the absence of local TV revenue sharing would lead to a concentration of playing talent in the strong-drawing cities that is more extreme than that which maximizes league-wide revenues, from (20). Furthermore, increased gate sharing (a decrease in α), without a comparable increase in local TV revenue sharing, would add to this distortion because it would increase the importance of local TV revenues in team decisions. On the other hand, introducing local TV revenue sharing would move the league toward more equal competitive balance which increases league-wide revenues and profits. From an overall point-of-view, this looks like a winner as a way to finance needed subsidies for weak teams. There is a need for empirical work aimed at resolving these issues.

Looking into the effect of gate sharing on league-wide profits, the answer is unambiguous in the case where there is no local TV. Gate sharing has no effect on competitive balance and, hence, no effect on league revenues. Further, gate sharing leads to lower talent costs; league-wide profits go up with more gate sharing. When there are local TV revenues that are not shared, an increase in gate-sharing changes the distribution of talent in the league. If local TV marginal revenue is more sensitive to market size than is gate revenue, an increase in gate sharing reduces league-wide revenues. An increase in gate sharing also reduces salary costs, so the answer is ambiguous, depending upon which effect dominates—the cost effect or the revenue effect.

There also is some ambiguity about the impact of gate sharing on the distribution of profits among teams. Looking at the case of a two-team league is instructive. The effect of an increase on profits of the two teams operating under free agency, with no local TV revenues, is given in (21):

$$\frac{d\pi^i}{d\alpha} = R^i - R^j - w^i \frac{dc}{d\alpha} = R^i - R^j - 2w^i MR^*,$$
$$\frac{d\pi^j}{d\alpha} = R^j - R^i - w^j \frac{dc}{d\alpha} = R^j - R^i - 2w^j MR^*, \tag{21}$$

where $dc/d\alpha = 2MR^*$ and $dw^i/d\alpha = dw^j/d\alpha = 0$ from (17). Because team j is the weak-drawing team, $R^i > R^j$ and, hence, more gate sharing (a lower α) increases the profits of the weak-drawing team, that is, $d\pi^j/d\alpha < 0$. The effect of more gate sharing on the strong-drawing team is ambiguous because $d\pi^i/d\alpha \gtrless 0$ depending on whether $R^i - R^j \gtrless w^i 2MR^*$. While increasing revenue sharing raises team i's subsidy to team j, it also lowers team i's talent costs. Intuitively, if the teams are close in drawing potential, then a decrease in α does not result in much added revenue sharing, and the reduction in salary cost that accompanies more revenue sharing dominates, leading to an increase in profits for team i as well. The wider apart are the drawing potentials of the two teams, the more likely it is that increased gate sharing will lead to a fall in profits for the strong-drawing team. Comparable results hold for the case of an n-team league.

Turning to the actual behavior of leagues, we do not have any real-world experiments involving substantial changes in gate or local TV revenue sharing rules to use to test the theory. But the theory might shed some light on the differences among leagues as to revenue sharing arrangements. Historically, there has been vigorous opposition to more equal gate and local TV revenue sharing in MLB, the NBA, and the NHL. The NFL's generous revenue sharing arrangement dates back to the league's earliest years when survival of weak-drawing teams was of central concern, but those generous sharing rules have been extended to TV as well. The different approaches might reflect differences in the dispersion of drawing potentials among the leagues, with drawing potential of football cities more equal than the other sports. What is true, given the revenue sharing rules of the various

TABLE 10
TOTAL REVENUE GINI COEFFICIENTS IN ALL SPORTS 1991–1994

League	1991	1992	1993	1994	Average
NFL	.047	.051	.037	.054	.047
NHL	.125	.119	.162	.184	.184
MLB	.158	.154	.149	.140	.150
NBA	.195	.139	.151	.159	.161
Average	.131	.116	.125	.134	.126
NFL As Percentage of Average	36%	44%	30%	40%	37%
NFL As Percentage of Next Highest	38%	43%	25%	39%	32%

Source: *Financial World*, May issues for years in table.

leagues, is that team revenues are more equal in the NFL than in the other leagues, as indicated in Table 10. Over the period 1991–1994, using the revenue estimates from *Financial World* magazine, the NFL Gini coefficient averaged only about 30 percent of the Gini coefficients of the other leagues, among which the NBA distribution of team revenues was least equal, followed by MLB and the NHL.

To summarize, a revenue sharing arrangement in which gate and local TV revenues are subject to the same sharing rules leads to larger league-wide profits than under the current arrangement in MLB. This occurs both because revenue sharing lowers salary costs and because this kind of revenue sharing moves a league towards its revenue-maximizing distribution of talent. In the NHL and NBA, where there is no sharing either of gate or local TV revenues, introduction of revenue sharing among teams has advantages because of lower salary costs. The problem for these leagues is to find some way of achieving this outcome through acceptable side payments to damaged parties, in this case, strong-drawing teams. On the other side, the attitude of players' unions toward more equal revenue sharing is of interest. The issue had not arisen until the current labor dispute in baseball, but the rational response of the union is to oppose more gate and local TV revenue sharing unless players are compensated in some way.

B. *National TV Revenue Sharing*

The last successful rival league entering into pro team sports was the American Football League (AFL), 1960–69, which merged with the NFL in 1966 under very favorable terms. One reason for the AFL's success was its national TV contract. Originally, the contract was with ABC at $2 million per year, with NBC winning the contract in 1965 at $9 million per year.

The NFL was in a vulnerable TV position in 1960 due to a court-ordered injunction forbidding it to engage in league-wide national TV contract negotiations: United States v. NFL, 116 F. Supp. 310 (1953), 196 F. Supp. 445 (1961). Until Congress exempted league-wide national TV contracts form antitrust in 1962, NFL teams negotiated individual local and regional broadcasting contracts. After the exemption, the league signed a contract with CBS (for $4.7 million) for national coverage. In the 1993 season, the league had national

TABLE 11
REAL TELEVISION INCOME, MLB, NFL, AND NBA
1962–1993
(in millions of 1982–84 dollars)

Year	MLB National	MLB Local	MLB Total	NFL Total	NBA[a] Total
1962	13	42	55	16	n.a.
1963	17	42	59	18	n.a.
1964	23	46	69	52	n.a.
1965	31	51	82	53	5
1966	30	53	83	68	5
1967	35	51	84	77	4
1968	36	53	89	72	4
1969	42	59	101	70	4
1970	41	57	98	134	15
1971	45	54	99	129	15
1972	43	55	98	127	14
1973	41	54	95	122	20
1974	36	51	87	123	18
1975	34	48	82	116	17
1976	40	48	88	111	16
1977	38	48	86	104	17
1978	35	45	80	262	15
1979	32	44	76	236	25
1980	50	47	97	209	22
1981	45	53	98	195	20
1982	55	67	122	230	19
1983	59	96	155	335	25
1984	157	101	258	435	24
1985	150	108	258	464	23
1986	166	128	294	n.a.	23
1987	173	136	309	477	49
1988	174	134	308	466	58
1989	198	187	385	492	128
1990	277	191	468	757	236
1991	270	185	455	719	237
1992	259	252	511	684	320
1993	183	243	426	779	350

Source: *Broadcasting and Cable* (*Broadcasting* to 1993), various issues.
Notes:
[a]NBA figures do not include local TV prior to 1989. Some MLB teams occasionally are not included in the local TV figures reported in the source.

TV contracts worth about $950 million per year with all three major networks, ESPN, and TNT. For the current contract, Fox has replaced CBS in televising the National Conference with a bid of $1.4 billion for four years. Between 1970 and 1993, the percent growth in real TV income in sports has been 364 percent for MLB, 481 percent for the NFL, and 1500 percent for the NBA (see Table 11).

National TV contracts in all sports uniformly involve equal sharing of such revenues by all league teams (with some negotiated, temporary exclusions for expansion franchises). In a one-team-one-vote environment, equal sharing is more or less guaranteed because the national contract can be approved only if there is a virtual consensus among league teams. Weak-drawing teams can block unequal sharing proposals by refusing to permit televising of games involving them and the strong-drawing teams.

There are obvious advantages to a league from a league-wide contract as compared to individual contracts. In the case of the NFL, shifting in 1962 from individual team contracts to a league-wide contract led to a 33 percent increase in TV income (from $3.5 million to $4.7 million). Interestingly, the New York Giants took a decrease in income (from $370,000 to $337,000 that first year), but, as indicated in Table 11, things turned around quickly and significantly for NFL teams. Strong-drawing teams, which contribute more audience than weak-drawing teams, certainly are subsidizing weak-drawing teams because each is receiving an equal share of national TV revenues.

National TV revenue sharing per se should have no effect on competitive balance because payments to teams are independent of each team's win-percent. But the fact that TV audiences (and advertising income) are larger when big city teams participate in playoffs and championship series provides profit incentives for a league to adopt policies that promote less competitive balance. The rising importance of national TV revenues in the profit pictures of all leagues will increase incentives in this direction in the future.

VI. *Rival Leagues, Expansion, and Movement of Franchises*

Over and above their earnings from the day-to-day operations of their teams is the main source of income for owners of pro sports teams, namely, capital appreciation of franchise values. The data series appearing in Quirk and Fort (1992, ch. 2) document an average annual rate of increase of franchise prices in baseball of roughly 7.5 percent per year (1901–1990), while the rates of price escalation were at annual rates of 16 percent for the NBA (1950–1990) and 20 percent for the NFL (1950–1990). Franchise prices in the 1980s escalated to annual rates of increase of around 20 percent in baseball and over 30 percent in both the NBA and the NFL. Historical data series on franchise values in all sports exhibit plateaus in the growth path during periods when rival leagues are in business in a sport and during periods of expansion in the number of teams in a league, as simple economic intuition would predict.

At the present time there are monopoly leagues in all four major pro sports in the U.S., historically, the normal state of affairs. Monopoly profits earned by leagues invite entry, so that one critical aspect of league decision making is acting to inhibit entry into the sport by rival leagues. Rival leagues lead to bidding wars for players, can cut into gate receipts, and decrease the value of TV rights for the existing league, lowering profits and adversely affecting the market prices of franchises. Rival leagues have not been an uncommon phenomenon, but generally they have been rather short lived. There have been six rival leagues in baseball since 1876, when the National League was organized; seven in football since 1920, when the American Professional Football Association (the predecessor organization to the NFL) was formed; two in basketball since the merger of the Basketball Association of American and the National Basketball League formed the NBA in 1949; and one in hockey since 1917, when the NHL began operations. (Quirk and Fort 1992, chs. 8 and 9; and Quirk and Rubin Saposnik 1992, document the history of rival leagues.) There have been a couple of resounding successes among rival leagues—the American (baseball) League, 1901 to present; the American (baseball) Association (1883–1892); and the American Football League IV (the fourth with that name, 1960–1969)—as well as utter failures, including the World Football Association (1974–1975), the U.S. Football League (1983–1985), and the Union (baseball) Association (1884).

A measure of the importance of rival leagues and the role they play in the economics of sports is the number of existing franchises that originally began play as members of rival leagues. As of 1994, 12 of the 28 MLB teams originally were members of rival leagues and four more came into existence because of pressure by the stillborn Continental League in 1959–1960. Fourteen of the 28 NFL teams started in rival leagues and two more were added to counter the threats posed by AFL IV. Nine of the 27 NBA teams were from rival leagues and four NHL teams came from the World Hockey Association, with one more added by the NHL as an expansion team in direct response to the WHA.[21] If

[21] The following teams entered from rival leagues (original team location in parentheses). Baseball: American Association: Los Angeles (Brooklyn), Pittsburgh, Cincinnati, and St. Louis; American League: Boston, New York (Baltimore), Oakland (Philadelphia), Detroit, Cleveland, Minnesota (Washington), Chicago, and Baltimore

leagues were organized as syndicates, sharing league-wide profits among teams, leagues (presumably) would expand into every location that would increase the total profits to the league. Expansion fees would be charged to new entrants that essentially would transfer all rents to the league. This might still leave some potentially profitable locations available to a rival league, because the existing league would take into account in its measure of marginal profitability such externalities as the threat value of vacant locations in extracting subsidies from local governments. But even so, the profit potential to investors in a rival league from exploiting promising locations that have been bypassed in expansion certainly would be limited.

This raises the question as to why so many rival leagues have formed over the history of pro sports. One answer is that leagues are not organized as syndicates. Each team has exclusive rights to league activities in its franchise area, defined as a circle of specified radius about the team's stadium or arena. Until the 1980s, member teams in all leagues had veto power over entry into their franchise areas by other league teams. While this has now been changed to approval by a super-majority of league members, as a practical matter, each league team can block entry into its franchise area by other league teams.[22]

This suggests that rival leagues arise not so much from the existence of a number of profitable locations without teams, but from the profit potential of megalopolis markets such as New York, Los Angeles, the Bay Area, and Chicago where league rules limit entry by other league teams. Given league rules on franchise rights, emergence of rival leagues can occur even when the existing league is aggressive in expanding out to near the zero-rent margin in terms of profitable locations. Under this scenario, rival leagues have as a major goal breaking into a protected, high-profit, megalopolis market.[23]

Examples are numerous. The American (baseball) Association began play in 1882, placing teams in a number of big city locations (New York, Philadelphia, and St. Louis) vacated by the National League. AFL I came into existence in 1926 after the New York Giants vetoed an application by Red Grange and his manager for an expansion franchise at Yankee Stadium. The All-American

(Milwaukee/St. Louis); as a result of pressure from the Continental League, the New York Mets, Houston, California (Los Angeles), and Texas (Washington) were added to MLB. Basketball: National Basketball League: Philadelphia (Syracuse), Atlanta (Tri-Cities), Los Angeles (Minneapolis), Sacramento (Rochester), and Detroit (Fort Wayne); American Basketball Association: New Jersey, San Antonio, Denver, and Indiana. Hockey: World Hockey Association: Winnipeg, Quebec, Edmonton, Hartford; the New York Islanders were added by the NHL to forestall a proposed WHA franchise in Long Island. Football: American Football League III: Los Angeles Rams (Cleveland); All American Football Conference: Cleveland, San Francisco, Indianapolis (Baltimore); American Football League IV: New England (Boston), Buffalo, Kansas City (Dallas), Denver, Houston, San Diego (Los Angeles), New York Jets, Los Angeles Raiders (Oakland), Miami, and Cincinnati; Minnesota and Dallas were added as expansion franchises in response to AFL IV plans for franchises in those cities.

[22] When teams violate league rules, the status of territorial rights is less certain. While the three-quarters rule was regarded as a reasonable restraint of trade when the NBA's Clippers moved from San Diego to Los Angeles without league approval [NBA v. San Diego Clippers, 815 F.2d 562 (9th Cir. 1987)], a jury found the rule to be unreasonable in the L.A. Raiders case [L.A. Memorial Coliseum Commission v. NFL, 468 F. Supp. 154 (C.D. Cal. 1979), 726 F.2d 1381 (9th Cir. 1984), 791 F.2d 1356 (9th Cir. 1986)].

[23] In 1966, it was the threat by the AFL to enter the market of the Chicago Bears that apparently played a major role in bringing about the merger agreement between the AFL and the NFL. In the resulting agreement, essentially all of the compensation paid to the NFL by AFL owners went to pay the San Francisco Forty-Niners and the New York Giants for invasion of their territories by the Oakland Raiders and the New York Jets.

TABLE 12
FRANCHISE LOCATIONS AND MOVES BY DECADE IN U.S. CITIES BASEBALL, FOOTBALL, AND BASKETBALL
1950s, 1960s, 1970s, 1980s

Pop. Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BASEBALL															
50s MLB	3**	2	1	2*	1	2*	–	1	2*	1	1	1	–	–	1
60s MLB	2	2	2	1	1	2	1	1	1	2*	1	1	1	1	–
70s MLB	2	2	2	1	1	2	1*	1	1	1	1	1	1	1	1
80s MLB	2	2	2	2	1	1	1	1	1	–	–	1	1	1	1
FOOTBALL															
50s NFL	2*	2*	1	1	1	–	1	1	–	1	1	1	–	1*	–
60s NFL	1	1	1	1	1	1	–	1	1	1	1	1	1	–	–
AFL	1	–	1*	–	–	1	1	–	–	–	–	–	–	1	1
70s NFL	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1
WFL	1*	1	1	1	1	–	–	1*	–	–	–	–	1*	–	–
80s NFL	2	2	1	2*	1	1	1	1	1	1	1	1	1	1*	1
USFL	1	1	1	1	1*	1*	–	–	1*	1*	–	–	–	–	1
BASKETBALL															
50s NBA	1	–	–	1	1	1	–	–	1	–	1	1	1	–	1
60s NBA	1	2*	1	2*	1	1	1	–	1*	–	–	1	–	–	–
ABL-ABA	2*	1*	3	1	–	3**	–	3*	–	2*	1	–	2**	1	–
70s NBA	2	1	1	1	1	1	1	1	–	–	1*	1	1	–	–
ABA	1	1*	–	–	–	–	1*	–	–	1	–	–	1*	–	–
80s NBA	2	2	1	1	1	1	1	1	1	1	1	1	1	–	–

Football Conference was organized in 1946 after Chicago's Bears and Cardinals had several years earlier voted down an application by a group led by actor Don Ameche for an NFL franchise ultimately to be located in Los Angeles. According to George Halas' biography, the two teams hoped to save the location for a future franchise move by the Cardinals (Halas 1979, p. 205). The Continental (baseball) League was organized by Branch Rickey and William Shea in 1958 for the purpose of putting pressure on MLB to put a National League team in New York after the Dodgers and Giants left. The Continental League folded after MLB agreed to admit the Mets to the NL in 1962.

If a rival league is successful, the inevitable outcome is merger with the existing league in order to exploit the resulting market power over players, TV networks and stations, and local governments. The federal government has even participated in this move toward monopolization, passing a bill to exempt the merger of the AFL and NFL in the 1960s, and holding hearings to persuade the NBA to merge with the ABA in the 1970s. Most often, based on the history of rival leagues, the rival league suffers either partial or complete failure with most if not all original team owners suffering losses. On the other hand, the payoff from success can be impressive. For example, even though its commissioner, Al Davis, reportedly fought the AFL-NFL merger, the NFL allowed AFL owners to join for a fee of $2 million each when expansion franchises were selling for $8 million.

Even when a full-fledged merger does not occur, the end of hostilities in a war with a rival league often comes about through an agreement to take in one or more teams from the rival league, as in

TABLE 12 (*Cont.*)

Pop. Rank	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Other
BASEBALL																
50s MLB	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
60s MLB	1*	1	–	1	2*	1	1	–	–	–	–	–	–	–	–	–
70s MLB	2*	1	1	1	1	–	–	1	–	–	–	–	–	–	–	–
80s MLB	1	1	1	1	–	–	–	1	1	1	–	–	–	–	–	–
FOOTBALL																
50s NFL	1/2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1/2
60s NFL	1/2	–	1	–	–	–	1	–	–	–	1	–	–	–	–	1/2
AFL	–	1	1*	–	1	1	–	–	1	1	–	–	—	–	–	–
70s NFL	1	1/2	1	1	1	1	1	1	1	–	1	1	–	–	–	1/2
WFL	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	8*
80s NFL	1	1	1*	1	1	1	1	1	1/2	1	–	1	–	–	–	2 1/2
USFL	–	–	1	–	1	1	1*	–	–	–	1*	1*	–	–	–	6
BASKETBALL																
50s NBA	1*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5
60s NBA	1*	1	–	1	1	1	1	–	–	–	–	–	–	–	–	2
ABL-ABA	–	–	–	–	1	–	–	1	1	1	1	–	–	–	–	2
70s NBA	1	1	1	–	2*	1*	–	1*	1	1	1*	–	1	1	–	3
ABA	–	–	–	–	1	–	–	–	1	1	1	–	–	–	–	5
80s NBA	1	1	–	1*	–	1	1	–	1	–	1	–	–	–	1	5

Notes: Entries in the table indicate that a team was, or teams were, located at the city with that population rank at some time during the decade. City ranks change from decade to decade, so city names are not included in the table. A single asterisk indicates that one team moved from that location during the decade while a double asterisk indicates that two teams moved from that location during the decade. The NBA totals in the 1970s include four teams that moved to the NBA in that decade—New Jersey, San Antonio, Denver, and Indiana. The "1/2" designation refers to the Green Bay Packers who played half of their home games in Green Bay and the other half in Milwaukee.

the cases of the ABA and WHA. Lucky second- or third-generation owners of such teams can make out well in such cases. A recent example is Peter Pocklington, owner of the WHA-NHL Edmonton Oilers.

Rival leagues can also trigger antitrust suits. Since 1922, MLB has been exempted from application of the antitrust laws due to the U.S. Supreme Court decision in Federal Baseball Club of Baltimore v. National League [250 U.S. 200 (1922)] as reaffirmed in Toolson v. New York Yankees [346 U.S. 356 (1953)], Flood v. Kuhn [407, U.S. 258 (1971)], and extended to include exemption from state antitrust laws in State v. Milwaukee Braves, Inc. [385, U.S. 990 (1966)]. All other sports are subject to the antitrust laws, including in principle application of the laws to punish predatory practices undertaken to discourage entry by a rival league. However, in the two leading cases, namely, AFL v. NFL [205 F. Supp. 60 (C.D. Md. 1962), 323 F.2d 125 (4th Cir. 1963)] and USFL v. NFL [644 F. Supp. 1040 (S.D. N.Y. 1986)], no financial damages or other punishment were assessed despite convincing evidence of illegal practices by the NFL.

League rules on franchise rights and expansion act to subsidize weak-drawing teams by strengthening their bargaining power with local governments, through league decisions to leave unoccupied localities that can profitably support a team. The payoffs from this are subsidized stadium and arena rental agreements. A very rough estimate of the annual subsidies provided through government-owned stadiums and arenas is in the range of $500 million per year, most of which goes to weak-drawing pro sports teams (Quirk and Fort 1992, p. 171). But league rules on franchise rights also act to protect strong-drawing teams in megalopolis centers from competition within the league, encouraging the formation of rival leagues with resulting costs for all league members. Just what the balancing of costs and benefits is between weak- and strong-drawing teams is debatable.

Table 12 summarizes the way in which franchise moves and expansion have taken place on a decade-by-decade basis, from the 1950s through the 1980s. The data are in general agreement with rational economic behavior by leagues and rivals, that is, with franchises being located in the largest available markets, and with rival leagues moving into megalopolis centers along with small-city locations that have been by-passed in league expansion.

Differences among the leagues in their expansion policies help to explain differences in rival league activities as well. Major league baseball has been offered some protection from entry by rival leagues through its antitrust exemption, but a more important reason might be its history with respect to locating franchises, minimizing the available markets to be targeted by a rival league. In turn, this undoubtedly reflects the fact that two separate and somewhat independent leagues have competed with one another for franchise locations over their histories.

Table 12 shows that, with the exception of the 1958 moves of the Dodgers and the Giants which triggered organization of a rival league, MLB has maintained two teams in each of the largest markets since the 1950s and has left little in the way of uncovered markets in the top-20 largest cities to the present day. (Washington, D.C. is, of course, the long-standing and almost unique exception.) The NFL had only one team in each of the top population centers up to its merger with the AFL, along with other significant gaps among top-20 cities, and there was an even more inviting situation for rival leagues in basketball up to the late 1960s.[24]

VII. *Summary and Conclusions*

The problem of maintaining financial viability for teams located in weak-drawing markets is a major one for sports leagues. The analysis here argues that an enforceable salary cap is the only one of the cross-subsidization schemes currently in use that can be expected to accomplish this while improving competitive balance in a league. But there are important enforcement problems with a cap because teams are led to choices that fail to maximize revenues.

[24] Cities in the top 30 by population rank that did not have franchises at the end of the 1980s in the various leagues are as follows (population rank is in parentheses)—MLB: Washington, D.C. (10), Miami (11), Tampa (20), Phoenix (21), Denver (22), Portland (26), New Orleans (27), Norfolk (28), Columbus (29), and Sacramento (30); NFL: St. Louis (14), Baltimore (18), Portland (26), Norfolk (28), Columbus (29), and Sacramento (30); NBA: St. Louis (14), Pittsburgh (15), San Diego (19), Tampa (20), Cincinnati (23), Kansas City (25), New Orleans (27), Norfolk (28), and Columbus (29). Teams in cities below the top 30 by population rank were—NFL: Indianapolis (32), Buffalo (33), and Green Bay (not ranked at all); NBA: San Antonio (31), Indianapolis (32), Charlotte (35), Salt Lake (37), and Orlando (38). In the 1990s, MLB added Miami, Denver, Phoenix, and Tampa Bay-St. Petersburg while the NFL added Charlotte, Jacksonville, and St. Louis (this last by a move of the former L.A. Rams).

There are any number of unresolved theoretical and empirical issues that remain in this area. At the theoretical level, there is the general question of why it is that leagues have not been able to find ways to finesse profit distribution problems to move toward revenue-maximizing strategies, e.g., adopting the same sharing rules with respect to gate and local TV revenues. There are insights provided by the championship model that need to be incorporated into the analysis of leagues, taking explicitly into account risk-averse decision making by owners facing the uncertainties introduced by playoffs. The role of player unions and collective bargaining in influencing league decisions on cross-subsidization and other issues has been completely ignored in our treatment and deserves detailed attention. In particular, the fact that free agency has led to a much more skewed distribution of player salaries in baseball (Fort 1992; Quirk and Fort 1992, pp. 235–39) raises some interesting questions as to negotiating positions unions might take in the future.

The continuing growth of leagues in terms of number of teams raises the questions as to whether, even with divisional breakdowns and more and more inclusive playoff schemes, there is some "natural" upper limit to the number of teams that a league can maintain profitably. An interesting topic for exploration is the idea of breaking up the existing leagues into independent competing leagues on the lines of earlier court-ordered moves in the cases of the oil, aluminum, and tobacco cartels, with some sort of umbrella structure leading into an all-league championship series.

At another level, the extraordinary rates of escalation of franchise values over extended periods of time in football and basketball and, to a lesser extent, baseball, await an intuitively appealing explanation in terms of rational economic behavior. Unresolved empirical issues abound in the economics of sports, including testing the theory presented in this paper. Given the growing importance of the salary cap in management-labor negotiations in sports, a reliable test of the impact of the NBA cap on competitive balance would certainly be useful. As reported here, the different impacts of free agency and a rookie draft on competitive balance raise both theoretical and empirical questions that deserve treatment. In general, testing the theoretical conclusions found here concerning competitive balance is a job that still needs to be done.

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