Competitive Balance and Income Redistribution in Team Sports[1]

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Abstract: This paper starts with the observation that in most individualistic sports (e.g. golf, tennis, boxing) rewards are highly dependent on performance, while in most team sports direct rewards are almost independent of performance. This paper takes the perspective of Contest (Tournament) Theory and considers the incentive properties of revenue sharing agreements which are performance independent and performance related. The analysis is extended to balance-dependent income such as collective broadcast contracts.

Keywords: Team sports, contest (tournament) theory

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However, when they had been running half an hour or so, and were quite dry again, the Dodo suddenly called out `The race is over!' and they all crowded round it, panting, and asking, `But who has won?' This question the Dodo could not answer without a great deal of thought, and it sat for a long time with one finger pressed upon its forehead (the position in which you usually see Shakespeare, in the pictures of him), while the rest waited in silence. At last the Dodo said, `*Everybody* has won, and all must have prizes.'

Alice in Wonderland, Chapter 3

1. Introduction

It is widely accepted, both among economists and the general public that prizes are good way to provide incentives in sporting contests among individuals. The winner of a World Boxing title fight, the US Masters or the Wimbledon tennis championship expects to walk away with a substantially larger purse than any other contestant[3]. Prizes are deemed efficient because they ensure that the right quality of player enters each tournament and because they maximise the incentives of the contestants to provide effort[4]. In team sports, however, prize giving is much rarer. Instead, it is argued that fans are only interested in balanced contests and therefore there must be redistribution of resources from rich teams to poor teams[5]. This argument has been used by the owners of sports teams over and over again as a defence against antitrust challenges to restrictive agreements both in the US and in Europe. At various times it has been used as a defence in cases concerning restriction of player mobility (reserve clauses), player negotiating rights (draft rules), wages (salary caps) and the collective sale of broadcasting rights[6]. In North America the argument is used to justify rules

[3] In 2000 Tiger Woods won $9.2m in prize winnings on the PGA Tour, nearly double the winnings of the next best player and around four times the earnings of the fifth best player. In the 2000 men's' tennis tour Gustavo Kuerten won more than 50% more in prize money than the fifth ranked player, and twice as much as the ninth ranked player.

[4] Given that contestants may be risk averse, some insurance may be provided in the form of appearance fees, but by and large the prizes dominate the reward scheme. Ehrenberg and Bognanno (1990a) and (1990b) provide statistical evidence that larger prizes produce lower scores in golf tournaments, implying greater effort.

[5] A winner of the World Series or the Superbowl gets a ring, and possibly a bonus from his team owner, but the team owner receives nothing. By and large the same is true outside of North America. In soccer the professional teams traditionally participate in tow competitions during the season- the (knock-out) Cup and the League. However, traditionally there is no direct financial reward to the winner of either contest.

[6] It might be argued that winning teams attract significant additional income from sponsorship, endorsements and other forms of success related revenue opportunities, but this is equally true of say, golf and tennis.

that share gate money with the visiting team (e.g. the 40% share granted in the NFL), the equal division of income from the collective sale of broadcast rights and the equal division of income from merchandising (again, primarily in the NFL).

While a similar story might be told for team sports outside North America, some prize-like elements seem to be emerging in the soccer world. In the English Premier League, whose live broadcast contract is now worth over $500m per year, 25% of the money is awarded on the basis of league performance, with the league champions being awarded twenty times the amount paid to the team coming bottom[7]. Prize giving is thus possible and practised in team sports, but it is rare.

One contribution of this paper is tie the analysis of incentives in sports leagues more closely to a strand of economic theory that seems ideally suited to the purpose: "Contest Theory" or "Tournament Theory" (henceforth we will refer to it as Contest Theory, but either name will do). This has been applied to areas of economic activity such as rent seeking (e.g. Tullock, (1980), innovation (e.g. Loury (1979)) labour markets (e.g. Lazear and Rosen (1981)) but most writer on team sports literature have not referred closely to this literature[8]. Moreover, while economists writing in the contest literature regularly claim the applicability of their models to sports, there have been no detailed attempts by these authors to interpret their models in the light of established sports practices. Two recent papers Palomino and Sakovics (2000) and Palomino and Rigotti (2000) have considered some of these issues. The first of these papers considers the motivation for revenue sharing and argues that it is less likely when teams in one league face rivals from another. The second paper considers the impact of revenue sharing rules and argues that revenue sharing is desirable to the extent that it enables teams to compete in the future, even if it dulls the incentive to compete now. However, in both of these papers teams are assumed either to face wealth constraints or to derive benefits in later seasons from current investments, so

[7] Thus in the 1997/98 season, £34m was set aside for the performance related element. This was divided by the sum of the ranks (= 210 for a twenty team league) and each team received (21-R) 210ths of £34m where R was their rank in the League.
[8] For example, Fort and Quirk's 1995 survey of team sports in the Journal of Economic Literature did not refer to these or any other papers in the contest literature -e.g. Holmstrom (1982), Green and Stokey (1983), Dixit (1987), Nalebuff and Stiglitz (1983), Nitzan (1994), Rosen (1986). As far as I know few other sports economist cite these authors or any of the more recent contest literature (e.g. Skaperdas (1996), Dasgupta and Nti (1998), Gradstein and Konrad (1999)).

that the income derived from past competitions is a significant component of current competitiveness. In this paper no such assumption is made, leading to somewhat different conclusions.

The main conclusion of this paper is that the standard income redistribution mechanisms adopted in team sports are motivated by the desire of teams to limit economic competition. If fans only care about the balance of a contest, then the optimal investment in team quality by each member of the league cartel is negligible. Profit maximisation by individual owners without some form of collusion will result in significant positive investment. Sharing revenues diminishes the incentive to invest and therefore gets the team closer to the collusive solution. In a contest model, revenue sharing of the conventional kind actually reduces competitive balance. However, if league income from activities such as broadcasting are redistributed on the basis of performance, then it can be shown (a) investment will increase (dissipating economic profits) and (b) competition will become more balanced. While the collusive implications of revenue sharing have long been recognised in the sports economics literature, there are important differences between the contest theory approach and that literature, and little attention has been paid to alternative incentive mechanisms. The reason that organisers of individualistic sports such as tennis and golf events have to offer significant prizes is that there is little restriction on entry and therefore talent will quickly migrate to the organiser offering the steepest reward schedules. In team sports, however, talent generally has a relatively limited range of options outside of the major league, and therefore the organisers (team owners) can enter into collusive arrangements. However, to the extent that players can be mobile between roughly similar leagues competing in different countries (e.g. the European soccer leagues of Italy, England and Spain), then owners are under more pressure to provide competitive incentives, and this may account for the emergence of sharper incentives in cases such as the Premier League[9].

The paper is set out as follows. The main analysis of the paper is set out in the next section, which is divided in several subsections. First the basic model is introduced,

[9] There is much less revenue sharing of any kind in Europe compared to North America. Gate revenues are not shared in any major league, and while broadcasts rights are collectively sold and redistributed in England and Germany, this is not the case in Italy and Spain.

then impact of conventional revenue sharing schemes is analysed, and then a form of revenue redistribution based on a prize fund is analysed. The next subsection considers broadcast income as a prize, and after that implications of different broadcast income distribution schemes is considered. Lastly, the impact of the demand for team quality is analysed. The concluding section discusses some critical assumptions in the model and policy questions raised by the analysis.

2. Contest success functions, team sports and redistribution

(a) The basic model: revenues as a function of success

In the contest literature players compete to win a prize with some probability p which depends on each player's efforts. A sporting contest can be of this kind, but in team sports the participants usually engage in league play where each team plays each other team home and away, and generates an income from selling tickets. To make the connection with the contest literature we suppose that each team has a "fan" revenue function which depends upon the success of the team, and that success itself depends on the "effort" of each team (positively on own effort, negatively on the effort of rivals). In this case effort is identified with investment by the owners in hiring playing talent. The revenue generating function is thought of as the income the home team generates from selling tickets, refreshments and merchandising at the ground, and also local TV income.

We restrict the analysis to a two team league to focus on the most important assumption of the model, that there is an asymmetry in the revenue generating function for each team. Most of the contest theory literature deals with symmetric contests. There is an important strand of the literature (Harris and Vickers (1985), Rosen (1986), Dixit (1987) and Baik (1994)) which deal with asymmetry, but this literature does not consider agreements among the contestants to influence the incentive structure of the contest (rather than rules imposed by outsiders). We begin by defining the contest success function for the teams which we can interpret as the percentage of matches won. Success depends on relative expenditure on playing talent and takes the logit formulation commonly adopted in the literature:

(1) $$w_1 = \frac{h(x_1)}{h(x_1)+h(x_2)} \quad , w_2 = 1 - w_1$$

where x_1 and x_2 is expenditure on playing talent. The function h(.) is increasing in x_i and h(0) = 0 (this equivalent to failing to field a team). Thus the function describes the transformation of player contracts (measured by x) into playing performance on the pitch. This formulation entails the natural restriction that winning percentages of each team must add up to 100%. Throughout the paper it will be assumed that these h(.) functions are identical for each team- no team has a competitive advantage in production[10].

We now define the revenue function (R_1) of team 1 to be σw_1 and of team 2 (R_2) to be simply w_2 , where $\sigma \geq 1$ is an index of the superiority in revenue generating potential of team 1 (when $\sigma = 1$ we have the symmetric case). Successful teams attract more revenue so that when $\sigma > 1$ team 1 will generate more income from a given win percentage than team 2. To ensure that the revenue function is strictly concave we require:

(2) $h_i''(h_1 + h_2) < 2h_i'$

(h_i is shorthand for $h(x_i)$ and h_i' is its first derivative) Under this assumption fan marginal revenue from success is always increasing, but there are diminishing returns (it is never the case that fan revenues decrease with success).

The profit functions for each team are thus:

(3) $\pi_i = R_i - x_i$

[10] Empirical evidence on the ability of some team owners to achieve *systematically* higher returns from a given expenditure over a long period of time is mixed. Given the ability to observe much of the production process of the opposition, one would expect best practice to be adopted quite rapidly in the team sports industry.

We consider league organisations where each team is an independently owned entity and where the owner's objective is the maximisation of own profits. This description fits with most economically significant professional sports leagues in the world-Major League Baseball, the NFL, NBA or NHL in North America and the major soccer leagues of Europe: Serie A in Italy or the Premier League in England. Some writers in Europe (e.g. Sloane (1971)) have suggested that soccer clubs are not typically profit maximisers, either being owned by the fans on a not-for-profit basis or being constrained by legal rules from the distribution of dividends or other means for distributing profits. We will discuss this issue in section 4. In some other cases, such as the Soccer World Cup or in international cricket and rugby, the teams are organised by national representative bodies that distribute surpluses for the promotion of the sport in general[11].

From (3) we derive the first order conditions for profits to be a maximum

(4) $x_1 : \sigma h_1' h_2 = (h_1 + h_2)^2$, $x_2 : h_2' h_1 = (h_1 + h_2)^2$

Which together imply the (Nash) equilibrium condition

(5) $$\frac{\sigma h_1'}{h_2'} = \frac{h_1}{h_2}$$

This leads to two basic results:

Result 1: $\sigma = 1$ => each team owner invests in the same quantity of talent and therefore expects to achieve the same winning record

Result 2: $\sigma > 1$ => The owner of team 1 invests more than the owner of team 2 and therefore expects to achieve a better winning record.

[11] And, often, supply substantial perquisites to members of the governing body.

It is useful to consider the reaction functions associated with the first order conditions. The sign of the slope is equal to the sign of the cross partial derivatives of the profit functions, which are:

$$(6) \qquad \frac{\partial^2 \pi_1}{\partial x_1 \partial x_2} = \frac{\sigma(h_1 - h_2) h_1' h_2'}{(h_1 + h_2)^3} \quad , \quad \frac{\partial^2 \pi_2}{\partial x_1 \partial x_2} = \frac{(h_2 - h_1) h_1' h_2'}{(h_1 + h_2)^3}$$

Thus each reaction function reaches a maximum when it passes through the 45^0 line, regardless of symmetry. In the symmetric case the reaction functions intersect on the 45^0 line, and if team 1 (resp. team 2) invests more than team 2 (1) its reaction function is upward sloping, while if it invests less its reaction function is downward sloping (see figure 1). It follows that in the asymmetric equilibrium team 1's reaction function must be upward sloping and team 2's downward sloping. In the language of Bulow et al.(1985), investment in playing talent is a strategic complement for team 1 but a strategic substitute for team 2. It will become apparent that the reactions will always have this basic shape- even when we add demand for other aspects of a contest of interest to the fans such as competitive balance and the quality of the teams.

Intuitively, when a rival is weak, small increases in the strength of that rival encourage a competitive response in terms of increased investment. However, when a rival is already strong, increasing its strength merely serves to discourage its competitor. The implications of this become clear when we turn to the consideration of revenue sharing.

Unlike many economic models, such as Cournot quantity setting games, the aggregate effort/investment at the Nash equilibrium of the contest success function is sensitive to the distribution of abilities/potential (see e.g. Bergstrom and Varian (1985))[12]. Thus inequality of revenue generating potential not only leads to unbalanced contests: it is also likely to diminish total investment in talent (see e.g. Baik, proposition 2, p374). In the present case, suppose we alter the revenue generating functions to $R_1 = sw_1$ and $R_2 = (1-s)w_2$ so that if s = ½ each team has an equal revenue generating potential from any given level of win percent, while as s increases (decreases) the increase (decrease) in revenue generating potential for team 1 at a given win percent is exactly offset by a decrease (increase) in revenue generating potential for team 2 at the same win percent. Suppose also w_1 is simply $x_1/(x_1+x_2)$, then it is straightforward to show that $x_1^* + x_2^* = s(1-s)$ which has a maximum at $s = ½$. In other words, increasing inequality diminishes total investment by the league.

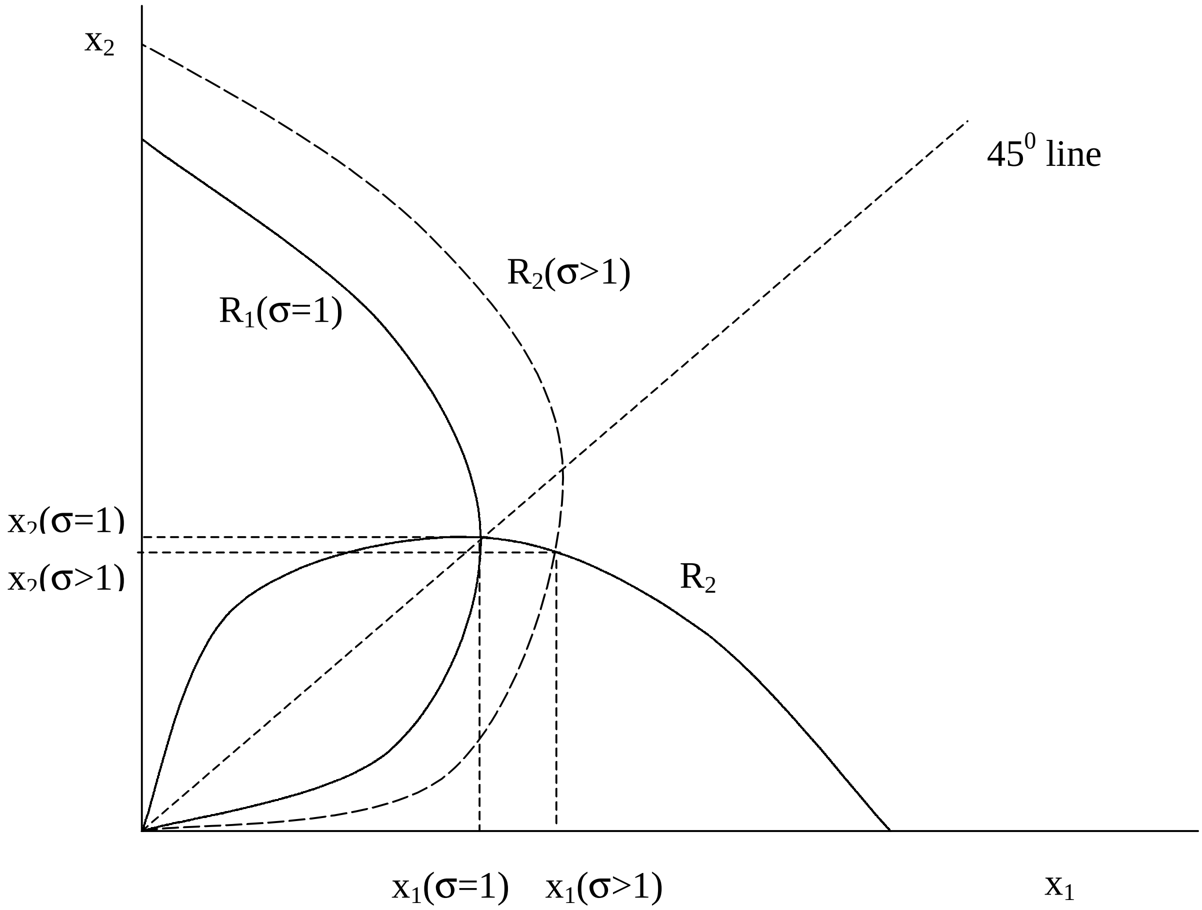

Figure 1: Reaction functions for contest success functions for symmetric (σ=1) and non-symmetric (σ>1) cases

[12] I am indebted to Tommaso Valletti for this point.

Note that s(1-s) is in fact the harmonic mean of the team revenue generating potential, and total investment is unaffected as long as the harmonic mean is constant. The economic implication of this is that the "iso-talent" curve is concave, so that when one team is dominant, it requires only a small redistribution (of drawing power) in favour of the weak team to preserve a constant quantity of talent in the league, while as dominance is reduced the required redistribution becomes larger and larger.

(b) Revenue sharing in the basic model

Traditionally revenue sharing involves dividing the revenue of the home team with visiting team for each match. Originally this meant primarily revenue from ticket sales, but in the broadcast era it could also mean local broadcast income. We write the profit functions as follows:

(7) $\pi_i = \alpha R_i + (1-\alpha) R_j - x_i$

where $½ \leq \alpha \leq 1$ is the revenue sharing parameter. It is straightforward to derive the first order conditions for the case of local revenue sharing:

(8) $x_1: h_1' h_2 = [\alpha(1+\sigma) - 1](h_1 + h_2)^2$, $x_2 : h_2' h_1 = [\alpha(1+\sigma) - \sigma](h_1 + h_2)^2$

which yield the equilibrium condition :

(9) $$\frac{h_1'[\alpha(1+\sigma)-1]}{h_2'[\alpha(1+\sigma)-\sigma]} = \frac{h_1}{h_2}$$

From which we can derive two more results:

Result 3: Equilibrium investment in playing talent is increasing in α[13]. This means that as the extent of sharing increases, talent investment diminishes.

[13] Comparing (4) and (8) it is apparent that for any given investment in talent by team 2, team 1 will select a lower level of investment as α decreases since $\alpha(1+\sigma) - 1 < \sigma$ and the difference increases with α. A similar observation can be made for team 2.

Result 4: For all equilibria involving positives levels of investment by both teams, revenue sharing diminishes the marginal incentive for team 2 to invest more than it does for team 1, and therefore revenue sharing enhances the degree of imbalance in win percentages caused by the imbalance in revenue generating potential.

Result 5: The profits of each team are increasing in the degree of revenue sharing

Result 4 follows from the fact that $[\alpha(1+\sigma) - 1]/[\alpha(1+\sigma) - \sigma] > \sigma$ for $\sigma < \alpha/(1-\alpha)$, otherwise which case there is no equilibrium involving positive investment by both teams. For $\sigma < \alpha/(1-\alpha)$, note that the RHS of equations (5) and (9) are identical. If revenue sharing is introduced and investment levels are maintained at the pre-sharing equilibrium levels then the LHS of (9) will in fact be greater than the RHS. Equilibrium can be restored by reducing the marginal playing performance of team 1 and/or increasing the marginal playing performance of team 2. Given concavity this implies increasing x_1 and/or reducing x_2 respectively, so that overall the relative dominance of team 1 on the pitch is also increasing.

Intuitively, these results have a natural interpretation. Revenue sharing dampens the incentive to invest for both teams because the marginal benefit of own investment is now shared. In fact, in this model the fully collusive equilibrium is zero investment in talent (since only relative performance matters) and revenue sharing enables the owners to get closer to the fully collusive outcome. This point has been dwelt upon at some length in the team sports literature (see e.g. Atkinson et al., prop. 3, p. 33, Fort and Quirk, p.1287, Vrooman, prop. 5, p979). However, the impact of revenue sharing is asserted to be neutral in much of this literature. As Vrooman puts it "Paradoxically, revenue maximisation with revenue sharing…yields the same competitive balance solution as… *without* revenue sharing." This "paradox of sharing" emerges as a consequence of the specification of the cost function adopted in most of this literature. In the contest literature costs are simply a function of one's own effort (investment). However, Fort and Quirk and Vrooman treat costs as a function of winning percentage (see Fort and Quirk p. 1286 and Vrooman p. 973), which for any plausible story of sports competition must be some function of the *share* in total playing talent for team i. Thus each team can choose its own profit maximising win percentage and the profit functions under revenue sharing can be reduced to

(10) $\pi_1 = \alpha\sigma\, w_1 + (1-\alpha)\, w_2 - w_1^{\beta}$, $\pi_2 = \alpha\, w_2 + (1-\alpha)\sigma\, w_1 - w_2^{\beta}$

where the parameter $\beta \neq 1$ in order to ensure that the problem has an interior solution. The first order conditions are:

(11) $\alpha\sigma - (1-\alpha) - \beta w_1^{\beta-1} = 0$ and $\alpha - (1-\alpha)\sigma - \beta w_2^{\beta-1} = 0$

Which imply the equilibrium condition

(12) $w_1^{\beta-1} - w_2^{\beta-1} = (\sigma - 1)/\beta$

Which is independent of the revenue sharing parameter α. The choice between these two specifications (contest theory and the conventional sports economics theory) can be viewed largely in terms of theoretical attractiveness. The contest theory specification imposes a natural restriction that teams cannot achieve a winning record less than 0% or greater than 100% for non-negative investments in playing talent, while in the sports literature referred to any such restriction must be imposed. Furthermore, the assumption that costs depend on relative rather than absolute effort/investment seems implausible. Using the former specification, if the two teams were each to double their expenditure on players leaving expected winning percentage unchanged, then expected costs would also be unchanged.

A further difficulty with conventional approach concerns the interpretation of revenue sharing. In the absence of revenue sharing it is natural to suppose that each team is a price taker in the market for winning percentage. The equilibrium is defined by the equality of winning percentage marginal revenue for each team, and the market price of talent adjusts so that marginal revenue equals marginal cost. This price taking story no longer makes sense in a revenue sharing model, since each team is engaged in buying talent to select both its own and its rival's winning percentage- the perspective is now that of a monopolist, so the adjustment of marginal cost to the marginal revenues no longer has any natural interpretation- marginal cost must be fixed as a kind of “deus ex machina” in order to render the first order conditions consistent. No such assumption is required within the contest theory framework.

(c) Revenue sharing with a prize

Local revenue redistribution of the kind considered in the previous section is a tax upon effort. Its effect, unsurprisingly, will be to reduce effort all round, and in contest success models will reduce the effort of the weakest for whom the marginal returns to effort are smallest. However, there are other mechanisms for the redistribution of income that will neither reduce effort or competitive balance. One such mechanism is a prize fund generated by a lump sum tax on team income. Suppose each team pays some fixed fee L/2 into a fund which is then awarded on the basis of winning percentage. In this case the profit function for each team becomes:

$$(13)\ \pi_1 = \frac{(\sigma + L)h(x_1)}{h(x_1) + h(x_2)} - \frac{L}{2} - x_1, \quad \pi_2 = \frac{(1+L)h(x_2)}{h(x_1) + h(x_2)} - \frac{L}{2} - x_2$$

So that the first order conditions are:

$$(14) \qquad x_1 : (\sigma + L)\, h_1'\, h_2 = (h_1 + h_2)^2 , \qquad x_2 : (1 + L)\, h_2'\, h_1 = (h_1 + h_2)^2$$

For each team the marginal incentive to invest has been enhanced by the addition of a performance related reward. The first order conditions can be expressed as the ratio:

$$(15)\ \left(\frac{\sigma + L}{1+L}\right)\frac{h_1'}{h_2'} = \frac{h_1}{h_2}$$

Result 6: Lump sum taxation used to fund prizes as a positive function of contest success will enhance competitive balance, increase investment in playing talent and reduce profitability.

comparing (15) with (5) it is apparent that as L increases the choice of investment for each team will converge to the same level, which in turn will produce competitive balance. However, in the model total profits will fall (a) because both teams spend more on investment and (b) because the local revenue generating superiority of team 1 means that any move toward competitive balance reduces income. This is not as unrealistic as it may sound. Local revenues depend on local fan bases, and these may indeed be highly dependent on local team success, particularly at the margin[14].

(d) Broadcast income as a prize

Competitive balance is more likely to be important from the point of view of national (and international) broadcast rights, where many viewers may have much weaker attachments to the teams on show and are more interested in seeing a high quality and closely fought contest[15]. Thus the demand for competitive balance can be introduced naturally as an additional element in the demand for team sports.

Collectively sold broadcast rights can be thought of as a type of lump sum income[16] that can then be used to fund a prize. Given that the demand for competitive balance introduces some significant non-linearities into the model explicit solutions cannot easily be derived. But it is possible to make some general observations and produce simulation results that appear robust and intuitive.

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[14] Take the example of the Chicago Cubs in baseball. Even though they are seldom in contention for a World Series, Wrigley Field is almost always full, largely since fans seem to have a sentimental attachment to the old ballpark as much as to the team. Nothing in the model is inconsistent with this observation. However, the model asserts that if the team were in contention there would be an increase in demand for tickets and merchandising.

[15] This is obviously true of an event such as the World Cup Final or the Superbowl where the vast majority of viewers have no strong commitment. When these events are highly unbalanced the impact on ratings and advertising revenues can be dramatic.

[16] Strictly speaking collective sale involves the pooling of ownership rights by the teams, so the stronger teams give up more than the weaker ones. However, if the pooling of rights produces greater income than can be achieved individually, either because the broadcast value of the league

First consider the typical kind of broadcast agreement, where income is divided equally among the teams, but the income is increasing in the degree of competitive balance. To simplify the analysis we now assume that team quality is a linear function of investment, i.e. $h(x_1) = x_1$. In this case the profit functions become:

$$(16)\ \pi_1 = \frac{\sigma x_1}{x_1 + x_2} + \frac{B x_1 x_2}{2(x_1 + x_2)^2} - x_1, \quad \pi_2 = \frac{x_2}{x_1 + x_2} + \frac{B x_1 x_2}{2(x_1 + x_2)^2} - x_2$$

where B is a constant and the amount of balance sensitive income depends on share of each team in total investment- if one team possesses all the talent then income from this source will be zero. The first order conditions are now

$$(17)\ \frac{\sigma x_2}{(x_1 + x_2)^2} + \frac{B x_2 (x_2 - x_1)}{(x_1 + x_2)^3} = 1, \quad \frac{x_1}{(x_1 + x_2)^2} + \frac{B x_1 (x_1 - x_2)}{(x_1 + x_2)^3} = 1$$

Result 7: Increasing (competitive balance sensitive) broadcasting income shifts the equilibrium in the direction of increasing competitive balance (i.e. closer to the 45^0 line). However, the reaction functions retain the same basic shape as shown in figure 1- they are upward sloping for low values of a rival's investment (strategic complements and downward sloping for high values of a rival's investment (strategic substitutes).

Subtracting one first order condition from another and rearranging it can be shown that $w_1 = (\sigma + B)/ (1 + \sigma + 2B)$ which is decreasing in B, and as B tends to infinity w_1 tends to ½. In other words, a relative increase in balance-sensitive income will diminish the dominance of the strong-drawing team. The slope of the reaction function for team 1 can be shown to equal:

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championship as a whole is greater than the sum of the values of the individual matches, or because collective sale enable the league to extract rents, then all teams may prefer collective to individual sale.

$$\text{(18)} \quad \frac{\sigma(x_1 - x_2)}{(x_1 + x_2)^3} + \frac{B(x_1 - x_2)(x_2 - x_1)}{(x_1 + x_2)^4} + \frac{2Bx_1x_2}{(x_1 + x_2)^4}$$

Where the first term is the slope of the reaction function in the absence of income from competitive balance and is negative in the region where $x_2 > x_1$. The second term in zero whenever the two teams are evenly balances, but otherwise negative when either team is stronger than the other- which means that the response of a stronger team to an increase in a weaker teams' investment is damped (strategic substitutability is diminished) . The third terms introduces an extra element of strategic complementarity for all values of a rival's investment. The difference between the reaction functions in are sketched in figure 2.

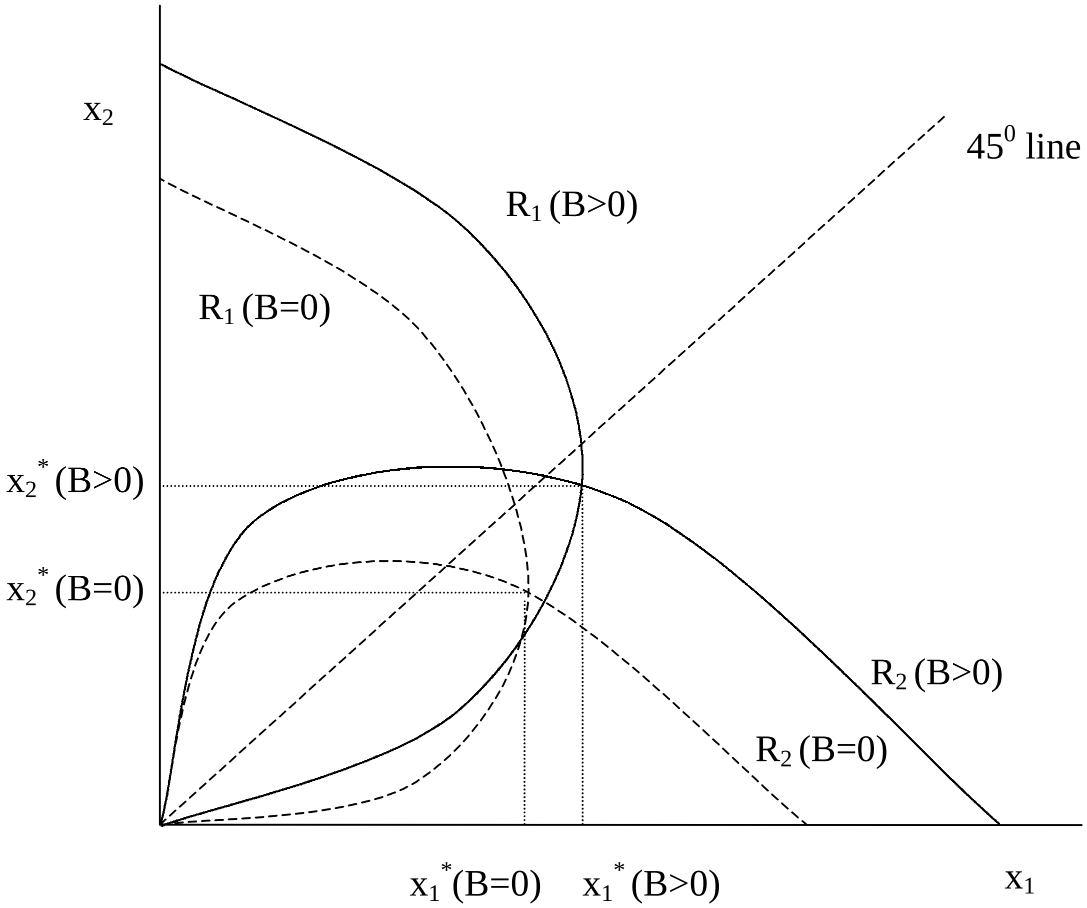

Figure 2: Comparison of reaction functions for contest success functions with and without and competitive balance sensitive income

(e) Mechanisms for distributing broadcast income

This analysis suggests that the choices of individual teams in cases where league income is increasing in competitive balance will themselves tend to be balanced. But what if the balance enhancing income were distributed on the basis of performance, so that more successful teams (in terms of winning percentage) receive a larger share of the balance-sensitive income? At first glance one might expect a result similar to Result 7, so that performance based redistribution of balance-sensitive income would lead to an even higher degree of competitive balance in equilibrium. But in fact this need not be the case. For profit functions defined as follows:

$$(19) \qquad \pi_1 = \frac{\sigma(x_1+x_2)^2 + Bx_1{}^2x_2}{(x_1+x_2)^3} - x_1, \quad \pi_2 = \frac{(x_1+x_2)^2 + Bx_1x_2{}^2}{(x_1+x_2)^3} - x_2$$

it is not possible to derive any analytical results even with the simplified production technology assumed here. However, we can use simulations to compare investment, winning percentages, revenues and profits for the Nash equilibria derived from either (16) or (19). Some results are shown in Table 1.

Cases 1 and 2 illustrate the impact asymmetry in revenue sharing when there is balance-sensitive income. Case 3 compares the impact of the two types of distribution scheme when there is symmetry and balance-sensitive income is positive. Performance based distribution will lead to higher investment levels and lower profits than equal sharing. Case 4 shows the impact of the two types of distribution when there is asymmetry. As in case 3, performance based distribution is associated with higher player spending than equal sharing, but also leads to a less balanced contest. This result was robust to all variations of the parameter values for L and σ considered. The explanation of this result (which goes in the opposite direction to Result 7, where redistribution on the basis of performance enhanced balance compared to equal sharing) is that the impact of balance-sensitive income now becomes tied in the reaction functions of each team owner. Given that team 2's owner views team 1's investment as a strategic substitute it prefers a relatively smaller increase in talent investment than team 1 when balance-sensitive income is contested. Similarly, since team 1's owner views team 2 investment as a strategic complement, when balance-sensitive income is contested team 1 chooses to increase its investment by proportionately more than team 2.

Table 1. Comparison of "Equal sharing" and "performance based incentives" used for the distribution of balance-sensitive income.

		x_1	x_2	w_1	R_1 *(local)*	R_2 *(local)*	$R_1(B)$	$R_2(B)$	π_1	π_2
Case 1	ES&PB	.25	.25	.5	.5	.5	0	0	.25	.25
Case 2	ES&PB	.36	.24	.6	.9	.4	0	0	.54	.16
Case 3	ES	.25	.25	.5	.5	.5	.125	.125	.375	.375
	PB	.313	.313	.5	.5	.5	.125	.125	.313	.313
Case 4	ES	.343	.274	.556	.833	.444	.123	.123	.614	.294
	PB	.412	.320	.563	.844	.437	.138	.108	.571	.225

Case 1: σ = 1, B = 0
Case 2: σ = 1.5, B = 0
Case 3: σ = 1, B = 1
Case 4: σ = 1.5, B = 1
ES: Equal sharing of balance sensitive income (B)
PB: Performance based sharing of balance sensitive income (B)
x_i is investment, w_1 is the winning percentage of team 1, R_i(local) is revenue from local support (e.g. first term in (16)), R_i(L) is the share balance sensitive income (e.g. second term in (16)).

(f) The demand for quality

So far the modelling framework has incorporated demand for success of the home team, demand for competitive balance, but not demand for quality of the contest as a whole. This leads to the perverse conclusion that the joint profit maximising equilibrium would involve each team spending the smallest possible sum on playing talent (given the constraint that zero investment produces zero revenues). Even if the two teams were the only producers of sporting competition one might expect that at very low levels of quality fans and TV viewers might substitute for some alternative leisure activities, while the availability of both alternative sports and alternative leagues of teams playing the same sport suggests that the overall quality of competition is a significant factor in the demand for the competition of a particular league. Quality of competition can be enhanced in ways unconnected to the quality of the teams, for example by the supply of entertainment during the game, catering and other facilities, improved broadcasting techniques and so on. However, the quality of play, and the abilities of the players also no doubt play a role in the demand for the team competition.

While this is an important consideration, it does not significantly affect the contest theory analysis. We can straightforwardly include the demand for player quality by adding a term in the profit function for each team which is a function of the total talent of each team. In the symmetric case this we can write

(20) $$\pi_i = \frac{h(x_i)}{h(x_1)+h(x_2)} + \left(h(x_1)+h(x_2)\right)^{\gamma} - x_i$$

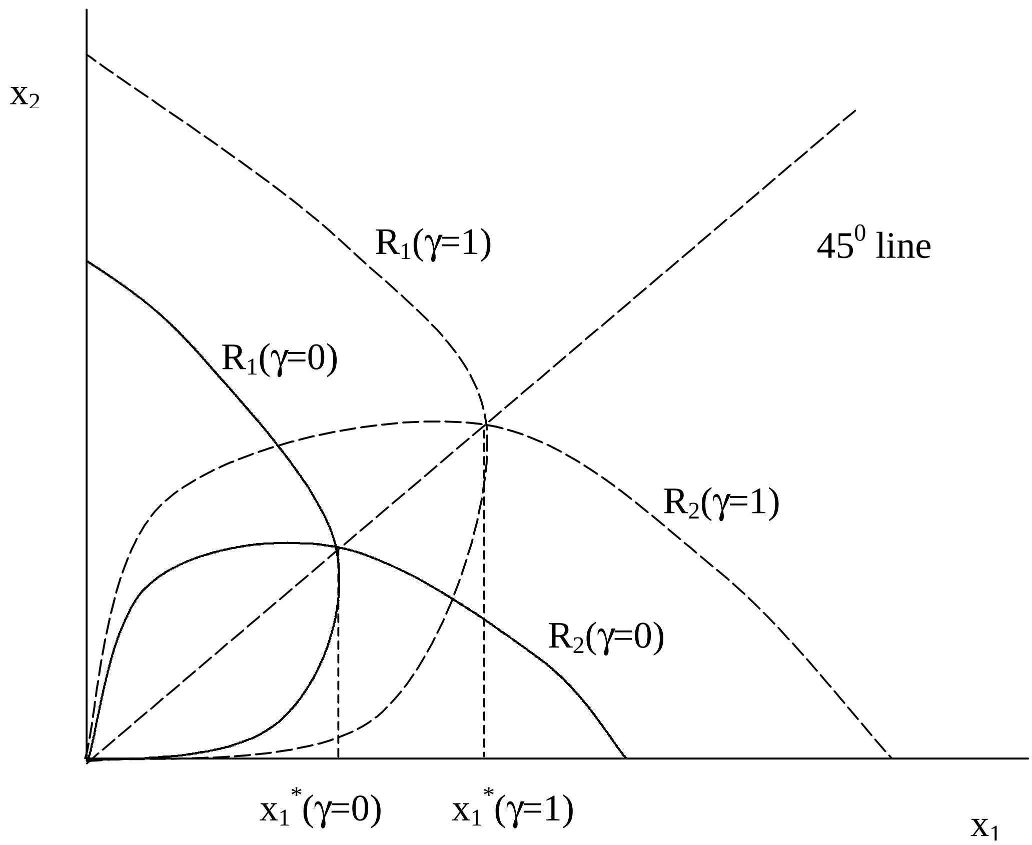

Figure 3: Reaction functions for contest success functions with symmetric local revenues (σ=1) and demand for quality

Where $\gamma > 0$ measures the sensitivity of revenues to total team quality. Taking first order conditions it is straightforward to show that an increase in γ rotates the reaction functions around the origin (see figure 3). Otherwise, the properties of the reaction functions are entirely unchanged.

3. Policy implications and conclusions

So far the analysis has been based entirely on the assumption of profit maximising behaviour by teams. As mentioned in section 2, some economists have argued that European soccer league teams are better characterised as win maximisers subject to a breakeven constraint. The merits of these arguments have been discussed elsewhere (see e.g. Hoehn and Szymanski (1999), Fort and Quirk (2000)). The main point to make here is that local revenue sharing of the kind described in section 2 will always be balance-enhancing in this alternative model, since any revenues redistributed from large drawing teams diminishes their own investment in playing talent while raising the investment of their rivals. Thus the results are clearly quite sensitive to the assumptions about objectives.

Sticking with the profit maximising assumption, from the point of view of economic policy, one naturally wants to ask what the optimal distribution of talent in the league might be, as well as the overall investment of the teams. It might be argued that this issue is properly addressed by constructing a utility function for consumers. But given that consumers value three elements (at least) of a tournament (the success of their own team, the competitive balance of the league and the quality of play in the league) the prospects for deriving any general results from a utility function that might capture all of these elements at once seems remote. One important contribution of the paper is to show that the contest reaction functions follow the same basic shape regardless of the weight attached to the three elements.

However, identifying suitable welfare criteria is not unproblematic. From the producers' point of view teams want to minimise investment while achieving the degree of competitive balance that maximises total revenues. It might be tempting to adopt this view for social policy in order to minimise the use of scarce resources. This reflects the fact that the only real issue addressed in contest theory is productive efficiency- allocative efficiency is in general not discussed explicitly. However, the rent seeking literature adopts a different welfare criterion: the extent to which contest design maximises the dissipation of rents through the expenditure of effort (see e.g. Tullock (1980), Higgins et al (1985) Baye et al (1997)). This approach is more consistent with an antitrust approach that puts consumers' (fans', viewers') interests at the centre of policy making and therefore suggests that the objective is to achieve maximum investment in talent as well as an optimal degree of competitive balance[17].

In the model team owners' and consumers' interest in competitive balance do not diverge significantly, as long as owners can extract some of the rents from competitive balance. Where interests diverge is in the extent of talent investment. The main policy conclusion of the paper is that team owners will tend to choose revenue sharing schemes that are independent of performance because they reduce investment, even at the expense of reducing competitive balance. Performance based prizes, such as are found in individualistic sports, tend to dissipate rates- and that, one might conclude, is why team owners seldom advocate or introduce such schemes. The implication is that antitrust authorities should monitor collective agreements justified on the grounds of competitive balance to ensure that the incentive properties of such schemes tend toward rent dissipation rather than rent extraction.

Several important issues in the analysis of team sports have not been considered in this paper, most notably the labour market arrangements and restrictions that have been characteristic of sports leagues throughout the world. Other characteristics of league structures, such as entry rules into the league and promotion and relegation[18] have also been neglected. Moreover, a number of simplifying assumptions have been made to aid the analysis, the most objectionable of which might be the restriction of the league to two teams. The addition of extra teams raises the possibility that the results of matches may have an effect beyond ability of the home team to generate income. For instance, if there is one strong team and several weak teams in the league,

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[17] This issue goes beyond the partial equilibrium analysis of this paper, and depends upon the perceived social value of sports contests.

[18] See Szymanski and Ross (2000) and Noll (2000) for two recent papers on this subject.

then the revenue of all weak teams might be greater when one weak team wins instead of loses against the strong team. For example, the longer the weak teams remain in contention for the league title, the greater the interest in the championship. While this kind of effect may be important, it is unlikely to affect the main conclusions of this paper. Revenue sharing that is independent of performance is still likely to cause lower overall investment in talent while performance based revenue sharing is likely to dissipate rents and improve competitive balance. What may be important is the precise from of prizegiving. A single prize for the league as a whole may be inefficient if this leads teams out of contention to “give up” in mid-season. Prizes for all but the lowest rank (or penalties in the form of relegation) may be more efficient.

There is substantial scope for further research on the design of team sports contests. Given the wealth of data available this should be a fertile area for both theory and empirical testing in the future. This paper has tried to establish a specific connection to the branch of economic theory most closely related to sports leagues, namely contest theory, and has focused on the incentive properties of revenue sharing. Most team sports are organised along the lines suggested by Lewis Carroll, where all are winners and all must have prizes. This emerges a consequence of collusion among the team owners that actually stage the contest, compared to individualistic sports where owners of facilities for staging contests typically compete to attract the participation of the top stars. The paper has suggested that a more efficient outcome from the point of view of consumers interested in rent dissipation is revenue sharing of a form that rewards success.

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