A Model of Promotion and Relegation in League Sports

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Abstract

Sports leagues in different parts of the world are set up in different ways, some as open leagues and some as closed leagues. It has been shown that spending on players is higher in open leagues (Szymanski and Ross 2000 and Szymanski and Valletti 2005). This paper extends these studies, finding that sports leagues that practice promotion and relegation will have unambiguously higher aggregate spending on player talent than closed leagues. This will lower profits in the open league, but increase fan welfare.

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Introduction

Most North American sports leagues are closed leagues that operate with a fixed set of teams every season. This differs from other leagues throughout the world that have open leagues that practice promotion, or a team from a lower division being promoted to a higher league, and relegation, where the lowest teams of a given division are demoted to a lower division. The difference in league structure means teams make choices concerning inter-season strategies, investment in players, and investment in revenue generating activities differently.

All of the major sports leagues in North America, Major League Baseball (MLB), National Basketball Association (NBA), National Football League (NFL), the National Hockey League (NHL), and Major League Soccer (MLS) are closed leagues. Entry or expansion of a closed league is rare, granted only by the approval of existing team owners and is typically accompanied by a large fee. Since 1995 four teams have entered the NFL. The Carolina Panthers and Jacksonville Jaguars began play in 1995 and the Houston Texans, who began play in 2002, were allowed to enter the NFL after a $700 million payment to the league. The fourth team, the Cleveland Browns, was allowed to re-enter the league after the existing franchise left town for Baltimore.

Outside of North America most leagues are open leagues. Open leagues are set up with several hierarchical divisions and use a system of promotion and relegation. The primary determinant of promotion and relegation is on field success.[1] At the end of each season the worst performing teams in the upper divisions are relegated, or demoted, to a lower division and the best performing teams in lower divisions are promoted to higher divisions. The English Football League is divided into four hierarchical divisions. Below the Football League are several other

[1] The quality of facilities can be another, although less significant, factor.

smaller leagues. For detailed descriptions of the English Football League and historical facts see Noll (2002) and Szymanski and Valletti (2005).

The primary difference between an open and closed league is the ability for new teams to enter the existing league. As stated above, entry into a closed league requires the prior approval of the existing team owners and a large fee. A closed league will expand if there are profit maximizing opportunities in cities that do not currently have a professional team or to prevent entry by a competing league. Most likely a competing league would choose locations that were unexploited by an existing league, thus the existing league must choose to expand into unexploited markets in order to contest the other league. Promotion and relegation serves as a means of entry into the open leagues. Any person could start his or her own team, begin competing at the bottom of the league and gain promotion to the major league over time. Entry could also be achieved by purchasing an existing minor league team and hire quality players and coaches to achieve the same result. Entry in an open league does not require approval by a franchise fee or existing team owners.

Because closed league teams don't face free entry, there is less competition for television contracts and ticket prices. This allows teams to not only extract monopoly rents from these contracts, but they can also extract public subsidies for stadiums and facilities (Coates and Humphreys 2003 and Jasina and Rotthoff 2008) because of the scarcity of teams. The league, utilizing its monopoly powers, can also impose blackout rules on television coverage, which forces fans to purchase tickets to the event before the league broadcasts the event in local markets. This behavior is well documented in the literature (Noll and Zimbalist 1997 and Quirk and Fort 1992 and 1999).

In open leagues it is conceivable that a city could have more than one team competing in the same sport and even in the same league. London has several teams competing in the top two tiers of the English Football League. The presence of alternatives keeps ticket prices below monopoly levels, meaning the only monopoly powers a team can have, in open leagues, is a name brand monopoly. The presence of alternative teams also reduces the incentive for cities to pay subsidies to teams because a club's threat of relocation is limited since there is a credible threat of entry from a new team.

One example of the open league system is the history of Rushden and Diamonds in English soccer. In 1992 two teams, Rushden Town and Irthlingborough Diamonds merged to form Rushden and Diamonds. Prior to the merger, Rushden was relegated to the Southern League Midland Division because their facilities were deemed unfit for Premier Division football, and Diamonds competed in the United Counties League. The merged team was able to reach Football League status after 9 years.

Another advantage of promotion and relegation is that it eliminates meaningless games that are prevalent in North American sports where it becomes clear at some point during the season which teams will and will not compete for the championship that year. The teams who finish worst are rewarded with the best picks of next year's draft. In addition to this benefit, there are no penalties for coming in last. Teams actually go out of their way to lose games (Taylor and Trogdon 2002) because of these incentives and these meaningless games are less competitive and less desirable to fans. In open leagues teams compete for the right to be promoted, but also to avoid relegation. Teams not in contention for the league championship have the incentive to field the best quality team they can, all season long, to prevent relegation.

Adopting a model from Szymanski and Ross (2000), it can be shown that teams tend to spend more on player talent in an open league than in a closed league. The increased spending on player talent means that teams in an open league will be less profitable than teams in a closed league. This paper shows that the Szymanski and Ross model implies that aggregate spending is higher for an open league, relative to the closed league, and aggregate profit is lower. A relegated team will have to play in a lower division which has lower revenue generating potential. Because of this, teams will spend more on player talent to avoid relegation. The prospect of promotion to a higher division, with more revenue generating potential, also causes teams in the lower division to spend more than they would in a closed league. These results are consistent with Noll (2002), where Noll concludes that, holding all else constant, leagues that practice promotion and relegation will have stronger teams than leagues that are closed. Major League Soccer (MLS), the top soccer league in the United States, will always be weaker than teams from the top leagues in Europe because the MLS is a closed league.

Szymanski and Ross (2000) consider a case with two large market teams and two small market teams and find that the difference between the strength of the two markets determines the total effort in the league. As the difference between the markets increases, total league effort increases, but they were unable to generalize any results for their model. Szymanski and Valletti (2005) take the Szymanski and Ross (2000) model a step further by solving and generalizing the model for the n-team case. Our paper continues the generalization of this model by allowing the contrast of a closed system and an open system. We solve for the equilibrium levels of spending on player talent as a function of league size and the number of teams being promoted and relegated.

The next section will set up the models for both the open and closed leagues, followed by the analysis of these models. The last section will conclude.

Models

Open League

A two-period, two-division model is developed so that spending on talent in the first period is affected by the prospect of promotion and relegation. Assume that large market teams, teams 1 and 2, start in the top division and small market teams, teams 3 and 4, start in the lower division. First period expected profit for large market teams can be written as

$$E(\pi_1) = \frac{t_1}{t_1 + t_2}\left(\mu + \delta D_{\mu 1}\right) + \frac{t_2}{t_1 + t_2}\delta D_{\mu 2} - t_1 \qquad (1)$$

where t_i is spending by team i on player talent, $D_{\mu 1}$ is the expected profit of a large market team from retaining a place in the top division and $D_{\mu 2}$ the expected profit following relegation to the lower division. The drawing power of large market teams is μ, which is assumed to be greater than one, and δ is the discount rate. First period expected profit for small market teams is

$$E(\pi_3) = \frac{t_3}{t_3 + t_4}\left(\lambda + \delta D_1\right) + \frac{t_4}{t_3 + t_4}\delta D_2 - t_3 \qquad (2)$$

where D_1 is the expected profit of a small market team from promotion to the top division and D_2 is the expected profit from remaining in the bottom division. The drawing power of small market teams is λ, which is assumed to be less than one. Maximizing each of these functions with respect to spending, t, yields

$$t_1^* = t_2^* = \frac{1}{4}\left[\mu + \delta\left(D_{\mu 1} - D_{\mu 2}\right)\right] \qquad (3)$$

$$t_3^* = t_4^* = \frac{1}{4}\left[\lambda + \delta\left(D_1 - D_2\right)\right] \qquad (4)$$

These terms generalize for n teams in the top division and for n teams in the lower division

$$t_i^* = \frac{n-1}{n^2}\left[\mu + \delta\left(D_{\mu 1} - D_{\mu 2}\right)\right] \tag{5}$$

$$t_i^* = \frac{n-1}{n^2}\left[\lambda + \delta\left(D_1 - D_2\right)\right] \tag{6}$$

Assuming team 2 is relegated to the lower division and team 3 is promoted to the top division, second period expected profit for each team is

$$E\left(\pi_1^2\right) = \frac{t_1}{t_1 + t_3}\mu - t_1 \tag{7}$$

$$E\left(\pi_3^2\right) = \frac{t_3}{t_1 + t_3} - t_3 \tag{8}$$

$$E\left(\pi_2^2\right) = \frac{t_2}{t_2 + t_4}\mu\lambda - t_2 \tag{9}$$

$$E\left(\pi_4^2\right) = \frac{t_4}{t_2 + t_4}\lambda - t_4 \tag{10}$$

Maximizing equations 7 through 10 with respect to team spending on player talent, t, and solving for second period spending on player talent results in

$$t_1^{2*} = \frac{\mu^2}{\left(1+\mu\right)^2} \tag{11}$$

$$t_3^{2*} = \frac{\mu}{\left(1+\mu\right)^2} \tag{12}$$

$$t_2^{2*} = \frac{\lambda\mu^2}{\left(1+\mu\right)^2} \tag{13}$$

$$t_4^{2*} = \frac{\lambda\mu}{\left(1+\mu\right)^2} \tag{14}$$

Given these values we can solve for second period expected profit.

$$\pi_1^2 = D_{\mu 1} = \frac{\mu^3}{(1+\mu)^2} \tag{15}$$

$$\pi_3^2 = D_1 = \frac{1}{(1+\mu)^2} \tag{16}$$

$$\pi_2^2 = D_{\mu 2} = \frac{\lambda\mu^3}{(1+\mu)^2} \tag{17}$$

$$\pi_4^2 = D_2 = \frac{\lambda}{(1+\mu)^2} \tag{18}$$

These values can be generalized for n-teams per division.

$$t_1^{2*} = \frac{(n-1)\mu(k\mu-(k-1))}{(k\mu+(n-k))^2} \tag{19}$$

$$t_2^{2*} = \frac{(n-1)\lambda\mu((n-k)\mu-(n-k-1))}{(k+(n-k)\mu)^2} \tag{20}$$

$$t_3^{2*} = \frac{(n-1)\mu((n-k)-(n-k-1)\mu)}{(k\mu+(n-k))^2} \tag{21}$$

$$t_4^{2*} = \frac{(n-1)\lambda\mu(k-(k-1)\mu)}{(k+(n-k)\mu)^2} \tag{22}$$

$$\pi_1^2 = D_{\mu 1} = \frac{(k\mu-(k-1))^2\mu}{(k\mu+(n-k))^2} \tag{23}$$

$$\pi_2^2 = D_{\mu 2} = \frac{((n-k)\mu-(n-k-1))^2\lambda\mu}{(k+(n-k)\mu)^2} \tag{24}$$

$$\pi_3^2 = D_1 = \frac{((n-k-1)\mu-(n-k))^2}{(k\mu+(n-k))^2} \tag{25}$$

$$\pi_4^2 = D_2 = \frac{((k-1)\mu - k)^2 \lambda}{(k+(n-k)\mu)^2} \tag{26}$$

The subscripts represent teams that are promoted and relegated in each division. Assuming that there are n-teams per division, team 1 represents the values for a large market team that remains in the top division while team 2 represents the values for a large market team relegated to the lower division. Team 3 represents the values for a small market team promoted from the lower division to the top division and team 4 represents the value for a small market team that remains in the lower division. The variable k, represents the number of teams that are promoted and relegated at the end of the first period. For simplicity, the number of teams promoted is equal to the number of teams relegated.

Inserting the values from equations 15 and 17 into equation 3 and the values from equations 16 and 18 into equation 4 yields

$$t_1^* = t_2^* = \frac{1}{4}\left[\mu + \frac{\delta(1-\lambda)\mu^3}{(1+\mu)^2}\right] \tag{27}$$

$$t_3^* = t_4^* = \frac{1}{4}\left[\lambda + \frac{\delta(1-\lambda)}{(1+\mu)^2}\right] \tag{28}$$

Generalized for n-teams per division and k number of teams being promoted and relegated results in first period spending on player talent for large market teams and small market teams

$$t_1^* = \frac{n-1}{n^2}\left[\mu + \delta\left(\frac{(k\mu-(k-1))^2\mu}{(k\mu+(n-k))^2} - \frac{((n-k)\mu-(n-k-1))^2\lambda\mu}{(k+(n-k)\mu)^2}\right)\right] \tag{29}$$

$$t_3^* = \frac{n-1}{n^2}\left[\lambda + \delta\left(\frac{((n-k-1)\mu-(n-k))^2}{(k\mu+(n-k))^2} - \frac{((k-1)\mu-k)^2\lambda}{(k+(n-k)\mu)^2}\right)\right] \tag{30}$$

Once the values of $D_{\mu 1}$, D_{μ}, D_1, D_2, t_1^* and t_3^* are calculated, it is possible to calculate first period expected profit for large and small market teams.

$$\pi_1^1 = \pi_2^1 = \frac{1}{4}\left[\mu + \delta\left(\frac{(1+3\lambda)\mu^3}{(1+\mu)^2}\right)\right] \tag{31}$$

$$\pi_3^1 = \pi_4^1 = \frac{1}{4}\left[\lambda + \delta\left(\frac{(1+3\lambda)}{(1+\mu)^2}\right)\right] \tag{32}$$

For n-teams per division and k number of teams being promoted and relegated, first period expected profit is

$$\pi_1^1 = \frac{1}{n^2}\left[\mu + \delta\left(\frac{(k\mu-(k-1))^2\mu}{(k\mu+(n-k))^2} + \frac{(n^2-1)((n-k)\mu-(n-k-1))^2\lambda\mu}{(k+(n-k)\mu)^2}\right)\right] \tag{33}$$

$$\pi_3^1 = \frac{1}{n^2}\left[\lambda + \delta\left(\frac{((n-k-1)\mu-(n-k))^2}{(k\mu+(n-k))^2} + \frac{(n^2-1)((k-1)\mu-k)^2\lambda}{(k+(n-k)\mu)^2}\right)\right] \tag{34}$$

Closed League

Initially it is assumed that the closed league is made up of two large market teams. Expected profit for each period can be written as

$$E(\pi_1) = \frac{t_1}{t_1+t_2}\mu - t_1 \tag{35}$$

The profit maximizing spending on player talent and expected profit each period will be

$$t_1^* = t_2^* = \frac{\mu}{4} \tag{36}$$

$$\pi_1 = \pi_2 = \frac{\mu}{4} \tag{37}$$

Admission of a small market team, t_3, into the league would not be profitable for the two large market teams. Spending on player talent for the large market teams and the small market team becomes

$$t_1^* = t_2^* = \frac{2\mu^2}{(\mu+2)^2} \tag{38}$$

$$t_3^* = \frac{2\mu(2-\mu)}{(\mu+2)^2} \tag{39}$$

Team profit is now

$$\pi_1 = \pi_2 = \frac{\mu^3}{(\mu+2)^2} \tag{40}$$

$$\pi_3 = \frac{(\mu-2)^2}{(\mu+2)^2} \tag{41}$$

The addition of the third team reduces the profit of each incumbent by

$$\frac{\mu(3\mu^2-4\mu-4)}{(\mu+2)^2} \tag{42}$$

Aggregate profit falls by

$$\frac{3\mu^2-8\mu+4}{2(\mu+2)} \tag{43}$$

In this model, entry will only occur if the existing teams can obtain a fee large enough to compensate them for their lost profit.

Since large market teams will not voluntarily expand the league, it is more conceivable that large and small market teams form competing leagues. Assuming teams 1 and 2 are large market teams and teams 3 and 4 are small market teams, teams face the same problem each period. Expected profit can be written as

$$E(\pi_1) = \frac{t_1}{t_1 + t_2}\mu - t_1 \tag{44}$$

$$E(\pi_3) = \frac{t_3}{t_3 + t_4}\lambda - t_3 \tag{45}$$

The drawing power of large market teams is μ and is assumed to be greater than one. The drawing power of small market teams is λ and is less than one. The profit maximizing spending on player talent and expected profit each period is

$$t_1^* = t_2^* = \frac{\mu}{4} \tag{46}$$

$$\pi_1 = \pi_2 = \frac{\mu}{4} \tag{47}$$

$$t_3^* = t_4^* = \frac{\lambda}{4} \tag{48}$$

$$\pi_3 = \pi_4 = \frac{\lambda}{4} \tag{49}$$

These values can be generalized for n-teams per league as

$$t_1^* = \frac{n-1}{n^2}\mu \tag{50}$$

$$\pi_1 = \frac{1}{n^2}\mu \tag{51}$$

$$t_3^* = \frac{n-1}{n^2}\lambda \tag{52}$$

$$\pi_3 = \frac{1}{n^2}\lambda \tag{53}$$

Analysis of the Models

Figures 1 and 2 show the values of team effort and team profit for top and bottom division teams in an open league. Since teams in the top division have a higher drawing power than teams in the bottom division, top division teams spend more on player talent than bottom division teams. As the number of teams in the top division increases, spending on player talent decreases. The incentive to invest in player talent decreases and the probability of winning the championship decreases. In figure 1, top division teams spend an average of 1079% more on player talent than teams in the bottom division.

The incentive for bottom division teams to invest in player talent decreases as the number of teams in the bottom division increases. Teams in the bottom division do not face the prospect of relegation since there are only two divisions in the model, but the probability of promotion to the higher division decreases as the number of teams in the division increases. The difference in spending by teams in the top and bottom divisions decreases as the drawing power of top division and bottom division teams get closer, where wages is a proxy for effort.

Figure 1 Open league team effort, μ=1.2, λ=0.1, δ=0.1, k=2

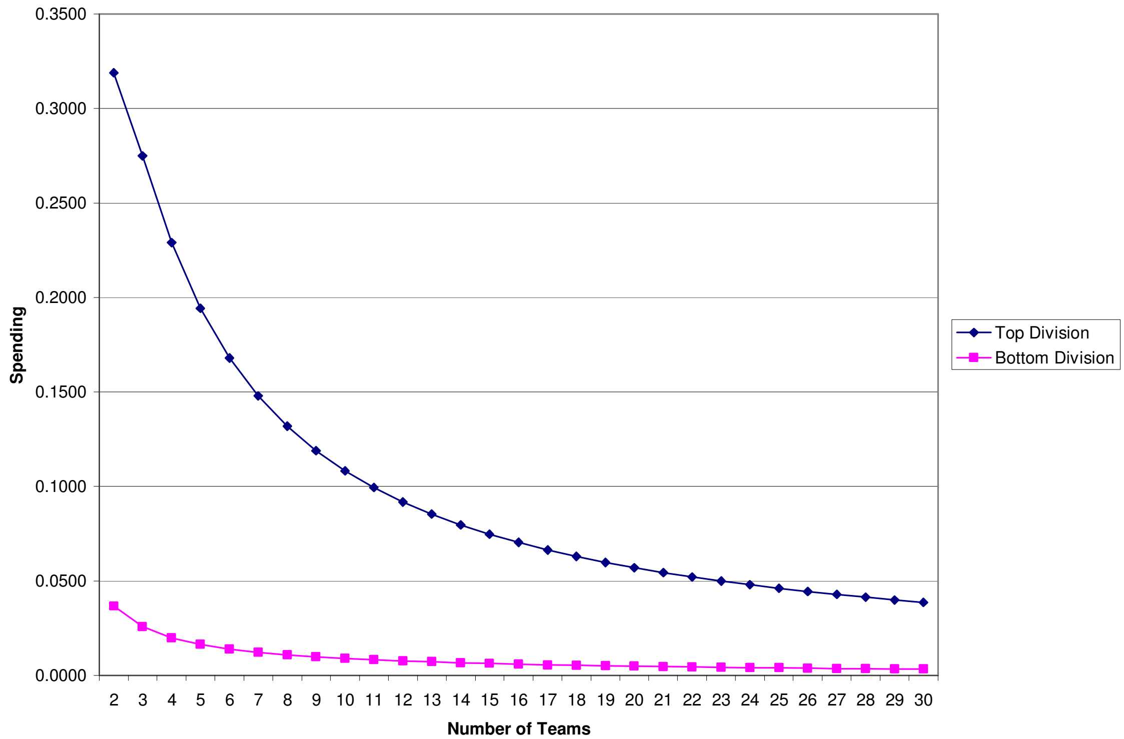
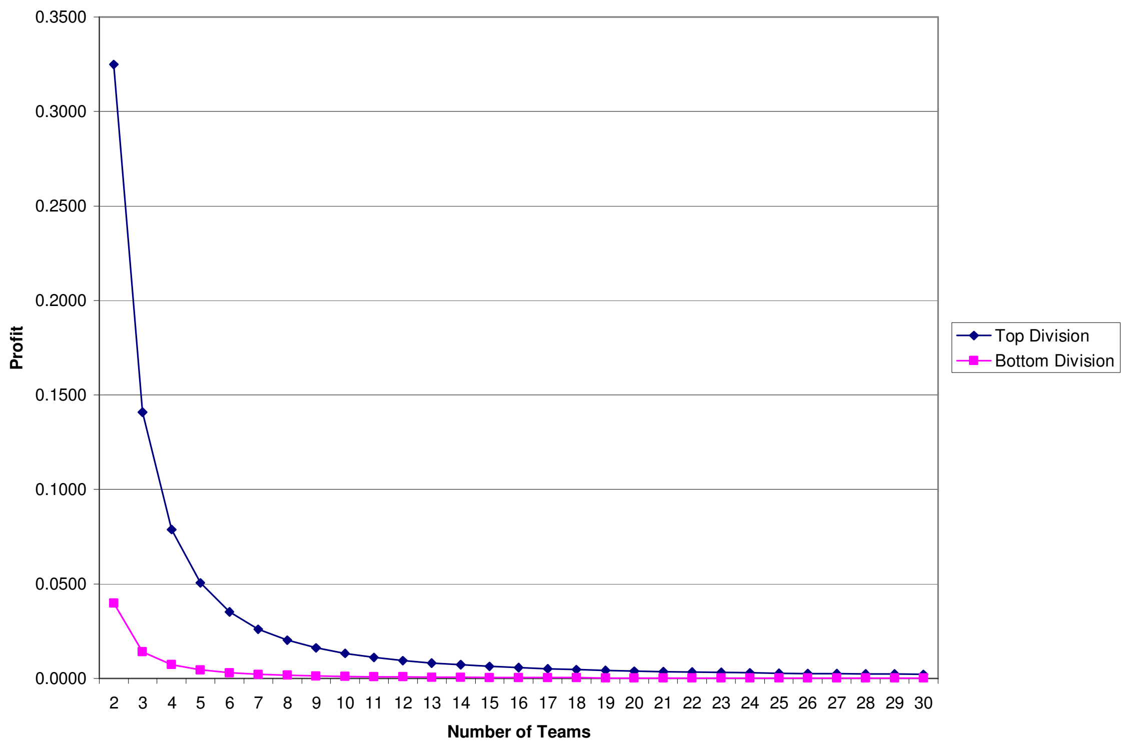


Figure 2 Open league team profit μ=1.2, λ=0.1, δ=0.1, k=2



An important implication of our model is the impact of changing k, the number of teams promoted and relegated, on the spending of large market teams. Holding all else constant, as k increases, the threat of relegation increases, giving teams the incentive to spend more on player talent. Recall that relegation means playing in a lower division with lower revenue generating potential. To avoid relegation, teams will spend more on player talent. Increases in k have the opposite impact on team profit. As k increases, team profit decreases. Changing k has the opposite impact on the spending by teams in the bottom division. As k increases, the prospect of promotion increases, and teams have less of an incentive to spend on player talent. As spending decreases team profit increases.

A major change occurred in England's football league in the late 1980's and early 1990's. The top division, later named the Premier League, shrunk from 22 to 20 teams between

1986 and 1988. The Premier League returned to 22 teams during the 1991-1992 season and then back to 20 teams in the 1995-1996 season. Dominant teams in the Premier League were apparently unhappy and in 1992 the Premier League broke away from the Football League, but still participated in the promotion and relegation scheme with the lower divisions. In order to decrease the number of teams in the Premier League, the number of teams relegated at the end of a season would have to be increased. The model predicts that this would lead to an increase in spending on player talent by teams in the top division to avoid relegation. The model also predicts that once the Premier League is established with fewer teams, profits will increase for those teams fortunate enough to retain a spot in the top division.

Figure 3 compares team spending in an open league to team spending in a closed league. In general, top division teams spend more on player talent than large market teams in a closed league. The threat of relegation gives teams in the top division an additional incentive to invest in higher quality players than teams in closed leagues. Large market teams in a closed league do not have to worry about relegation when they make decisions on how much to spend on player talent.

Teams competing in the bottom division of an open league will spend more on player talent than small market teams in a closed league because of the prospect of promotion. Teams in the bottom division spend more for two reasons. The first is that teams seek promotion because the top division has higher revenue generating potential than the bottom division. The second reason teams seek promotion is that the prize or championship can only be won by teams in the top division. Promotion and relegation gives teams an added incentive to spend more on player talent than teams in a closed league. This suggests that the overall quality of play will be higher in an open league than in a closed league resulting in more competitive games and higher fan utility.

Figure 4 graphs aggregate spending in open and closed leagues. We would expect aggregate spending in an open league to be greater than aggregate spending in a closed league because of the additional incentives created by the promotion and relegation system. On average aggregate spending in the open league is 0.41% higher than aggregate spending in the closed league.

Figure 3, team effort u=1.2, lambda =.1, delta=.2, k=2

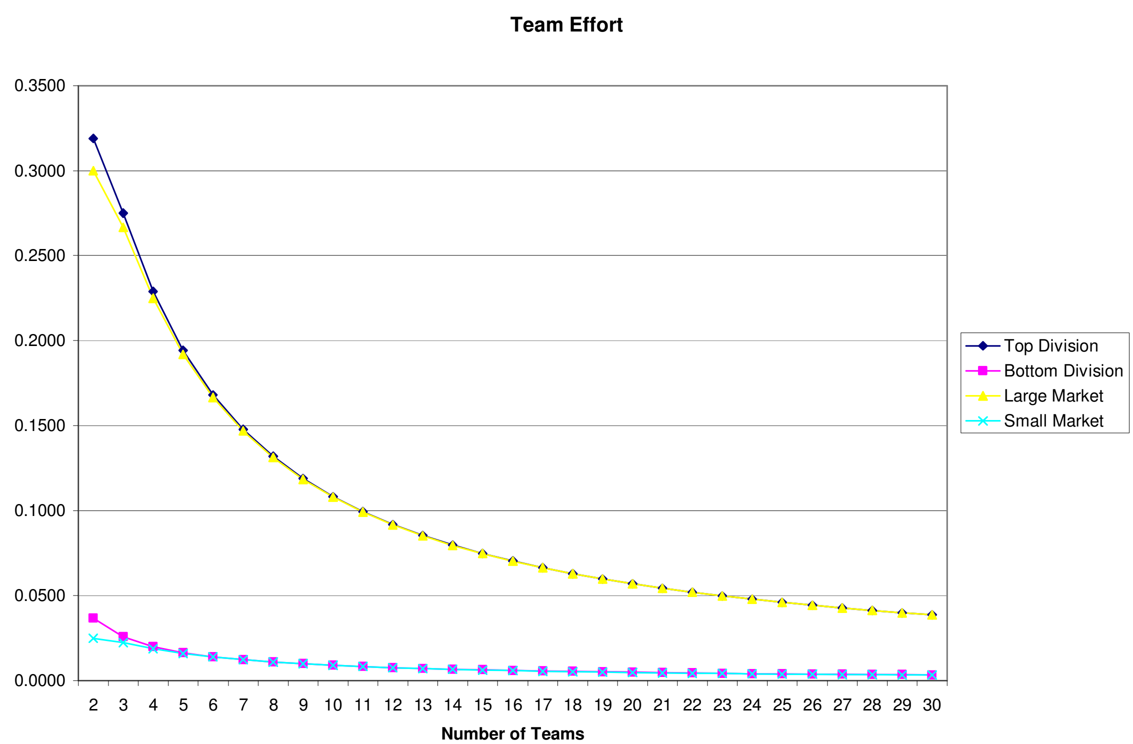
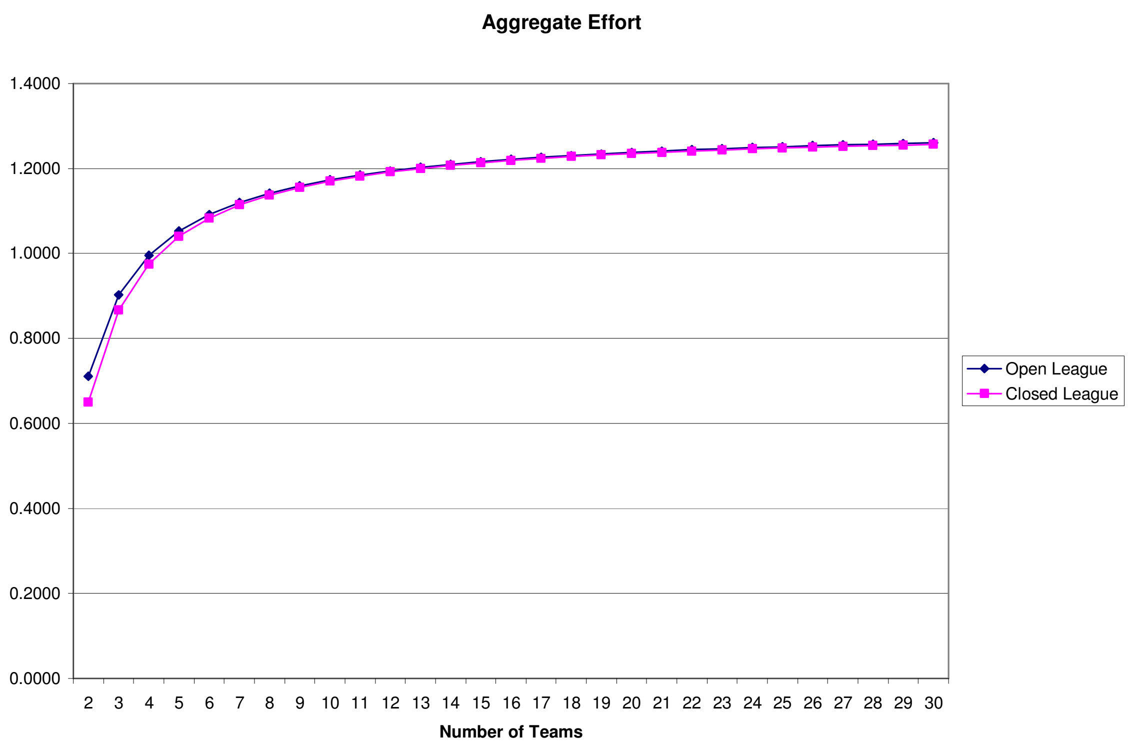


Figure 4 Aggregate effort u=1.2, lambda =.1, delta=.2, k=2



As the relative difference in the drawing power of large market teams and small market teams increases, both team spending and aggregate spending in the open league increases relative to the spending in the closed league. Top division teams (open market) spend more on player talent than large market teams (closed market) and bottom division teams spend more on player talent than small market teams. The difference in aggregate spending increases as μ increases.

Figures 5 and 6 compare an open league with a top and bottom division to a single major league. The number of teams in the major league is equal to the sum of the number of teams in the top and bottom divisions. Figure 5 graphs team spending in the open league to team spending in the major league. Teams in the major league spend less on player talent than teams in both divisions of an open league. Figure 6 graphs aggregate spending in the open league and major league. Aggregate spending will be higher in the open league than aggregate spending in the major league. The results presented in figure 5 and 6 are important because they tell us the potential impact of breaking up the monopoly leagues that exist in North American sports. If a league such as Major League Baseball was forced to breakup and form two separate leagues that practiced promotion and relegation, aggregate league spending would increase. The increase in spending would lead to an increase in the quality of play and thus an increase in fan utility.

Figure 5 team effort u=1.1, lambda =.9, delta=.2, k=2

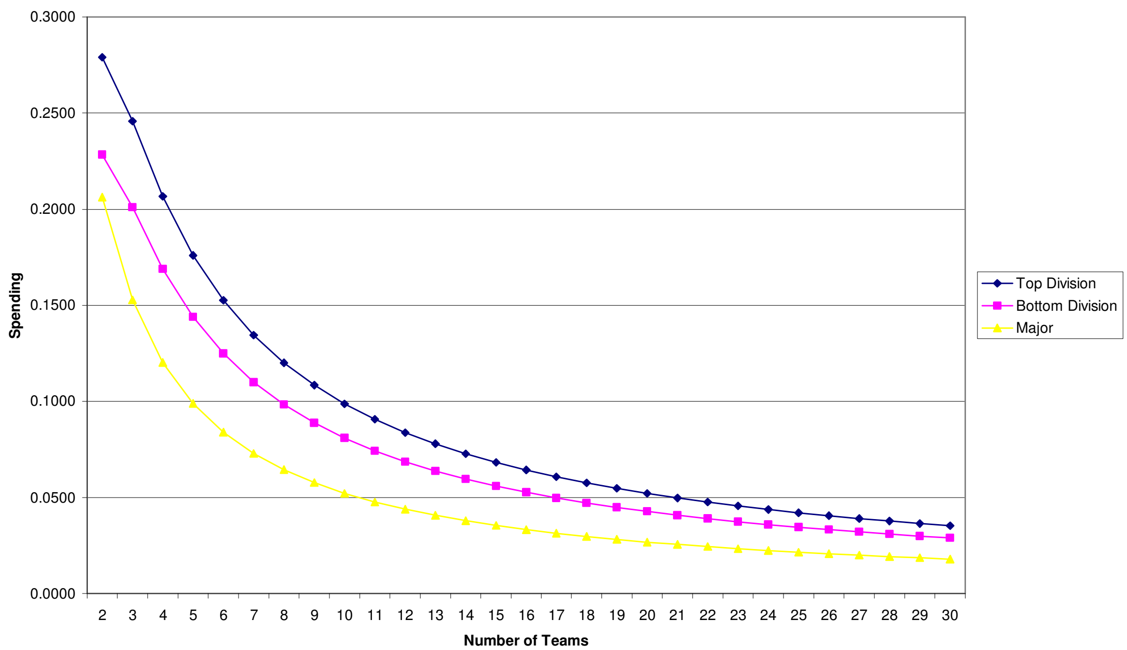
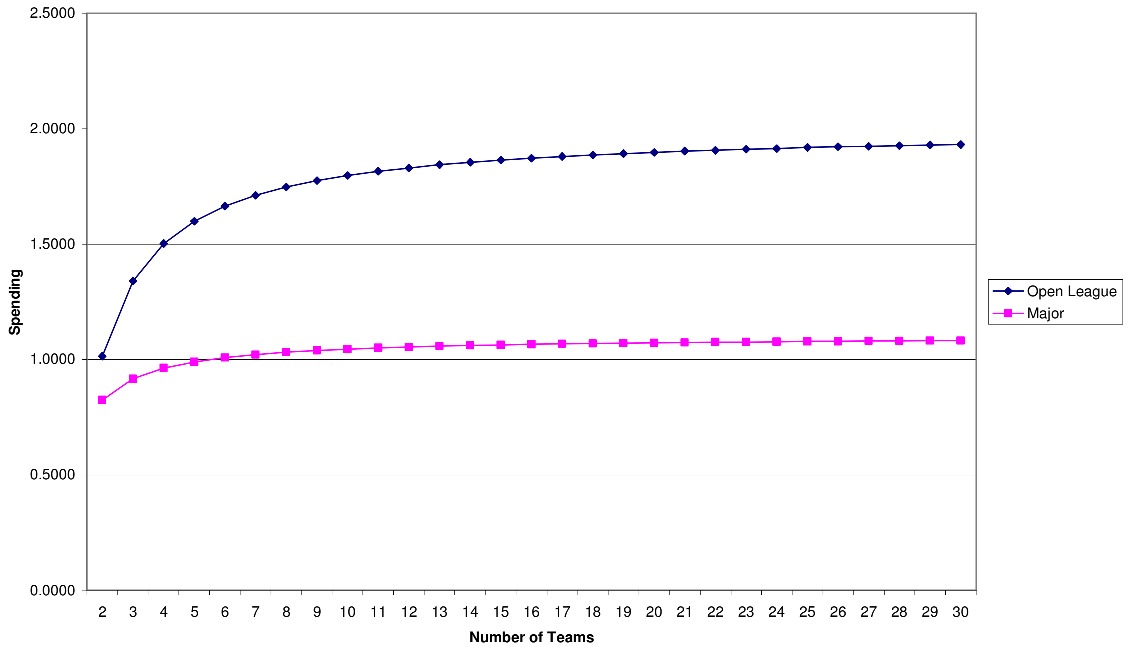


Figure 6 Aggregate effort u=1.1, lambda =.9, delta=.2, k=2



The model makes no clear predictions about competitive balance. Large market teams will tend to dominate the league because they generate more revenue to spend on quality players. Although small market teams get promoted to the top division, their stay may be brief. These teams do not generate enough revenue to compete in the top division and are, therefore relegated soon thereafter. Even this brief stay in the top division may be beneficial to small market teams. Noll (2002) finds that on average, promotion into the Premier League is accompanied by an increase in attendance of 6,000 people per game. The benefits of promotion seem to last for a while after the team has been relegated to the lower division. This gives marginal teams the incentive to pursue a strategy of bouncing back and forth between the top division and the lower division.

Conclusion

This research extends the models found in Szymanski and Ross (2000) and Szymanski and Valletti (2005) and generates new results on aggregate spending. In particular, this paper finds that sports leagues that practice promotion and relegation will have unambiguously higher aggregate spending on player talent than closed leagues.

Promotion and relegation adds an additional dimension to league play that is not present in closed leagues. In order to avoid relegation, teams must play at the highest level all season long. Competition among top division teams to avoid relegation produces more spending on player talent than large market teams in a closed league. Teams in lower divisions will spend more on player talent than small market teams in a closed league since the prospect of promotion means higher expected profit. Higher spending on player talent at each hierarchical level means that the overall quality of play will be higher in an open league. If fans derive utility from the quality of on-field play, fans of open leagues will have higher utility than fans of closed leagues.

The issue of competitive balance is often used as an excuse for the restrictive practices in North American sports leagues. Teams in North America argue that in order to keep or promote competitive balance they must impose things like salary caps, luxury taxes and revenue sharing. An extension of this framework to these issues would be a worthwhile undertaking.

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