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Abstract: This paper compares conventional static measures of competitive balance with measures that take account of the mobility of teams into the upper ranks of professional leagues, which we call dynamic competitive balance. We use this measure to compare the open soccer leagues that permit entry by the process of promotion and relegation, to the closed leagues of North America where there is no automatic right of entry. We also identify the theoretical distribution on entrants to the top k ranks assuming that all teams have equal probabilities of winning. We find that the open leagues we study are less balanced, dynamically, than closed leagues, and also that open leagues lie much further away from the theoretical distribution than closed leagues.

1. Introduction

"All schemes used in the United States punish excellence in one way or another. The European football approach punishes failure by promoting excellent minor league teams to the majors and demoting (relegating) poor performing major league teams back down to the minors. The revenue loss from a potential demotion to a lower class of play is severe punishment for low quality---severe enough that salary treaties, league sharing arrangements, and unified player drafts are so far thought to be unnecessary, even though star salaries are enormous. It is an interesting economic question as to which system achieves better results."

Rosen and Sanderson (2001)

It is a long-standing proposition in sports economics that "better" means "more balanced" results. Competitive balance refers to the expectations of fans about who will be the winner. In a perfectly balanced contest fans believe all outcomes are equally possible so there is complete outcome uncertainty. In a perfectly unbalanced contest the winner is known ex ante with probability 1. It seems reasonable to suppose that without at least some degree of competitive balance, fans will lose interest in a competition. A stronger proposition would be that, all else equal, a more balanced contest is a more interesting one. Assuming for the moment that this is true, an important issue in the comparison of different league systems will be whether one league is more balanced than another.

Previous studies have measured "match uncertainty" or "seasonal uncertainty", and both of these measures can be compared across leagues. Match uncertainty refers simply to expectations about a particular game, and this can be measured, for example, by studying pre-match betting odds.[1] However, interest in a league competition goes beyond uncertainty about a particular match and many fans are attracted by uncertainty about the overall outcome of the championship. The closeness of an overall championship race can be measured in a number of ways, e.g. the number of games behind the leader that the following k teams are as the season ends, the date at which at the championship outcome becomes known with certainty, or more generally, the standard deviation of success (e.g. win percentage) among the teams.

These measures tell us something about competitive balance in a "static" sense- the balance of a particular match or season, but for many fans there is also interest in competitive balance in a "dynamic" sense: do particular teams dominate the championship over time? This paper proposes a natural basis for comparing dynamic competitive balance among leagues and a theoretical benchmark. The natural basis is to consider the cumulative frequency of teams entering the top k ranks of a league (ranked by some measure such as win percentage). By analogy we can think of dynamic competitive balance like the spread of an epidemic- the more balanced a league the more rapidly teams enter the ranks of the top k.

This raises an important additional consideration. In a "closed" league of, say, twenty teams, only twenty teams can ever enter the top k. The more teams, the greater the potential for entry into the top k, just as the absolute number of people succumbing to a disease must be increasing in the total population. Leagues in North America are typically closed in the sense used above (although there can be some new entry from the sale of additional franchises and league mergers). By contrast, in most other countries leagues are "open" in the sense that at the end of each season the worst performing teams are demoted to the immediately junior league and replaced by the best performing teams from that league. The European Commission (1998) has gone so far as to suggest that "the system of promotion and relegation system is one of the key features of the European model of sport". Given this hierarchical structure it is apparent that the population of potential entrants into the major league is, over time, much larger (and possibly unlimited) compared to a closed league.

One central concern of this paper is whether this "equality of opportunity" translates into equality of outcome, as measured by competitive balance. Our theoretical benchmark approaches this issue by asking how many teams would be expected to enter the top k ranks in league system where resources were so distributed that each match played were perfectly balanced. In other words, if success were purely random (because all sources of systematic

[1] A review of these studies is provided by Szymanski and Kuypers (1999).

variation, such as resource inequality, had been removed) how much mobility would there be in a given league structure? Calculating this benchmark for a closed league with a fixed number of teams is relatively straightforward, but as we show the case of an open league is more complex. However, by deriving these values we can compare actual with theoretical mobility and derive a kind of Gini coefficient, measuring the closeness of league outcomes to a perfectly balanced ideal. It turns out that North American leagues are far closer to the theoretical ideal than their European counterparts, a phenomenon that can be accounted for by the much greater extent of resource equalisation measures in North America e.g. gate revenue sharing, collective merchandising, draft rules, salary caps and so on.

The paper is set out as follows. In the next section we compare measures of static and dynamic competitive balance for North American major league sports and the dominant national sports leagues in Europe for soccer. In section 3 we derive our theoretical benchmark for closed and open leagues. In section 4 we consider the difference in mobility comparing theoretical and actual measures. Section 5 concludes.

2. Static and dynamic competitive balance

Most measures of competitive balance in the literature are essentially static- they analyse the equality of winning opportunities for individual matches or for a championship season taken as a whole.[2] For example, Quirk and Fort (1995) hypothesise that if seasonal win percentages become less dispersed then a league has become more competitively balanced. They review some allegedly balance-enhancing reforms in the North American professional leagues (e.g. the introduction of the salary cap in the NBA in 1984, the NFL rookie draft introduced in 1936 and the beginning of free agency in baseball in 1976). In general they find no significant change in the standard deviation after the reforms and therefore conclude that there is no evidence that competitive balance was in fact enhanced.

[2] An exception is Szymanski (2001) who compares the competitive balance of two different competitions.

Horowitz (1997) uses an entropy index to measure changes in competitive balance over time in Major League Baseball (and finds that there is underlying trend toward increasing balance over the period 1903-1995). Applying the concept of entropy to a closed league seems natural enough, but it is less clear how one might extend this to a league with promotion and relegation. Quirk and Fort (1992) look at balance over time by adopting another measure based on seasonal variance. If a given league were perfectly balanced the winning probability for each team in each match would be 0.5, which would also be the expected value of the seasonal win percentage. The standard deviation of this win percentage would then $0.5/\sqrt{m}$ where m is the number of matches played. This can be used as an "idealised" measure of the standard deviation for a particular league. Expressing the actual standard deviation as a ratio of the idealised standard deviation thus provides a basis for comparing the degree of competitive balance of different leagues.

In this paper we have chosen to compare three North American leagues (Major League Baseball (MLB), The National Football League (NFL) and the National Hockey League (NHL)) to three national soccer leagues in Europe (Italy, England and Belgium). In terms of revenues and broadcast audiences the first two in each region are somewhat larger than third, but within both regions the basic league structures are comparable. Above all, the North American leagues are all closed and the European soccer leagues all open.

Table 1: Actual standard deviation of win percentages divided by idealised standard deviation

Decade	*MLB (1950-99)*	*NFL (1950-99)*	*NHL (1949-98)*	*England (1949-98)*	*Italy (1949-98)*	*Belgium (1953-2000)*
1950s	2.23	1.48	2.04	1.15	1.33	1.26
1960s	2.05	1.63	1.93	1.33	1.50	1.45
1970s	1.88	1.60	2.61	1.44	1.47	1.54
1980s	1.66	1.46	2.08	1.48	1.34	1.67
1990s	1.68	1.51	1.83	1.40	1.61	1.67

Note: ties (draws) are treated as half a win. European leagues refer to the top division of the national soccer league.

As Quirk and Fort have noted, the data for the North American leagues indicate a trend toward competitive balance over time in baseball, but no trend in the NFL or NHL. On this

measure the NFL has tended to be the most balanced of the North American leagues and the NHL the least balanced. As has been noted in the work of Kipker (2000), the European soccer leagues seem by comparison to be more balanced (although the European trend is toward less balance). Thus in the 1950s each of the three European leagues had lower standard deviations than any of the North American leagues, and in the case of England the actual standard deviation was only 15% higher than the idealised standard deviation. However, by the 1990s the gap had narrowed considerably, and for instance, the NFL seemed more balanced than either Italian of Belgian top divisions.

The principal weakness of a static measure of competitive balance such as this is that it takes no account of the identity of the successful teams.[3] So for example, according to the data the NFL was less balanced than the top soccer division in England, but in between 1990 and 1999 six different teams won the Superbowl whereas in England only five different teams won the League Championship. Moreover, in England one team won the title on five occasions (Manchester United), whereas the biggest winner in the US won only three times (Dallas).[4] To consider the dynamics more fully we have looked at the number of different teams winning the league title and the number of teams entering the top ranks.[5]

We conjecture that fans care about balance in the sense that they want a reasonable prospect that the identity of the winners will change from time to time (although they may also care about the variance of success among the teams within the season). "Turbulence" at the top increases the interest of fans of a greater number of teams. If, say, each team experiences diminishing returns to success in terms of fan interest, then a league that is

[3] This fact may also produce uninformative information within a given period. For instance the standard deviation of winning percentages tends to put too much weight among weaker teams. To give an example, imagine 10 teams competing in a league in a given year. In the first scenario, there is a team much stronger than everybody else that wins every single match, while the remaining teams have identical strength and win 50% of the matches. In the second scenario, there are 5 slightly stronger teams and 5 slightly weaker teams, where a team has 50% chance of winning a match among "equals", while a stronger team has 80% probability of winning against a weaker team. Despite it would be natural to describe as more balanced the second scenario, the normalized standard deviation of win percentages would yield the same numerical value in both cases.

[4] Rolling the data two years further forward would highlight the point even more clearly: only 4 winning teams in England, one of which won seven of the ten titles, while in the NFL there were seven different winners.

more balanced in this dynamic sense will be more successful. This point has been made elsewhere, see e.g. Ross and Lucke (1997) and Szymanski (2001) who finds some empirical support for the conjecture. In this paper our aim is to compare dynamic competitive balance across open and closed league. To do this we have looked at the number of entrants into the ranks, first over the full 50 years of data, then over forty years, thirty years, twenty years and ten years. The data is reported in Tables 2 and 3.

Table 2: Teams that had the highest winning percentage or were winners of the league championship

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
50-99	16	20	13	16	12	10
60-99	16	18	13	13	12	8
70-99	14	14	12	9	10	8
80-99	12	9	10	7	7	7
90-99	6	7	7	5	4	4

Note: North American teams selected on the basis of regular season win percentage. European teams selected on the basis on actual championship wins. Traditionally 2 points were awarded for win, 1 for a draw (tie). Tied winning percentages were then decided on goal difference. However, from the 1980s onward leagues introduced the award of 3 point for a win and 1 for a draw. In the data the champions always had the highest win percentage, but in 9 out of the 150 championships considered the champions were tied in win percentage with the team ranked second (on goal difference). In 1995 Blackburn Rovers won the English championship on the basis of the new points system but would have tied on the old points system (which is the same as our measure of win percentage) and had an inferior goal difference to the team ranked second.

Table 2 shows the number of different teams with the highest win percentage in each season. The North American leagues have developed the post season play-off season over the period in question in order to involve more teams in the championship race for longer. The play-off system introduces more randomness in outcomes and therefore adds to uncertainty even if the teams are not well balanced competitively. Since we are interested in competitive balance rather than uncertainty itself in this paper we have restricted ourselves to considering win percentages during the regular season only (see note to Table 2).

[5] League rank is the standard measure of performance in Europe. For North American leagues we have ranked teams according to their regular season win percentage.

For the North American leagues the NFL had the greatest number of teams entering the top rank for four out of the five periods considered, although in the last decade the performance of all three leagues looks remarkably similar on this measure (notwithstanding the recent dominance of the New York Yankees in baseball).

For any of the five ranges considered, both the Italian and Belgian leagues had less variation in the number of teams appearing in this rank than any of the North American leagues. Only when the last forty or fifty years are considered did the English league have as many teams entering the top rank, and for both of these ranges the NFL had more teams achieving the highest win percentage. Thus despite the greater opportunity through promotion and relegation for teams to reach the highest rank, there seems to be relatively less turnover at the very top in open European leagues than in the closed North American leagues. On average over the last thirty years there have been 50% more teams achieving the highest rank in North America compared Europe.[6]

Table 3: Teams that entered the top five ranks

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium**
51-00	28	31	21	34	19	32
61-00	28	30	21	27	18	28
71-00	28	29	21	24	18	24
81-00	28	28	21	22	14	21
91-00	23	26	18	16	12	18

* 1953-2000 only.
Note: all teams selected on the basis of regular season win percentage.

The story told by Table 3 is slightly different. Looking at the last ten years, a very large fraction of all teams in the each of the North American leagues managed a top five finish in term of win percentage. 46% more teams in the closed leagues achieved this feat on average than in the open European leagues. However, as we go back further the number of teams entering the top ranks does not increase significantly for the North American case, but does in the European case. Clearly, once all the members of a closed league have entered the top five, the population of entrants can only increase through franchise

expansion. In an open league, however, there need be no limit to the increase in the population. Thus in the case of England there were only 16 teams entering the top five ranks over the last decade, but 34 teams entered over the entire fifty year period, more than for any league in the sample (during this period the top division was restricted to 22 or fewer members in each season). Over this lengthy period the number of teams entering the top five in North America and Europe is almost identical. Thus openness in Europe seems to give roughly similar opportunities over a very long period time, even if there are fewer opportunities over relatively short timespans. Whether this is enough to make an open European league as competitively balanced as a closed North American league in the eyes of the fans must be doubtful at least.

In order to set this picture in a proper perspective, we now consider the theoretical probability of teams entering the top k of ranks for open and closed leagues, under the hypothesis that in each season each contestant in a division has an equal probability of winning each match.

3. Entry in the top *k* ranks

(a) Closed leagues

We consider first the case of n teams that are grouped together and compete in a closed league with no system of promotion and relegation. Under the hypothesis that the outcome of the championship in a given year is purely random, each team has the same probability $1/n$ of being ranked 1st, 2nd, …, n^{th}. The probability that a team is ranked in the top k places in a generic year is then $w(k) = k/n$. After T years, the probability that a given team has been placed at least once in the top k places is $w(k, T) = 1 - (1 - w(k))^T = 1 - [(n - k)/n]^T$. Finally, the expected number of teams that has won one of the top k positions in the first T years is:

[6] In writing this paper we have looked at some of the descriptive statistics for other European leagues such as Spain, Germany, Portugal and Scotland. In all cases a similar pattern emerges to that described here.

(1) $$y^{CL}(k,T) = nw(k,T) = n - \frac{(n-k)^T}{n^{T-1}}.$$

Equation 1 represents our benchmark for a closed league (CL). In particular, the expected number of teams that has won the title at least once after T years is simply $y^{CL}(1, T) = \frac{n^T - (n-1)^T}{n^{T-1}}$, increasing at a decreasing rate over time, from 1 when $T = 1$, to n when T tends to infinity.

(b) Open leagues

We now consider the typical European way of organising a team contest. There are L leagues ordered from the top division to the lowest one: league 1 is the "premier" league that awards the championships while league L is the lowest league. League l consists of n_l teams, $l = 1, \ldots, L$. In a generic period, a team in league l can either remain in the same league, or go to an "adjacent" league. We denote respectively by $p(l)$ and by $r(l)$ the total number of promotions to the league above and the total number of teams relegated to the league below league l.[7] If the outcome of each league is random, the probability that a team is in division l at time t is:

(2) $$d(l,t) = d(l,t-1)\frac{n_l - r(l) - p(l)}{n_l} + d(l-1,t-1)\frac{r(l-1)}{n_{l-1}} + d(l+1,t-1)\frac{p(l+1)}{n_{l+1}},$$

where $l = 1, \ldots, L$ and $r(L) = p(1) = 0$, $d(0, t) = d(L + 1, t) = 0$.[8] It can be verified that $\sum_{l=1}^{L} d(l,t) = \sum_{l=1}^{L} d(l,t-1) = 1$ since a team starts at $t = 0$ in some league with probability 1, i.e. $d(l, 0)$ is 1 for only one value of l and zero otherwise. In order to take into account the initial distribution of teams, we denote with a subscript l the league where a team starts at the beginning, $d_l(j, 0) = 1$ if $j = l$ and 0 if $j \neq l$.

[7] In principle, both $p(\cdot)$ and $r(\cdot)$ should depend on t; however we can drop the dependency from time under the hypothesis of random ranking as long as the number of teams in a given league is constant over time. In practice the number of promotions and relegations can change between periods and this feature can be easily accommodated in our framework.

[8] To ensure that the number of teams in a given league is constant over time, we assume $p(l) = r(l - 1)$.

The probability that a team is ranked in one of the top k places of the premier division in a generic year t is given by the joint probability $d_l(1, t)\ k/n_1$. We are now in a position to calculate the probability that, after T years, a team that started in league l in the initial period $t = 0$ has been placed at least once in the top k places of the top division. This probability depends on initial conditions and corresponds to the complement to 1 of the probability that such team has never been placed in the top k positions, i.e. the team was either in a lower division or in the top one but never "picked" one of the top placements:

$$(3) \qquad w_l(k,T) = 1 - \prod_{t=0}^{T}\left[\sum_{l=2}^{L} d_l(l,t) + \frac{n_1 - k}{n_1} d_l(1,t)\right] = 1 - \prod_{t=0}^{T}\left[1 - d_l(1,t)k/n_1\right].$$

The expected number of teams that has been placed in the top k positions after T years is:

$$(4) \qquad y^{OL}(k,T) = \sum_{l=1}^{L} n_l w_l(k,T).$$

Equations 2, 3 and 4 represent the benchmark for an open league (OL) and it is the counterpart to equation 1. Once it is known the number of teams in each league, as well as the number of teams promoted and relegated to adjacent leagues and the initial conditions, it is immediate to obtain the value of the expected number of teams observed in the top positions after T years. For instance, if a total number n of teams is split equally among L leagues, the teams are ordered in a way such that $d_1(1, 0) = 1$ for the first group of n/L teams, $d_2(2, 0) = 1$ for the second bunch of n/L teams and so on, and if 1 team is promoted and 1 team is relegated in any period, the expected number of teams that has won the premier league at least once after T years is given by:[9]

[9] With a simple spreadsheet it is immediate to confirm that with the same total number of teams $y^{OL}(1, T) < y^{CL}(1, T)$ for any $T > 1$. The difference between the two expected numbers of winning teams becomes smaller as T grows, or if "turbulence" is increased by increasing the number of teams promoted/relegated in any period.

$$y^{OL}(1,T) = (n/L)\sum_{l=1}^{L}(1-\prod_{t=0}^{T}[1-d_l(1,t)L/n])$$

$$d_l(1,t) = [d_l(1,t-1)(n/L-1) + d_l(2,t-1)]L/n$$
$$d_l(l,t) = [d_l(l,t-1)(n/L-2) + d_l(l-1,t-1) + d_l(l+1,t-1)]L/n \qquad l = 2,3,...,L-1$$
$$d_l(L,t) = [d_l(L,t-1)(n/L-1) + d_l(L-1,t-1)]L/n.$$

4. Mobility in theory and in practice.

In the previous sections we have looked at the actual number of entrants into top ranks and derived the theoretical distributions of teams appearing in top positions in closed and open leagues under the assumption of equal winning probabilities. In this section we compare the difference between the actual and theoretical distributions.

Applying the theory of the previous section to the precise structure of each league Table 4 shows the number of teams that would have been expected to achieve the highest seasonal win percentage (if all teams had equal win probabilities) over the same periods considered in Table 2. Table 5 shows the theoretical prediction of entrants into the top 5 of win percentages (if all teams had equal win probabilities), analogous to the actual data of Table 3.[10]

Table 4: Theoretical number of teams with highest seasonal winning percentage under equal playing strength

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
51-00	22	23	18	37	40	39
61-00	21	21	18	32	33	31
71-00	18	19	17	26	26	24
81-00	14	15	14	18	18	17
91-00	9	9	9	9	9	9

[10] Numbers in Table 4 and 5 are rounded. They were obtained taking into account entry and exit of teams, as well as variations in the number of promotions and relegations over time. For instance, in England the third division was split in 1959 into a 3rd and a 4th division. Our calculations do take into account all such institutional features and are available on request.

In general there are two conflicting effects that produce differences in the theoretical predictions for the closed North American and open European leagues. Firstly, in recent decades the expansion of North American leagues to around thirty teams has increased the number of potential winners relative to the European leagues where the size of the top division varies in size between sixteen and twenty-two teams. The second effect is that promotion and relegation gives more teams an opportunity to enter the major league. With equal winning probabilities it can be seen that these two effects would have cancelled each other out over the last decade and the closed leagues would have produced as many winners as the open leagues. Over time however, the promotion and relegation effects increasingly dominates the expansion effect and over a fifty year period the open leagues should have produced around twice as many winners as the closed leagues.

In all cases the actual number of winners in each cell of Table 2 is smaller than the theoretical prediction, but the shortfall is much more pronounced for the open leagues.

Table 5: Theoretical number of teams with top 5 seasonal winning percentage under equal playing strength

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
51-00	28	29	25	82	104	100
61-00	28	29	25	78	94	84
71-00	28	29	25	70	78	67
81-00	28	29	25	57	58	48
91-00	25	25	24	32	33	28

Table 5 illustrates a sharper contrast between the open and closed leagues. Even in a relatively short period of time the promotion effect dominates the expansion effect so that under equal win probabilities the open leagues could have been expected to see more entrants into the top five ranks. This contrasts with Table 3 where it was shown that in reality the situation was the reverse- more teams entered the top five ranks in the closed leagues compared to the open leagues. Even within a ten year period most teams in a closed league should enter the top five ranks- so over a longer period of time the theoretical number of entrants does not increase by much. However, for open leagues the theoretically possible number of entrants increases rapidly, so that over fifty years the number of

entrants under equal win probabilities is around one hundred. Once again, the gap between theory and reality is much greater for the open leagues.

To illustrate the size of the gap figures 1 and 2 show the relationship between theoretical and actual entry for NFL while figures 3 and 4 offer the same comparison for Serie A, the top soccer division of Italy. In each figure the broken lines represent the theoretical number of entrants for each of the five time ranges, while the solid lines illustrate the actual rate of entry. The figures also provide some perspective on the expected and actual entry on a year by year basis. Figures 1 and 2 show that actual entry is quite close to theoretical entry assuming equal playing strengths, suggesting that in dynamic terms the NFL is a fairly balanced competition (particularly looking at entry into the top 5 win percentages). On the other hand, figures 3 and 4 demonstrate a large gap between theoretical and actual entry in Italy. Actual entry increases only very slowly, both for into the group of champions and into the top 5, and there is no evidence of convergence towards the theoretical limit. This suggests that equality of opportunity in open leagues in Europe has not translated into any equality of outcomes.

[Insert figures 1 - 4]

While these charts paint a very clear picture, it is desirable to quantify the differences between the open and closed leagues in some way. We propose a Gini-type index that relates theoretical to actual entry[11]. Thus we calculate an index G where

$$G(T^*) = \frac{\sum_{T=1}^{T^*} y^L(k,T) - \sum_{T=1}^{T^*} y_a^L(k,T)}{\sum_{T=1}^{T^*} y^L(k,T)} \tag{5}$$

where T^* is the range of years considered and $y^L(k, T)$ and $y_a^L(k, T)$ are respectively the theoretical and the actual number of teams appearing in rank k or higher in a given league L

[11] An alternative index is proposed in the annex to this paper.

= {CL, OL}over a period of *T* years. Thus a value of *G* close to zero indicates a perfectly balanced league while a value of *G* close to unity indicates a perfectly unbalanced league.[12] Table 6 reports the *G*-index for the highest seasonal win percentage across the leagues.

For every period considered the *G*-index for the closed leagues is lower than the G-index for the open leagues, suggesting that the closed leagues were closer to the theoretical distribution under equal winning probabilities. In fact, the *G*-index for the closed leagues never rose above 0.5, while for the open leagues value is either above or close to 0.5 for almost all periods. Looking at the individual leagues, there is some indication that baseball

Table 6: *G*-index for teams with highest seasonal winning percentage

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
51-00	0.34	0.19	0.42	0.44	0.66	0.70
61-00	0.30	0.15	0.36	0.44	0.55	0.70
71-00	0.30	0.21	0.40	0.54	0.48	0.62
81-00	0.05	0.39	0.39	0.57	0.44	0.51
91-00	0.19	0.24	0.12	0.24	0.38	0.54

has become more balanced over the last twenty years while there is no obvious trend in the NFL or NHL. For the open leagues Belgium was generally furthest away from the theoretical distribution under equal win probabilities, but for the individual leagues there was no clear trend over time.

Table 7: *G*-index for teams with top 5 seasonal winning percentage

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
51-00	0.16	0.04	0.18	0.54	0.78	0.64
61-00	0.18	0.08	0.20	0.60	0.77	0.59
71-00	0.17	0.17	0.23	0.58	0.70	0.59
81-00	0.09	0.15	0.17	0.53	0.67	0.53
91-00	0.11	0.07	0.14	0.35	0.51	0.37

As far as the top 5 are concerned, the *G*-index scores for the closed leagues are all very similar and close to 0. Comparing Tables 6 and 7 this suggests that the closed leagues have

[12] This indicator depends on the starting year; moreover the longer the time series the less informative is the more recent data.

been more successful at creating contenders rather than sharing out the most successful slot. However, since the ultimate Championship winners have been determined by play-offs that are more random than the regular season, this is probably not a problem. By contrast, the *G*-index for the open leagues suggest that entry into the top 5 has been more or less as difficult as into the top rank, and without a system of play-offs this suggests both little mobility at the top and considerably less competitive balance than in the closed leagues.

5. Conclusions

This paper has proposed a measure of competitive balance that is dynamic, taking into account the turnover of teams at the top over time, rather than conventional measures that tend to emphasise *within*- but not *between*-season competitive balance. We have shown that by a conventional measure the open soccer leagues of Europe are, if anything, more balanced than the North American closed leagues. However, by the dynamic measure of competitive balance the open leagues appear significantly less balanced than the closed leagues. We believe that the dynamic measure presents a better picture of competitive balance than the static measure.

One reason for believing that this is a better picture is that we have calculated the theoretical distribution of winning teams under the null hypothesis of equal winning probabilities for the teams, and shown that the open leagues deviate far more from the theoretical distribution than the open leagues. The hypothesis that the Europe's open leagues are competitively balanced is far harder to support than the hypothesis that North America's closed leagues are balanced.

This does not, however, imply that there is less interest in European soccer than in North American sports. Anecdotally, the obsession with professional sports is as great in Europe as in North America. Competitive balance is not the only factor that may interest the fans. Europe's competitions are more complex, involving an array of competitions played more

or less simultaneously (domestic league and Cup club competition, international club competition and international representative competition)[13]- and this rich mix provides a greater variety of foci for many fans. Interest also focuses itself on the fact that makes the leagues open in the first place- promotion and relegation, which adds an extra dimension to league competition (see Ross and Szymanski (2000) and Noll (2000) for a detailed discussion).

However, to the extent that competitive balance does matter, our measure of dynamic balance suggests a gap between open and closed leagues. It is interesting to speculate why this might be. Of course, it is frequently remarked upon that the array of potentially balance-enhancing measures used in North America – gate, TV and merchandise revenue sharing, draft rules, salary caps, roster limits and so on are either absent or less significant in Europe. But this begs the question as to why the European leagues have eschewed these mechanisms. In order to answer these questions, one would have to understand the incentives that teams have to spend resources on playing talent. Once effort spent by teams is endogenized, it is not clear if an open league provides higher-powered incentives than a closed league, even less so if aggregate effort is taken into account. These are aspects that deserve additional theoretical research. From a policy point of view, perhaps the most interesting topics for further debate are (a) whether the alternative sources of interest in European soccer compensate fans for the relative lack of competitive balance and (b) whether the choice of balance enhancing measures are hindered by the promotion and relegation system itself.

[13] Thus the most talented players in Europe may appear in as many as four major competitions in a single season

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Figure 1: Entry to the highest rank in the NFL

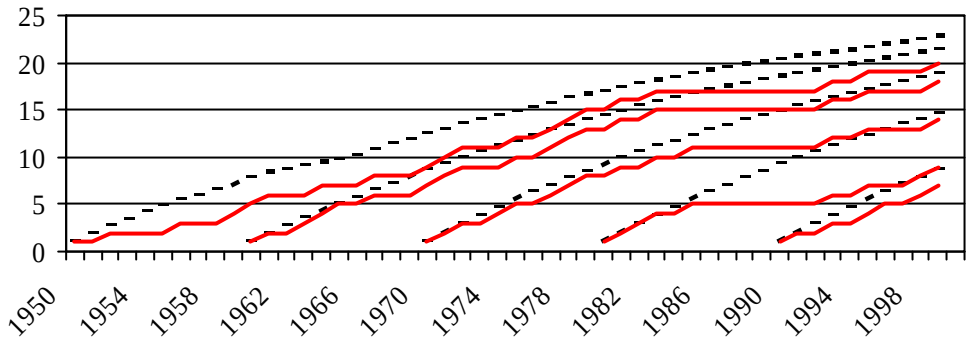


Figure 2: Entry to the top 5 ranks in the NFL

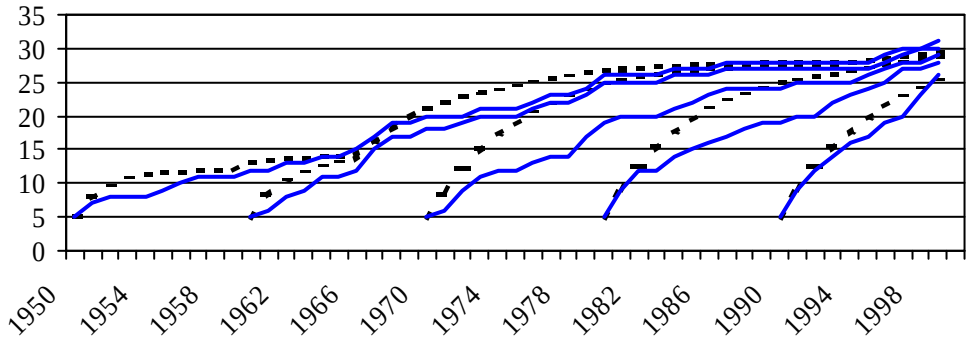


Figure 3: Entry to the highest rank in Italy

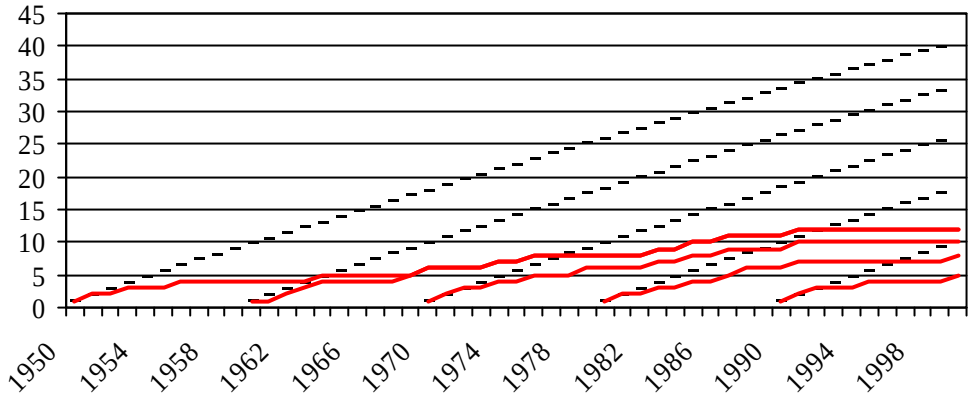
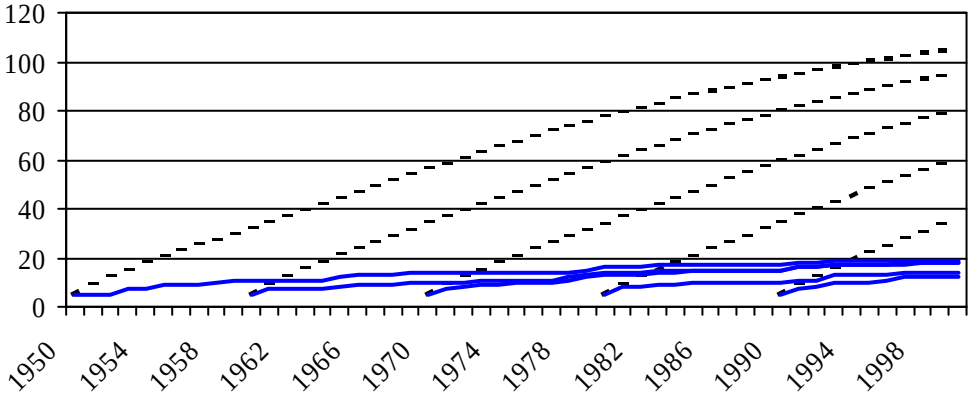


Figure 4: Entry to the top 5 ranks in Italy



Annex

In this annex we propose an indicator alternative to the *G*-index. As a first step, we calculate – as with the *G*-index – $y^L(k, T)$ i.e. the theoretical number of teams appearing in rank k over a period of T years. This number takes into account all the precise details of a certain league that may have changed over time. Then, we calculate $n(k, T)$, i.e. the equivalent dimension of a closed league with a constant structure that would have generated then same number of teams appearing in rank k over the same period. In the third step, we consider the actual number $y_a^L(k, T)$ and then construct $n_e(k, T)$, i.e. the theoretical dimension of a closed league with a constant structure that would have generated the same number. Finally, our indicator is given by the ratio $n_e(k, T)/n(k, T)$. Results are reported in Table A1. A league is balanced the closer is the *E*-index to 1, i.e. to the equivalent theoretical benchmark. Notice that this exercise allows to construct an indicator that is homogeneous both for open and for closed leagues. This indicator gives a snapshot of competitive balance at the end of a given period, without concentrating on how a particular configuration is reached over time – contrary to the *G*-index. Results illustrate once again the sharp contrast between open and closed leagues.

Table A1: *E*-index for teams with highest seasonal winning percentage

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
51-00	0.65	0.83	0.67	0.21	0.12	0.11
61-00	0.67	0.75	0.65	0.15	0.12	0.09
71-00	0.61	0.58	0.58	0.10	0.12	0.13
81-00	0.62	0.36	0.49	0.07	0.11	0.15
91-00	0.29	0.41	0.36	0.13	0.09	0.13

Table A2: *E*-index for teams with top 5 seasonal winning percentage

Period	*MLB*	*NFL*	*NHL*	*England*	*Italy*	*Belgium*
51-00	1.00	1.06	0.84	0.39	0.16	0.29
61-00	1.00	1.02	0.84	0.31	0.16	0.29
71-00	1.00	0.99	0.89	0.29	0.18	0.31
81-00	1.01	0.97	0.83	0.28	0.18	0.37
91-00	0.91	1.06	0.70	0.34	0.23	0.51