Measuring competitive intensity in sports leagues

Abstract

Purpose

For managers of sports leagues, it is crucial to produce an attractive competition. For that to happen, it is vital to consider that leagues frequently have more sub-competitions than 'just' the championship. In European top football leagues, for instance, four sub-competitions are common (championship, qualification for Champions- or Europa League, avoiding relegation). This paper introduces a new method for measuring competitive intensity (CI) in round-robin sports leagues considering all relevant sub-competitions and applies it to Germany's Bundesliga.

Design/methodology/approach

The newly developed model calculates a CI-Index for each sub-competition and the league as a whole. The application to the Bundesliga analyses its viability and the development of the league's CI over the past 22 seasons.

Finding

The newly introduced CI-Indices prove to be a viable tool for evaluating a league's competitive intensity. The application to the Bundesliga shows that the seasonal CI dropped after 2009/10, which can mainly be attributed to a decline in the championship's CI.

Practical implication

The results show that it is important to facilitate a high CI in each of Bundesliga's four sub-competitions. Efforts have to be made to ensure that especially the Europa League remains as attractive as possible for the participating teams and their fans because this sub-competition constantly makes the greatest contribution to the seasonal CI.

Originality/value

The new method measures competitive intensity by quantifying the different sub-competitions and their contribution to the seasonal CI. This allows the organisers of sports leagues to assess the intensity of the individual sub-competitions as well as the league as a whole.

Keyword: competitive intensity, European football, sporting prize structure, sub-competitions, German Bundesliga

Introduction

Football is watched and played by billions of people around the globe and Europe is the most noted football market regarding revenue and total level of competition. Five of the world's most renowned national leagues are located in Europe (England, Spain, Italy, Germany, France) and generate very considerable fan interest and turnover (Statista, 2018). Frequently, the question is asked if these leagues actually (still) are exciting. Media often states that this is not the case for the German Bundesliga (Fritsch, 2018; Gerards, 2018; Rehbock, 2018) because Bayern Munich has won 16 championship titles since the introduction of the three-point rule (season 1995/96) and the league has not seen another champion for the past seven seasons. Bayern's national dominance is unparalleled in current European football. Nonetheless, the average stadium attendance in the Bundesliga has been the highest in Europe (42,388) over the past years with a utilization of 91% (Batardière, 2018) and a record turnover of € 4.02 billion for 2018/19 (DFL, 2020).

This contradicts what the pioneers of sport economic research Rottenberg and Neale posit: That balanced competition and therefore uncertainty of outcome is more attractive to spectators and should be the purpose of league organizers. According to Rottenberg (1956), this should be achieved through a perfect distribution of player talents. Whereas Neale (1964) describes his proposition with the Louis–Schmeling paradox and mentions league standing effects. More recent research concludes that the demand for participating in or watching football matches

somehow depends on the suspense of a tight competition (uncertainty of outcome) (Szymanski, 2003) and shows that perceived competitive balance (CB) is the most significant indicator for a leagues' attractiveness (Koenigstorfer *et al.*, 2010). But the current situation in the German Bundesliga demonstrates that there has to be something else that attracts fans to the stadiums and causes them to spend money on watching football. Therefore, it might be time to rethink the existing theories of the economics and management of professional football (Ramchandani *et al.*, 2018).

In 2004, Kringstad and Gerrard developed the theory of competitive intensity (CI) and defined it as 'the degree of competition within the league/tournament with regards to its prize structure' (Kringstad and Gerrard, 2004, p. 120). As all European football leagues are not just about contention for the championship title, further sub-competitions are played within these leagues. This means that more than one 'prize' can be won (other prizes are the qualification for a European club competition or avoiding relegation). Thus 'competitive intensity will give a picture of how intense is the competitiveness according to the different subcompetitions (and prizes) in a league' (Andreff and Scelles, 2015, p. 825).

It can be assumed that almost all teams will be a contender in one of the different sub-competitions throughout the season (Kringstad and Gerrard, 2007). If it is not the championship race, it might be the qualification for the two international competitions of UEFA (Union of European Football Association) or the fight against relegation. Also, betting on outcomes of football matches is a huge market (Scarf and Rangel Jr., 2017). And for the Bundesliga, the opportunities to bet on sub-competitions apart from the championship underline their importance (Hanau *et al.*, 2015), which should also be true for other leagues.

However, only very few scholars have used the theory of competitive intensity so far. Kringstad and Gerrard (2004) suggest that a measurement of CI 'has to take into account all prizes/outcomes of a league, computing the level of uncertainty of each of them, and finally weight them on basis of their relevance' (p. 128). According to Cairns *et al.* (1986) as well as

Szymanski (2010) uncertainty in this context can refer to mid-term/seasonal uncertainty, meaning seasonal sub-competitions such as the championship race or the fight against relegation. Whereas the outcome of matches (short-term/match uncertainty) or the degree of dominance (or the lack thereof) of one or more teams over several seasons (long-term/championship uncertainty) can also be considered.

This study aims at developing a novel measurement for mid-term/seasonal competitive intensity of round robin leagues that also considers the CI of relevant sub-competitions of a league. By calculating a CI-Index for each sub-competition and the league as a whole, a comprehensive ex-post picture of seasonal CI will be gained. To test the viability of the new model, it is applied to German Bundesliga's last 22 seasons dating back to 1996/97. Against this backdrop, three specific Bundesliga-seasons are scrutinized in depth to see if their very different CI-Indices are actually a viable indication of a differing seasonal CI. Therefore, this paper's contribution is twofold: First, it extends the methodical literature on competitive intensity. Second, the specific application of the model and in part also the theoretical model provide relevant insights for league organisers and managers.

This paper proceeds as follows. The following literature review summarizes past works on CI. The third section describes the development of the CI-Index-Model. Afterwards, the empirical application to the Bundesliga is described. The final sections are a discussion of the viability and limitations of the CI-Index and a conclusion.

Literature review

The basic idea of competitive intensity is that seasonal competition in leagues without a playoff system is frequently not only aimed at winning the championship. In European football, for instance, qualifying for the UEFA Champions- or the Europa League is extremely attractive as well for several reasons (Buraimo *et al.*, 2006). Financially, additional income from

broadcasting and matchday revenues, bonus payments when reaching the knockout stage, attractive sponsoring deals and an increase in the sales of the club's UEFA licensed merchandise products can be expected. Also, increased media interest and popularity are potential results of such a qualification. The inherent idea of sport is that winning is always better than losing. And winning the 'prize' of participation in a European competition corresponds to this idea, thus resulting in pride for the clubs and their fans.

Furthermore, fighting relegation is a key issue for many participants in European football leagues for basically the same reasons: the interest of the media and sponsors is higher if a team plays on the highest national level (Könecke *et al.*, 2017). This in turn results in higher revenues for the club and the region. Fans also tend to be more likely to affiliate themselves with teams in the first tier and political and general public support is higher. Due to all this, it has been shown that the risk of insolvency is significantly increased in the leagues below the first division (Beech *et al.*, 2010), which is especially true after a relegation (Scelles *et al.*, 2018; Szymanski, 2017; Szymanski and Weimar, 2019). These aspects underscore the interrelationship between sporting and economic success (Augustin, 2008).

Hence, the idea of competitive intensity has to be understood much broader than merely a close race for the championship or competitive balance in the sense that everybody has a realistic shot at the title. In the eyes of Andreff and Scelles (2015), the concept can be regarded as a modern translation of the league standing effects described by Neale (1964). And Scelles *et al.* (2013a, p. 4184) consider competitive intensity 'a more innovative notion' than competitive balance.

CI was first recorded by Kringstad and Gerrard (2004, 2005) who in this context also derived the term 'being in contention' from Jennett (1984) who was the first to see two different competitions (championship race/avoiding relegation) within one league. His model of attendance at Scottish league football checked the teams' contention in 1.080 matches between 1975/76 and 1981/82 regarding the points needed to be successful in one of the two

competitions. As Table 1 shows, also other authors dealt with the phenomenon of 'being in contention'. This was mainly done considering two sub-competitions (championship and relegation), which were the only ones at that time. As it turns out, the contention in sub-competitions has a significantly positive impact on attendance and can awaken a greater fan interest (Kringstad and Gerrard, 2007).

The novel approach of this study follows the measurements suggested by Kringstad and Gerrard (2005) as well as by Scelles et al. (2011a), which are the only studies that actually measure CI (see Table 1). Therefore, these two methods are examined in detail hereafter.

Kringstad and Gerrard (2005) tested end-of-season CI and compared it to competitive balance (CB) in the Premier League for the period from 1994/95 to 2003/04. They utilized a sum calculation of prize interval, weight of prize and total number of prizes and showed that a high CI can be achieved despite low CB. They assume that sports prices at the top of the ranking are more attractive than the 'price' of avoiding relegation. With this in mind, they have defined different weightings for the sub-competitions: 1 for winning the championship, $1/1.5^2$ for direct qualification to the UEFA Champions League, $1/1.75^2$ for qualifying for the UEFA Champions League Qualifiers, $1/2^2$ for qualification for the former UEFA Europa League (UEFA Cup) and $1/3^2$ for avoiding relegation. Based on this, they propose the following formula to calculate end-of-season competitive intensity: $CI = \sum_{i=0}^{i=n} w_i P_i$, where P_i is the intensity of the prize interval i and w_i is the weight of the price i. They set the price interval for a sub-competition at 10 points and propose to measure P_i 'as the sum of the proportional gap between the points of the prize-winning team and the points of each team in the prize interval.' (Kringstad and Gerrard, 2005, p. 2): $P_i = \sum(1 - gap / 10)$

For example, the first four Bundesliga teams in 2005/06 (final standings) had 75, 70, 68 and 61 points, the intensity of the prize championship (P1) was:

$P1 = [1 - (75 - 70) / 10] + [1 - (75 - 68) / 10] = 0.8$ (the 4th is not taken into account here because the gap to the 1st is more than 10 points).

This calculation is done for all five sub-competitions and the results are added. The sum gives the CI value of the particular season. The main weaknesses of the method are the rather subjective weightings and the rather random setting of intervals of 10 points. The end-off season CI is enormously influenced by the championship fight, whereas the fight against relegation is almost insignificant because of the weightings. For clubs such as SC Freiburg or Mainz 05 in Germany's Bundesliga, however, the major goal is to remain in the Bundesliga year after year. Therefore, this specific sub-competition has great importance for such clubs and their stakeholders.

Scelles *et al.* (2011a) worked with an intraleague and Scelles *et al.* (2011b) on an intramatch CI concept. They used metrics for measuring uncertain situations of teams regarding a sub-competition and ranking changes in relation to the sub-competitions in the first French football, rugby and basketball leagues. The measurement proposed by Scelles et al. (2011a) is based on two different parameters providing information about the Intra-Championship Competitive Intensity (ICCI): the Intra-Championship uncertainty (ICU) and the Intra-Championship Fluctuations (ICF).

The ICF-Index gives information about how many changes in standings (regarding the sub-competitions) have occurred during a season in relation to the total amount of matchdays -1 (since there are no standing changes on the first matchday). Assuming in a Bundesliga season, there are 152 position changes in the table throughout the season, *ICF = 152 / (34-1) = 4.6*.

The ICU-Index gives an information about which percentage of the teams can change their position in terms of the sub-competitions during the next two matchdays (6 points distance). For this purpose, the percentages are determined at eight fixed measuring points, whereupon the mean value is determined. Applied to a Bundesliga season, the measuring points are the following matchdays: 13 (one third of the season), 17 (halfway through the season), 23 (two thirds of the season) as well as 30, 31, 32, 33 and 34 (each of the last five matchdays). With assumed percentage values this leads to:

ICU= (85%+72%+71%+50%+55%+49%+42%+33%) / 8 = 57.1%.

Since eight measurements are taken, this is a dynamic approach to measuring CI. However, the time of measurement and the interval of two matchdays are also subjective. The authors note that the ICU-Index is of greater importance, but do not generate a condensed ICCI value. Furthermore, the ICF- and ICU-Index do not differentiate the contribution of the sub-competitions but only give total index values.

In further research Scelles *et al.* (2013a, 2013b) tested effects of intraleague outcome uncertainty regarding the same sporting stakes on spectator demand in Ligue 1, Pro A (basketball) and Top 14 (rugby) between 2008/09 and 2010/11. Based on these studies, Andreff and Scelles (2015) checked whether the chance of reaching a more favorable sporting stake has an impact on fan demand and found a positive correlation. Pawlowski *et al.* (2018) modified their CI measurement by considering the remaining points needed to ensure a sporting prize, comparing it to the perceived game uncertainty in two Bundesliga matchdays in 2014/15 to examine TV audience demand.

Table 1 provides an overview of the previous mid-term/seasonal studies considering sub-competitions in sports leagues. Besides the league and season under investigation it shows the number of sub-competitions included, core objective of the study and the type of measurement the author(s) used. Usually, rather shorter time periods in connection with demand models have been scrutinized for football. Only the studies which have been described in detail above actually attempt to measure CI. However, it has not been analyzed very exactly which sub-competition contributes to a league's total CI to which extent. Consequently, the present work extends the current literature by introducing a novel approach for determining the precise competitive intensity in sports leagues considering all relevant sub-competitions.

Table 1. Previous studies considering sub-competitions of sports leagues (seasonal level)

author(s)	league(s)	season under investigation	sub-competition (variable)	objective of study
Jennett (1984)	Scottish Football League	1975/76-1980/81	championship, relegation	explaining attendance[a]
Borland (1987)	Victorian Football League	1950-1986	contender for playoffs	explaining attendance
Cairns (1987)	Scottish Football League	1971/72-1979/80	championship, relegation	influence of league structure on attendance
Dobson and Goddard (1992)	English Football League (Div. 1-4)	1989/90-1990/91	championship/ promotion	explaining standing and seated attendance
Baimbridge *et al.* (1996)	English Premier League	1993/94	championship, relegation	influence of TV broadcasting on attendance
Kringstad and Gerrard (2005)	English Premier League	1994/95-2003/04	championship, UEFA CL[b], UEFA CL qualifiers, UEFA Cup, relegation	introducing CI measurement, comparison CB and CI
Scelles *et al.* (2011a)	French Ligue 1 & basketball Pro A	2004-2009	Ligue 1: championship, UEFA CL, UEFA CL qualifiers[c], UEFA Cup, UI-Cup, relegation Pro A: six later thirteen (playoffs)	introducing ICCI model, optimizing league design
Pawlowski and Anders (2012)	German Bundesliga	2005/06	championship, UEFA CL	explaining attendance
Scelles *et al.* (2013a, 2013b), Andreff and Scelles (2015), Scelles *et al.* (2016)	French Ligue 1	2008-2011	championship, UEFA CL, UEFA CL qualifiers, UEFA EL, potential UEFA EL (for 5th), potential UEFA EL qualifiers (for 5th or 6th), relegation	explaining attendance
Buraimo and Simmons (2015)	English Premier League	2000/01-2007/08	championship, qualification for UEFA CL or EL, relegation	explaining TV audience
Scelles (2017)	English Premier League	2013/14	championship, UEFA CL, UEFA EL, potential UEFA EL, relegation	explaining TV audience
Bond and Addesa (2020, 2019)	Italian Serie A	2012/13-2014/15	championship, UEFA CL, UEFA CL qualifiers, UEFA EL, UEFA EL qualifiers, relegation	explaining attendance (2020)/TV audience (2019)

Notes: [a]attendance refers to stadium attendance demand, [b]UEFA CL/EL= direct qualification to the UEFA Champions League/Europa League (former UEFA-Cup) in the following season. [c]UEFA CL/EL qualifiers= participation in the qualification stage for the UEFA Champions League/Europa League in the following season

A new model for the measurement of competitive intensity

We were inspired by the graphic approaches in the works of Jennett (1984, pp. 182–183), a pioneer in the thoughts on CI, and Heinemann (1995, p. 182), a German sports economist and sociologist, who describes the phenomenon of mid-term uncertainty in sports leagues using a very general graph. Our general aim is to develop a numerical ex-post analysis of the seasonal CI of a sports league with more sub-competitions than 'just' the championship that is based on a graphical analysis. By determining the value of certain surface areas in this graph and multiplying them by a matchday-ratio pertaining to when a certain sub-competition was decided, CI-Indices are calculated for the sub-competitions and the league as a whole. For instance, these values can be used to compare different seasons and different round robin leagues, thus providing a novel analysis of the mid-term/seasonal CI.

The Competitive Intensity-Diagram

The new model (Figure 1) was developed in view of analyzing a European football league. Considering, the four sub-competitions with their respective sporting prizes are: winning the championship (C), qualification for UEFA Champions League Qualifiers (CL), qualification for UEFA Europa League (former UEFA Cup) Qualifiers (EL) and avoiding direct relegation (adR). Naturally, the model can be adapted to leagues that have more or fewer prizes.

On the x-axis, the progress of a season is recorded in percent (max. 100%) in Figure 1. The y-axis depicts the percentage of points that have been gained thus far (max. 100%). This means that at the beginning of a season, all teams are located at point S because they have played 0% of the matches and have won 0% of the points. At the end of the season, all teams are situated somewhere on the right side of the graph because they have played 100% of the matches. The extremes are points Z, which shows the position of a team that has won 0% of the points after 100% of the matches, and M, which is the outcome of a perfect season in which a team has won

100% of all possible points. This means that line segment $\overline{SM}$, which bisects the quadratic coordinate system in Figure 1, depicts the path of a team that obtains all possible points at any time of the season (e.g., 33% of the theoretically possible point maximum after 33% of the season has elapsed). In turn, line segment $\overline{SZ}$ depicts the path of a team that wins no points at all, thus finishing the season with 0% of the theoretical point maximum. Since in reality, both of these outcomes are very unlikely, the teams will finish their season between Z and M, depending on the percentage of points they have gained. If, for example, a team in a league with a maximum of 102 points (equals 18 teams with three points awarded for a win) has won 82 points at the end of the season, it would reach the coordinates (100|80.4). This means that after the 34 matchday (at 100% of matchdays), 80.4% of the maximum point total was reached.

Points C_y, CL_y, EL_y and adR_y indicate the point total needed at the end of a season to succeed in the respective sub-competition (C, CL, EL, adR). That means that C_y is the point total of the champion. CL_y and EL_y are the points won by the lowest ranking teams still qualified for CL and EL. And adR_y is the point total of the lowest ranking team to avoid direct relegation.

Consequently, line segments $\overline{SC_y}$, $\overline{SCL_y}$, $\overline{SEL_y}$ and $\overline{SadR_y}$ show the averaged paths of the champion, the last-ranked qualifier for the Champions- and the Europa League Qualifiers and the weakest team to avoid direct relegation. Since these ‘paths’ are theoretical average values, the respective team will not have exactly followed them but will have encountered themselves below, above or on the path at any given time of the season.

[Figure 1 near here]

[Table 2 next to Figure 1]

Figure 1. Competitive Intensity-Diagram (CI-Diagram) (an extensive legend is provided in Table 2)

Table 2. Legend of Figure 1

Points C_x, CL_x,EL_x and adR_x in Figure 1 can be interpreted as the time of a season at which a team that has not yet won a single point has to win all remaining matches to still become champion, qualify for CL or EL or avoid direct relegation. In turn, if a team crosses to the right of line segment $\overline{C_xC_y}$ at any time during the season, it is no more in contention for the leagues' championship title but still competing for the other three prizes. When a team crosses to the right of line segment $\overline{CL_xCL_y}$, it cannot win a spot in the Champions League Qualifiers anymore, but remains a contender in the two remaining sub-competitions. If a team is on the right of line segment $\overline{EL_xEL_y}$, the Europa League Qualifiers can no longer be reached but the fight against relegation might still be relevant. If line segment $\overline{adR_xadR_y}$ is crossed to the right, the team cannot avoid direct relegation anymore.

If this is the case, the team has reached triangle A_{d4} (which can be referred to as 'failure zone relegation' – Figure 1 and Figure 2). Note that part of this assumption is that A_{d4} only borders on line segment $\overline{adR_xadR_y}$ but the line segment is *not* part of the triangle (which applies to the other triangles in Figure 2 and the corresponding line segments as well). Teams reaching triangle A_{d3} at any point in time have successfully avoided direct relegation but missed the EL. Teams that have irrevocably qualified for EL reach A_{d2} as soon as this is the case and those who secured participation in CL are in A_{d1}. Thus, A_{d1}, A_{d2}, A_{d3} and A_{d4} can be understood as 'dead-end areas'. Teams in these areas cannot change their situation in terms of the four sub-competitions anymore. Consequently, if all teams except for the champion (who finishes above A_{d1}) have reached one of the triangles, all four sub-competitions have been decided and only the ranking within the sub-competitions can still change in the remainder of the season.

[Figure 2 near here]

Figure 2. Teams' potential drop-out of the contention for the different sub-competitions from the first matchday (t_0) to the last (t_f)

Calculation of the Competitive Intensity-Index

The Competitive Intensity-Index (CI-Index) is a numerical indicator of the CI of a specific season or sub-competition that is calculated based on surface areas in the CI-Diagram. Each sub-competition is represented by the correspondingly named parallelogram A_C, A_{CL}, A_{EL} or A_{adR} (generally: number of prizes = number of parallelograms) from Figure 3. To sketch the parallelograms, points C_y, CL_y, EL_y and adR_y are projected to the left side of the CI-Diagram resulting in C_y", CL_y", EL_y" and adR_y". Next, horizontal lines are drawn from C_y" to C_y, CL_y" to CL_y and so on. Since we are in a square, the (constant) y-coordinates of these horizontal lines equal the heights of the corresponding parallelogram. The parallelograms' bases are C_b, CL_b, EL_b and adR_b. Their lengths can be calculated by subtracting the y-coordinate of C_y, CL_y, EL_y and adR_y from 100. The surface areas of A_C, A_{CL}, A_{EL} and A_{adR} are calculated by multiplying the bases' lengths (C_b, CL_b, EL_b and adR_b) by the corresponding heights (C_h, CL_h, EL_h and adR_h). These surface areas can be understood as a first indicator of the CI of the different sub-competitions.

[Figure 3 near here]

Figure 3. A_C, A_{CL}, A_{EL} and A_{adR} highlighted in the Competitive Intensity Diagram

It can be considered problematic to only use values as an indicator of CI that mirror the league standings after the final matchday. It should rather also be taken into account how long a specific sub-competition has not been decided because if competitive intensity is high, the decision should come rather late. To deal with this methodological challenge, the analysis is further refined by incorporating the decision time of the different sub-competitions.

This is done by first determining the respective matchdays when no additional team could still become champion, qualify for CL or EL or avoid direct relegation anymore. Afterwards, the

CI-Indices are determined by multiplying the surface areas of parallelograms A_C, A_{CL}, A_{EL} and A_{adR} by the corresponding squared matchday-ratio [decision matchday (dMD)/total matchdays (eMD)]. If, for example, the championship of a league with 34 matches has been decided on the 31st matchday, the area of A_C is multiplied by $(31/34)^2$. Squaring the weights of sub-competitions is also done by Kringstad & Gerrard (2005) and Pawlowski *et al.* (2018) to mathematically strengthen their influence.

This yields the following equations (1) to (5) for the different CI-Indices:

$$(1) \quad CI_C = A_C * \left(\frac{dMD}{eMD}\right)^2 = C_h * C_b * \left(\frac{dMD}{eMD}\right)^2$$

$$(2) \quad CI_{CL} = A_{CL} * \left(\frac{dMD}{eMD}\right)^2 = CL_h * CL_b * \left(\frac{dMD}{eMD}\right)^2$$

$$(3) \quad CI_{EL} = A_{EL} * \left(\frac{dMD}{eMD}\right)^2 = EL_h * EL_b * \left(\frac{dMD}{eMD}\right)^2$$

$$(4) \quad CI_{adR} = A_{adR} * \left(\frac{dMD}{eMD}\right)^2 = adR_h * adR_b * \left(\frac{dMD}{eMD}\right)^2$$

$$(5) \quad CI_{season} = CI_C + CI_{CL} + CI_{EL} + CI_{adR}$$

Theoretical maxima of CI-Indices

To create a benchmark for further analysis it is crucial to know the theoretical maximum of the CI-Index, which can be determined as follows: The largest surface area of a sub-competition arises when half of all points have to be attained at the end of a season to win the prize [coordinate point (100|50)]. The corresponding parallelogram (A_C, A_{CL}, A_{EL} or A_{adR}) will yield 2.500 area units as each percentage point more or less needed to win the prize diminishes the surface area (Table 3). Moreover, the matchday-ratio will be 1 as the sub-competition is decided on the last matchday.

[Table 3 near here]

Table 3. Properties of the area units based on the number of points reached in %

If in our exemplary European football league all teams reach 50% of the points on the last matchday, all four sub-competitions will be decided just then. A_C, A_{CL}, A_{EL} and A_{adR} are superimposed and yield 2.500 area units. Also, all matchday-ratios will be 1. Thus, the value of CI_{season} will be at its theoretical maximum of 10.000 units (4 x 2.500). In this case, the competitive intensity is maximized and so is the competitive balance as all teams are competing for the championship title until the last matchday [assumption (1)]:

(1) if CI_{season} = max., then CB_{season} = max.

This is in line with the early reflections of Rottenberg (1956) regarding a perfectly balanced league in which the championship race is decided on the last matchday of a season with all teams having the same amount of points. The highest suspense in terms of uncertainty of outcome is described with a 50% probability of winning (Mullet *et al.*, 1994; Quirk and Fort, 1997) and would occur as well.

Empirical application of the CI-Index-Model to Germany's Bundesliga

In order to test the viability of the CI-Index-Model, an investigation of the CI of 22 seasons of the German Bundesliga (from 1996/97 to 2017/18) was conducted. An application to the Bundesliga seems advisable due to the league's economic importance and the current situation with the dominance of FC Bayern Munich. In addition, the number of teams participating in the league (18) and sub-competitions (4) has not changed in the investigation period, so no changes of CI can be attributed to variations of this kind. Finally, to the best of our knowledge, no attempt has ever been made to measure CI over a longer period in the German Bundesliga. Against this backdrop, the application of the model further serves to determine the contribution of the different sub-competitions to the total CI of the league. Furthermore, it is scrutinized if

there have been any considerable changes in the CI of the Bundesliga's sub-competitions or the league as a whole during this period.

Data collection

Following Ramchandani *et al.*'s (2018) analysis of CB in the top five European football leagues, the first idea was to begin the analysis with the season 1995/96. Since then three points instead of two are awarded for a win in all football leagues worldwide. But in 1995/96 only the champion qualified for the Champions League, which means that the season actually only had three sub-competitions. Afterwards, this has not been the case anymore, which is why 1996/97 is the first season taken into account. It also has to be mentioned that until 2008 an additional qualification tournament for the UEFA Cup (which later became the Europa League) existed, the UEFA Intertoto Cup (UI-Cup). The following calculations do not take this additional sub-competition into account since it would considerably diminish the comparability of the results of the seasons before and after its abolition.

The final table of each season was used to gather the following information: number of points achieved at the end of the season by the teams that (a) won the championship, had the lowest place in standings to still qualify for (b) the Champions League Qualifiers and (c) the Europa League Qualifiers or (d) were the lowest scoring team not to be directly relegated.

For the calculation of the CI-Indices, the matchday-ratio is also required, which is why the matchdays on which each sub-competition was eventually decided were determined for all relevant seasons (Table 4). All required data were obtained from www.footballdatabase.eu.

[Table 4 near here]

Table 4. German Bundesliga decision matchdays (dMD) in all sub-competitions form 1996/97 to 2017/18

Results

Employing equations (1) to (5), the CI for the past 22 Bundesliga-seasons was calculated (Table 5). As can be seen in Figure 4 and Table 5, the value of CI_{season} dropped after 2010/11 in comparison to prior seasons. This decline can mainly be attributed to a decline in CI_C as all other sub-competitions show rather steady CI-Indices.

Figure 5 and Table 5 indicate that the average CI_C amounts to 1644.5 units and fluctuates much more than the other sub-competitions (sd=476.3). CI_{CL} shows an average value of 2275.6 (192.0), CI_{EL} of 2458.0 (60.3) and CI_{adR} of 2208.1 (103.5). The contributions of the different sub-competitions to the average of CI_{season} is 18.9% for CI_C, 26.6% for CI_{CL}, 28.7% for CI_{EL} and 25.8% for CI_{adR}. Consequently, the championship race contributes least, while the other sub-competitions' contributions are very similar with CI_{EL} outranking CI_{CL} and CI_{adR} that are almost equal. As can be seen in Table 5, the difference in CI between the championship race and the other sub-competitions also reflects in the decision matchdays. The qualification for EL and the fight against direct relegation were almost always decided on the final matchday (both means 33.8). The race for CL has only lasted this long twelve times (mean 33.2) and the one for the championship only six times (mean 31.8) in the past 22 years.

In the period under scrutiny, the number of teams qualifying for CL and EL differed. Depending on the season, the lowest ranking winning a spot in the Champions League Qualifiers varied from second to fourth place. In 1997/98 only two teams qualified for the CL. Afterwards, the third was the lowest-ranking team to do so eleven times, the fourth ten times. If the latter was the case, the average CI_{CL} is 2327.6, if three teams qualified it is 2251.3 and for 1997/98 (two teams) it is 2023.0. These results suggest that a higher number of qualification opportunities seem to have a mildly positive effect on CI_{CL}.

The number of teams qualifying for EL varied between two and four. Twelve times, two teams qualified, nine times it was three and in 1996/97 there were four. The corresponding CI_{EL} are

2457.5, 2454.4 and 2496.2, respectively. This and the low standard deviation of only 60.3 show that further qualification opportunities do not seem to have a relevant effect on CI_{EL}.

The ranking needed to avoid direct regelation was 15 until 2007/08. Since then the team finishing 16th plays two relegation matches against the third-placed of the second division, but the Bundesliga teams almost always (eight out of ten times) successfully remained in the league. The average CI_{adR} is 2208.1 units. For the time until 2007/08, it is 2262.9 and 2142.4 afterwards, which constitutes a minor decrease.

[Figure 4 near here]

Figure 4. Progression of CI-Indices from 1996/97-2017/18 in German Bundesliga

[Table 5 near here]

Table 5. Results overview

[Figure 5 near here]

Figure 5. Box plot corresponding to the sub-competitions: championship (C), Champions League (CL), Europa League (EL) and avoid direct relegation (adR) from 1996/97-2017/18

In an effort to validate the informative value of the CI-Indices, three seasons are scrutinized in more detail. First, the season that generates the highest CI_{season} with 9649.2 (2000/01), which is close to the theoretical maximum of 10,000 units. For this season, the values of the CI-Indices of all sub-competitions only differ in a range of just under 150 units, which means that their contributions to CI_{season} are very much alike.

A more detailed look at the season's outcome illustrates that the 38 points of the 15th-placed team is the second highest value of any non-relegated team in the period under scrutiny. It is three points above the average of 34.8. Additionally, the champion has the lowest point total with 63 points. On average, a team needs 76.3 points to become champion. The last team to

qualify for CL has 57 points, which is four points below the average (61), while EL is reached with 55 points (2.1 above the average of 52.9). These small differences in the point totals indicate that all teams were not too far apart throughout the season. On the last matchday, there were ten teams still in contention for a sporting prize and the outcomes of eight of the final nine matches mattered in this regard.

In comparison, the lowest CI_{season} (2013/14) falls 2148.2 units short with 7501.0. The corresponding CI_C only amounts to 654.6 (just 2.1 above the lowest value) and CI_{adR} is the lowest value of any season since 1996/97 with 1946.4. Both, CI_{CL} (2403.9) and CI_{EL} (2496.2), are comparably high. Since all competitions except the championship (27th matchday) were decided on the final matchday of the season.

In this season, the champion reached 90 points (second highest total since 1996/97), which is 14 above the average. The team that just avoided direct relegation reached only 27 points (lowest total), which is eight points below the average. Even though the actual standings in the race against relegation were decided at the last matchday of the season, none of the three contenders had the possibility to avoid the relegation matches described above. The 15th-ranked team ended up had five points ahead of the 16th (relegation). The weakest teams to reach the Champions League and the Europa League Qualifiers gained 61 and 53 points, respectively, which are average values. Consequently, the low CI-Index for 2013/14 correctly indicates a low CI for the season.

With a CI_{season} of 8593.4, the 2004/05 season is closest to the mean (8586.2) and median (8630.8) of all seasons examined. Also, the CI-Indices of the sub-competitions (CI_C 1538.1, CI_{CL} 2438.5, CI_{EL} 2465.4 and CI_{adR} 2151.4) are close to the corresponding averages. The championship had already been decided on the 31st matchday, slightly earlier than the average (31.8). CL and EL were decided on the last matchday (means 33.2 and 33.8), while the fight against relegation was decided one matchday in advance (mean 33.8). The champion scored 77 points, which is again close to the average, CL was reached with 59 points (two below the

mean). The largest difference occurred in EL with 4.1 points above the average. The team in 15th place scored 36 points and thus 1.2 points more than the mean. The point difference of this team and the lowest scoring team to qualify for EL is 21 points, which is only slightly less than the difference between the 15th and the champion in 2000/01. Again, the CI-Index correctly indicates the CI of the season under scrutiny, which in the case of 2004/05 was very average.

Discussion of the viability and limitations of the CI-Index

Feddersen and Maennig (2005, p. 2) state that 'the individual final league standings for the various team sports leagues [are] a good basis for the calculation of competitive balance in the sense of uncertainty of seasonal outcome' (p. 2) (other studies working with final league standings are Bird, 1982; Dobson and Goddard, 1992; Feddersen *et al.*, 2006; Jennett, 1984). Our calculation of the CI-Indices further meets the requirements for a CI-measurement established by Kringstad and Gerrard (2004) as (a) all sub-competitions and (b) their outcome uncertainty and (c) relevant weights are taken into account. In contrast to Kringstad and Gerrard (2005), it was decided to weigh the sub-competitions with the matchday-ratio and not based on 'arbitrary prize weightings' (p. 2). This contrast to past research is justified because the decision matchday is a very strong indicator of the CI of a specific sub-competition and its contribution to the CI of a league as a whole.

As could be seen in the results summarized in Table 5, using equations (1) to (5) to calculate the CI-Indices for 22 consecutive seasons for Germany's Bundesliga yields a new informative outcome. The results show that the league's CI has dwindled since 2009/10 because the championship race's CI has been rather small since then (especially from 2011/12 onward). This is in line with a qualitative assessment of the league that has been discussed in the introduction as Bayern Munich has won all championships since 2012/13 and frequently at a very early stage (four of six titles were won on or before the 30th matchday and none on the

last). The in-depth analyses of three different seasons with the highest (2000/01), the lowest (2013/14) and an average CI_{season} (2004/05) further underscore the viability of the CI-measurement developed in this paper. It became obvious that a higher CI-Index indicates a stronger CI pertaining to a specific sub-competition or an entire league.

Nevertheless, it is recognized that there are limitations to the novel measurement. For instance, a particular team's actual progress throughout the season is not taken into account. It is also not considered exactly how many teams are realistically competing in different sub-competitions. This is a shortcoming in comparison to the studies of Kringstad and Gerrard (2005), Scelles et al. (2011a), Scelles et al. (2013b, 2016) as well as Scelles (2017), who applied more dynamic measurements of the CI.

Furthermore, methodological problems arise if the prize structure of the league is affected by post-season events. In Germany, for instance, the cup final is played after the closing of the season and depending on who wins the cup, one more team could reach a European competition based on the outcome of the league. Since the calculation of the CI-Indices is conducted ex-post, the qualifying places after the cup final were included in the calculation. Moreover, it does not change the notion of CI in general or in relation to a specific sub-competition but more the suspense related to reaching a specific standing at the end of the regular season.

Besides, the UEFA Intertoto Cup (UI-Cup), which was an additional qualification tournament for the UEFA Cup until 2008, has not been considered for methodological reasons discussed above. But it can be expected that the UI-Cup should not have had any bearing on the CI of the remaining sub-competitions, which is why using four sub-competitions in this study seems viable.

Taking the model's limitations into account against the background of the research interest of this study, the CI-Indices fulfil the purpose of giving a very realistic ex-post picture of the CI of the different sub-competitions and the entire league for a specific season. Consequently, it can be stated that the model elaborated in this paper is a viable instrument for an ex-post

determination of (a) the CI of a specific sub-competition and (b) the CI of a league without playoff system that incorporates more than one sub-competition. It also can help to assess how changes of regulations (such as two or three points for winning, more relegation places or an additional number of teams) affect the CI. Even though this has not been done in the present study, the graphical analysis that is the basis for the calculations can furthermore be used to check at what time which team still had a chance of winning a certain prize. This could be one avenue for further research to make the model more dynamic.

Conclusion and implications

The general aim of this study is to develop an ex-post analysis of the CI of a sports league with more than just one 'prize' (which would normally be the championship title) that takes the importance of the different sub-competitions for the CI of a league into account. The calculation of the different CI-Indices is based on a graphical analysis. After the surface areas pertaining to the different sub-competitions are calculated, they are multiplied by the corresponding matchday-ratio to determine the CI-Indices. The specific CI-Indices that have been proposed in this study (CI_C, CI_{CL}, CI_{EL}, CI_{adR} and CI_{season}) relate to a European football league incorporating four different sub-competitions (championship, Champions League Qualifier, Europa League Qualifier and fight against direct relegation). As has briefly been stated above, the model can be adapted to any other league with any number of sub-competitions by including the appropriate number of CI-Indices (one per sub-competition). The CI of the entire league is always calculated by summarizing the sub-competitions' indices. As has been discussed in the previous chapter, the model's limitations are outweighed by its strengths, which is why the CI-Indices constitute a viable tool for determining CI in sports leagues. If we compare the presented method with previous research (see Table 1), it becomes clear that so far no method has been able to obtain such a clear overall picture of the competitive intensity of a league. The developed

ex-post analysis does not only determine the contribution of individual competitions to CI_{season}. It also evaluates each sub-competition individually, which makes comparisons over time or between different leagues possible for the sub-competitions as well.

Against this background, some implications can be derived from the application of the CI-measurement to Germany's Bundesliga for the time since 1996/97. Very generally, the goal of the league organizers should be to promote a 'four-class society', i. e. to generate the highest possible intensity in each of the four sub-competitions. Especially since CL, EL and adR have shown comparably high CI-levels rather permanently, the attractiveness and CI of these sub-competitions have to be protected since the decline in CI of the championship race is the main reason for the decline in CI since 2009/10. But it is not realistic – and looking at the prospects in European competitions probably not desirable – to create a perfect CB in the Bundesliga, which in turn would lead to a more even CI within the sub-competitions. From a league manager's point of view, though, it could be worth an effort to ascertain that there is at least one regular competitor for the current dominator of the league (FC Bayern Munich). This could be achieved by weakening the dominator by sanctions. However, this would be quite difficult to implement and undesirable regarding success in international club competitions. For the time being, it remains to be seen whether the reformed formula for allocating funds for the 2017/18 season (DFL, 2016) can contribute to this issue or whether further measures should be taken.

The results have shown that the sub-competition EL has been the most intensive competition over the years. For this reason, the German league organisers (DFL) should make every effort at UEFA to ensure that the Europa League remains as attractive as possible for the participating teams and their fans. Attractive kick-off times, victory bonuses and the association's appreciation of the competition are potential measures. Naturally, the same reasoning generally applies to CL and the fight against relegation because they also considerably contribute to the Bundesliga's CI. Since the Champions League is financially much more attractive than the Europa League and the importance of remaining in the Bundesliga has been established in past

research, the Europa League seems to be the most problematic sub-competition in terms of attractiveness or relevance.

Regarding the number of teams that won the 'prize' in the different sub-competitions, it turned out that it was not too relevant if four or fewer teams qualified for CL or EL. If four teams made the corresponding European tournament, CI_{CL} is 2327.6 and CI_{EL} 2496.2. If it was fewer teams, the differences were not very high. This means that the existence of the sub-competition seems to be the relevant aspect, as the exact number of potentially successful teams in the sub-competition has not been too important a factor in the study period.

'The UEFA Executive Committee has approved the creation of a third UEFA club competition for the 2021-2024 competition cycle' (UEFA, 2018). Hence, it is a related question if the introduction of another sub-competition is a good idea. Even though another sub-competition would most likely further the theoretical competitive intensity indicated by the CI-Indices, it is questionable if another prize could be added that would be attractive for the teams winning it in the long run. And – as has been discussed regarding EL – the attractiveness of the prizes is a key issue here. If a prize is not attractive or – even worse – if winning it should be avoided because of its unattractiveness, it would actually diminish the logic of CI in a league because teams could purposefully try to avoid winning this 'prize'. Consequently, before including a sub-competition into the calculation of a league's CI-Index it has to be ensured that it is attractive for the teams and their fans. If this is not the case, it should not be included in the calculation – and probably abolished as well.

For managers of sports leagues, high CI-Indices for all sub-competitions can be an important indicator of an exciting product. For marketing purposes, it can be profitable to know which contribution the sub-competitions have to the CI_{season}. Especially in the second half of the season, there is the possibility to consider important matches within the different sub-competition when scheduling the match day. Since most sports leagues are marketed centrally and their revenues are passed on via a distribution key, the CI-Indices could, among other

things, be used to control whether the distribution key contributes to maintaining CI in the league.

As becomes obvious from these reflections, the importance of the different prizes is perceived differently by clubs and fans. This manifests in differences in terms of their attractiveness and attendance appeal, which has for example been shown for French Ligue 1 (Scelles *et al.*, 2016). Such an investigation for Germany's Bundesliga could be conducted using the results from this paper.

Furthermore, future research could focus on other ways of incorporating weights for the different sub-competitions into the calculation of the CI-Indices. In this paper, the weight was based on the decision matchdays, which is advantageous because it can easily be applied to calculations in other leagues as well. But Kringstad and Gerrard (2005) had originally introduced another weighting for the sub-competitions in European football (C=1; CL= $1/1{,}5^2$; EL= $1/2^2$, adR= $1/3^2$) that was later adopted by Pawlowski *et al.* (2018). In this study (demand model), the weightings are applied to reflect the attractiveness of sub-competitions for the spectators. But this was not our primary intention in our study. Nevertheless, further research on this issue is called for to determine when to best use which type of weighting.

A subsequent research objective is the combination of the ICF-Index by Scelles et al. (2011a) and our CI-Indices. The reason for this is that including the fluctuations in standing would further refine the measurement of the CI in the different sub-competitions and the league as a whole. As stated above, further use of the information included in the graphical analysis that is the basis for calculating the CI-Indices could also serve this purpose. Regarding the application of the general model for the assessment of the CI of a sports league that was introduced in this paper, a number of further avenues for future research can be identified. First of all, a more detailed look could be taken at the Bundesliga in order to scrutinize the effects of different measures and developments on the league's CI. For instance, the reform of the payoff structure

of the Champions League in 1999/2000 and its effects on CI in the following years could be looked at.

Moreover, the analysis of the CI-Indices of other European football leagues would have considerable scientific value. For example, a comparison of the ‘Big Five’ leagues (England, Spain, Italy, France and Germany) and the development of CI over the course of time and in relation to different changes in the sub-competitions would be very worthwhile as it could lead to a much better understanding of league regulation in European football and its effects on CI. Additionally, an application to other sports and league systems would be insightful to learn more about the possibilities to increase CI in team sports competitions in general depending on the characteristics of the different sports and sports leagues. This could, for instance, be a comparison between North American and Europe leagues, since both want to generate the highest possible CI, but try to achieve this in different ways. Using CI-Indices as variables in analyses of viewer or spectator demand should also be a promising venture point for future research.

References

Andreff, W. and Scelles, N. (2015), "Walter C. Neale 50 Years After: Beyond Competitive Balance, the League Standing Effect Tested With French Football Data", *Journal of Sports Economics*, Vol. 16 No. 8, pp. 819–834.

Augustin, J. (2008), *Strategisches Management in der Fuáball-Bundesliga*, Igel Verlag.

Baimbridge, M., Cameron, S. and Dawson, P. (1996), "Satellite television and the demand for football: A whole new ball game?", *Scottish Journal of Political Economy*, Vol. 43 No. 3, pp. 317–333.

Batardière, K. (2018), *European Leagues Fan Attendance Report*, available at: https://europeanleagues.com/wp-content/uploads/FINAL-EPFL_FA_18-VERSION-2018.01.12.pdf (accessed 15 Mai 2020).

Beech, J., Horsman, S. and Magraw, J. (2010), "Insolvency events among English football clubs", *International Journal of Sports Marketing and Sponsorship*, Vol. 11 No. 3, pp. 53–66.

Bird, P.J. (1982), "The demand for league football", *Applied Economics*, Vol. 14 No. 6, pp. 637–649.

Bond, A.J. and Addesa, F. (2020), "Competitive Intensity, Fans' Expectations, and Match-Day Tickets Sold in the Italian Football Serie A, 2012-2015", *Journal of Sports Economics*, Vol. 21 No. 1, pp. 1–24.

Bond, A.J. and Addesa, F. (2019), "TV demand for the Italian Serie A: star power or competitive intensity?", *Economics Bulletin*, Vol. 39 No. 3, pp. 2110–2116.

Borland, J. (1987), "The demand for Australian rules football", *Economic Record*, Vol. 63 No. 3, pp. 220–230.

Buraimo, B. and Simmons, R. (2015), "Uncertainty of outcome or star quality? Television audience demand for English Premier League football", *International Journal of the Economics of Business*, Vol. 22 No. 3, pp.449-469.

Buraimo, B., Simmons, R. and Szymanski, S. (2006), "English football", *Journal of Sports Economics*, Vol. 7 No. 1, pp. 29–46.

Cairns, J. (1987), "Evaluating changes in league structure: the reorganization of the Scottish Football League", *Applied Economics*, Vol. 19 No. 2, pp. 259–275.

Cairns, J., Jennett, N. and Sloane, P.J. (1986), "The economics of professional team sports: a survey of theory and evidence", *Journal of Economic Studies*, Vol. 13 No. 1, pp. 3–80.

DFL (2020), *DFL WIRTSCHAFTSREPORT 2020: Die wirtschaftliche Situation im Lizenzfußball*, available at: https://www.dfl.de/de/publikationen/dfl-report-archiv/ (accessed 21 March 2020).

Dobson, S.M. and Goddard, J.A. (1992), "The demand for standing and seated viewing accommodation in the English Football League", *Applied Economics*, Vol. 24 No. 10, pp. 1155–1163.

Feddersen, A. and Maennig, W. (2005), "Trends in competitive balance: Is there evidence for growing imbalance in professional sport leagues?", *Hamburg Contemporary Economic Discussion Paper No. 01/2005*, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1520591 (accessed 19 Mai 2020).

Feddersen, A., Maennig, W. and Borcherding, M. (2006), "The novelty effect of new soccer stadia: The case of Germany", *International Journal of Sport Finance*, Vol. 1 No. 3, pp. 174–188.

Fritsch, O. (2018), "Das ist keine Liga mehr", *Zeit online*, 11 May, available at: https://www.zeit.de/sport/2018-05/fussball-bundesliga-fc-bayern-muenchen-meister (accessed 15 Mai 2020).

Gerards, C. (2018), "So langweilig ist die Bundesliga", *Süddeustche Zeitung*, 23 January, available at: https://www.sueddeutsche.de/sport/bundesliga-langweilig-datenanalyse-1.3836500 (accessed 15 Mai 2020).

Hanau, T. von, Wicker, P. and Soebbing, B.P. (2015), "Determinants of expected vs. actual match outcome: An examination of the German Bundesliga", *Soccer & Society*, Vol. 16 No. 1, pp. 63–75.

Heinemann, K. (1995), *Einführung in die Ökonomie des Sports: Ein Handbuch, Beiträge zur Lehre und Forschung im Sport*, Vol. 107, Hofmann, Schorndorf.

Jennett, N. (1984), "Attendances, uncertainty of outcome and policy in Scottish league football", *Scottish Journal of Political Economy*, Vol. 31 No. 2, pp. 176–198.

Koenigstorfer, J., Groeppel-Klein, A. and Kunkel, T. (2010), "The attractiveness of national and international football leagues: Perspectives of fans of 'star clubs' and 'underdogs'", *European Sport Management Quarterly*, Vol. 10 No. 2, pp. 127–163.

Könecke, T., Preuss, H. and Schütte, N. (2017), "Direct regional economic impact of Germany's 1. FC Kaiserslautern through participation in the 1. Bundesliga", *Soccer & Society*, Vol. 18 No. 7, pp. 988–1011.

Kringstad, M. and Gerrard, B. (2004), "The concepts of competitive balance and uncertainty of outcome", in Papanikos, G.T. (Ed.), *The economics and management of mega athletic events: Olympic games, professional sports, and other essays*, Athens Institute for Education and Research, Athens, Greece, pp. 115–130.

Kringstad, M. and Gerrard, B. (2005), "Theory and Evidence on Competitive Intensity in European Soccer", paper presented at International Association of Sports Economists Conference Paper.

Kringstad, M. and Gerrard, B. (2007), "Competitive Balance in a Modern League Structure", Abstarct at North American Society for Sport Management Conference (NASSM), available at: https://www.nassm.com/files/conf_abstracts/2007_1715.pdf (accessed 7 April 2020).

Mullet, E., Hermand, D., Sastre, M.T.M., Nisot, A. and Rusineck, S. (1994), "Probability, value, and… suspense", *Journal of economic psychology*, Vol. 15 No. 3, pp. 537–557.

Neale, W.C. (1964), "The peculiar economics of professional sports", *The quarterly journal of economics*, Vol. 78 No. 1, pp. 1–14.

Pawlowski, T. and Anders, C. (2012), "Stadium attendance in German professional football–The (un) importance of uncertainty of outcome reconsidered", *Applied Economics Letters*, Vol. 19 No. 16, pp. 1553–1556.

Pawlowski, T., Nalbantis, G. and Coates, D. (2018), "Perceived game uncertainty, suspense and the demand for sport", *Economic Inquiry*, Vol. 56 No. 1, pp. 173–192.

Quirk, J. and Fort, R.D. (1997), *Pay dirt: The business of professional team sports*, Princeton University Press.

Ramchandani, G., Plumley, D., Boyes, S. and Wilson, R. (2018), "A longitudinal and comparative analysis of competitive balance in five European football leagues", *Team Performance Management: An International Journal*, Vol. 24 No. 5/6, pp. 265-282.

Rehbock, M. (2018), "Auch in puncto Langeweile ist Bayern europaweit Spitze. Dominanz in internationalen Fußballligen", available at: https://www.sportschau.de/fussball/punkteabstand-in-europas-ligen-100.html (accessed 25 September 2018).

Rottenberg, S. (1956), "The baseball players' labor market", *Journal of political economy*, Vol. 64 No. 3, pp. 242–258.

Scarf, P. and Rangel Jr., J.S. (2017), "Models for Outcomes of Soccer Matches", in Albert, J., Glickman, M.E., Swartz, T.B. and Koning, R.H. (Eds.), *Handbook of Statistical Methods and Analyses in Sports, Chapman & Hall / CRC Handbooks of Modern Statistical Methods*, CRC Press, Boca Raton, pp. 341–354.

Scelles, N. (2017), "Star quality and competitive balance? Television audience demand for English Premier League football reconsidered", *Applied Economics Letters*, Vol. 24 No. 19, pp. 1399–1402.

Scelles, N., Desbordes, M. and Durand, C. (2011a), “Marketing in sport leagues: Optimising the product design. Intra-championship competitive intensity in French football Ligue 1 and basketball Pro A”, *International Journal of Sport Management and Marketing*, Vol. 9 No. 1-2, pp. 13–28.

Scelles, N., Durand, C., Bah, T.S. and Rioult, F. (2011b), “Intra-match competitive intensity in French football Ligue 1 and rugby Top 14”, *International Journal of Sport Management and Marketing*, Vol. 9 No. 3-4, pp. 154–169.

Scelles, N., Durand, C., Bonnal, L., Goyeau, D. and Andreff, W. (2013a), “Competitive balance versus competitive intensity before a match. Is one of these two concepts more relevant in explaining attendance? The case of the French football Ligue 1 over the period 2008–2011”, *Applied Economics*, Vol. 45 No. 29, pp. 4184–4192.

Scelles, N., Durand, C., Bonnal, L., Goyeau, D. and Andreff, W. (2013b), “My team is in contention? Nice, I go to the stadium! Competitive intensity in the French football Ligue 1”, *Economics Bulletin*, Vol. 33 No. 3, pp. 2365–2378.

Scelles, N., Durand, C., Bonnal, L., Goyeau, D. and Andreff, W. (2016), “Do all sporting prizes have a significant positive impact on attendance in a European national football league? Competitive intensity in the French Ligue 1”, *Ekonomicheskaya Politika/Economic Policy*, Vol. 11 No. 3, pp. 82–107.

Scelles, N., Szymanski, S. and Dermit-Richard, N. (2018), “Insolvency in French soccer: The case of payment failure”, *Journal of Sports Economics*, Vol. 19 No. 5, pp. 603–624.

Statista (2018), “Soccer - Statistics & Facts”, available at: https://www.statista.com/topics/1595/soccer/ (accessed 13 September 2018).

Szymanski, S. (2003), “The Economic Design of Sporting Contests”, *Journal of Economic Literature*, Vol. 41, pp. 1137–1187.

Szymanski, S. (2010), *The comparative economics of s*port, Palgrave Macmillan, London.

Szymanski, S. (2017), “Entry into exit: insolvency in English professional football”, *Scottish Journal of Political Economy*, Vol. 64 No. 4, pp. 419–444.

Szymanski, S. and Weimar, D. (2019), “Insolvencies in Professional Football: A German Sonderweg?”, *International Journal of Sport Finance*, Vol. 14 No. 1, pp. 54–68.

Table 1. Previous studies considering sub-competitions of sports leagues (seasonal level)

author(s)	league(s)	season under investigation	sub-competition (variable)	objective of study
Jennett (1984)	Scottish Football League	1975/76-1980/81	championship, relegation	explaining attendance[a]
Borland (1987)	Victorian Football League	1950-1986	contender for playoffs	explaining attendance
Cairns (1987)	Scottish Football League	1971/72-1979/80	championship, relegation	influence of league structure on attendance
Dobson and Goddard (1992)	English Football League (Div. 1-4)	1989/90-1990/91	championship/ promotion	explaining standing and seated attendance
Baimbridge *et al.* (1996)	English Premier League	1993/94	championship, relegation	influence of TV broadcasting on attendance
Kringstad and Gerrard (2005)	English Premier League	1994/95-2003/04	championship, UEFA CL [b], UEFA CL qualifiers, UEFA Cup, relegation	introducing CI measurement, comparison CB and CI
Scelles *et al.* (2011a)	French Ligue 1 & basketball Pro A	2004-2009	Ligue 1: championship, UEFA CL, UEFA CL qualifiers[c], UEFA Cup, UI-Cup, relegation Pro A: six later thirteen (playoffs)	introducing ICCI model, optimizing league design
Pawlowski and Anders (2012)	German Bundesliga	2005/06	championship, UEFA CL	explaining attendance
Scelles *et al.* (2013a, 2013b), Andreff and Scelles (2015), Scelles *et al.* (2016)	French Ligue 1	2008-2011	championship, UEFA CL, UEFA CL qualifiers, UEFA EL, potential UEFA EL (for 5th), potential UEFA EL qualifiers (for 5th or 6th), relegation	explaining attendance
Buraimo and Simmons (2015)	English Premier League	2000/01-2007/08	championship, qualification for UEFA CL or EL, relegation	explaining TV audience
Scelles (2017)	English Premier League	2013/14	championship, UEFA CL, UEFA EL, potential UEFA EL, relegation	explaining TV audience
Bond and Addesa (2020, 2019)	Italian Serie A	2012/13-2014/15	championship, UEFA CL, UEFA CL qualifiers, UEFA EL, UEFA EL qualifiers, relegation	explaining attendance (2020)/TV audience (2019)

Notes: [a]attendance refers to stadium attendance demand, [b]UEFA CL/EL= direct qualification to the UEFA Champions League/Europa League (former UEFA-Cup) in the following season. [c]UEFA CL/EL qualifiers= participation in the qualification stage for the UEFA Champions League/Europa League in the following season

Table 2. Legend of Figure 1

remarkable points in the CI-Diagram			
S	start of season	$\overline{EL_xEL_y}$	drop-out line Europa League Qualifiers (also: boundary of A_{EL} to A_{d3} and A_{adR} – see underneath)
M	theoretical maximum point total on last matchday	$\overline{adR_xadR_y}$	drop-out line relegation (also: boundary of A_{adR} to A_{d4} – see underneath)
Z	zero points on last matchday	$\overline{C_yC_y'}$	= C_b, base of A_C
C_y	point total of champion	$\overline{CL_yCL_y'}$	= CL_b, base of A_{CL}
CL_y	point total of weakest team to qualify for Champions League Qualifiers	$\overline{EL_yEL_y'}$	= EL_b, base of A_{EL}
EL_y	point total of weakest team to qualify for Europa League Qualifiers	$\overline{adR_yadR_y'}$	= adR_b, base of A_{adR}
adR_y	point total by weakest team to avoid direct relegation	$\overline{C_y'C_y''}$	= C_h, height of A_C
		$\overline{CL_y'CL_y''}$	= CL_h, height of A_{CL}
line segments in CI-Diagram		$\overline{EL_y'EL_y''}$	= EL_h, height of A_{EL}
$\overline{SM}$	path of a team that would have won every match	$\overline{adR_y'adR_y''}$	= adR_h, height of A_{adR}
$\overline{SZ}$	path of a team that would have lost every match		
$\overline{SC_y}$	averaged path of champion		
$\overline{SCL_y}$	averaged path of weakest team qualifying for Champions League Qualifiers	**denoted areas in CI-Diagram**	
$\overline{SEL_y}$	averaged path of weakest team qualifying for Europa League Qualifiers	A_{d1}	success zone qualification for Champions League Qualifiers, (or failure zone championship, depending on ambitions)
$\overline{SadR_y}$	averaged path of weakest team avoiding direct relegation	A_{d2}	success zone Europa League Qualifiers, (or failure zone Champions League)
$\overline{C_xC_y}$	drop-out line championship race (also: boundary of A_C to A_{d1} and A_{CL} – see underneath)	A_{d3}	success zone relegation (or failure zone qualification Europa League Qualifiers)
$\overline{CL_xCL_y}$	drop-out line Champions League Qualifiers (also: boundary of A_{CL} to A_{d2} and A_{EL} – see underneath)	A_{d4}	failure zone relegation

Table 3. Properties of the area units based on the number of points reached in %

Points in %	A_X	surface area loss	
100	0	475	
95	475	425	
90	900	375	
85	1275	325	
80	1600	275	
75	1875	225	
70	2100	175	
65	2275	125	
60	2400	75	
55	2475	25	
50	2500	0	A_X max.
45	2475	25	
40	2400	75	
35	2275	125	
30	2100	175	
25	1875	225	
20	1600	275	
15	1275	325	
10	900	375	
5	475	425	
0	0	475	

Table 4. German Bundesliga decision matchdays (dMD) in all sub-competitions form 1996/97 to 2017/18

	C	**CL**	**EL**	**adR**
Season	dMD	dMD	dMD	dMD
2017/18	29	34	34	34
2016/17	31	31	34	33
2015/16	33	33	33	33
2014/15	30	30	34	34
2013/14	27	34	34	34
2012/13	28	34	34	34
2011/12	32	33	33	34
2010/11	32	33	33	34
2009/10	34	34	34	34
2008/09	34	34	34	34
2007/08	31	32	34	34
2006/07	34	32	34	34
2005/06	33	33	34	34
2004/05	31	34	34	33
2003/04	32	34	34	34
2002/03	30	34	34	34
2001/02	34	33	34	33
2000/01	34	34	34	34
1999/00	34	34	34	34
1998/99	31	34	33	34
1997/98	33	32	34	34
1996/97	33	34	34	33
Ø	**31.8**	**33.2**	**33.8**	**33.8**

Table 5. Results overview

Season	CI_{season}	CI_C	share in %	places CL	CI_{Cl}	share in %	places EL	CI_{El}	share in %	place adR	CI_{adR}	share in %
2017/18	8226.6	1057.3	12.9	4	2484.6	30.2	2	2496.2	30.3	16	2188.6	26.6
2016/17	7961.0	1310.4	16.5	4	1981.6	24.9	3	2491.3	31.3	16	2177.6	27.4
2015/16	7961.7	1115.5	14.0	4	2340.6	29.4	3	2354.2	29.6	16	2151.4	27.0
2014/15	7961.1	1359.7	17.1	4	1871.5	23.5	3	2476.0	31.1	16	2253.9	28.3
2013/14	7501.0	654.6	8.7	4	2403.9	32.0	3	2496.2	33.3	16	1946.4	25.9
2012/13	7752.7	652.5	8.4	4	2484.6	32.0	2	2500.0	32.2	16	2115.5	27.3
2011/12	8192.5	1448.3	17.7	4	2281.8	27.9	3	2347.0	28.6	16	2115.5	25.8
2010/11	8496.2	1724.1	20.3	3	2177.6	25.6	2	2310.7	27.2	16	2283.7	26.9
2009/10	9157.1	2153.0	23.5	3	2403.9	26.3	3	2484.6	27.1	16	2115.5	23.1
2008/09	9006.2	2188.6	24.3	3	2337.6	26.0	2	2403.9	26.7	16	2076.1	23.1
2007/08	8363.1	1578.9	18.9	3	2070.6	24.8	2	2491.3	29.8	15	2222.2	26.6
2006/07	8987.6	2153.0	24.0	3	2023.0	22.5	2	2500.0	27.8	15	2311.6	25.7
2005/06	8648.2	1833.6	21.2	3	2093.4	24.2	2	2499.0	28.9	15	2222.2	25.7
2004/05	8593.4	1538.1	17.9	3	2438.5	28.4	3	2465.4	28.7	15	2151.4	25.0
2003/04	8835.5	1764.1	20.0	3	2311.6	26.2	2	2476.0	28.0	15	2283.7	25.8
2002/03	8843.3	1515.3	17.1	3	2452.9	27.7	2	2491.3	28.2	15	2383.7	27.0
2001/02	8815.8	2153.0	24.4	3	2093.4	23.7	3	2476.0	28.1	15	2093.4	23.7
2000/01	9649.2	2361.6	24.5	4	2465.4	25.6	2	2484.6	25.7	15	2337.6	24.2
1999/00	9281.0	2034.8	21.9	4	2496.2	26.9	2	2496.2	26.9	15	2253.9	24.3

1998/99	8613.4	1495.8	17.4	4	2465.4	28.6	2	2340.6	27.2	15	2311.6	26.8
1997/98	8953.0	2093.4	23.4	2	2023.0	22.6	3	2499.0	27.9	15	2337.6	26.1
1996/97	9096.2	1992.9	21.9	3	2361.6	26.0	4	2496.2	27.4	15	2245.5	24.7
Mean	8586.2	1644.5	18.9	3.4	2275.6	26.6	2.5	2458.0	28.7	15.5	2208.1	25.8
Sd	532.7	476.3	4.6	0.6	192.0	2.7	0.6	60.3	1.9	0.5	103.5	1.4
Min	7501.0	652.5	8.4	2.0	1871.5	22.5	2.0	2310.7	25.7	15.0	1946.4	23.1
Max	9649.2	2361.6	24.5	4.0	2496.2	32.0	4.0	2500.0	33.3	16.0	2383.7	28.3

Figure 1

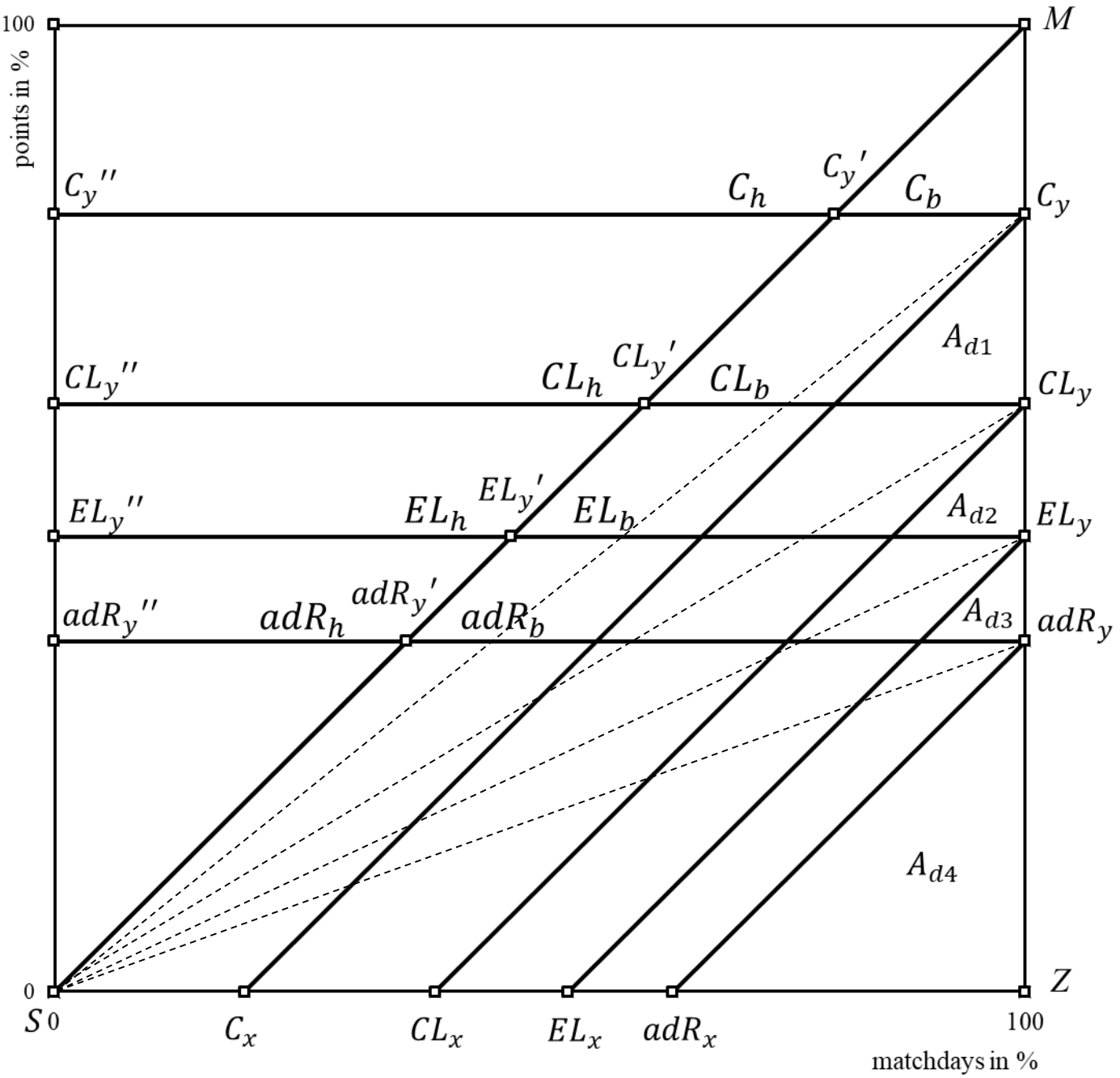

100
points in %
M
C_y''
C_h
C_y'
C_b
C_y
A_{d1}
CL_y''
CL_h
CL_y'
CL_b
CL_y
EL_y''
EL_h
EL_y'
EL_b
A_{d2}
EL_y
adR_y''
adR_h
adR_y'
adR_b
A_{d3}
adR_y
A_{d4}
0
Z
S 0
C_x
CL_x
EL_x
adR_x
100
matchdays in %

Figure 2

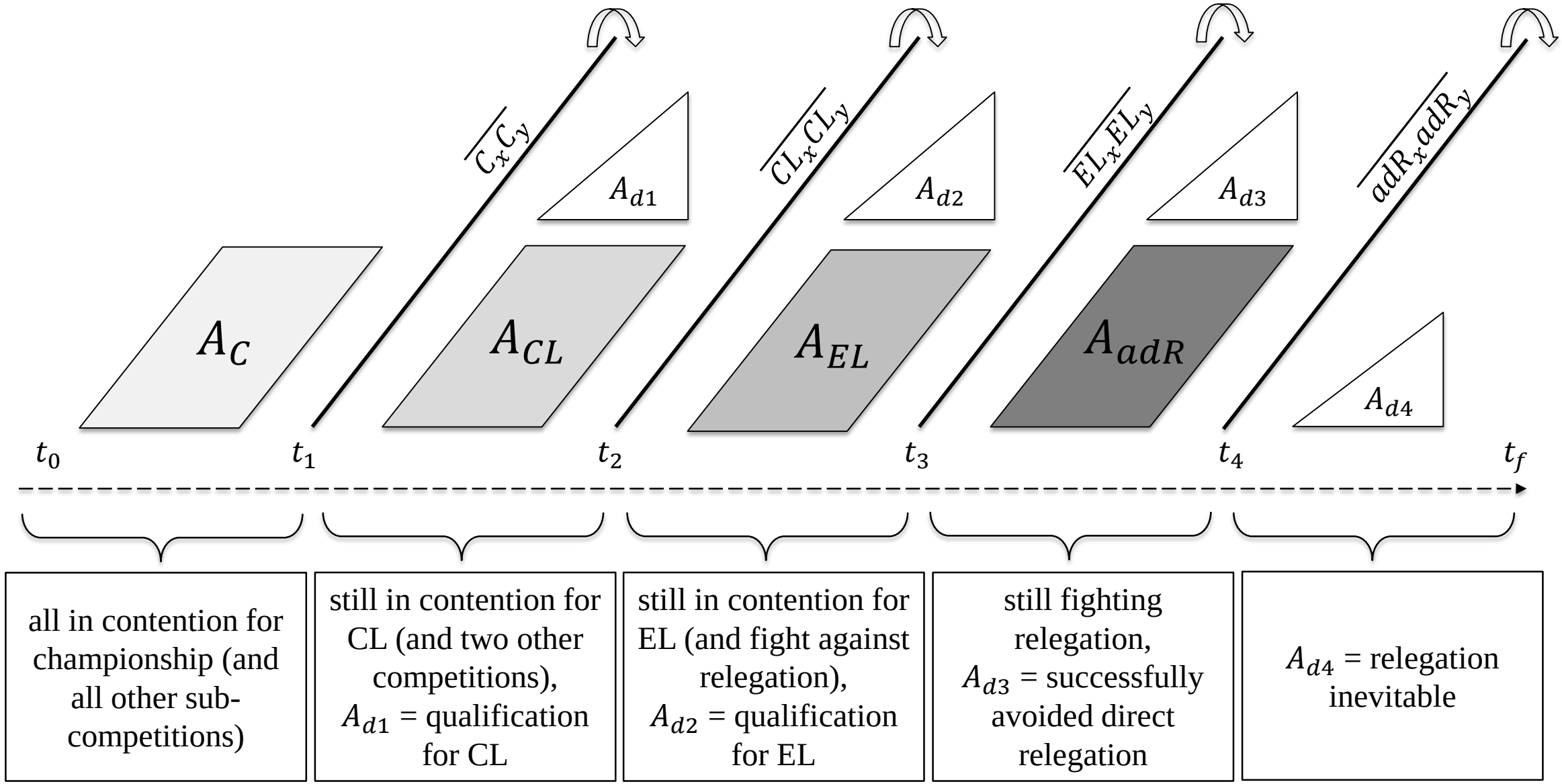
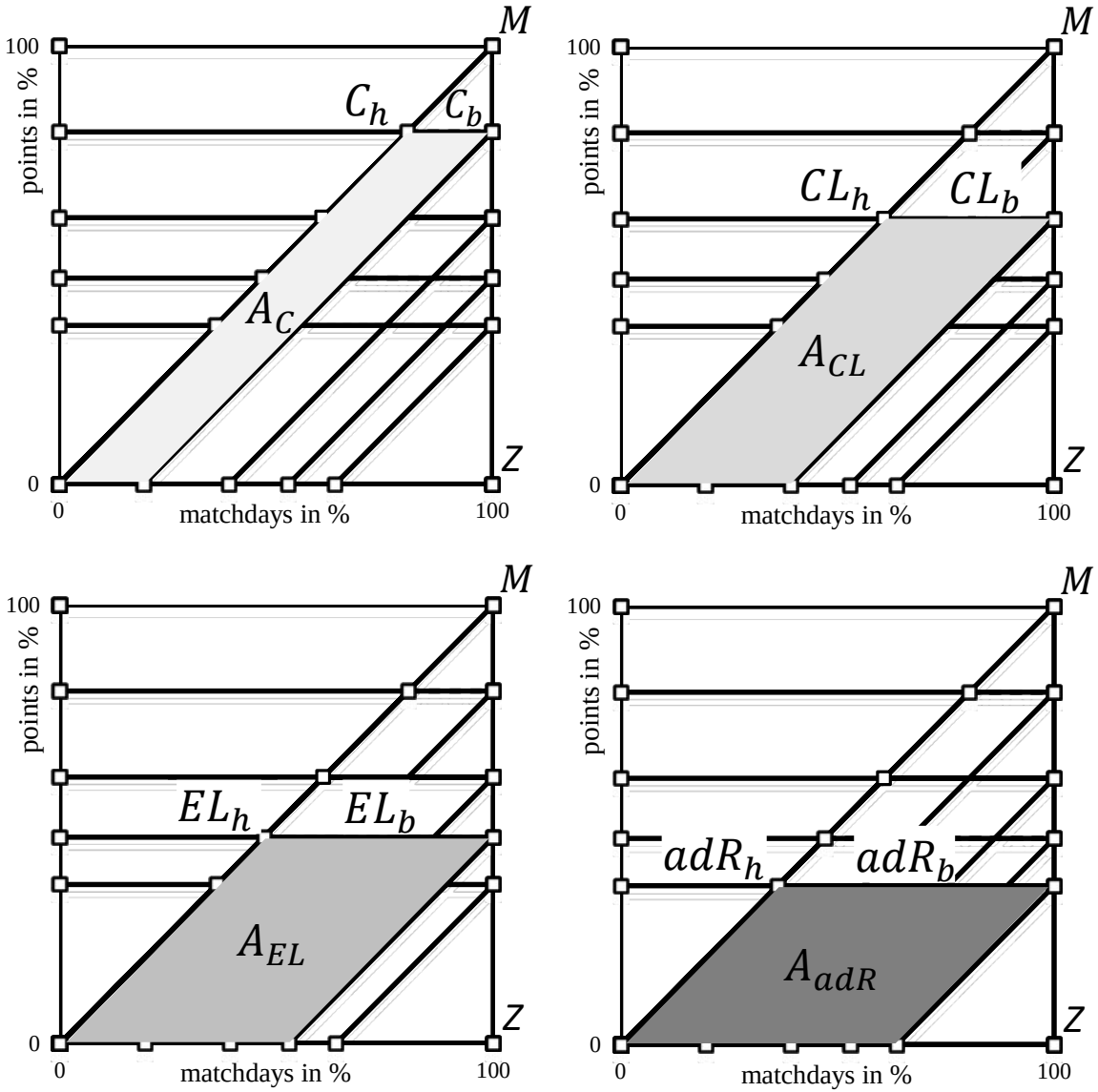

$\overline{C_x C_y}$
$\overline{CL_x CL_y}$
$\overline{EL_x EL_y}$
$\overline{adR_x adR_y}$
A_{d1}
A_{d2}
A_{d3}
A_{d4}
A_C
A_{CL}
A_{EL}
A_{adR}
t_0
t_1
t_2
t_3
t_4
t_f
all in contention for championship (and all other sub-competitions)
still in contention for CL (and two other competitions), A_{d1} = qualification for CL
still in contention for EL (and fight against relegation), A_{d2} = qualification for EL
still fighting relegation, A_{d3} = successfully avoided direct relegation
A_{d4} = relegation inevitable

Figure 3



Legend:

A_C = $C_b * C_h$; first competitive intensity indicator of championship race

A_{CL} = $CL_b * CL_h$; first competitive intensity indicator of Champions League Qualifiers

A_{EL} = $EL_b * EL_h$; first competitive intensity indicator of Europa League Qualifiers

A_{adR} = $adR_b * adR_h$; first competitive intensity indicator of fighting relegation

Figure 4

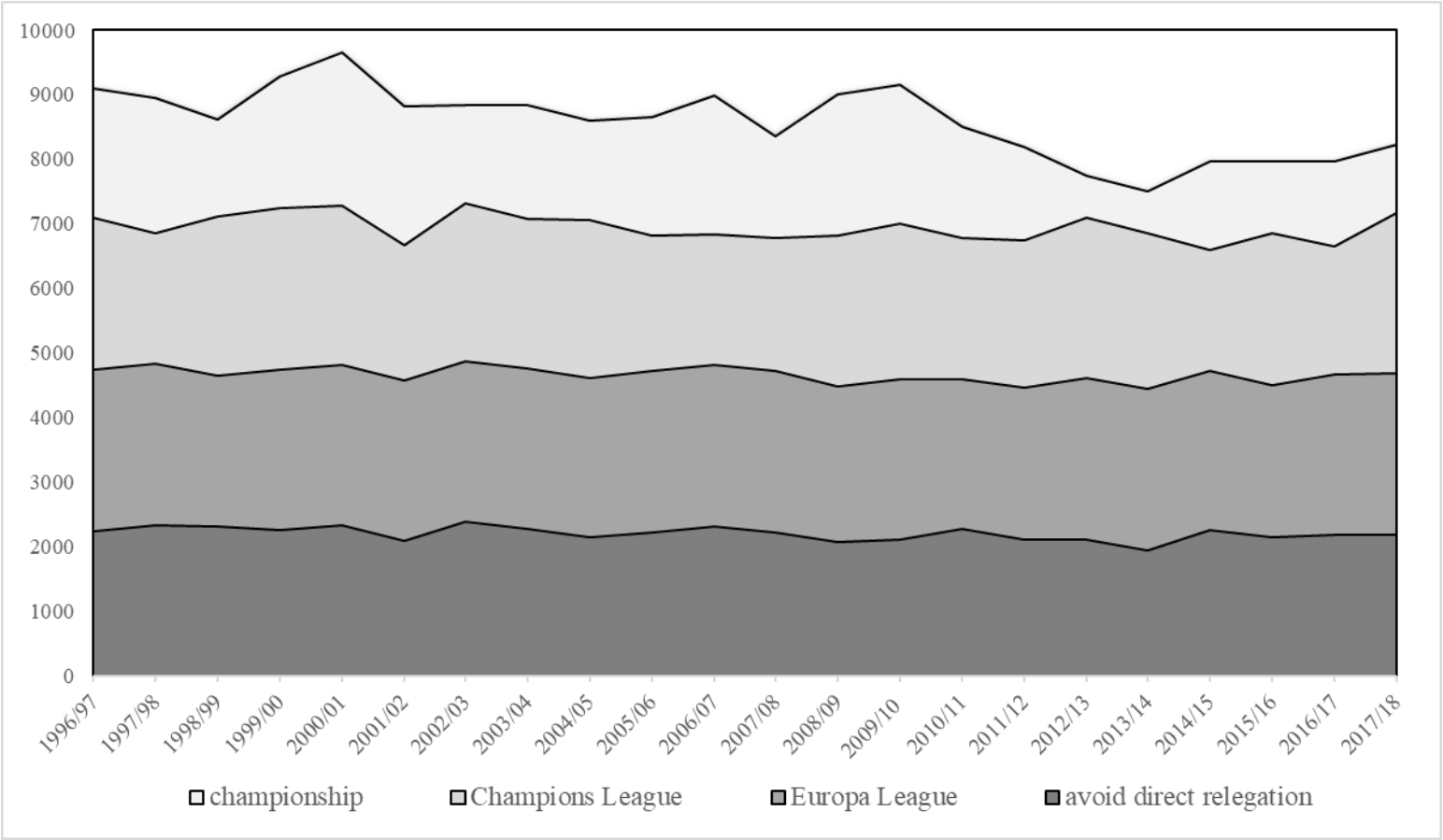
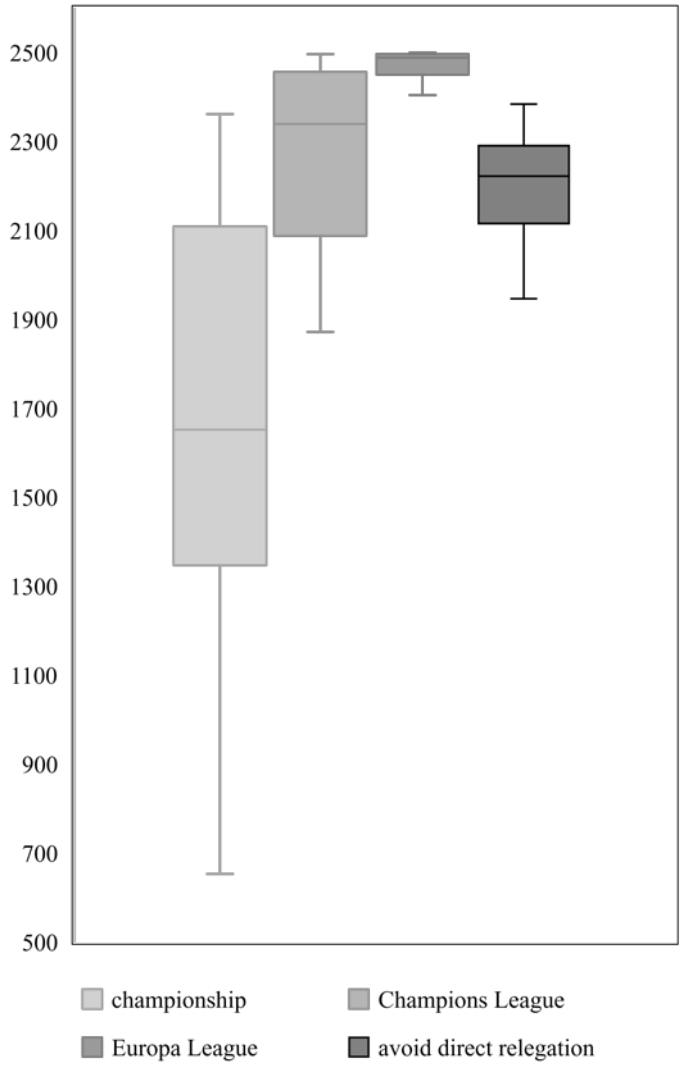

10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
championship
Champions League
Europa League
avoid direct relegation

Figure 5


2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
championship
Champions League
Europa League
avoid direct relegation