Demand for professional and semi-professional sports leagues – on the relevance of substitution within and between sports

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dedicated to my parents

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Abbreviations

AIC	Akaike Information Criterion
ATE	Average Treatment Effect
BBL	German Basketball Bundesliga
BIC	Bayesian Information Criterion
CFL	Canadian Football League
CHL	Champions Hockey League
DEL	German Ice Hockey League
DKSE	Driscoll and Kraay Standard Errors
EHF	European Handball Federation
EPL	English Premier League
ETR	Endogenous Treatment Regression
FE	Fixed Effects
FIFA	International Federation of Association Football
HBL	German Handball Bundesliga
IV	Instrumental Variable
MLB	Major League Baseball
MLS	Major League Soccer
NASL	North American Soccer League
NBA	National Basketball Association
NCAA	National Collegiate Athletic Association
NFL	National Football League
NHL	National Hockey League
OLS	Ordinary Least Squares
RSV	Interstate Broadcasting Treaty
SMSA	Standard Metropolitan Statistical Area
TV	Television
UEFA	Union of European Football Associations
UOH	Uncertainty of Outcome Hypothesis
US	United States
USA	United States of America
1BL	German Football Bundesliga
2BL	Second German Football Bundesliga

1 Introduction

“Competition between sports for fans’ money and attention is increasingly fierce” (The Economist, 2019). Under this headline, the article published by the international newspaper ‘The Economist’ describes the intensified competition that leagues face on the sports market nowadays. By entering new markets and proliferating their products, sports leagues attempt to extend their market shares over other supposed competitors. The assumed threat of competition and fan substitution between sports leagues is directly linked to revenue losses, which, at its worst, is decisive on the financial survival of clubs and leagues. Consequently, insights about substitution effects within the sports industry appear highly valuable for several stakeholders when setting any competitive strategies. For these reasons, this dissertation addresses the relevance of substitution within and between sports in depth. In the following, the problem statement, the central research question, and the overall objectives addressed in this dissertation are outlined in detail in this introductory chapter (Chapter 1.1). The second section gives an overview on the structure of this work (Chapter 1.2).

1.1 Problem statement

Within the entertainment industry, several suppliers such as theatres, cinemas, or professional sports vie for consumers’ spending on leisure time activities. Consequently, competition may evolve since these suppliers offer products (services) addressing the same consumer need, that is, entertainment during leisure time. While it does not appear to be unambiguous whether such products indeed compete with each other for consumer demand, the identification of competitors and substitute products is crucial for suppliers when intending to realise any competitive strategies.

As part of the entertainment industry, league officials and club managers of (professional) sports leagues may face competition from alternative leisure activities in general and other sporting events in particular. Attending a sports event live in the stadium or arena is always a choice between several alternatives. Ongoing discussions among sport officials over the last years confirm that leagues and clubs are perceived to be competitors with regard to the demand for their products. In particular, sport officials claim that leagues and clubs suffer from substitution in attendance demand and thus decreased ticket revenues.[1]

Substitution in attendance demand may occur when spectators are given the choice to attend one game instead of another game live in the venue. For instance, in North America, Los Angeles (United States of America; USA) is the home of two clubs of each of the five Major Leagues.[2] This triggers discussions on local fan substitution. Likewise, Berlin (Germany) hosts two clubs from the first football division (*Bundesliga*; 1BL) as well as one first division club from each of the three popular team sports (leagues) handball (*Handball Bundesliga*; HBL), basketball (*Basketball Bundesliga*; BBL) and ice hockey *(Deutsche Eishockey Liga*; DEL), causing debates on economic competition between these clubs. While economic competition may cause substitution in consumer demand within and between top-tier leagues, lower division clubs (such as the fourth division club *Berliner Athletik-Klub 07*, which is also located in Berlin) might suffer particularly in the presence of several high-quality alternatives.

Moreover, while the number of live broadcasts of sports leagues has increased considerably over time, fans might substitute between live attendance and watching either another game or the same game live on broadcast. For instance, since sports leagues in Germany regularly begin and end more or less at the same time of the year and matchdays are frequently scheduled on weekends, there is a sizable number of overlapping games broadcasted live on television (TV) or online stream. Likewise, officials of sports leagues (clubs) expect negative consequences on the attendance of a game when it is also broadcasted live.[3]

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[1] For instance, the top-tier league of German handball changed the weekdays of season matches taking place (from season 2017/18 onwards) in order to reduce competition with regard to temporal overlaps with top-tier football (soccer) leagues (e.g., Göbel, 2017; Handball World, 2019).

[2] The five North American Major Leagues involve the National Football League (NFL), the National Basketball Association (NBA), the Major League Baseball (MLB), the National Hockey League (NHL), and the Major League Soccer (MLS).

[3] For instance, in the NFL, the local TV blackout policy permits local broadcasts of games only if a certain capacity utilisation threshold is met (e.g., Gropper & Anderson, 2018).

These propositions give rise to the central research question, *whether (semi-) professional sports clubs indeed face substitution in attendance demand – and if this is the case: to what extend is attendance affected by substitution?*

While analysing substitution in attendance demand has some tradition (predominantly in North American sports leagues), previous findings appear to be limited or need to be considered with caution for three reasons (a detailed literature review is provided in Chapter 3). *First*, previous studies are limited with regard to the substitution measures employed. Measuring substitution is not (always) straightforward and detecting effects may appear challenging if rough or insufficient (substitution) measures are used. *Second*, empirical evidence on European sports is limited. In this regard, substitution effects are not *per se* comparable across settings since the relevance of substitution on demand may differ when looking at different sports systems, that is, there are considerable differences between the European and North American system. *Third*, previous findings are inconclusive since methodological difficulties seem to be present when analysing substitution effects.

By tackling these shortcomings and extending the empirical evidence, this dissertation intends to answer the aforementioned central question. First, since previous studies either neglected the European setting or remain inconclusive due to methodological issues, it remains unclear whether (semi-) professional sports clubs (in Europe) indeed face substitution in attendance. Second, by employing novel substitution measures, this dissertation attempts in subsequent steps to explain to what extend attendance demand is affected.

Finally, empirical evidence in this regard may be highly relevant for several stakeholders within the sports industry. The focus is on professional and semi-professional leagues, that is, lower division football as well as top-tier leagues in other sports. Since leagues beyond top-tier football highly depend on matchday revenues, insights about substitution in attendance demand are particularly relevant for league officials and club managers of such leagues.

1.2 Structure of the dissertation

In order to elaborate on the central research question and to tackle limitations of previous studies, this dissertation is structured in the following way. Subsequent to this introduction including the problem statement, the central research question, and the overall objectives of the dissertation (Chapter 1), the following chapter discusses the theoretical framework (Chapter 2). Thereafter, the relevant literature, including the current shortcomings of previous studies, is presented (Chapter 3). In the next chapter (Chapter 4), the research objectives for the subsequent empirical studies are provided. The following chapter (Chapter 5) comprises three empirical studies conducted within the scope of this dissertation. Each of these studies is self-contained and elaborates on one or more previously formulated research objectives. The concluding chapter (Chapter 6) summarises the central findings of the studies, discusses theoretical, methodological, and practical implications, as well as critically describes the limitations of this dissertation. In this regard, suggestions on future research are provided.

2 Theoretical framework

The market in which (semi-) professional sports leagues operate exhibits idiosyncratic characteristics compared to other (more traditional) industries. Likewise, defining markets, determining substitute products, and delineating substitution effects appear to be challenging in this industry. In order to understand how substitution effects in demand may (theoretically) unfold within (semi-) professional sports, the peculiar characteristics of the sports market must be described in the first place. In this regard, the following chapter describes the market structure in which professional sports leagues (clubs) operate (Chapter 2.1). The subsequent chapter gives a short overview on market definition within an industry in general and discusses whether sports leagues (clubs) in particular constitute competitors and thus operate within the same market (Chapter 2.2.). While the first two chapters provide a framework in which substitution effects develop, the last chapter addresses substitute products and substitution in demand (Chapter 2.3).

2.1 Market structure

The market structure, proxied by the number of firms and the market power they possess, determines the performance of single firms and the economic output of the industry as a whole. The fewer the number of firms in a certain market, the greater their potential to exert market power. The one extreme with regard to market structures is perfect competition imposing no entry or exit barriers for many firms (this type is rather theoretical and an ideal conception). Firms offer homogenous products on the market and behave as price-takers. The other extreme, that is, a monopoly structure, enforces high barriers on firms. The monopolist holds the market power to act as a price-maker (Chevalier-Roignant & Trigeorgis, 2011). Obviously, the ideal market position from a firm’s perspective is to hold a monopoly to the extent that antitrust laws permit such a position.

While several market structures exist that are positioned between both extremes, *monopolistic competition* appears to be particularly noteworthy when describing the structure of the sports market. Monopolistic competition as introduced by Chamberlin (1933) and Robinson (1933) is defined as a market structure in which one firms’ decision does not directly affect those of other firms (as is the case in perfect competition), while all firms are price-makers (as is the case for monopolists). In this regard, firms sell differentiated products, that is, products on the market are similar, however, there are noticeable differences between these products. Moreover, even though all firms hold market power because they offer differentiated products, one firm is rather negligible to the entire market (Thisse & Ushchev, 2016).

The professional sports industry constitutes a peculiar case. Neale (1964) differentiates between economic competition and sporting competition and argues that the firm within the professional sports industry is not the single club but the league as a whole. While clubs compete with each other in the sporting competition, they also collaborate with each other in order to produce the product itself, that is, the match within the league competition. In this regard, professional sports leagues constitute natural monopoly providers. Sloane (1971) argues, however, that the characteristic of joint production does not define the league to be a *firm*. Instead, the clubs appear to operate as a *cartel* in which members maximise joint and individual profits. It is argued that collusion is essential in order to reach (at least approximately) equal distribution of playing strength between clubs within a league (El Hodiri & Quirk, 1971). For instance, league members must undertake collusive actions (e.g., joint sale of media rights) to maintain (amongst others) a certain degree of competitive balance (Fort & Quirk, 1995; Stewart, Nicholson & Dickson, 2005). While cartels and monopolies are generally prevented by antitrust laws, in the professional sports industry, sports leagues are frequently excluded from the reach of antitrust laws or receive a special treatment. This may rely predominantly on the peculiarity of this industry as described above.

In many industries, the market is dominated by a few large firms dictating market conditions, whereas many small firms have only minor impacts on the market and its competitors (Chevalier-Roignant & Trigeorgis, 2011). Such an asymmetry in power between the positions of small and large businesses may be further triggered by new brand introductions. By proliferating product varieties, established firms protect profits and leave insufficient room for other market players (e.g., Schmalensee, 1978).

Likewise, within the sports industry, dominant leagues hold economic power and might be unaffected by potential competitors (Ross, 2003). For instance, professional football leagues in Europe already have a massive appeal among sport consumers. Moreover, they extended their portfolio considerably during recent years.[4] However, it is not clear whether (or not) professional football is explicitly pushing smaller leagues out of the market in order to obtain higher profits.

Cartel conduct enables professional sports to act as dominant firms and to eliminate a large share of the competition *within their sports*. At the same time, leagues *across different sports* may offer differentiated products within the sports market and might face monopolistic competition to each other. Whether leagues (clubs) constitute competitors within and across sports and thus operate within the same market is discussed in the following chapter.

2.2 Market definition

When analysing threats arising from substitution, firms need to first define the market in which they operate. While substitute products and substitution in demand constitute the central aspects of this dissertation as described in the subsequent Chapter 2.3, market definition and the identification of competitors depends upon both supply and demand side characteristics. This section provides a short overview on these characteristics and the intensity of competition.

Porter (1980) introduced the five forces when analysing industry performance. These forces have an impact on the intensity of competition within an industry, while in turn they are themselves affected by the industry’s structure described in the previous chapter (Chapter 2.1). Among other forces, one key aspect of competitive analysis is the competition among existing firms within an industry. Competitive actions are employed by all competitors to gain higher market shares. Moreover, the threat of new entrants to the market (determined by entry barriers) as well as substitute products determine the intensity of competition.[5] In order to assess competition within an industry and to

[4] The attractiveness of football was intended to be expended by introducing staggered kick-off times (e.g., in the UEFA Champions League), adopting weekday slots (e.g., in the English Premier League) and introducing new competitions (e.g., the UEFA Nations League). Monopolistic behaviour and the ongoing expansion of professional football cause concerns among league officials and managers in smaller sports.

[5] Bargaining power of both suppliers and customers also affect industry performance.

evaluate the threat of substitutes, it is essential to define its competitors in the first place. Once a firm is capable of identifying its competitors, the market in which the firm operates is defined.

Competitor identification is a challenging, though critical, task in the analysis of industry structures and conditions of rivalry. Companies must define their competitors to assess their strengths and weaknesses in order to determine the effect of market power on consumers as well as to design and realise any competitive strategies. Besides, as postulated in industrial organisation economics, defining markets is crucial with regard to antitrust and regulatory policies (Bergen & Peteraf, 2002).

The identification of supposed competitors depends on both supply and demand side characteristics. The *supply side* characteristics relate to the extent of similarity between firms with regard to production (and technological) capabilities. The *demand side* analysis refers to the similarity of products and thus, the substitutability. Proper consideration of both sides is crucial since, for instance, incorrect market definition may result in unawareness of a firm with regard to activities of competitive relevance (Bergen & Peteraf, 2002).

In contrast to more traditional industries, market definition in the professional sports industry appears to be less straightforward. Basically, clubs and leagues *across* and *within* sports offer the putative *same* products, that is, matches and league competitions. However, firstly, since the sports industry is composed of peculiar market structures such as natural monopolies (cartels) and dominant firms (as discussed in Chapter 2.1), *supply side* characteristics may not *per se* be the same across leagues and sports. For instance, different leagues have unequal economic (e.g., differences in financial power) and sporting (e.g., differences in sporting quality) preconditions. Secondly, with regard to *demand side* characteristics, the products offered by clubs and leagues may be too different in the eyes of consumers and thus not substitutable. Whether (or not) these products theoretically constitute substitutes is addressed in the following chapter.

2.3 Substitute products

Spatial competition is a widely researched domain (firstly, in the context of location theory) introducing the relevance of the impact of product characteristics on competition and thus substitution in demand. The seminal work of Hotelling (1929) considers homogenous products that differ in one dimension only, that is, the location within a geographical space. Although there exist, for instance, many firms selling the same product within an industry, large geographical distance between firms reduces the impact of competition, that is, "the market is commonly subdivided into regions within each of which one seller is in a quasi-monopolistic position" (Hotelling, 1929, p. 41).

Chamberlin (1933) and Robinson (1933) criticised the assumption of perfect competition with many homogenous products on real markets by introducing the theory of monopolistic competition. Subsequently, Kaldor (1935) and, after that, further authors (e.g., Salop, 1979) questioned the assumption made in the theory of monopolistic competition that each firm can potentially compete directly with all the other firms by having merely a negligible impact on its competitors. Instead, competition is localised, that is, a firm is confronted with a limited number of competitors by having a sizable impact on the neighbouring firms.

Lancaster (1966) extended the idea of competition within a geographical space by introducing characteristic dimensions of products. The theory of product differentiation emerged that includes products with differing qualities as well as different varieties. Theoretically, consumers do not derive utility from the consumption of products but from the consumption of the products' characteristics since consumers attempt to consume their preferred optimal product varieties. In other words, every product takes a certain position in the geographic and characteristic space. Two products constitute better substitutes the closer both products lie together in a given space. In this regard, if homogenous products are offered by different firms at the same price, consumers purchase from different firms due to differences in the geographic dimension. The full price of a certain product is composed of the actual price, transport costs as well as the utility loss arising from the consumption of a product that differs from the consumers' ideal product (Thisse, 1987).

Theory on product differentiation distinguishes between vertical and horizontal differentiation (e.g., Shaked & Sutton, 1983; Shaked & Sutton, 1987). Vertical product differentiation describes products differing in quality only. If two products are offered at the same price, all consumers prefer the one with the higher quality. Horizontal product differentiation refers to product characteristics (including the geographic space) offering differentiation of products apart from quality. If all products are offered at the same price, the consumers' demand differs with regard to their most preferred choice based on such characteristics (Cremer & Thisse, 1991).[6]

Substitution and substitute products have a long tradition in economic theory (e.g., Hicks, 1932; Clotfelter, 1977; Kraiselburd, Narayanan & Raman, 2004). Substitute products can easily be replaced by other products and serve the same purpose. Thus, the degree of need satisfaction is hardly or not at all reduced by replacing the products. The cross-price elasticity of substitutes is positive, meaning that a price increase for a substitute leads to a decrease in the quantity of sales of this product and, at the same time, to an increase in the quantity of sales of the other product. *Perfect* substitutes show no differences in terms of quality, price, or other characteristics. In contrast to this, the core function of *imperfect* substitutes is the same, however, there are differences with regard to quality, price, or characteristics.

Complementary products constitute the opposite. The use of such a product requires the use of another product, so that both products complement each other. If the price increases for one of the products, the demand may not only decrease for this product but also for the complement. While the differentiation between substitution in demand and complementary characteristics seems to be theoretically obvious, the relationship between products constituting either substitutes or complements appears to be not so clear in any case (e.g., Zheng, Zhen, Dench & Nonnemaker, 2017; Hall, Palsson & Price, 2018).

With regard to professional sports, the seminal paper of Rottenberg (1956) was the first to discuss the availability of substitutes and its impact on the demand for sports. The availability of substitutes comes along with the consumers' decision to consume one sport (event) instead of another. While some fans do not substitute and stick to their

[6] Consumer preferences can be rather homogenous, diffuse or clustered. Homogenous preferences do not yield profitable product differentiation since consumers prefer the same or similar product characteristics. Diffuse preferences of consumers imply that every consumer prefers various characteristics hampering profitable product variants on the market. Clustered preferences include sufficient large groups of consumers demanding different product characteristics so that several products persist on the market (Pfähler & Wiese, 2008).

favourite product either way, spectators with less commitment for a certain sport (or league/ club) might switch preferences. Accordingly, a differentiation between *sport-specific* (or league-/ club-specific) and *general sports* fans, potentially consuming any available sport in the market, is crucial in the first place (Mongeon & Winfree, 2013). Such neutral spectators are much more likely to substitute one game for another. Moreover, product differentiation occurs on the sports market. While vertical product differentiation refers to different qualities across divisions of the same sport, horizontal product differentiation relates to differences in other characteristics such as different sports. Finally, whether certain games constitute substitutes to each other depends on consumers' preferences. In particular, within the sports market, games may form either perfect or imperfect substitutes due to quality and price, but the other important factor is the unknown heterogeneity of consumers with regard to further characteristics.

Based on the aforementioned theoretical considerations, four types of substitution are identified within this dissertation, including (i) substitution across different divisions (leagues) of the same sport due to vertical differentiation. If consumers have the choice between watching a top or lower division game, it seems reasonable that general sports fans prefer to watch the product comprised of higher quality, that is, the top division game (*type I*). Moreover, (ii) substitution across different sports and (iii) substitution within the same competition may occur, referring to horizontal product differentiation. With regard to the former, substitution might take place across sports played on the same quality level. For instance, general sports fans may substitute between top-tier leagues of different team sports (*type II*). With regard to the latter, substitution within the same competitions means that clubs competing sportingly in a league may also compete economically (*type III*). Finally, (iv) substitution might occur within the same game since, nowadays, consumers can choose between alternatives of watching a game, that is, attending live in the venue or watching the broadcast (TV, computer, tablet, or any other device) (*type IV*).

Substitution of type I, II, III, and IV is expected to occur under certain circumstances. In line with Hotelling (1929), substitution in live attendance is facilitated by spatial proximity between sports clubs. Moreover, if games in close geographic proximity take place concurrently, a choice has to be made on attending one instead of the other game live in the respective venue. Likewise, in case of parallel games (regardless of spatial proximity) or when considering the same game, substitution may also exist between either attending a game at a given venue or watching another/ the same game on TV or online stream. In this regard, sports fans may prefer to watch certain games as broadcasts instead of allocating their available time and money for live attendance due to individual time and budget constraints as introduced by Becker (1965). This means that substitution may occur not only among general sports fans but also to some extent with regard to sport-specific (or league-/ club-specific) fans.

Summing up, live attendance might substitute live attendance at another venue. Moreover, concurrent TV or online broadcasts of sport events are assumed to substitute attendance demand. While these effects may occur between clubs and leagues within and across different divisions and sports (substitution type I, II, and III), substitution effects might also exist between attending a game live in the venue and watching the same game on TV or online stream (substitution type IV).[7]

[7] The number of live broadcasts increased significantly over time with regard to both (semi-)professional and non-professional European sports.

3 Literature review

Spectator sports demand in the sports economics literature is typically explored by measuring either TV or live attendance. While the literature on TV demand increased significantly during recent years, analysing attendance already has a long tradition in the field of sports economics. Likewise, while there are some studies on substitution with regard to TV demand (e.g., Tainsky & Jasielec, 2014; Mills, Mondello & Tainsky, 2016; Mondello, Mills & Tainsky, 2017; Sung, Mills & Mondello, 2019), the empirical research predominantly looked at substitution in attendance demand. Since the focus of this work is on live attendance, the following chapters summarise the empirical findings on substitution effects in this regard.[8]

The literature on substitution in attendance demand concentrated, so far, on North American and European leagues. However, there are crucial differences between the studies examining one or the other setting with regard to the research focus set and the substitution measures employed. In order to highlight these differences between the two strands distinguished in this dissertation, the relevant substitution literature on type I, II, and III (a description of the substitution types is provided in Chapter 2.3) is presented separately for North America and Europe. Since there are no significant differences detected between the studies analysing one or the other setting with regard to substitution type IV, this constitutes the third literature strand within this dissertation.

The first strand of the literature emerged in North America where the sports system is made up of major leagues on the top-tier level as well as minor leagues, junior leagues, and college leagues (e.g., organised by the National Collegiate Athletic Association (NCAA)). The literature on North American sports leagues covers several sports with regard to substitution between major leagues, substitution between major leagues and lower-level leagues, as well as substitution within the same league. A comprehensive overview is provided in Chapter 3.1.

[8] While this work analyses substitution in attendance within the sports industry, some studies also examined substitution between sports and other types of leisure activities (e.g., Hart, Hutton & Sharot, 1975; Izquierdo Sanchez, Elliott & Simmons, 2016).

The second strand of the substitution literature evolved in Europe. In contrast to American sports, one sport, that is football, takes a particular position because it dominates the demand within the sports market in Europe. Moreover, even lower football divisions (clubs) consist of semi-professional/ professional structures and, furthermore, enjoy high popularity among sport consumers (this is discussed in detail in Chapter 5.1).[9] The substitution literature, so far, covers mainly substitution effects within the same sport, that is, football. This strand of literature is presented in more detail in Chapter 3.2.

Finally, while the first and second strand consider substitution type I, II, and III, covering sports (leagues) either in the North American or European setting, the third strand of the substitution literature evolved similarly in both North American and European leagues. The decision to either attend a game live in the venue or to watch it on broadcast (substitution type IV) was examined in the previous literature with regard to several sports and different levels of play. Interestingly enough, theoretical expectations and empirical evidence appear to be inconsistent. The present state of research including a discussion on discrepancies between theoretical expectations and empirical evidence is presented in Chapter 3.3.

In the following three chapters, an overview of the present state of research on the impact of substitution on attendance is provided. Empirical evidence is presented with regard to competition between clubs and leagues, that is, fan substitution within and across sports (type I, II, and III) in North American sports leagues (Chapter 3.1) and European sports leagues (Chapter 3.2). Afterwards, studies on substitution effects between attending a game live in the venue and watching the same game on broadcast (type IV) are presented (Chapter 3.3). Finally, based on the present state of research presented in these chapters, the research gaps are identified and the research desiderata are delineated (Chapter 3.4).

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[9] In contrast to the North American sports system, the European sports system is composed of sporting promotion and relegation between divisions.

3.1 Substitution types I, II, and III in North American leagues

In this chapter, findings on the impact of substitution on attendance in North American leagues are presented. These studies cover three types of substitution, that is, across different divisions or leagues of the same sport (type I), across different sports (type II), and within the same competition (type III).

Early studies focused on attendance demand in the MLB.[10] For instance, Hill, Madura, and Zuber (1982) found that multiple professional baseball teams in a certain standard metropolitan statistical area (SMSA)[11] adversely affect attendance demand. Moreover, while Baade and Tiehen (1990) revealed an adverse effect on attendance in the presence of other professional sports teams in the same city, Kahane and Schmanske (1997) excluded substitution measures from their models due to insignificant impacts of baseball and other sports teams in the same geographic area on MLB attendance.[12]

Paul (2003) found a negative impact from the existence of professional baseball, football, and basketball clubs in the same metropolitan area on the attendance of NHL clubs. Moreover, Winfree, McCluskey, Mittelhammer, and Fort (2004) revealed that the closer two MLB teams are located to each other, the lower is the attendance compared to teams that are farther apart. The authors also found an initial reduction in MLB teams' attendance when a new team moves into the area.[13]

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[10] Books (book chapters) by Demmert (1973) and Noll (1974) also took substitution in demand into account. A (more or less early) literature review including some theoretical considerations is provided by Winfree (2009a).

[11] The SMSA, used in the North American literature, defines a geographical region consisting of a core city and its surroundings that are connected via economic and social factors.

[12] An early study on North American sports used questionnaires to explore the impact of the existence of other sport teams in the same area on attendance (Hansen & Gauthier, 1989). Moreover, Solberg and Mehus (2014) find in the European market, by employing an empirical survey on Norwegian football fans, that fans with strong preferences for foreign football attended less frequently in the stadium.

[13] Further studies looked at competition and substitution with regard to location choices. For instance, Davis (2006) examined factors determining whether a city hosts a minor league baseball team and the level at which that team competes. The author found that the time from the nearest MLB team has a positive impact on both. In addition to this, testing the impact of football, basketball, and hockey teams on the presence of a baseball team show insignificant (football and basketball) or inconsistent (hockey across levels) results. Moreover, some studies used location models to forecast the best regions/ cities with regard to expansion and relocation decisions of professional sports clubs by including competition to other clubs and leagues (e.g., Rascher & Rascher, 2004; Rascher, Baehr, Wolfe & Frohwerk, 2006).

Some studies used the NHL season-long lockout in the 2004-2005 season as a natural experiment to examine substitution effects. For instance, Winfree and Fort (2008) revealed that fans substitute minor and junior league hockey for the NHL. They also found that there is no difference whether (or not) an NHL team is located in the same area for minor league teams' attendance, suggesting no relevance of geographical proximity of competitors when analysing substitution effects. Moreover, Winfree (2009b) concluded (by using the lockout) from separate analysis of minor league hockey, junior league hockey, and the NBA, that fan substitution is bigger for lower-level hockey and NBA teams located in cities also hosting NHL teams. Likewise, Rascher, Brown, Nagel, and McEvoy (2009) found, by using the same natural experiment, an increase in attendance demand for the NBA and minor hockey leagues.

More recent studies confirm previous findings. For instance, Gitter and Rhoads (2010) detected fan substitution between minor league baseball and the MLB by finding that increased ticket prices for the nearest MLB team to the respective minor league team result in higher attendance figures for the lower-level team. In addition to this, the authors used the MLB strike in the 1994/ 1995 season and found an increase in attendance for minor leagues during this period. Moreover, by examining NBA data, Mongeon and Winfree (2012) found that attendance decreases with the number of both NBA teams and teams of the three major sports leagues NFL, MLB, and NHL within the same SMSA.[14]

Finally, there are some studies that did not use attendance data to capture competition, although they confirm previous findings on substitution effects with regard to all three types of substitution. By using passenger car border crossings (on game days) between the US and Canada, studies by Mills and Rosentraub (2014) as well as Mills, Winfree, Rosentraub, and Sorokina (2015) revealed fan substitution either within the same competition (Mills & Rosentraub, 2014) or across different leagues of both the same sport and different sports (Mills et al., 2015). Moreover, Bradbury (2019) employed revenue

[14] Analysing MLB, NBA, NFL and NHL data provided evidence that professional sports teams spatially compete when pricing their tickets (Henrickson, 2012).

data instead of attendance data and found that the presence of multiple teams in a certain market has a negative impact on the revenues generated in the NFL and the NBA, but not in the MLB or the NHL.

3.2 Substitution types I, II, and III in European Leagues

In the following, findings on the impact of substitution type I, II, and III on attendance demand in European leagues are presented. While the literature on North American sports leagues came up with early studies predominantly considering the impact of nearby competitors, previous studies on European sports employed different measures of substitution. For instance, Hynds and Smith (1994) used attendance data in British cricket test matches and employed dummy variables for contemporaneous sporting competitions in tennis and football (Wimbledon and World Cup). Regardless of spatial competition, the authors found negative coefficient signs, suggesting substitution across sports.

Thereafter, studies emerged looking at substitution within the same sport across different levels of play. For instance, Forrest, Simmons, and Szymanski (2004) as well as Buraimo, Forrest, and Simmons (2009) used data on second division English football and found substitution effects from concurrent broadcasted club competitions (e.g., UEFA Champions League) on attendance demand. Likewise, Forrest and Simmons (2006) detected substitution effects from concurrent European competition broadcasts by utilising game-day attendance data on the second, third, and fourth divisions of the English Football League. Moreover, Buraimo et al. (2009) revealed a reduction in attendance in the presence of rivals in the same market area.[15]

Robinson (2012) looked at substitution within the same competition and employed data on the relationship between the attendances of ten football clubs in five English cities and four football clubs in two Italian cities. By using cointegration analysis, the authors conclude that supporters of a team may switch their support to a rival club.

[15] By examining the English Premier League, Baimbridge, Cameron, and Dawson (1996) found a positive impact from other Premier League football clubs within the same area on attendance. The authors concluded that this variable likely discovered an overall support for a particularly fanatical locality.

Beyond data on professional and semi-professional football, Storm, Nielsen, and Jakobsen (2018) applied attendance data from Danish handball league games. While the authors did not find substitution within the same sport across leagues, that is, simultaneous TV coverage of the women's handball league, they found substitution with regard to broadcasted games within the same competition. Finally, by using Danish first division football data, Nielsen, Storm, and Jakobsen (2019) found that attendance decreases for games concurrently broadcasted with English Premier League games when it is raining or snowing.[16]

3.3 Substitution type IV

After considering the present state of research with regard to fan substitution between clubs and leagues in the previous chapters, in the following, empirical evidence on substitution within the same game is presented. Theoretically, as described in Chapter 2, viewing a broadcasted game is assumed to constitute a substitute to live attendance of the same game. However, the empirical evidence with regard to this relationship is inconclusive since previous studies found either significant substitution effects, no significant effects, or even complementary relationships between TV broadcasts and attendance.[17]

A comprehensive overview on the present state of research with regard to substitution type IV is provided by Wallrafen, Deutscher, and Pawlowski (2020).[18] This overview presents 30 related studies including information on the data used, the methods employed, and the results found. While twelve studies detected a negative effect from broadcasting games on attendance demand, four found a positive effect, and five did not find any significant effect. In addition to that, nine studies found mixed results depending on different measures and specifications employed.

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[16] Moreover, Kringstad, Solberg, and Jakobsen (2018) found similar results for the first division of Norwegian football, that is, broadcasted games from the big five European leagues (in England, Germany, France, Spain and Italy) have a negative impact on attendance.

[17] Some studies also found complementary relationships between clubs when analysing broadcast viewership (e.g., Mills et al., 2016; Sung, Mills & Tainsky, 2017).

[18] The work by Wallrafen et al. (2020) also constitutes the third study of this dissertation (see Chapter 5.3).

The present literature on this inconclusive relationship covers analysis from both North American (e.g., Kaempfer & Pacey, 1986; Humphreys, 2002; Mirabile, 2015) and European leagues (e.g., Peel & Thomas, 1992; Allan, 2004; Cox, 2018). Moreover, these studies analysed different sports, such as American football (e.g., Falls & Natke, 2014), baseball (e.g., Lemke, Leonard & Tlhokwane, 2010), basketball (e.g., McEvoy & Morse, 2007), football (e.g., Buraimo & Simmons, 2009) or handball (e.g., Storm et al., 2018), as well as different levels of play, that is, top-tier leagues (e.g., Welki & Zlatoper, 1999; Nielsen et al., 2019), college leagues (e.g., Price & Sen, 2003; Falls & Natke, 2017) and lower divisions (e.g., Peel & Thomas, 1992; Forrest & Simmons, 2006).

The previous studies used regression analysis techniques that are commonly employed within the empirical attendance demand literature, such as ordinary least squares (OLS) or Tobit (in case of censored attendance data) regressions. However, these estimation techniques may produce incorrect estimates in case of selection issues arising from the broadcasters' preference to broadcast the most attractive games, which are also expected to attract comparably larger gate attendances. Interestingly enough, while some recent studies emphasised the existence of potential endogeneity bias when analysing this relationship, they did not account for this bias in their estimations (Falls & Natke, 2014; Falls & Natke, 2017). Moreover, other studies estimating OLS and Tobit models either highlighted afterwards that significant results are biased due to endogeneity (e.g., Storm et al., 2018) or did not find significant results when employing two-stage models (e.g., Martins & Cró, 2018).

3.4 Research gaps and desiderata

Based on the review of previous studies, overall, the empirical evidence suggests the existence of competition and substitution across and within sports. However, the studies appear to be limited and give reason to consider (at least) some findings with caution. Three research gaps are identified that are presented in the following. In this regard, the need for further research with respect to substitution in (semi-) professional sports leagues is discussed.

First, the measures employed to capture the impact of substitution on attendance appear to be limited in several ways. On the one hand, the North American literature clearly focuses on theoretical considerations of Hotelling (1929), that is, the impact of spatial proximity of competitors on demand. On the other hand, studies on European sports leagues predominantly looked at temporal overlaps of substitute products by neglecting the relevance of spatial proximity. Even though previous studies revealed substitution effects within and across sports, the measures employed appear to be rough given the narrowed focus areas on either spatial or temporal relevance, thus, research needs to consider both simultaneously. Moreover, while the literature suggests that concurrently played games constitute substitutes, effects may also unfold in a lagged manner, that is, nearby games may be in competition even if they do not take place concurrently. For instance, beyond direct temporal overlaps, the relevance of (mid-term) intertemporal time and budget constraints (Becker, 1965) of sports consumers might cause local substitution within a certain time frame, that is, substitution occurs a few days before or after games of substitutes. In addition to this, some studies either used rather imprecise (aggregated) substitution measures such as the season-long NHL lockout in 2004-2005 (e.g., Winfree & Fort, 2008) or applied imprecise demand measures such as passenger car border crossings instead of attendance data (e.g., Mills et al., 2015) or the average per game attendance instead of per game attendance (e.g., Gitter & Rhoads, 2010). Finally, previous measures applied seem outdated to some extent and need to be reconsidered. For instance, in spite of new technologies facilitating the use of modern types of broadcasting, such as online streaming with computer, tablet, or smartphone, the literature almost exclusively employed TV data only in order to capture substitution effects.[19] Overall, based on insufficient measures, previous studies, so far, might have explained only a certain fraction of substitution effects and neglected more complex dimensions of substitution, which may result in biased effect sizes estimated.

Second, there are shortcomings in the literature with regard to certain settings. This is associated with the fact that substitution is not *per se* comparable across different settings. The impact of substitution on demand may differ when looking at different sports

[19] Falls and Natke (2014) as well as Falls and Natke (2017) constitute exceptions within the substitution literature providing evidence on the impact of online streaming on attendance.

systems across states. For instance, the North American Major Leagues are characterised by franchise licensing systems and territorial restrictions,[20] whereas the European system operates with sporting promotion and relegation of clubs and facilitates the existence of several clubs within a certain region. Thus, findings on substitution in North America and Europe may appear hardly comparable due to systematically different preconditions (selection issues in North American leagues since competition within the same region is limited or even avoided) when analysing competition for (local) consumers. Moreover, the European setting appears to be idiosyncratic since the supremacy of top-tier football leagues overshadows other smaller leagues such as lower divisions in football as well as top-tier divisions in other sports. While the few existing studies of European leagues largely covered substitution type I (within the same sport), this evidence predominantly looked at concurrent games played in international competitions and neglected competition to domestic league games. In addition to this, there is, so far, no study that examined substitution type II (between leagues across sports).[21] Overall, considering substitution in the well examined setting in North America and transferring findings to a, so far, neglected setting, that is, European sports leagues, does not appear to be advisable and thus, needs further research.

Third, methodological difficulties are present when explaining substitution effects. OLS and Tobit estimations may produce incorrect estimates in case of endogeneity issues. In this regard, appropriate econometric modelling is required with regard to substitution within the same game, or more precisely, concerning the impact of broadcasting a game live on TV (online stream) on the attendance demand of the same game. While the state of research is already rich when counting the number of studies dealing with this issue, the empirical evidence remains inconclusive. Moreover, studies explicitly taking poten-

[20] In the NFL, for instance, "once a franchise is established, it receives a 'Home Territory,' defined under Article IV of the NFL Constitution as the city in which the franchise is based, extended out seventy-five miles from the corporate limits of such city. … Once a franchise has been granted and a Home Territory established, the NFL Constitution provides that no franchise has the right to change the city in which it is based without a prior vote of approval by at least three-fourths of the teams existing in the league at the time" (Follett, 2020, p. 2206). Likewise, "in the NBA, an area with a radius of 75 miles surrounds each NBA team, and no other NBA team is permitted to locate within that radius without permission of the incumbent team" (Rascher & Rascher, 2004, p. 277). Likewise, major leagues expand teams' local marketing territories (e.g., Lombardo, 2016).

[21] Hynds and Smith (1994) solely looked at British Cricket and competing major tournaments, that is, Wimbledon tennis and FIFA Football World Cup.

tial selection bias into account are scarce, which might explain (at least) to some extent inconsistencies in previous findings. Thus, further research evaluating the econometric modelling is needed in this regard.

The present state of research described in this chapter addressed fan substitution within and across sports (type I, II, and III) in both North American sports leagues and European sports leagues. Moreover, a literature review on substitution effects between attending a game live in the venue and watching the same game on broadcast (type IV) was provided. Overall, the research gaps identified refer to either insufficient (substitution) measures, shortcomings in the literature on European leagues, or methodological issues concerning substitution within the same game. In the following chapter, the research objectives of the empirical studies conducted in this dissertation are presented that intend to elaborate on the described research gaps.

4 Research objectives

Three studies are conducted within the scope of this dissertation. These studies intend to address the aforementioned shortcomings of the previous literature presented in Chapter 3 in order to elaborate on the central research question raised in Chapter 1, that is, whether (semi-) professional sports clubs face substitution in attendance demand – and if this is the case: to what extend is attendance affected by substitution.

By using game-level data of German sports leagues in all of the three studies, the impact of substitution on attendance demand is examined. In this regard, novel empirical designs are applied, and previously neglected settings are considered. Before presenting the studies of the dissertation in Chapter 5, the research objectives of each study are described concisely in the following.

Study 1

Wallrafen, T., Pawlowski, T., & Deutscher, C. (2019). Substitution in sports: the case of lower division football attendance. *Journal of Sports Economics*, *20*(3), 319-343.

Study 1, presented in Chapter 5.1, intends to contribute to the literature on substitution across different divisions of the same sport. By using data from fourth division football in Germany, substitution to both domestic football leagues (*Bundesliga* and *2. Bundesliga*) and international football club competitions (UEFA Champions League) is analysed. In this regard, the study extends the scarce literature on lower divisions and semi-/ nonprofessional leagues in the European setting as well as competition to domestic league games. Beyond that, this study's main objective is the introduction of a more sophisticated substitution measure. By taking spatial and temporal dimensions of substitution simultaneously into account, a more complex way of measuring substitution effects is provided. In this regard, both local and nonlocal competition of lower division football to top-tier competitions is considered. Finally, the knowledge on substitution effects gained in this study provides essential groundwork for the implementation of the further developed substitution measure in Study 2.

Study 2

> Wallrafen, T., Nalbantis, G., & Pawlowski, T. (2021). Competition and fan substitution between professional sports leagues.

Study 2, presented in Chapter 5.2, analyses substitution across different sports in a European setting, so far neglected in the substitution literature. Data from the top-tier German leagues in handball, basketball, and ice hockey are gathered to capture substitution effects arising from professional football, since, as described earlier, the supremacy of top-tier football constitutes an idiosyncratic setting for testing substitution. Moreover, the main objective of this study is to provide more insights into how substitution effects unfold. In this regard, the study builds upon knowledge acquired by Study 1 and employs a further developed substitution measure testing scheduling overlaps of (local) games within a certain time frame in order to look at intertemporal consumption plans of consumers.

Study 3

> Wallrafen, T., Deutscher, C., & Pawlowski, T. (2020). The impact of live broadcasting on stadium attendance reconsidered: some evidence from 3rd division football in Germany. *European Sport Management Quarterly*, doi: 10.1080/16184742.2020.1828967

Study 3, presented in Chapter 5.3, intends to make a contribution to the literature on substitution within the same game, that is, attending a game live at the venue or watching it on broadcast. Similar to Study 1, this study uses lower division attendance data and contributes to the demand literature on leagues beyond top-tier divisions. By using third division football data in Germany, appropriate econometric modelling techniques are employed in order to tackle endogeneity issues. In this regard, this study explicitly compares the results with and without adequately modelling selection issues arising from the broadcasters' preference to broadcast the most attractive games, which are also expected to attract comparably larger gate attendances. Moreover, the setting utilised in this work facilitates the use of improved substitution measures, that is, third division games are broadcasted on both TV and online stream, thus the study extends the scarce empirical evidence on the impact of online streaming on attendance.

5 Empirical studies

This chapter contains the three aforementioned empirical studies. Study 1 and Study 3 of this dissertation are published in *Journal of Sports Economics*[22] and *European Sport Management Quarterly*[23], respectively. Study 2 is currently submitted for review.[24]

Every study includes an introduction, a theoretical framework, and a literature review. This is followed by the methodology, providing information on the data used as well as on the measures and the econometric approach employed. Furthermore, every study contains sections presenting the results and the conclusion. Finally, each study provides a list of references and an appendix that includes robustness checks with regard to the main findings. Manuscript structures and styles (citation, references, notes, etc.) refer to the guidelines of the respective journals.

[22] This is an 'Accepted Manuscript' of an article published by SAGE Journals in Journal of Sports Economics, 2019, available online: https://journals.sagepub.com/doi/abs/10.1177/1527002518762506

[23] This is an 'Accepted Manuscript' of an article published by Taylor & Francis Group in European Sport Management Quarterly, 2020, available online: https://www.tandfonline.com/doi/full/10.1080/16184742.2020.1828967

[24] This is the latest version of a manuscript currently submitted for review in Review of Industrial Organization (Publisher: Springer). For more information see https://www.springer.com/journal/11151

5.1 Substitution in sports: the case of lower division football attendance (Study 1)

Article

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Substitution in Sports: The Case of Lower Division Football Attendance

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Abstract

Commercialization processes in European football are facilitated by reducing concurrent games *within* the leagues and reallocating kickoff times to prime time slots abroad. Consequently, the number of top division games that temporally overlap with lower division games has increased significantly during recent years. By using attendance data of around 6,000 games in Germany's fourth division, this article is the first to empirically test whether such overlaps have any adverse demand effects for lower division games. Fixed effects panel regressions reveal that overlapping games indeed reduce the demand for lower division games, suggesting some negative spillovers of commercialization processes in football.

Keywords

attendance, spatial competition, substitution, demand

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Substitution in sports: the case of lower division football attendance

Introduction

Lower divisions constitute the fundament of European professional football leagues and the open league system generally allows entry to professionalism for all clubs. Moreover, professional clubs benefit in acquiring talent that was formerly trained and developed by lower division clubs (Göke, Prinz, & Weimar, 2014). At the same time, however, lower and top division clubs are potential competitors with regard to the demand for their products, in particular when games are played at the same time and/or in close proximity. In general, lower division games regularly take place during the weekend or during the late evening of weekdays to allow amateur and semi-professional players holding down a regular job on weekdays. Historically, most of the top division games were scheduled either Saturdays (England, Germany, and in France since the 1990s) or Sundays (Spain and Italy) leaving the rest of the week exclusively for lower division games. During recent years, however, top divisions have decided to (i) spread the schedule across an increasing number of days per week, (ii) reduce the number of concurrent games within the first (and second[1]) divisions, and (iii) reallocate kick-off times to prime time TV slots in lucrative markets abroad, in order to increase media right revenues by boosting airtime and media coverage.

For instance, in the first years after its foundation in 1962, games in the German Bundesliga were only played on Saturday afternoon (starting at 3.30pm). Since the late 60’s, however, considerable changes took place with Friday evening games becoming a fixed part in the match calendar from the season 1972/73 onwards and Sunday games being played regularly since the season 1990/91. During recent years, the typical matchday was further subdivided by introducing different kick-off times for both Saturday and Sunday games. Finally, season 2017/2018 is the first with even ten games taking place either on Monday evening or Sunday at noon. This development has significantly increased the number of scheduling conflicts and temporal overlaps with lower division games in Germany.

In England, where the trend of scattering top division games between and over the weekdays developed first, compensation payments for lower division clubs were demanded some years ago (Forrest & Simmons, 2006). In Germany, most recent changes made this issue a hot topic since lower division clubs expect (financial) support from professional football clubs to enforce their concerns, while accusing professional football of self-serving action and negligence of grassroots (*Frankfurter Rundschau*, 2017). In England as well as Germany the major argument brought forward in these discussions is the expected threat of substitution in fan interest. More precisely, lower division clubs fear concurrent top division games to reduce their gate attendance because consumers have to choose between parallel games and might prefer attending or watching on TV top division games instead of lower division games. If top division games indeed serve as substitutes for lower division games this could be highly problematic for the latter, since ticket sales serve as the primary revenue stream for lower division clubs. In fact, low(er) attendance is a familiar reason of clubs being involved in financial crisis and insolvencies frequently occur amongst lower division clubs in particular (Buraimo, Simmons, & Szymanski 2006; Scelles, Szymanski, & Dermit-Richard, 2016). Consequently, the existence of substitution in consumer demand between leagues would imply that financial stability of lower division clubs is threatened by recent commercialization processes in professional football.

Despite the relevance of this topic, no study has yet tested this much debated claim empirically for European football. Instead, there is a clear academia focus on substitution effects in North American sports (a detailed overview is provided below), where the trend of scattering match days over the week is also apparent. For instance, National Basketball Asscociation (NBA) games are nowadays scheduled for every single weekday. However, these studies just analyse spatial competition by neglecting temporal overlaps (e.g. Paul, 2003; Winfree, McCluskey, Mittelhammer, & Fort, 2004). To the best of our knowledge, Forrest and Simons (2006) published the only paper that previously looked at possible substitution in consumer demand for games played in leagues beyond the top two domestic football divisions. Their study, however, focuses on possible substitution effects caused by live broadcasts of UEFA Champions League games involving Premier League clubs only, neglecting the most relevant sort of games in the ongoing debates, that is, concurrent games played in professional domestic leagues.

Using game level panel attendance data of around 6,000 games played in Germany's fourth division ("Regionalliga") between 2012 and 2016, this paper intends to contribute to the literature by analysing for the first time substitution in demand caused by concurrent football games played by local and non-local first and second division clubs in both domestic leagues and international club competitions. Moreover, this paper adds to the current state of research on substitution in sports by jointly looking at and systematically disentangling the different dimensions of substitution, that is, spatial and/or temporal overlaps of games taking place. Overall, our results indicate that scheduling overlaps with first and second division games negatively influence attendance in the German fourth division, suggesting negative financial consequences of the above described commercialization processes in professional football for lower division clubs. These findings are robust to different model specifications and accompanied by expected effects of standard control variables that were previously used in demand models for top division football games.

The remainder of the paper is as follows: The second section discusses the theoretical background of our study and some relevant conceptual issues on substitution. Moreover, it summarizes the related literature on substitution in sports. The third section provides some background information on the fourth division in Germany and describes the data used as well as the empirical design employed. The fourth section discusses the major findings, and the fifth section concludes.

Theoretical background and related literature

The decision to watch (or not watch) a sporting event live is a choice between alternatives, and the (non-)availability of substitutes is generally assumed to influence the demand for sports (Rottenberg, 1956). Substitutes for stadium spectators in our setting, that is, fourth division football games in Germany, are highly idiosyncratic. From a theoretical point of view, however, it appears plausible to assume that top division games are perceived as (imperfect) substitutes for at least a number of consumers who generally enjoy watching football games live, and neither explicitly cheer for a certain club nor division. Such consumers are referred to as *general football fans* (Mongeon & Winfree, 2013) or *neutral spectators* in the following. Those neutral spectators have a preference for quality (Rosen, 1981), prefer known quality to unknown new talent (MacDonald, 1988), and build consumption capital for popular suppliers (Adler, 1985). It seems likely that these neutral consumers explicitly prefer to watch a top division instead of a lower division game live when given the choice. If such games are taking place in close geographic proximity, these fans potentially choose to attend the top division game in the stadium. Such kind of substitution refers to the *spatial dimension*, that is, proximity of substitutes, as first discussed by Hotelling (1929) in his location model of a duopolistic market for homogeneous products. Given the popularity of watching live football on TV, however, substitution might also occur between attending a lower division game in the stadium and watching a top division game live on TV. Such kind of substitution refers to the *temporal dimension* only and does not require any spatial proximity.

The empirical analysis of substitution in sports has already a long tradition. Early studies focused on substitution between leisure activities in general (Késenne, 1980; Késenne, 1983), between leisure activities and stadium attendance (Hart, Hutton, & Sharot, 1975; Zhang, Smith, Pease, & Jambor, 1997) or between stadium attendance and TV viewing (Baimbridge, Cameron, & Dawson, 1996; Allan, 2004).

Previous studies on substitution in stadium attendance between professional sport clubs predominantly focused on the spatial dimension only, that is, whether (or not) a club is located in the same market area, thus neglecting the relevance of temporal overlaps of games. Such studies detect significant substitution effects in attendance for clubs (i) *within the same competition* (Demmert, 1973; Noll, 1974; Hill, Mandura, & Zuber, 1982; Hansen & Gauthier, 1989; Baade & Tiehen, 1990; Winfree et al., 2004; Winfree, 2009a), (ii) *across different sports*, that is, between clubs of the National Hockey League (NHL), the National Football League (NFL), the Major League Baseball (MLB), and the National Basketball Association (NBA) in North America (Paul, 2003; Rascher, Brown, Nagel, & McEvoy, 2009; Winfree, 2009b), and (iii) *across different divisions of the same sport*, that is, competition between minor and major league clubs (Rascher et al., 2009; Winfree, 2009b; Gitter & Rhoads, 2010).

Fewer studies exist that previously looked explicitly at the *temporal dimension* of substitution. For instance, Hynds and Smith (1994) studied attendance demand for friendly games in British cricket and could detect, apart from spatial proximity, a negative impact of concurrent sporting events on attendance (Wimbledon tennis and World Cup soccer). Moreover, Winfree and Fort (2008) found increased attendance for minor league hockey clubs during the 2004-2005 NHL lockout. In addition, Mills and Rosentraub (2014) as well as Mills, Winfree, Rosentraub, and Sorokina (2015) could detect an increase of passenger car crossings into the US when US major league clubs play at home on the same day, suggesting substitution within and between major leagues across borders. Next to these studies on North American sports, only three studies exist that previously looked at the temporal dimension of substitution in football. Forrest, Simmons, and Szymanski (2004) examined 3,312 games played in the English second division (i.e., the English Football League Championship) and found adverse impacts on attendance from concurrently broadcasted European club competitions (UEFA Champions League, UEFA Cup, and Cup Winners' Cup) involving English Premier League clubs. Moreover, Forrest and Simmons (2006) used panel data of more than 4,000 games in the (professional) second, third, and fourth divisions of English Football League and found reduced attendance if concurrent UEFA Champions League games involving Premier League clubs were broadcasted live. Finally, Buraimo, Forrest, and Simmons (2009) analysed the English Football League Championship (overall 2,884 games) and could confirm the existence of substitution effects caused by concurrent UEFA Champions League games broadcasted live. Moreover, they found that attendance reduces with an increasing number of competitors in the same market area.

Summing up, most studies empirically testing substitution in sports have predominantly focused on the spatial dimension neglecting any relevance of temporal overlaps, while the few existing studies looking at the temporal dimension of substitution mostly ignored the spatial dimension of substitution. Moreover, to the best of our knowledge, only three papers previously looked at substitution in demand for upper and lower division football games. These papers, however, neglected testing possible substitution caused by the most relevant sort of games in the ongoing debates, that is, concurrent games played in professional *domestic* leagues.[2] Therefore, this paper intends to contribute to the *general literature* on substitution in sports by systematically considering jointly both spatial and temporal dimensions of substitution and to the *football demand literature* in particular by looking for the first time at possible substitution in demand caused by concurrent games played by local and non-local first and second division clubs in both domestic leagues and international club competitions.

Data and empirical strategy

Sample selection and measures

Our study is focused on fourth division football in Germany. Considering market values of clubs, i.e., aggregated market valuations of players in a club, we look at leagues beyond the professional three divisions which consist of clubs with semi-/non-professional structures. For instance, as shown in Figure 1, the mean market value of a first (second) [third] division club in the season 2015/2016 translates to €140.00 million (€19.09 million) [€6.87 million] while it translates to just €3.46 million in the fourth division.[3] In contrast to the upper divisions, however, the range in market values between fourth division clubs is much larger with the maximum in season 2014/2015 in conference West measuring a ratio of 1:1,184 while the comparable maximum ratios in the first (second) [third] divisions “just” measure 1:25 (1:3) [1:8]. This indicates the considerable discrepancy between the clubs’ financial structures. Consequently, some clubs predominantly hire professional players with high market values while others mainly operate with amateur players being less valuable. In this regard, the fourth division is the highest division exhibiting rather semi-/non-professionalism than professionalism, which is highly relevant when considering ongoing political debates in German football.

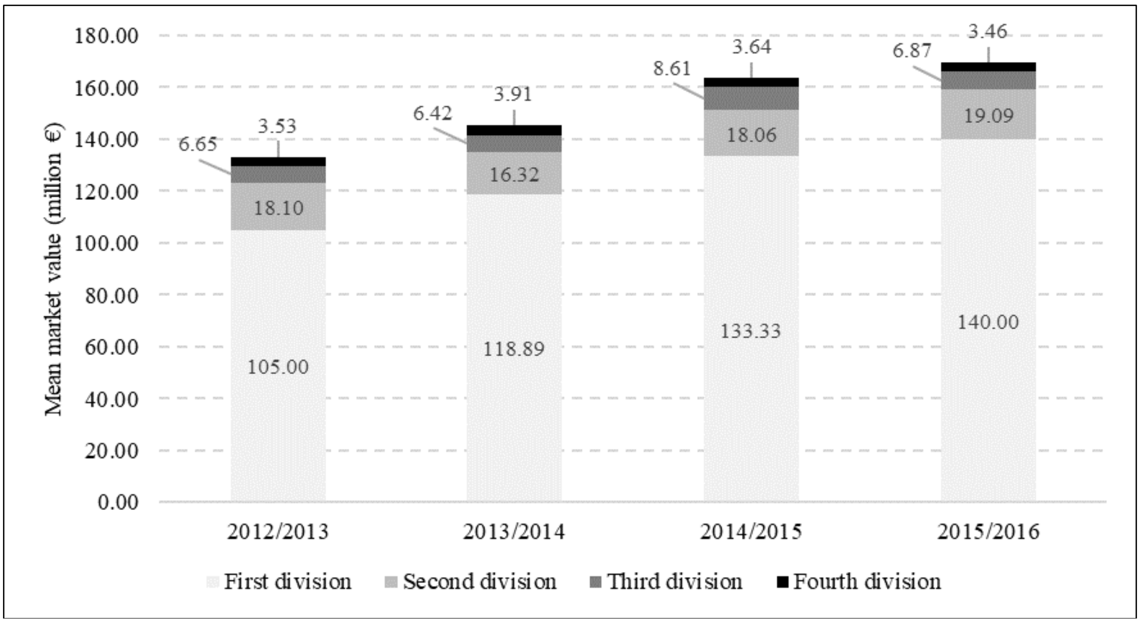

Figure 1. Mean market values per season.

Source: Data are collected from transfermarkt.de.

Prior to the last structural reform in 2012, the fourth division was organized by the German National Football Federation (DFB), and consisted of three conferences, grouped according to the geographical location of the clubs (North, West, and South). Since 2012, the organization of the fourth division is up to the five German regional football federations and, consequently, the fourth division is nowadays subdivided into five conferences (North, Northeast, West, Southwest, and Bavaria). These structural reforms prior to the 2012/2013 season restricted our data collection to four seasons (2012/2013 to 2015/2016) and a total of 5,952 games available for our analysis (overall, 262 observations were deleted due to missing information on attendance figures, precipitation or betting odds).

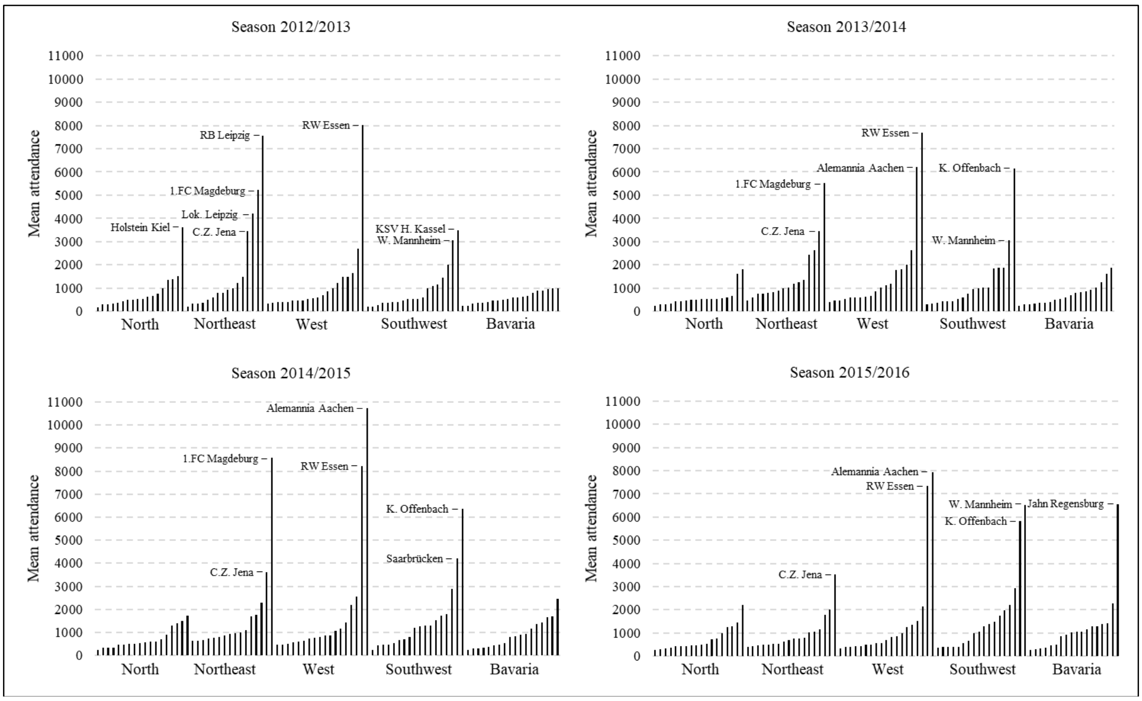

Figure 2. Mean attendance of fourth division clubs per season (denoted clubs display an average attendance of more than 3,000 spectators).

Our model attempts to explain stadium attendance of fourth division games. As can be seen in Figure 2, two-third of the clubs have an average attendance of less than one thousand spectators per game. However, as further indicated in Figure 2, the distribution of average attendance is highly skewed to the right with very few clubs exhibiting average attendance figures beyond three thousand spectators per game. This means, for instance, that history-rich clubs like *Alemannia Aachen* (mean attendance of 7,950 in the season 2015/2016) competed with clubs such as *FC Wegberg-Beeck* (mean attendance of 400 in the season 2015/2016) in the same conference (West). In consequence of this skewed distribution of attendance, the natural logarithm of attendance is used as the dependent variable. Note that fourth division games do not sell out, hence the results do not face issues of demand above stadium capacity.

Overall, four different measures are developed to test for possible (i) *substitution* in demand. To capture the impact of local substitutes with regard to spatial and temporal *dimensions*, two dummy variables are implemented. The first variable measures whether or not at least one top division game takes place within a radius of 50 kilometres (31 miles) around the stadium of a fourth division game played on the same day (*Local*).[4] Overall, 578 “nearby games” where played during the period under consideration with 38 games showing more than one top division game played on the same day and taking place within the same radius of a fourth division club. Table 1 provides an overview on the number of nearby games played on the same day per weekday.

Table 1. Summary of games played nearby on the same day per weekday (2012/13-2015/16).

Weekday	First division	Second division	First & second division
Monday	0	0	0
Tuesday	5	10	15
Wednesday	1	2	3
Thursday	0	0	0
Friday	17	48	65
Saturday	270	127	397
Sunday	29	69	98
Total	322	256	578

The second variable measuring local substitution depicts games on the same day played by teams of the same club. While this sounds strange at first sight, it considers a peculiar situation in European professional football, that is, professional football clubs are allowed to have a reserve team usually made up by players younger than 23 years (U23) playing in the third division or below. Since we expect a specific case of substitution between different teams of the same club, a second variable (*Reserve*) is used. Moreover, we examine possible substitution effects with regard to *temporal overlaps* only, that is, between fourth division games as well as first division games broadcasted live on television. This type of substitution is captured by two variables and includes fourth division games that were played up to 105 minutes before or after the kick-off time of first division games since regular football games are composed of two halves with 45 minutes each and a halftime break of 15 minutes. The first variable measures concurrently broadcasted first division games in the domestic league (TV_{BL}), and (in line with Forrest et al., 2004, Forrest & Simmons, 2006, and Buraimo et al., 2009) the second variable measures concurrently broadcasted UEFA Champions League games involving German clubs (TV_{CL}). The former measure is restricted to concurrent domestic first division games broadcasted live on Saturday afternoon at 3.30pm which is the traditional kick-off time for first division games with five games being played at the same time. The main reason for focusing on this particular kick-off time slot is the corresponding TV format, covering parallel broadcasts of all concurrent games with frequent switches between the different games (in particular right after important events such as goals scored), which is extremely popular amongst general football fans / neutral spectators. We also include an interaction term (*Local x* TV_{BL}) since certain games might be subject to both types of substitution. Table 2 shows the number of games per conference suffering from overlapping schedules.

Table 2. Number of games by type of substitution measure per conference (2012/13-2015/16).

Conference	Local	Reserve	TV_{BL}	TV_{CL}
North	34	41	228	12
Northeast	41	17	9	6
West	281	29	591	42
Southwest	121	15	516	22
Bavaria	63	22	448	26
Total	540	124	1,792	108

Next to these measures of substitution, we control for factors that were previously found to influence attendance demand. These measures are classified into the following categories: (ii) *time variables*, (iii) *contest variables*, (iv) *costs of attendance variables*, and (v) *habit variables*. With regard to category (ii) *time variables,* dummy measures for every single weekday are included, since fourth division club games take place on every day of the week. In addition, we control for the match day of the season and its squared term (*Matchday*, $Matchday^2$), expecting more attendance at the beginning and at the end of the season with less attendance during the winter season (Pawlowski & Anders, 2012).[5] Concerning (iii) *contest variables*, following Forrest and Simmons (2002), we control for the number of points achieved by both teams in their previous five games ($Performance_H$, $Performance_A$) to depict the actual sporting performance of the teams. An increasing number of points is expected to result in higher ticket demand. In addition, we control for game uncertainty by using home win probabilities (*Homewin*) and their squared term ($Homewin^2$) calculated by margin adjusted betting odds.[6] Moreover, we assume that reserve teams of upper division teams attract less away fans since the majority of these fans might rather support the top-tier team on the road ($Team2_A$). To control for (iv) *costs of attendance*, the travel costs of away fans are approximated by the kilometre distance between the home and away teams' stadium (*Distance*). Demand is expected to decline with increasing distance between the two cities, though this is assumed to occur in a non-linear manner, supporting the inclusion of the squared term ($Distance^2$) (Baimbridge et al., 1996). Taking opportunity costs into account, rain or snow during the day of the game (*Precipitation*) are assumed to keep fans from attending (Gärtner & Pommerehne, 1978)[7]. Finally, (v) *habit variables* control for any habit persistence effects by fans (Borland & Lye, 1992; Peel & Thomas, 1992). In this regard, the natural logarithm of the home and away teams' average attendance in the previous season is included in the model ($ln(Habit_H)$, $\ln(Habit_A)$). Subject to promotion and relegation, some home or away teams played in a different division in the season before. Therefore, in line with Forrest and Simmons (2006), we use dummy variables for promoted and relegated teams ($Prom_H$, $Prom_A$, $Releg_H$, and $Releg_A$) and included interaction terms with the habit variables. Expectations of these variables are ambiguous since coefficients might be positive (e.g. since fans of promoted teams might be euphoric and recently relegated teams might have more sporting quality), as well as negative (e.g. since recently promoted teams might have increased ticket prices and fans of relegated teams might be disappointed by the previous relegation). A summary description of all variables as well as descriptive statistics are provided in Table 3 and 4.

Table 3. Variable description.

Variables	Description	Type
Dependent variable		
ln(Att)	Natural logarithm of game attendance	Metric
Substitution variables		
Local	First or second division game within a radius of 50 km on the same day	Dummy
Reserve	Upper division team game on the same day as the reserve team game	Dummy
TV_{BL}	Concurrent first division games on Saturday at 3.30 pm	Dummy
TV_{CL}	Concurrent UEFA Champions League game with a German club at 8.45 pm	Dummy
Time variables		
Monday,…, Sunday	Game played on Monday,…, Sunday	Dummy
Matchday	Matchday under consideration	Metric
Contest variables		
$Performance_H$	Number of points scored by the home team in the previous five games	Metric
$Performance_A$	Number of points scored by the away team in the previous five games	Metric
Homewin	Probability of a home win (derived from betting odds)	Metric
$Team2_A$	Away team is reserve team of an upper division team	Dummy
Cost variables		
Distance	Distance between home and away teams' stadiums in kilometres	Metric
Precipitation	Rain or snow during the day of the game	Dummy
Habit variables		
$ln(Habit_H)$	Natural logarithm of home teams' average attendance in previous season	Metric
$ln(Habit_A)$	Natural logarithm of away teams' average attendance in previous season	Metric
$Prom_H$	Home team promoted in the season before from division 5	Dummy
$Prom_A$	Away team promoted in the season before from division 5	Dummy
$Releg_H$	Home team relegated in the season before from division 3	Dummy
$Releg_A$	Away team relegated in the season before from division 3	Dummy

Estimation

Promotion and relegation of clubs as well as differences in numbers of match days played due to different numbers of participating clubs, that is, between 16 and 19 clubs per conference and season, yield some variation in the structure of the data. Therefore, the data is organized as an unbalanced panel with home teams as cross-sectional units (140 groups) and match days as time series units (148 match days). For choosing the appropriate estimation method, tests for heteroscedasticity, autocorrelation, and cross-sectional correlation were conducted first. Considering substantial variation of attendance demand between clubs in the data, the modified Wald test indicates presence of heteroscedasticity. Moreover, persistence of attendance within and across panels is typically shown to be an econometric problem in attendance related panel data. Likewise, the Wooldridge test for autocorrelation reveals first-order autocorrelation, and the Breusch-Pagan lagrange multiplier test indicates cross-sectional correlation. Finally, examining consistency of estimations from random and fixed effects estimators, robust

Table 4. Descriptive statistics.

Variables	Mean	SD	Min	Max
Dependent variable				
ln(Att)	6.545	0.976	2.996	10.319
Substitution variables				
Local	0.091	0.287	0	1
Reserve	0.021	0.143	0	1
TV_{BL}	0.301	0.459	0	1
TV_{CL}	0.018	0.133	0	1
Time variables				
Monday	0.014	0.119	0	1
Tuesday	0.061	0.240	0	1
Wednesday	0.058	0.233	0	1
Thursday	0.012	0.109	0	1
Friday	0.158	0.364	0	1
Sunday	0.242	0.428	0	1
Matchday	18.367	10.411	1	38
Contest variables				
$Performance_H$	6.215	3.626	0	15
$Performance_A$	6.331	3.606	0	15
Homewin	42.172	14.840	4.602	96.353
$Team2_A$	0.265	0.442	0	1
Cost variables				
Distance	139.510	84.432	0	482.105
Precipitation	0.479	0.500	0	1
Habit variables				
$\ln(Habit_H)$	6.571	0.863	4.663	9.338
$\ln(Habit_A)$	6.599	0.856	4.663	9.351
$Prom_H$	0.221	0.415	0	1
$Prom_A$	0.228	0.419	0	1
$Releg_H$	0.031	0.174	0	1
$Releg_A$	0.031	0.173	0	1

Hausman tests (Wooldridge, 2002; Hoechle, 2007) rejected the random effects model. Given these test statistics, fixed-effects regression models with Driscoll and Kraay standard errors (DKSE) (Driscoll & Kraay, 1998) are employed which are generally applicable to unbalanced panel data, and are heteroscedasticity consistent as well as robust to general forms of cross-sectional and temporal dependence (Hoechle, 2007). Estimations using DKSE require to assign the lag length *m(T)* up to which the residuals may be autocorrelated. *T* in this regard denotes time series units of the data, that is, 148 match days. Following Hoechle (2007), we chose the lag length by using Newey and West's (1994) plug-in procedure:

$$m(T) = floor[4\left(\frac{T}{100}\right)^{\frac{2}{9}}] \quad (1)$$

Accordingly, the maximum lag order of autocorrelation is set to four. We test the robustness of our results against different lag lengths. Since results do not vary, we decided to not add them to the manuscript (they are, however, available upon request).

Results

Overall, we estimated three different models. The first model "Local rivalry" is focused on both the spatial and temporal dimension of substitution by considering "nearby" played first and second division games on the same day. The second model "TV rivalry" is focused on the temporal dimension of substitution only, that is, concurrent domestic first division as well as UEFA Champions League games involving German clubs and broadcasted live. The third model "Local & TV rivalry" considers all types of substitution and includes an interaction term taking into account that 336 games simultaneously suffer from both types of substitution indicated by *Local* and TV_{BL}. Table 5 shows the estimates for the three fixed-effects regression models with DKSEs.

Results concerning our (i) substitution variables suggest that significant substitution effects exist when estimating separately rivalry from local games and rivalry from TV broadcasts. Moreover, considering all substitution variables together, estimates still reveal negative impacts at conventional levels of significance, highlighting that one substitution measure does not interfere the other. Therefore, we take the third model "Local & TV rivalry" as our main model and discuss the corresponding estimates in the following.

Based on these estimates, the average marginal effects can be calculated.[8] For instance, nearby games played on the same day result on average in a 10.5 percentage point's decrease in attendance in the corresponding fourth division game. Comparably, reserve teams suffer even more from their respective top-tier division teams playing (23.2 percentage points). Moreover, attendance of fourth division games decreases on average by 18.9 (14.1) percentage points in the presence of concurrent live broadcasts of first division domestic league (UEFA Champions League) games. Finally, as indicated by the positive sign of the interaction term ($Local \times TV_{BL}$), the groups of spectators substituting fourth division games by top division games – independently of whether these games take place in close proximity or whether they are just available as live broadcasts on TV – are significantly overlapping.

Table 5. Results of fixed effects regressions with Driscoll and Kraay standard errors.

Variables	Local rivalry	TV rivalry	Local & TV rivalry
Substitution variables			
Local	-0.068 (0.019***)		-0.100 (0.034***)
Reserve	-0.203 (0.058***)		-0.209 (0.055***)
TV_{BL}		-0.164 (0.021***)	-0.173 (0.022***)
TV_{CL}		-0.126 (0.060**)	-0.132 (0.060**)
Local x TV_{BL}			0.109 (0.049**)
Time variables			
Monday	0.227 (0.066***)	0.124 (0.066*)	0.115 (0.066*)
Tuesday	-0.018 (0.041)	-0.093 (0.047**)	-0.099 (0.046**)
Wednesday	-0.026 (0.032)	-0.095 (0.036***)	-0.105 (0.035***)
Thursday	0.057 (0.053)	-0.028 (0.056)	-0.042 (0.056)
Friday	0.068 (0.015***)	-0.027 (0.022)	-0.030 (0.022)
Saturday	*reference category*		
Saturday, no BL		*reference category*	*reference category*
Sunday	0.054 (0.023**)	-0.033 (0.029)	-0.032 (0.028)
Matchday	-0.045 (0.005***)	-0.040 (0.005***)	-0.040 (0.005***)
Matchday² (×1000)	0.858 (0.110***)	0.744 (0.107***)	0.735 (0.106***)
Contest variables			
$Performance_H$	0.026 (0.002***)	0.026 (0.002***)	0.026 (0.002***)
$Performance_A$	0.009 (0.002***)	0.009 (0.002***)	0.009 (0.002***)
Homewin	-0.017 (0.002***)	-0.017 (0.002***)	-0.017 (0.002***)
Homewin² (×1000)	0.181 (0.024***)	0.181 (0.024***)	0.181 (0.025***)
$Team2_A$	0.233 (0.017***)	0.227 (0.016***)	0.228 (0.016***)
Cost variables			
Distance	-0.0049 (0.0003***)	-0.0048 (0.0003***)	-0.0048 (0.0003***)
Distance² (×1000)	0.0095 (0.0009***)	0.0093 (0.0009***)	0.0094 (0.0009***)
Precipitation	-0.055 (0.011***)	-0.055 (0.011***)	-0.056 (0.011***)
Habit variables			
$\ln(Habit_H)$	0.035 (0.044)	0.029 (0.044)	0.034 (0.043)
$\ln(Habit_A)$	0.337 (0.013***)	0.335 (0.013***)	0.334 (0.013***)
$Prom_H$	0.211 (0.187)	0.223 (0.187)	0.240 (0.185)
$Prom_A$	0.526 (0.130***)	0.553 (0.128***)	0.547 (0.129***)
$Releg_H$	-0.088 (0.202)	-0.115 (0.191)	-0.115 (0.192)
$Releg_A$	1.516 (0.415***)	1.518 (0.409***)	1.516 (0.406***)
$\ln(Habit_H)$ x $Prom_H$	-0.012 (0.028)	-0.014 (0.028)	-0.016 (0.028)
$\ln(Habit_A)$ x $Prom_A$	-0.068 (0.019***)	-0.073 (0.018***)	-0.072 (0.019***)
$\ln(Habit_H)$ x $Releg_H$	0.019 (0.025)	0.022 (0.024)	0.022 (0.024)
$\ln(Habit_A)$ x $Releg_A$	-0.182 (0.052***)	-0.181 (0.051***)	-0.181 (0.051***)
Constant	4.983 (0.311***)	5.074 (0.308***)	5.063 (0.307***)
Team Fixed Effects	*included*	*included*	*included*
Within R²	0.38	0.39	0.39
N	5,952	5,952	5,952

Note. The natural logarithm of attendance serves as dependent variable. Driscoll and Kraay standard errors are displayed in parentheses. The maximum lag order of autocorrelation is chosen by using Newey and West's (1994) plug-in procedure, and is set to four. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1.

These results are accompanied by predominantly expected effects of the control variables. For instance, the (ii) time variables reveal an increase of ticket demand for games played on Mondays, Fridays, and Sundays and a decrease for games played on Tuesdays and Wednesdays (all in comparison to games played on Saturdays). Moreover, we detect a U-shaped relationship between the number of match day (*Matchday, Matchday²*) and attendance with its minimum at around match day 27 (which takes usually place in spring around March or April). As expected, the (iii) contest variables reveal that actual sporting performances of the home and away team ($Performance_H$, $Performance_A$) have a significant positive impact on ticket demand in the fourth division. In contrast to theoretical expectations of game uncertainty but in line with several previous empirical studies (e.g. Coates, Humphreys, & Zhou, 2014 or Pawlowski, Nalbantis, & Coates, 2017), we find that attendance is declining with increasing levels of game uncertainty (*Homewin, Homewin²*).[9] Furthermore, and in contrast to some recent critical discussions about the perceived '(un)attractiveness' of reserve teams in lower divisions, games involving reserve teams on the road are associated with significant higher attendance figures ($Team2_A$). In addition, the (iv) cost variables show a significant U-shaped relationship of the distance between the stadiums of two opponents and attendance demand (*Distance, Distance²*). The minimum is obtained at around 257 km. Moreover, as expected, rain or snow during the match day (*Precipitation*) decreases stadium attendance. Completing control variables, (v) habit variables indicate habit persistence effects for away teams only ($ln(Habit_A)$). Moreover, there is a significant positive effect of previously promoted and relegated away teams ($Prom_A$, $Releg_A$) on attendance while the interaction terms ($ln(Habit_A) \times Prom_A$, $ln(Habit_A) \times Releg_A$) suggest a significant different habit persistence effect when those teams are involved in the game.

Due to the highly skewed distribution of attendance figures in fourth division football in Germany (see Figure 2), we tested the robustness of our results by excluding games that involve clubs with an average attendance demand of more than three thousand spectators per game. Results, however, do not vary (see Table A1 in the Appendix). Moreover, we re-estimated our models for subsamples of each of the five conferences separately (including clubs with an average attendance of more than three thousand spectators). Concerning our main findings, all but one substitution variable still display a negative sign though the level of significance has somewhat reduced given the low numbers of treated observations (see Table A2 in the Appendix). Finally, we tested the robustness of our results for local substitution against different radii of kilometres. We find negative impacts and increasing coefficients with growing radii with the maximum at 50 kilometres (see Table A3 in the Appendix).

Conclusion

Recent changes in German football intensified the discussion on consumer demand and the threat of substituting fan interests. In particular, concurrent games by top division clubs might cause reduced gate attendance in lower divisions. Since previous findings already suggest that substitution in demand by concurrently played European club competitions might indeed exist, we explicitly extend recent literature by analysing the impact of top-tier domestic league games on attendance at lower division games. Moreover, this paper adds to the general literature on substitution in sports by jointly looking at and systematically analysing the different dimensions of substitution, that is, spatial and/or temporal overlaps of games taking place.

By using game level panel attendance data of around 6,000 games played in Germany's fourth division between 2012 and 2016, overall, we find that substitution in demand from scheduling overlaps with first and second division games indeed exist. In particular, nearby games played on the same day result on average in a 10.5 percentage point's decrease in attendance in the corresponding fourth division game. Comparably, reserve teams suffer even more from their respective top-tier division teams playing (23.2 percentage points). Moreover, attendance of fourth division games decreases by 18.9 (14.1) percentage points (on average) in the presence of concurrent live broadcasts of first division domestic league (UEFA Champions League) games.

Based on these estimates, we are able to approximate the potential size of revenue losses caused by spatial and temporal overlaps. Given the mean attendance (i.e., 768 spectators per game, excluding games of outliers) and a rough estimate of average ticket prices (i.e., €11)[10] in the fourth division, the average loss in ticket revenues caused by nearby games is about €887 while concurrent broadcasted domestic league (UEFA Champions League) games translate into a revenues loss of about €1,597 (€1,191) per game. Considering *FC Oberneuland* (*Alemannia Aachen*) showing the minimum (maximum) mean attendance of all non-reserve teams with 293 (8,251) spectators per game, the range of revenue losses caused by nearby games is between €338 and €9,530 per game, while the range of revenue losses for concurrent broadcasted domestic league (UEFA Champions League) games is between €609 and €17,154 (€454 and €12,797).[11]

Given the range of these estimates on revenue losses, it appears reasonable to consider direct compensation payments from upper to lower division clubs, rather than reducing the number of concurrent games (which would again harm internationalization efforts), as an appropriate measure to foster lower division clubs. However, we would like to stress, that these figures are rather rough estimates of the potential size of revenue losses caused by spatial and temporal overlaps. Some spectators might deliberately shift their attendance to those lower division games not overlapping with upper division games, impacting lower division individual game attendance without impacting their average attendance and hence club revenues. Contrary, substituting upper for lower division games reduces (average) attendance and team revenues. As we cannot distinguish between those effects there is reason to assume an *upward bias* of our estimates. On the other hand, our estimates can only take into account revenue decrease due to lower attendance and ticket sales, neglecting the negative consequences for revenues from sponsoring, beverage, merchandise, and parking during the game (Coates & Humphreys, 2007), resulting in a *downward bias* of our results.

Appendix

Table A1. Results of fixed effects regressions with Driscoll and Kraay standard errors excluding games involving clubs with an average attendance of more than 3,000.

Variables	Local rivalry	TV rivalry	Local & TV rivalry
Substitution variables			
Local	-0.090 (0.022***)		-0.126 (0.035***)
Reserve	-0.199 (0.063***)		-0.204 (0.061***)
TV_{BL}		-0.171 (0.026***)	-0.176 (0.027***)
TV_{CL}		-0.152 (0.072**)	-0.159 (0.072**)
Local x TV_{BL}			0.114 (0.047**)
Time variables			
Monday	0.313 (0.072***)	0.208 (0.075***)	0.198 (0.075***)
Tuesday	-0.036 (0.050)	-0.107 (0.056*)	-0.112 (0.056**)
Wednesday	0.002 (0.035)	-0.070 (0.041*)	-0.080 (0.040**)
Thursday	0.057 (0.057)	-0.028 (0.061)	-0.045 (0.060)
Friday	0.060 (0.018***)	-0.039 (0.026)	-0.041 (0.026)
Saturday	*reference category*		
Saturday, no BL		*reference category*	*reference category*
Sunday	0.059 (0.026**)	-0.034 (0.035)	-0.032 (0.035)
Matchday	-0.045 (0.005***)	-0.039 (0.005***)	-0.039 (0.005***)
$Matchday^2$ (×1000)	0.838 (0.114***)	0.714 (0.113***)	0.707 (0.111***)
Contest variables			
$Performance_H$	0.025 (0.002***)	0.025 (0.002***)	0.026 (0.002***)
$Performance_A$	0.008 (0.002***)	0.008 (0.002***)	0.008 (0.002***)
Homewin	-0.015 (0.002***)	-0.015 (0.002***)	-0.015 (0.002***)
$Homewin^2$ (×1000)	0.162 (0.026***)	0.162 (0.026***)	0.163 (0.026***)
$Team2_A$	0.216 (0.017***)	0.211 (0.017***)	0.212 (0.017***)
Cost variables			
Distance	-0.0049 (0.0003***)	-0.0048 (0.0003***)	-0.0049 (0.0003***)
$Distance^2$ (×1000)	0.0096 (0.0009***)	0.0094 (0.0009***)	0.0094 (0.0009***)
Precipitation	-0.056 (0.011***)	-0.056 (0.011***)	-0.056 (0.012***)
Habit variables			
$\ln(Habit_H)$	0.059 (0.046)	0.055 (0.046)	0.059 (0.046)
$\ln(Habit_A)$	0.284 (0.016***)	0.282 (0.016***)	0.281 (0.016***)
$Prom_H$	0.212 (0.206)	0.216 (0.202)	0.231 (0.199)
$Prom_A$	0.206 (0.150)	0.233 (0.149)	0.218 (0.150)
$Releg_H$	-2.513 (1.711)	-2.263 (1.699)	-2.425 (1.686)
$Releg_A$	-3.009 (1.477**)	-2.747 (1.457*)	-2.725 (1.448*)
$\ln(Habit_H)$ x $Prom_H$	-0.013 (0.031)	-0.013 (0.030)	-0.015 (0.030)
$\ln(Habit_A)$ x $Prom_A$	-0.019 (0.022)	-0.023 (0.022)	-0.021 (0.022)
$\ln(Habit_H)$ x $Releg_H$	0.326 (0.213)	0.293 (0.212)	0.314 (0.210)
$\ln(Habit_A)$ x $Releg_A$	0.378 (0.190**)	0.346 (0.187*)	0.343 (0.186*)
Constant	4.994 (0.313***)	5.076 (0.312***)	5.068 (0.309***)
Team Fixed Effects	*included*	*included*	*included*
Within R^2	0.31	0.32	0.32
N	5,130	5,130	5,130

Note. The natural logarithm of attendance serves as dependent variable. Driscoll and Kraay standard errors are displayed in parentheses. The maximum lag order of autocorrelation is chosen by using Newey and West's (1994) plug-in procedure, and is set to four. Significance levels: ***$p \leq 0.01$, **$p \leq 0.05$, *$p \leq 0.1$.

Table A2. Results of fixed effects regressions by conference with Driscoll and Kraay standard errors.

Variables	North	Northeast	West	Southwest	Bavaria
Substitution variables					
Local	-0.113 (0.087)	-0.073 (0.073)	-0.071 (0.056)	-0.045 (0.076)	-0.134 (0.100)
Reserve	0.041 (0.092)	-0.313 (0.159*)	-0.421 (0.104***)	-0.420 (0.161***)	-0.210 (0.141)
TV_{BL}	-0.359 (0.062***)	0.246 (0.080***)	-0.239 (0.043***)	-0.187 (0.042***)	-0.114 (0.050**)
TV_{CL}	-0.195 (0.089**)	0.121 (0.229)	-0.074 (0.072)	-0.220 (0.134)	-0.122 (0.141)
Local x TV_{BL}	-0.119 (0.137)	*omitted*	0.086 (0.071)	0.024 (0.095)	0.172 (0.109)
Time variables					
Monday	0.132 (0.127)	0.257 (0.076***)	-0.116 (0.071)	-0.082 (0.085)	0.542 (0.182***)
Tuesday	-0.099 (0.159)	0.026 (0.203)	-0.283 (0.055***)	-0.045 (0.066)	-0.016 (0.087)
Wednesday	-0.136 (0.095)	-0.105 (0.073)	-0.234 (0.077***)	-0.123 (0.053**)	0.011 (0.077)
Thursday	-0.089 (0.156)	0.018 (0.067)	-0.214 (0.082***)	0.360 (0.201*)	0.061 (0.134)
Friday	-0.119 (0.055**)	0.158 (0.046***)	-0.122 (0.041***)	-0.114 (0.045**)	-0.007 (0.046)
Saturday					
Saturday, no BL	*reference category*	*reference category*	*reference category*	*reference category*	*reference category*
Sunday	-0.159 (0.060***)	0.077 (0.039*)	-0.122 (0.047***)	-0.041 (0.048)	0.057 (0.069)
Matchday	-0.047 (0.008***)	-0.051 (0.010***)	-0.035 (0.006***)	-0.035 (0.006***)	-0.038 (0.008***)
$Matchday^2$ (×1000)	0.968 (0.203***)	1.128 (0.300***)	0.646 (0.140***)	0.587 (0.152***)	0.651 (0.184***)
Contest variables					
$Performance_H$	0.033 (0.005***)	0.036 (0.005***)	0.021 (0.004***)	0.024 (0.005***)	0.020 (0.005***)
$Performance_A$	0.011 (0.006*)	0.006 (0.004)	-0.003 (0.004)	0.019 (0.006***)	0.008 (0.005*)
Homewin	0.005 (0.006)	-0.020 (0.006***)	-0.014 (0.005***)	-0.003 (0.005)	-0.035 (0.004***)
$Homewin^2$ (×1000)	-0.015 (0.057)	0.174 (0.065***)	0.115 (0.049**)	0.083 (0.047*)	0.362 (0.043***)
$Team2_A$	0.271 (0.039***)	0.199 (0.043***)	0.079 (0.042*)	0.101 (0.042**)	0.388 (0.038***)

Variables	North	Northeast	West	Southwest	Bavaria
Cost variables					
Distance	-0.0057 (0.0006***)	-0.0036 (0.0005***)	-0.0079 (0.0011***)	-0.0047 (0.0004***)	-0.0057 (0.0006***)
Distance² (×1000)	0.0111 (0.0019***)	0.0067 (0.0012***)	0.0280 (0,0049***)	0.0085 (0.0011***)	0.0119 (0.0018***)
Precipitation	-0.076 (0.024***)	-0.038 (0.028)	-0.037 (0.027)	-0.069 (0.019***)	-0.063 (0.024***)
Habit variables					
ln($Habit_H$)	-0.178 (0.068***)	-0.176 (0.099*)	0.106 (0.082)	0.127 (0.062**)	0.293 (0.100***)
ln($Habit_A$)	0.246 (0.030***)	0.361 (0.024***)	0.358 (0.024***)	0.243 (0.027***)	0.417 (0.030***)
$Prom_H$	-0.154 (0.531)	-0.555 (0.430)	1.333 (0.628**)	1.453 (0.594**)	-0.024 (0.417)
$Prom_A$	0.521 (0.315)	0.280 (0.375)	0.551 (0.290*)	0.796 (0.313**)	1.029 (0.320***)
$Releg_H$	*omitted*	-0.752 (0.231***)	3.235 (0.765***)	-2.141 (1.275*)	*omitted*
$Releg_A$	*omitted*	2.718 (0.313***)	-0.784 (0.816)	-2.934 (0.940***)	-1.386 (1.990)
ln($Habit_H$) x $Prom_H$	0.040 (0.080)	0.080 (0.066)	-0.161 (0.088*)	-0.183 (0.092**)	0.044 (0.062)
ln($Habit_A$) x $Prom_A$	-0.076 (0.050)	-0.011 (0.060)	-0.068 (0.043)	-0.121 (0.048**)	-0.150 (0.053***)
ln($Habit_H$) x $Releg_H$	*omitted*	0.127 (0.035***)	-0.383 (0.090***)	0.277 (0.153*)	-0.028 (0.026)
ln($Habit_A$) x $Releg_A$	*omitted*	-0.324 (0.048***)	0.077 (0.093)	0.390 (0.120***)	0.151 (0.254)
Constant	6.490 (0.451***)	6.393 (0.705***)	4.590 (0.571***)	4.762 (0.540***)	3.166 (0.692***)
Team Fixed Effects	*included*	*included*	*included*	*included*	*included*
Within R^2	0.39	0.46	0.48	0.43	0.48
N	1,077	1,016	1,350	1,219	1,290

Note. The natural logarithm of attendance serves as dependent variable. Driscoll and Kraay standard errors are displayed in parentheses. The maximum lag order of autocorrelation is chosen by using Newey and West's (1994) plug-in procedure, and is set to four. Significance levels: ***$p \leq 0.01$, **$p \leq 0.05$, *$p \leq 0.1$.

Table A3. Results of fixed effects regressions with Driscoll and Kraay standard errors for different radii of kilometres for local substitution.

Variables	20 kilometres	30 kilometres	40 kilometres	60 kilometres	70 kilometres
Substitution variables					
$Local_{20}$	-0.059 (0.076)				
$Local_{30}$		-0.065 (0.054)			
$Local_{40}$			-0.072 (0.045)		
$Local_{60}$				-0.093 (0.032***)	
$Local_{70}$					-0.054 (0.028*)
Reserve	-0.209 (0.056***)	-0.209 (0.056***)	-0.209 (0.056***)	-0.209 (0.055***)	-0.209 (0.056***)
TV_{BL}	-0.166 (0.022***)	-0.169 (0.022***)	-0.169 (0.022***)	-0.170 (0.022***)	-0.172 (0.023***)
TV_{CL}	-0.128 (0.060**)	-0.129 (0.060**)	-0.129 (0.060**)	-0.132 (0.060**)	-0.130 (0.060**)
Local x TV_{BL}	0.046 (0.082)	0.075 (0.065)	0.075 (0.059)	0.085 (0.043*)	0.062 (0.039)
Time variables					
Monday	0.118 (0.066*)	0.117 (0.066*)	0.117 (0.066*)	0.115 (0.066*)	0.116 (0.066*)
Tuesday	-0.099 (0.046**)	-0.100 (0.046**)	-0.100 (0.046**)	-0.100 (0.046**)	-0.100 (0.046**)
Wednesday	-0.104 (0.035***)	-0.104 (0.035***)	-0.104 (0.035***)	-0.104 (0.035***)	-0.105 (0.035***)
Thursday	-0.039 (0.056)	-0.040 (0.056)	-0.040 (0.056)	-0.043 (0.056)	-0.040 (0.056)
Friday	-0.033 (0.022)	-0.033 (0.022)	-0.032 (0.022)	-0.029 (0.022)	-0.030 (0.022)
Saturday					
Saturday, no BL	*reference category*	*reference category*	*reference category*	*reference category*	*reference category*
Sunday	-0.036 (0.029)	-0.035 (0.029)	-0.035 (0.029)	-0.032 (0.028)	-0.033 (0.028)
Matchday	-0.040 (0.005***)	-0.040 (0.005***)	-0.040 (0.005***)	-0.040 (0.005***)	-0.040 (0.005***)
$Matchday^2$ (×1000)	0.742 (0.105***)	0.740 (0.105***)	0.739 (0.105***)	0.736 (0.105***)	0.737 (0.105***)

Variables	20 kilometres	30 kilometres	40 kilometres	60 kilometres	70 kilometres
Contest variables					
$Performance_H$	0.026 (0.002***)	0.026 (0.002***)	0.026 (0.002***)	0.026 (0.002***)	0.026 (0.002***)
$Performance_A$	0.009 (0.002***)	0.009 (0.002***)	0.009 (0.002***)	0.009 (0.002***)	0.009 (0.002***)
Homewin	-0.017 (0.002***)	-0.017 (0.002***)	-0.017 (0.002***)	-0.017 (0.002***)	-0.017 (0.002***)
$Homewin^2$ (×1000)	0.182 (0.024***)	0.182 (0.024***)	0.182 (0.024***)	0.181 (0.024***)	0.181 (0.024***)
$Team2_A$	0.227 (0.016***)	0.227 (0.016***)	0.227 (0.016***)	0.229 (0.016***)	0.227 (0.016***)
Cost variables					
Distance	-0.0048 (0.0003***)	-0.0048 (0.0003***)	-0.0048 (0.0003***)	-0.0048 (0.0003***)	-0.0048 (0.0003***)
$Distance^2$ (×1000)	0.0094 (0.0009***)	0.0094 (0.0009***)	0.0094 (0.0009***)	0.0094 (0.0009***)	0.0094 (0.0009***)
Precipitation	-0.055 (0.011***)	-0.055 (0.011***)	-0.055 (0.011***)	-0.056 (0.011***)	-0.056 (0.011***)
Habit variables					
$\ln(Habit_H)$	0.033 (0.044)	0.033 (0.043)	0.033 (0.043)	0.033 (0.043)	0.033 (0.043)
$\ln(Habit_A)$	0.334 (0.013***)	0.334 (0.013***)	0.334 (0.013***)	0.335 (0.013***)	0.334 (0.013***)
$Prom_H$	0.232 (0.187)	0.235 (0.187)	0.238 (0.187)	0.235 (0.185)	0.239 (0.186)
$Prom_A$	0.548 (0.127***)	0.548 (0.128***)	0.550 (0.128***)	0.549 (0.129***)	0.548 (0.128***)
$Releg_H$	-0.113 (0.191)	-0.114 (0.190)	-0.113 (0.191)	-0.116 (0.192)	-0.113 (0.192)
$Releg_A$	1.509 (0.407***)	1.512 (0.406***)	1.511 (0.406***)	1.511 (0.408***)	1.514 (0.407***)
$\ln(Habit_H)$ x $Prom_H$	-0.015 (0.028)	-0.015 (0.028)	-0.016 (0.028)	-0.015 (0.028)	-0.016 (0.028)
$\ln(Habit_A)$ x $Prom_A$	-0.072 (0.018***)	-0.072 (0.018***)	-0.073 (0.018***)	-0.072 (0.019***)	-0.072 (0.018***)
$\ln(Habit_H)$ x $Releg_H$	0.022 (0.024)	0.022 (0.024)	0.022 (0.024)	0.022 (0.024)	0.022 (0.024)
$\ln(Habit_A)$ x $Releg_A$	-0.180 (0.051***)	-0.181 (0.051***)	-0.181 (0.051***)	-0.181 (0.051***)	-0.181 (0.051***)
Constant	5.072 (0.309***)	5.068 (0.307***)	5.065 (0.307***)	5.062 (0.307***)	5.065 (0.308***)
Team Fixed Effects	*included*	*included*	*included*	*included*	*included*
Within R^2	0.39	0.39	0.39	0.39	0.39
N	5,952	5,952	5,952	5,952	5,952

Note. The natural logarithm of attendance serves as dependent variable. Driscoll and Kraay standard errors are displayed in parentheses. The maximum lag order of autocorrelation is chosen by using Newey and West's (1994) plug-in procedure, and is set to four. Significance levels: ***$p \leq 0.01$, **$p \leq 0.05$, *$p \leq 0.1$

Notes

1. In European professional football, rights for the first and second divisions are frequently commercialized jointly.
2. While decision-making of scheduling international fixtures relies on several interests of stakeholders, the decisional power on scheduling domestic league games rests solely with national league organizations.
3. Data on the clubs‘ market values is collected from transfermarkt.de. We use this source for player’s market valuation as information is available from the first to the fourth division and the data is shown to be a good proxy for undisclosed figures (Bryson, Frick, & Simmons, 2013).
4. Considering North American clubs being substitutes within radii of around 80 kilometres (Mills & Rosentraub, 2014), 160 kilometres and more (Gitter & Rhoads, 2010), we assume professional and semi-/non-professional clubs in Germany to be substitutes within a smaller radius due to higher densities of clubs and shorter travel distances.
5. Occasionally, match days in the German fourth division do not take place in chronological orders due to difficulties in fixture scheduling – we take account of these irregularities by adjusting match day changes in our analysis.
6. Data on betting odds is collected from BetExplorer.com.
7. The unavailability of historic data for fourth division clubs prevents us from controlling for ticket prices.
8. Percentage points were calculated with 100 (e^{β} - 1) (see Nalbantis, Pawlowski, & Coates, 2017).
9. We tested the THEIL measure (Theil, 1967) in a different specification instead of the home win probability. In line with Pawlowski and Anders (2012), we find a significant negative impact on attendance and, therefore, conformity with our results for Homewin and $Homewin^2$ (results are available upon request).

10. This is a very rough estimate based on available data from conference West in season 2017/18. The €11 are just the average of the prices for standing areas (€8) and normal seats (€14).
11. The unavailability of revenue data for forth division clubs prevents us from comparing the magnitude of these losses with annual revenues per club.

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5.2 Competition and fan substitution between professional sports leagues (Study 2)

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Abstract

A peculiarity in professional sports is the fact, that leagues regularly hold monopoly power *within their sports.* However, whether and to what extent these leagues may compete with other leagues *across sports*, is rather unexplored yet. This paper contributes to the literature by analyzing competition and fan substitution in Germany, where top-tier league managers in handball, basketball and ice hockey have recently claimed to suffer from football's dominant position. Our attendance demand models confirm the existence of significant substitution effects in this setting, suggesting that leagues indeed compete economically *across sports.*

Competition and fan substitution between professional sports leagues

Introduction

Competitor identification is an important task for any company with competitive threats arising from substitutability either on the supply or the demand side. Moreover, it is important for clearly defining markets which, in turn, is crucial for developing antitrust and regulatory policies in any industry (Bergen and Peteraf, 2002). Accordingly, the analysis of substitutability has already some tradition in empirical economic research (e.g. Stigler and Sherwin, 1985; Kalnins, 2003).

A peculiar case in this regard is professional sports. On the one hand, leagues regularly hold monopoly power *within their sports* (for a discussion see Vrooman, 2009). On the other hand, they may well compete for broadcasting revenues, sports ownership or fan interest with leagues in *other sports*. In fact, already in 1982, the Circuit Court of Appeals (670 F.2d 1249) found the National Football League (NFL) ban on cross-ownerships to be anticompetitive based on the assumption that it detains teams in other sports – in this case North American Soccer League (NASL) teams – from sports ownership capital.[1]

However, whether and to what extent leagues *indeed* compete across sports, is rather unexplored yet. The few existing studies that previously looked at competition and fan substitution across sports exclusively focus on the North American market where selection issues are present. Most notably, the franchise system enables leagues to limit or even avoid any competition across sports within the same region. Moreover, most of these studies only offer limited evidence given the rather rough substitution measures employed.

By using game-level attendance data for the top-tier leagues in handball, basketball and ice hockey, we analyze the impact of top-tier football games played concurrently in Germany. As such, we intend to contribute to the literature in two ways. *First*, we analyze competition and fan substitution in a European setting, where the implemented promotion-and-relegation system makes it impossible for leagues to take full control over the team-league-allocation in a given league. Moreover, professional football (soccer), is dominating *by far* all other sports (see Buzzacchi et al., 2010) constituting a practically highly relevant case to explore. In fact, this dominant position raises serious concerns among league officials and managers in other sports who have recently claimed to suffer from an intensified competition for fan interests, particularly in Germany.[2] *Second*, we depart from previously implemented substitution measures and explicitly test whether substitution can be observed even for games that are not played concurrently, that is, few days before or after.

Overall, our findings suggest that scheduling overlaps with nonlocal and local football games have a sizeable negative impact on the demand for games in other sports leagues. Moreover, we provide some evidence for the relevance of (mid-term) intertemporal time and budget constraints since substitution effects are also evident within a few days before or after football games take place.

The remainder of the paper is as follows: The following section provides the theoretical background and discusses the related literature. The third section presents some relevant background information on the organizational and financial structures of the professional sports leagues and outlines the empirical strategy employed. The fourth section presents the findings of this study. The fifth section concludes.

Conceptual framework and related literature

Considering substitution in general, Hotelling's (1929) seminal work was the first to mention the relevance of spatial proximity of firms competing in a duopolistic market. Since then, the literature on spatial competition and location choice emerged (e.g. Lerner and Singer, 1937; Chamberlin, 1953; Lösch, 1954). Rottenberg (1956) was the first to discuss the relevance of (spatial) competition and possibilities of fan substitution in professional sports.

Following Mongeon and Winfree (2013), it can be argued that in contrast to fans of a specific sport, generally sport interested people are likely to consume any available sport in the market. Thus, 'general sports fans' might seek to attend all the games they are interested in and would not necessarily substitute one game for another. However, certain constraints keep these fans from consuming all the games they are generally willing to attend.

For instance, temporally overlapping games are forcing the ‘general sports fan’ to choose between either attending a game of sports league *x* at a given venue or watching a game of sports league *y* on TV (or computer, tablet, phone or any other favorite connected device). If clubs from different sports leagues are located in proximity, such a fan might even consider to physically attend a game of sports league *y* instead. Moreover, individual time and budget constraints (Becker, 1965) are forcing ‘general sports fans’ to allocate their available time and money to alternative leisure activities *within a certain time frame*.

Given these constraints and the massive appeal of professional football in Europe, it appears plausible to assume that professional football games are perceived as substitutes at least for ‘general sports fans’ who prefer the comparably larger popularity of football and the star appeal of its players (Adler, 1985) over other (less popular) sports and athletes.

Recent literature on substitution in sports has predominantly focused on substitution effects in North American Major Leagues. Some of these studies analyzed substitution effects of clubs competing within the same league (e.g. Winfree et al., 2004; Mills and Rosentraub, 2014; Tainsky and Jasielec, 2014; Mills et al., 2016; Tainsky et al., 2016; Mondello et al., 2017), while others looked at substitution across different leagues and divisions of the same sport (e.g. Winfree and Fort, 2008; Rascher et al., 2009; Gitter and Rhoads, 2010).

The few existing studies analyzing fan substitution in Europe focused on the latter. In this regard, attendance demand for lower division games was found to be negatively affected by concurrent European club competition broadcasts (Forrest et al., 2004; Forrest and Simmons, 2006; Buraimo et al., 2009). In addition, Wallrafen et al. (2019) found significant substitution effects between top and lower division football games by considering both spatial proximity and temporal overlaps. Finally, Nielsen et al. (2019) looked at the impact of English Premier League (EPL) broadcasts on Danish first division football attendance and introduced an interaction between televised games and weather conditions. They found that the negative effect of adverse weather conditions on attendance demand is amplified when EPL games are broadcast concurrently.

So far, only few studies have focused on competition between different sports (leagues). For instance, examining baseball attendance and local competition to other North American Major Leagues, Baade and Tiehen (1990) found that having other competitors in the same geographic area has an adverse effect on attendance. In contrast, Kahane and Schmanske (1997) did not find any statistically significant relationship in the same setting. Paul (2003) reported decreased attendance for NHL (National Hockey League) clubs due to the existence of other professional clubs in the same metropolitan area. With regard to the NBA (National Basketball Association), Rascher et al. (2009) as well as Winfree (2009) revealed a positive impact on attendance demand in the league during the 2004-2005 NHL lockout, signifying the existence of substitution effects between the two Major Leagues. Finally, Mills et al. (2015) provided evidence for fan substitution across North American Sports leagues by analyzing whether passenger car border crossings between the US and Canada are affected by NFL (National Football League), MLB (Major League Baseball), NHL, NBA and CFL (Canadian Football League) games of teams located across the border.

Our contribution to the literature is twofold. *First*, we analyze the relevance of local and nonlocal competition between sports leagues in the European market.[3] This seems highly relevant since a single sport, that is, football, is dominating *by far* the domestic sports markets in most European countries. Moreover, the North American franchise system enables leagues to limit or even avoid any competition across sports within the same region, thus raising some selection issues. In Europe, however, the implemented promotion-and-relegation system makes it impossible for leagues to take full control over the team-league-allocation in a given league. *Second*, our study is the first to test whether substitution can be observed even for games that are not played concurrently, that is, few days before or after. By considering such intertemporal consumption plans of sports fans, we intent to stimulate the empirical design of future studies analyzing substitution effects in sports and other (entertainment) industries.

Setting and empirical design

Our setting is Germany, where the leagues of the most popular sports are ranked among the best in Europe (Football 4th, Handball 1st, Basketball 7th, Ice Hockey 5th).[4] At the same time, however, football has a particularly dominant position in the German market with the average attendance (season 2014/2015) of handball, basketball and ice hockey being just about 12 (30) percent of the average attendance for the first (second) division in football. Likewise, large differences occur also with regard to the revenues generated by these leagues. Moreover, since all leagues begin and end more or less at the same time of the year (amongst others to avoid scheduling clashes with international tournaments such as the Olympic Games) and all matchdays are frequently scheduled on Fridays, Saturdays and Sundays, there is a considerable number of overlapping games (see Table 1 for more details about the respective leagues).

Table 1. League characteristics.

Characteristic	HBL	BBL	DEL	2BL	1BL
League system	Open	Open	Closed [1)]	Open	Open
Number of teams	18	18	14	18	18
Regular season modus	2x round robin	2x round robin	4x round robin	2x round robin	2x round robin
Playoffs	No	Yes	Yes	No	No
Points for win / draw / loss	2 / 1 / 0	2 / - / 0	3(2) / - / 0(1) [2)]	3 / 1 / 0	3 / 1 / 0
Season start	23/08/2014	02/10/2014	12/09/2014	01/08/2014	22/08/2014
Season end	05/06/2015	21/06/2015	26/04/2015	24/05/2015	23/05/2015
Average attendance	4,591	4,655	6,528	17,613	42,685
Total revenues in million EUR	96.1	97.8	107.4	463.1	2,391.8
Total expenditures in million EUR	89.8	94.1	Not specified	458.2	2,198.0

Notes: An open (closed) league system means (no) sporting promotion and relegation of clubs. [1)] DEL will implement an open league system from season 2020/2021 onwards. [2)] In the DEL, teams receive three points for a win or zero points for a loss within the normal playing time as well as two points for a win or one point for a loss when there is overtime and/or penalty shootout. Season scheduling, average attendance and revenues/expenditures as of season 2014/2015. Total league revenues/expenditures data were retrieved from DFL (2018) and Deloitte (2015). Figures exclude transfer revenues/expenditures. *Abbreviations*: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga; 1BL = First German Football Bundesliga; 2BL = Second German Football Bundesliga.

Sampling

We use game-level attendance data for the HBL, BBL and DEL over five seasons (2012/2013 to 2016/2017), with a gross sample of 1,566, 1,670 and 2,036 observations respectively. This reduces to a net sample of 1,506 HBL, 1,561 BBL and 2,001 DEL games due to the following reasons:

First, all leagues under consideration operate with a club licensing system. If clubs fulfil a set of requirements including sportive, legal and financial criteria, they are eligible to participate in the concerning competitions. During the period under consideration, four licenses were withdrawn as the clubs failed to meet either of these criteria. Two of these withdrawals occurred during the regular season leading to missing values for 34 games of *HSV Hamburg* (HBL, season 2015/2016) and 23 missing values for *Phoenix Hagen* (BBL, season 2016/2017).

Second, due to promotion and relegation, some football games potentially being in competition to HBL, BBL and DEL games were played by clubs participating in the third division (or even below) during any of the seasons in our observation window. Given that fourth division clubs (i) are regularly semi-professional only, (ii) their games are less popular in terms of demand, and (iii) severely affected by substitution to top-tier football themselves (see Wallrafen et al., 2019), the inclusion of football games played at that level causes severe endogeneity concerns. Therefore, we decide to remove these cases from our sample. Overall, 17 handball games (*ThSV Eisenach* in season 2013/14), 51 basketball games (*Mitteldeutscher B.C.* in season 2012/13; *Würzburg* in season 2012/13 and 2013/14) and 29 ice hockey games (*Straubing Tigers* in season 2015/16) are removed. In contrast, however, since empirical evidence suggests that third division clubs are only marginally affected by substitution to top-tier football (see Wallrafen et al., 2020), we decide to keep HBL, BBL and DEL games being in competition to games featuring teams which were (recently) relegated to the third division. Finally, we remove some observations (9 for the HBL, 35 for the BBL and 6 for the DEL) due to missing information on attendance figures, weather conditions and betting odds.

Empirical model

Our main hypothesis is that football games played concurrently or in temporal proximity have a negative effect on the demand in other leagues. In order to test this hypothesis, we regress the natural logarithm of attendance at the game of home team *i* against visiting team *j* in season *s* on variables capturing this potential substitution effects (S_{ijs}) as well as a vector of variables controlling for game characteristics, scheduling information and opportunity costs (C_{ijs}).[5] In order to control for unobservable heterogeneity between the markets of each team as well as time trends and season-specific unobserved effects, we include fixed effects identifying the home team (α_i), the away team (α_j) and the season (α_s). e_{ijs} is the error term capturing any unobservable factors affecting attendance leading to the following specification:

$$\ln(ATT)_{ijs} = \beta_1 S_{ijs} + \beta_2 C_{ijs} + \alpha_i + \alpha_j + \alpha_s + e_{ijs} \quad (1)$$

In order to measure substitution, we utilize two different variables (S_{ijs}). Following Forrest and Simmons (2006), we employ a dummy variable measuring concurrent televised UEFA Champions League games (*UCL*) featuring German clubs played on Tuesday and Wednesday – measuring '1' for games that were played up to two hours before or after the kick-off time of UEFA Champions League games.[6] Since local fans typically support local (football) teams (for a discussion see Giulianotti, 2002), the second variable measures the absolute number of days between each home game (of HBL, BBL and DEL clubs) and the temporally closest home game of the nearest 1BL or 2BL club (*Local*), thus every HBL, BBL and DEL team has a fixed football competitor in our setting (see Table A1). This way we are able to consider intertemporal consumption plans of sports consumers. We hypothesize that the more days are in between both games, the less likely it is that the time or budget constraints of the sports consumers are binding. Therefore, comparably larger substitution effects are expected for games with comparably closer temporal proximity.[7]

Table 2 provides an overview of the characteristics of respective football clubs (potentially) being in competition to HBL, BBL and DEL clubs. It becomes apparent that the sporting performance (average league ranking) and popularity (number of club members) of the potential substitutes is on average higher for BBL and DEL clubs than for HBL clubs. Moreover, compared to the BBL and DEL, the average distance to the nearest football club is larger in the HBL.

The vector of control variables (C_{ijs}) covers relevant predictors of attendance demand in line with previous empirical studies. Following Forrest and Simmons (2002), we use the points scored by the home ($Perf_H$) and away ($Perf_A$) team in the previous five games as a proxy for current performance. It is expected that better performance exerts a positive effect on demand. Furthermore, using betting odds data, we estimate the home win probability (*Hwin*) and its squared term ($Hwin^2$) to test the UOH (see Rottenberg, 1956, and Neale, 1964). Due to the bookmaker's margin, the sum of probabilities (i.e., 1/decimal odd) of all outcomes (i.e., home/away win and draw) is greater than one. As common in the literature, we adjust each probability by dividing it by the sum of all probabilities in a given game. Overall, the UOH postulates an inverse U-shaped relationship, that is, attendance is maximized in games where the contestants have rather equal chances of winning.[8]

Table 2. Characteristics of football clubs functioning as substitutes.

Football division	HBL			BBL			DEL		
	Average Ranking	Average Members	Average Distance in km	Average Ranking	Average Members	Average Distance in km	Average Ranking	Average Members	Average Distance in km
First division	10.6	67,123	55	10.0	86,603	38	8.8	82,609	16
Second division	9.2	15,417	38	7.0	19,545	49	9.0	22,846	16
Third division	6.5	8,404	63	5.9	4,314	49	11.2	2,700	52
Overall	9.9	47,558	51	8.6	56,689	43	9.0	58,099	17

Notes: The *Ranking* denotes the average of rankings at the end of each season of every substitute in our dataset. *Members* as of August 2019 and denote the average of club's members in our dataset. *Distance in km* denotes the average distance in kilometers between the venues of HBL, BBL and DEL clubs to the venues of their nearest football club competitor for each observation in our dataset. Data on *Ranking* and *Members* were retrieved from *www.transfermarkt.de*. The *Distance* is based on own calculations (see Table A1 in the Appendix). *Abbreviations*: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga.

Moreover, a set of dummy variables is used to control for the day of the week and public holidays (*Hday*). Based on previous findings it is expected that weekend games (Knowles et al., 1992) and games staged on public holidays (Schofield, 1983) attract larger audiences. Furthermore, we control for the number of matchdays played and its squared term (*Mday*, $Mday^2$). In line with previous studies on outdoor sports (e.g. Pawlowski and Anders, 2012; Pawlowski and Nalbantis, 2015), we expect to find higher demand at the beginning and the end of the season when all decisive games take place.[9]

In order to capture travel costs of away fans, we include the distance between the venues of both opponents (*Dist*) and its squared term ($Dist^2$) in our models.[10] In line with previous studies (e.g. Baimbridge et al., 1996), we expect a U-shaped relationship between distance and attendance. Short distances may capture traditional rivalries which typically attract more fans, while traveling longer distances is not uncommon for committed fans in Europe. Moreover, we include a variable measuring whether precipitation fell during the matchday (*Prec*). Following Nielsen et al. (2019), we expect an inverse

U-shaped relationship with regard to the average temperature (*Temp*)[11] on the day of the game (and its squared term *Temp²*) and attendance demand. Since the attractiveness of concurrent broadcasts may depend on weather conditions, we also include interaction terms between *UCL*, *Temp* and *Temp²*.[12] Our intuition is that precipitation and low temperatures may negatively affect attendance due to travel (in)conveniences. At the same time, however, relatively high temperatures usually come along with an increase in outdoor leisure activity options (Siegfried & Eisenberg, 1980), thus, also reducing attendance demand. Overall, since weather forecasts are regularly more reliable for temperature rather than precipitation, it appears plausible to assume that the decision to purchase a ticket may rely rather on temperature than precipitation.

Finally, we include a dummy variable measuring relocation since 25 HBL games, 36 BBL games and three DEL games were not played at the 'usual' home grounds but in nearby venues with larger capacities. All variable descriptions and descriptive statistics are provided in Tables 3 and 4.

We estimate equation (1) with a regression. Common issues when dealing with attendance data are sellouts and the fact that venue capacities may be reduced due to safety reasons and crowd segregation (Forrest et al., 2004). To approach these issues, we employ league specific Tobit models with individual cut-off points (Tobin, 1958; Amemiya, 1973). For our analysis we report models utilizing a capacity (right-censoring) limit of 99%.[13] Finally, we employ the Huber-White sandwich estimator with heteroscedasticity correction (see Huber, 1967; White, 1980).

Results and discussion

Table 5 presents the results of the Tobit estimations.[14] All estimates are discussed with regard to their effect on the latent attendance variable (see McDonald and Moffitt, 1980). Nonlinear relationships as well as interaction terms are illustrated graphically (see Figures 1 and 2). We begin the discussion of the results by focusing on both substitution measures first.

Table 3. Variable description.

Variable	Form	Description
Att	Metric	Game attendance
ln(Att)	Metric	Natural logarithm of game attendance
UCL	Dummy	Concurrent UEFA Champions League game featuring a German club (1 if 'yes')
Local	Metric	Absolute number of days between home team's game and home game of the nearest 1BL / 2BL club
$Perf_H$	Metric	Number of league points gained by the home team five games prior to the match
$Perf_A$	Metric	Number of league points gained by the away team five games prior to the match
Hwin	Metric	Probability of a home win derived from betting odds excluding bookmaker's margin
Day	Dummy	Day of the game (1 if 'Monday', 1 if 'Tuesday', …, 1 if 'Sunday') excluding public holidays
Hday	Dummy	Game is played on public holidays (1 if 'yes')
Mday	Metric	Number of matchdays under consideration
Dist	Metric	Distance (in kilometers) between the venues of the home and away team
Prec	Dummy	Precipitation, that is, rain or snow during the day of the game (1 if 'yes')
Temp	Metric	Average temperature (in degree Celsius) during the day of the game, plus a constant of '13' degrees
Reloc	Dummy	Game is relocated to another venue (1 if 'yes')
Playoffs	Dummy	Playoff game (1 if 'yes')

Abbreviations: 1BL = First German Football Bundesliga; 2BL = Second German Football Bundesliga; UEFA = Union of European Football Associations.

Table 4. Descriptive statistics.

	HBL				BBL				DEL			
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Att	4,744	2,741	1,195	44,189	4,598	2,107	1,800	14,500	6,555	3,983	1,254	51,125
UCL	0.078	0.269	0	1	0.023	0.150	0	1	0.045	0.208	0	1
Local	5.432	4.914	0	29	5.940	6.008	0	41	6.268	6.187	0	33
$Perf_H$	4.528	2.848	0	10	4.635	2.843	0	10	7.157	3.440	0	15
$Perf_A$	4.621	2.823	0	10	4.733	2.840	0	10	7.321	3.446	0	15
Hwin	55.075	26.215	3.328	93.680	59.584	23.847	4.224	96.329	46.617	10.122	14.812	77.542
Mon	0	0	0	0	0.011	0.104	0	1	0.006	0.080	0	1
Tue	0.041	0.199	0	1	0.036	0.186	0	1	0.100	0.299	0	1
Wed	0.278	0.448	0	1	0.079	0.270	0	1	0.053	0.224	0	1
Thu	0.007	0.085	0	1	0.038	0.191	0	1	0.012	0.109	0	1
Fri	0.066	0.249	0	1	0.083	0.276	0	1	0.398	0.490	0	1
Sat	0.334	0.472	0	1	0.359	0.480	0	1	0.009	0.097	0	1
Sun	0.240	.427	0	1	0.337	0.473	0	1	0.400	0.490	0	1
Hday	0.033	0.177	0	1	0.057	0.232	0	1	0.022	0.148	0	1
Mday	17.571	9.810	1	34	19.350	11.303	1	49	30.023	17.629	1	74
Dist	370.562	186.901	10.386	892.213	380.961	174.316	24.262	809.175	419.540	191.811	29.451	800.964
Prec	0.491	0.500	0	1	0.513	0.500	0	1	0.511	0.500	0	1
Temp	22.085	5.967	5.1	37.7	20.059	5.357	1.0	36.8	18.808	5.417	1.2	33.9
Reloc	0.017	0.128	0	1	0.023	0.150	0	1	0.001	0.039	0	1
Playoffs	-	-	-	-	0.085	0.278	0	1	0.103	0.305	0	1

Notes: Variable descriptions are provided in Table 3. Total number of observations for the HBL 1,506, for the BBL 1,561 and for the DEL 2,001. *Abbreviations*: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga.

Table 5. Tobit estimations.

Var.	HBL	BBL	DEL
UCL	-0.0345	0.377	-0.847**
	(0.172)	(0.265)	(0.423)
Local	0.00415***	0.00294***	0.00472***
	(0.00128)	(0.000789)	(0.000783)
$Perf_H$	0.00348	0.00496**	0.00596***
	(0.00252)	(0.00207)	(0.00153)
$Perf_A$	0.00729***	0.000685	0.00355**
	(0.00263)	(0.00203)	(0.00154)
Hwin	0.00967***	0.00968***	0.0119**
	(0.00149)	(0.00104)	(0.00470)
$Hwin^2$	-6.04e-05***	-7.56e-05***	-7.04e-05
	(1.33e-05)	(9.73e-06)	(4.62e-05)
Mon	*omitted*	-0.0544	0.166**
		(0.0405)	(0.0698)
Tue	-0.0514*	-0.106***	-0.142***
	(0.0283)	(0.0391)	(0.0195)
Wed	-0.137***	-0.0297	-0.122***
	(0.0195)	(0.0211)	(0.0253)
Thu	-0.0760**	-0.0587**	-0.0456
	(0.0379)	(0.0241)	(0.0550)
Fri	-0.00826	-0.0136	0.00712
	(0.0237)	(0.0145)	(0.00940)
Sat	-0.0219	-0.000131	0.103
	(0.0156)	(0.0102)	(0.0710)
Sun	*R*	*R*	*R*
Hday	0.0235	0.0132	0.0819**
	(0.0269)	(0.0234)	(0.0318)
Mday	0.0176***	0.00768***	-0.00516***
	(0.00490)	(0.00256)	(0.00184)
$Mday^2$	-0.000347**	-0.000138**	0.000186***
	(0.000135)	(7.04e-05)	(2.89e-05)
Dist	-0.000733***	-0.000729***	-0.00110***
	(0.000117)	(0.000111)	(0.000107)
$Dist^2$	7.58e-07***	6.74e-07***	9.66e-07***
	(1.42e-07)	(1.38e-07)	(1.36e-07)
Prec	-0.00294	0.00188	0.00829
	(0.0109)	(0.00832)	(0.00903)
Temp	-0.000638	0.00285	0.0108***
	(0.00621)	(0.00553)	(0.00408)
$Temp^2$	1.30e-06	-7.29e-05	-0.000249**
	(0.000145)	(0.000141)	(0.000114)
UCL * Temp	-0.00378	-0.0566**	0.0684
	(0.0187)	(0.0272)	(0.0425)
UCL * $Temp^2$	0.000131	0.00142**	-0.00143
	(0.000493)	(0.000668)	(0.00103)
Reloc	0.669***	0.587***	1.855***
	(0.144)	(0.0679)	(0.309)
Playoffs		-0.0312	0.00246
		(0.0334)	(0.0327)
Const	7.295***	9.092***	8.015***
	(0.107)	(0.0957)	(0.128)
Home team FE	*included*	*included*	*included*
Away team FE	*included*	*included*	*included*
Season FE	*included*	*included*	*included*
AIC	-200	-687	-379
BIC	225	-301	-43
N_{total}	1,506	1,561	2,001
$N_{censored}$	332	564	258

Notes: The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; HBL = Handball Bundesliga; R = Reference category.

In line with Nielsen et al. (2019), we find a moderating effect of weather conditions on the impact of UCL on attendance demand with regard to the BBL and DEL. Figure 1 shows that the magnitude of substitution effects caused by UCL is affected by fairly high and fairly low temperatures. However, league specific differences arise. For the DEL the findings point towards an inverse U-shaped relationship, that is, substitution effects caused by UCL decrease with increasing temperature and are minimized at around 12 degrees, afterwards, they marginally increase again with increasing temperature. For the BBL the findings point towards a U-shaped relationship, that is, substitution effects are minimized by low and high temperatures and are maximized at around 8 degrees. The differences between both leagues may be ascribed to the fact that BBL playoffs regularly start two months later (typically in June) than the DEL playoffs (typically in March), and the fact that the DEL is a winter sports league.

The finding that football games may substitute fan interest in some leagues is also reinforced by the results for our second substitution measure (*Local*) which shows that the greater the temporal gap with the game of the nearest football competitor the lower the effect of substitution in the concerning leagues. In detail, the models show that each additional day between a HBL (BBL) [DEL] game and the temporally closest game of the nearest football competitor leads to an increase in attendance by 0.4 (0.3) [0.5] percentage points.[15] For instance, given an average attendance of 4,591 (4,655) [6,528] spectators per HBL (BBL) [DEL] game, this translates into an average increase by 129 (98) [228] spectators when the football game is played *seven days* before or after. Finally, we tested the cross-model hypothesis of equalities of these coefficients. Results suggest that the three leagues do not differ (HBL/BBL: $\chi^2 = 0.64$, p = 0.42; HBL/DEL: $\chi^2 = 0.15$, p = 0.70; BBL/DEL: $\chi^2 = 2.56$, p = 0.11).

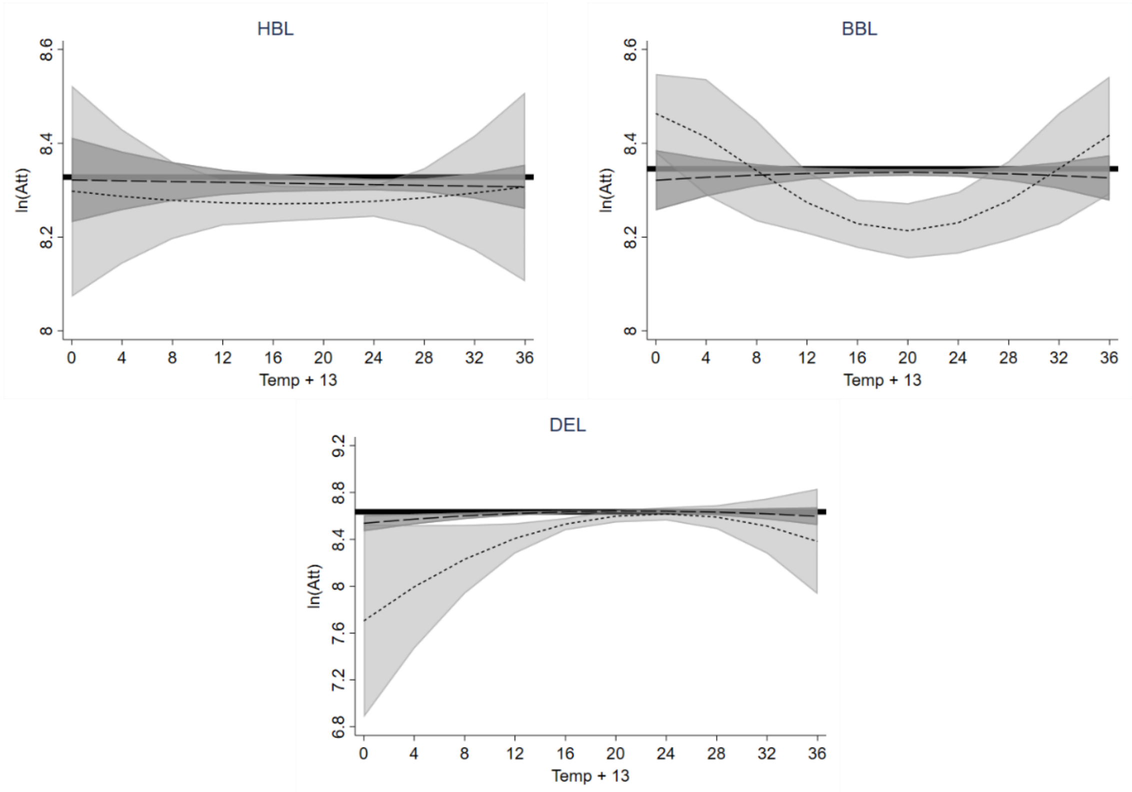

Figure 1. Predictive margins with 95% confidence intervals on the impact of *Temp* and *UCL*.

Notes: The long (short) dashed lines denote 'UCL = 0' ('UCL = 1'). The shaded areas denote the 95% confidence interval. The dark (light) shaded areas denote 'UCL = 0' ('UCL = 1'). The thick solid lines denote the average attendance per league. The minimum temperature in our dataset is -12. We added a constant of '13' degrees in order to prevent negative values when squaring the variable. *Abbreviations*: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga.

These findings come along with some plausible effects of the control variables. The better the performance of the home team ($Perf_H$) the higher the attendance at BBL and DEL games, while good performing away teams ($Perf_A$) attract larger audiences in the HBL and DEL. In addition, neither HBL, BBL nor DEL attendees seem to value game uncertainty. While the UOH suggests, that attendance would be maximized when both contestants have rather equal chances of winning, demand in the HBL (BBL) [DEL] is maximized at around 80% (64%) [84%] home win probability. Moreover, in line with Nalbantis et al. (2017), our findings are indicative of a threshold above which fluctuations in home win probabilities are less relevant (Figure 2). This is in line with previous literature suggesting that the preference for uncertain games is dominated by home win preferences and loss aversion (see Coates et al., 2014, and Pawlowski et al., 2018).

Furthermore, attendance figures for HBL and BBL games are maximized on Sundays while DEL games played on Mondays and public holidays (*Hday*) attract comparably larger audiences. We further find for all three leagues, that attendance increases as the season proceeds (*Mday*, *Mday²*), pointing towards a tipping point in the HBL and BBL. In detail, attendance is maximized at around matchday 25 (28) in the HBL (BBL), while in DEL attendance increases with an increasing rate. Moreover, travel distance (*Dist*, *Dist*^{2}) between the venues of both teams in contention indicates a U-shaped relationship regarding the demand for HBL, BBL and DEL games with the minimum at around 483 km in the HBL, 541 km in the BBL and 570 km in the DEL (see Figure 2). Finally, while precipitation during the day of the game (*Prec*) and playoff games (*Playoffs*) have no effect on attendance figures, relocated games (*Reloc*) attract larger audiences across leagues as expected.

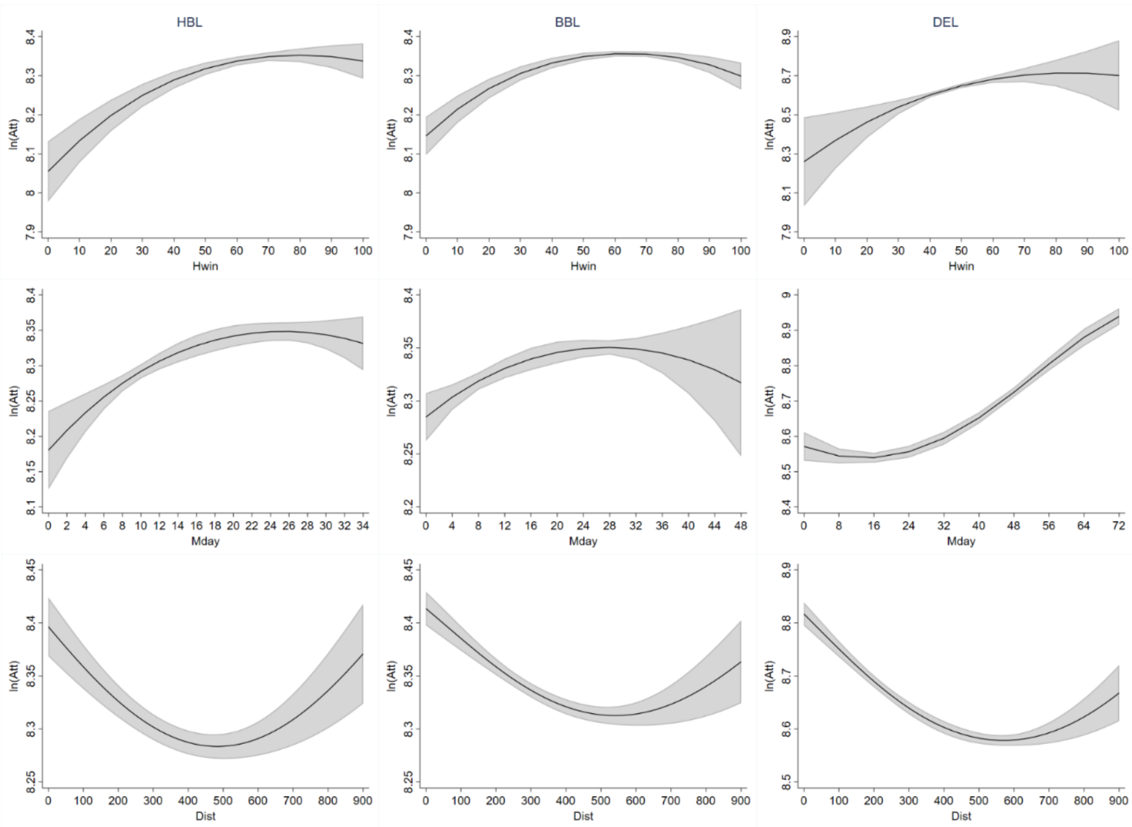

Figure 2. Predictive margins with 95% confidence intervals on the impact of home win (*Hwin*), matchday *(Mday)* and distance *(Dist*).

Notes: The shaded areas denote the 95% confidence interval. *Abbreviations*: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga.

To establish the robustness of our main findings, we re-estimate our models with different (sub-)samples and different specifications which are reported in Appendix B.

Firstly, we test whether the inclusion of third division football games affects our findings. First, we include a dummy variable capturing third division substitutes and interact this variable with our key variable *Local*. Second, we run subsample estimations by excluding all third division substitutes. For both specifications, our results remain (see Table B1 and B2).

Secondly, since our main models include regular season and playoff games, we re-estimate the models for BBL and DEL games excluding postseason playoff games. While we find no moderating effect of the temperature on the impact of *UCL* on attendance for the BBL, the main findings remain (see Table B3).

Thirdly, the decision to relocate a game to another venue is endogenous. For instance, one HBL club and three DEL clubs played home games in nearby (much bigger) football stadiums. Likewise, some HBL and BBL clubs moved for certain games to bigger indoor venues. Moreover, two HBL games were played in venues with outstandingly *small* capacities since the 'usual' home grounds were occupied. As a robustness check, we re-estimate all models by excluding these games. Our main findings remain (see Table B4).

Fourthly, Tobit models with fixed effects could be affected by the incidental parameters problem (see Neyman and Scott, 1948). As a robustness check, we estimate random effects Tobit models with home teams as cross-sectional units and matchdays as time series units including home team specific means of explanatory variables to approximate a standard panel fixed effects estimator as introduced by Mundlak (1978). Our results remain the same (see Table B5).

Fifthly, instead of the metric variable *Local* we include three dummy variables measuring whether football games were played (i) on the same day, (ii) up to *X* days before or (iii) after the HBL, BBL or DEL games. We test several specifications of *X*, with up to 21 days before and after, and find significant negative effects. Moreover, we find only weak evidence that the effects may differ with regard to whether football games were scheduled either before or after the concerning league games. Overall, results confirm our main findings (see Table B6).

Sixthly, some of the games were broadcast either on television or via online stream. The unavailability of (complete) historic data for HBL and DEL prevents us from controlling for this directly. Nevertheless, we take advantage of the fact, that all BBL games were broadcast live in three seasons (2014/2015 - 2016/2017) and run two tests just with the BBL sample. First, we re-estimate a subsample including only the seasons during which all games were broadcast live and test the equality of coefficients with regard to the variable *Local* in our main model. Second, we include a dummy variable in our main model measuring '1' for the seasons during which all games were broadcast live as well as an interaction term with the variable *Local* to test possible moderating effects. Both specifications suggest no significant differences compared to our main findings (see Table B7). Moreover, they suggest that apparently broadcasts do not entail any moderating effects on the impact of substitution.

Conclusion

Identifying competitors and determining the level of substitutability between products is indispensable to the process of delineating the boundaries of markets in antitrust analysis as well of developing any competitive strategies. A peculiar case in this regard is professional sports where domestic leagues hold monopoly power within their sports while eventually competing with leagues in other sports.

All in all, competition and substitution of leagues across sports is rather unexplored yet. While the few existing studies that previously looked at fan substitution focus exclusively on the North American market where selection issues are present, this study is the first to explore competition and fan substitution in a European setting. The advantage of a European setting is the fact that teams enter or leave divisions according to their sporting performance without territorial restrictions. In addition to this, we extent previously implemented substitution measures and test whether substitution can be observed even for games that are not played concurrently but few days before or after.

Our demand models reveal that attendance decreases if *UCL* games featuring a German club are scheduled concurrently. Moreover, we find that local football games staged shortly before or after HBL, BBL and DEL games also decrease attendance. This finding suggests the relevance of considering intertemporal consumption plans of consumers when examining substitution effects in sports. Considering, however, that inter-temporal consumption plans may differ between season ticket holders and regular ticket purchasers, as well as that spur-of-the-moment decisions of attending may occur, future studies are welcome to include these aspects in their analysis.

Overall, the findings suggest that different sports leagues in Germany *indeed* operate (at least to some extent) in the *same* market. Moreover, they show that professional leagues in Germany suffer from the popularity and dominance of football. Therefore, avoiding clashes with football games while scheduling the matchdays and kick-off times seems to be reasonable. If future studies confirm these findings in other settings, marketers and authorities would be generally well advised to depart from a single-sport perspective when developing or evaluating competitive strategies and regulatory policies in the sports industry.

Notes

1. The United States Supreme Court subsequently denied the NFL's petition for certiorari (459 U.S. 1074). However, Justice Rehnquist wrote a dissent in this case in which he argued (amongst others) that individual NFL teams compete with each other on the pitch, but rarely in the marketplace. Moreover, he argued that NFL teams compete as a unit against other sports leagues and other forms of entertainment for consumers. Note that the NFL continued to operate as if the cross-ownership ban was still in place (with few exceptions) until recently. The NFL owners voted to lift the longstanding cross-ownership prohibition in October 2018.
2. In Germany, the top-tier football league generates about eight times as much revenues (i.e., about €2.4 billion) as the top-tier leagues in handball ('Handball Bundesliga' – HBL), basketball ('Basketball Bundesliga' – BBL), and ice hockey ('Deutsche Eishockey Liga" – DEL) together (i.e., about €300 million). Quite recently, the HBL for instance decided to schedule the majority of games from season 2017/18 onwards either on Thursday evening or on Sunday noon in order to avoid scheduling clashes with football games.
3. To the best of our knowledge, the only related study in a European setting examines the effects of major tournaments, that is, the Wimbledon tennis tournament and the

FIFA Football World Cup, on the attendance of friendly games in British cricket (Hynds and Smith, 1994).

4. As of November 2018. In European professional sports, country rankings reflect the performance of the domestic clubs in Pan-European competitions such as the UEFA Champions League. Based on their international performance, these clubs accumulate points (referred to as “club coefficients”) which are summed over a certain period (three seasons in handball, four seasons in ice hockey, five seasons in football). Country rankings represent the collective (international) performance of these clubs over that period. Football rankings are based on the UEFA association club coefficients. Handball rankings are based on the European Handball Federation (EHF) club coefficients. Ice hockey rankings are based on the Champions Hockey League’s (CHL) club coefficients. Basketball rankings are taken from a commercial provider (eurohoops.net) since there is no official league level ranking of an international federation available.

5. The use of this log-specification allows for comparing estimates across leagues by interpreting results in percentage changes.

6. In contrast to Wallrafen et al. (2019), we do not employ a measure for concurrent televised domestic football games at the traditional kick-off time (i.e., Saturdays 3.30 p.m.), since we observe only very few HBL, BBL and DEL games on Saturday afternoons.

7. Due to the high demand for football game tickets in Germany (for instance, the average capacity utilization in the 1BL in season 2016/2017 was 91%; DFL, 2018), we expect that sports consumers purchase tickets several days in advance. Indeed, available disaggregated ticket sales data of a German 1BL club suggests, that about 95% of attendees regularly purchase tickets at least two days before kick-off.

8. Note, the UOH is subject to theoretical and empirical contradictions. Budzinski and Pawlowski (2017) provide a recent overview on alternative theories grounded in behavioral economics. See Pawlowski et al. (2018) or Nalbantis and Pawlowski (2018) for some latest empirical findings contradicting the UOH. An overview on previous studies testing the UOH for TV viewing is provided by Nalbantis and

Pawlowski (2016). For an overview on previous studies testing the UOH with regard to attendance demand see Pawlowski (2013), Coates et al. (2014) or Schreyer et al. (2016).

9. In some instances, matchdays in the HBL, BBL and DEL do not take place in a chronological order. Therefore, we manually adjusted these observations in order to obtain chronologically ordered matchdays.

10. Three HBL clubs (Bergischer HC, SG BBM Bietigheim and TVB 1898 Stuttgart) regularly play their home games in two different but nearby venues. Distances of these clubs as away teams are calculated by taking the mean of the distances to both venues.

11. The minimum temperature in our dataset is -12. In line with Nielsen et al. (2019), we added a constant of '13' in order to prevent negative values when squaring the variable.

12. Note, we also tested an interaction between UCL and Prec. Since we did not find any statistically significant results we decided to not include these variables in our models.

13. Our main findings remain when using 100% or 95% as alternative censoring levels (results are available upon request).

14. We run several models with different specifications. As main models we report those with the lowest (negative) values for AIC/BIC which suggest a better approximation to the true model (Jamison et al., 2016).

15. We examined the possibility of a nonlinear relationship between *Local* and attendance demand by implementing fractional polynomial selection procedures. In this regard, we tested up to four terms and a default set of eight powers (-2, -1, -0.5, 0, 0.5, 1, 2, 3) at a significance level of $\alpha = 0.1$ (see Royston, 2017). Results suggest a linear relationship for all three leagues (results are available upon request).

Appendix A

Table A1. Distances in kilometers to the venues of the nearest 1BL / 2BL substitutes of handball, basketball and ice hockey clubs.

HBL club	1BL / 2BL club	km	BBL club	1BL / 2BL club	km	DEL club	1BL / 2BL club	km
SC DHfK Leipzig	*RB Leipzig*	1	Würzburg	*Würzburger Kickers*	1	Hamburg Freezers	HSV Hamburg	1
HC Erlangen	1.FC Nürnberg	1	Löwen Braunschweig	Eintracht Braunschweig	4	Nürnberg Ice Tigers	1.FC Nürnberg	1
TVB 1898 Stuttgart	VfB Stuttgart	1	Ludwigsburg	VfB Stuttgart	12	Grizzlys Wolfsburg	VfL Wolfsburg	1
HSV Hamburg	HSV Hamburg	1	Phoenix Hagen	Borussia Dortmund	14	ERC Ingolstadt	FC Ingolstadt 04	2
TSV Hannover-B.	Hannover 96	1	Skyliners Frankfurt	Eintracht Frankfurt	14	Augsburger Panther	FC Augsburg	6
TUSEM Essen	Schalke 04	9	Bayern München	Bayern München	15	Düsseldorfer EG	Fortuna Düsseldorf	9
Füchse Berlin	Hertha BSC Berlin	18	Berlin	Hertha BSC Berlin	22*	EHC München	Bayern München	9
Rhein-Neckar-Löwen	SV Sandhausen	20	Baskets Bonn	1.FC Köln	32	Hannover Scorpions	Hannover 96	10
SG BBM Bietigheim	VfB Stuttgart	21	Ulm	*1.FC Heidenheim*	35	Kölner Haie	1.FC Köln	10
Bergischer HC	Bayer Leverkusen	27	Tigers Tübingen	VfB Stuttgart	37	Adler Mannheim	SV Sandhausen	20
TSG L.-Friesenheim	SV Sandhausen	31	Crailsheim Merlins	*VfR Aalen*	38	Eisbären Berlin	Hertha BSC Berlin	22*
TuS N.-Lübbecke	Arminia Bielefeld	33	Bamberg	Greuther Fürth	44	Krefeld Pinguine	Fortuna Düsseldorf	23
TV Neuhausen	VfB Stuttgart	37	Mitteldeutscher B.C.	*RB Leipzig*	46	Iserlohn Roosters	Borussia Dortmund	31
TBV Lemgo	*SC Paderborn*	38	Giessen 46ers	*FSV Frankfurt*	50	Straubing Tigers	*Jahn Regensburg*	52
Frisch Auf! Göppingen	VfB Stuttgart	47	Eisbären Bremerhaven	Werder Bremen	61	Fischtown P. B.	Werder Bremen	60
TV Grosswallstadt	*FSV Frankfurt*	48	Baskets Oldenburg	Werder Bremen	68	Schwenninger W. W.	SC Freiburg	71
GWD Minden	*Arminia Bielefeld*	51	SC Vechta	Werder Bremen	74			
VfL Gummersbach	Borussia Dortmund	53	Bayreuth	1.FC Nürnberg	76			
HSG Wetzlar	Eintracht Frankfurt	54	BG Göttingen	Hannover 96	92			
HBW Balingen-W.	VfB Stuttgart	72	Artland Dragons	*Arminia Bielefeld*	94			
TV Emsdetten	Borussia Dortmund	75	Science City Jena	*RB Leipzig*	97			
THW Kiel	Hamburger SV	84	TBB Trier	1.FC Kaiserslautern	129			
HSC 2000 Coburg	Greuther Fürth	87						
MT Melsungen	*SC Paderborn*	100						
SC Magdeburg	VfL Wolfsburg	101						
SG Flensburg.-H.	Hamburger SV	139						
ThSV Eisenach	*Würzburger Kickers*	140						

Notes: Distance as the crow flies is calculated by using the shortest curve between two points of a mathematical model of the earth (Vincenty, 1975; Picard, 2010). In italics are denoted first and second Bundesliga football clubs that participated also in the third division during our observation window (Arminia Bielefeld 2012/13, 2014/15; FSV Frankfurt 2016/17; Jahn Regensburg 2013/14, 2014/15, 2016/17; RB Leipzig 2013/14; SC Paderborn 2016/17; VfR Aalen 2015/16; Würzburger Kickers 2015/16; 1.FC Heidenheim 2012/13, 2013/14). *Abbreviations*: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga; km = kilometers; 1BL = First German Football Bundesliga; 2BL = Second German Football Bundesliga. *The second nearest substitute (first division club Hertha BSC Berlin) is taken instead of the nearest substitute (second division club 1. FC Union Berlin) as both clubs are in close proximity to the BBL / DEL club with only a few kilometers in between.

Appendix B

Table B1. Tobit estimations including a variable for third division substitutes (*3Division*).

Var.	HBL	BBL	DEL
UCL	-0.0194	0.374	-0.832*
	(0.173)	(0.265)	(0.435)
Local	0.00509***	0.00296***	0.00468***
	(0.00136)	(0.000809)	(0.000802)
3Division	0.109***	0.0268	-0.183***
	(0.0282)	(0.0254)	(0.0318)
Local * 3Division	-0.00835***	0.000113	0.000253
	(0.00301)	(0.00278)	(0.00210)
$Perf_H$	0.00339	0.00488**	0.00591***
	(0.00251)	(0.00208)	(0.00153)
$Perf_A$	0.00705***	0.000574	0.00341**
	(0.00263)	(0.00203)	(0.00153)
Hwin	0.00981***	0.00957***	0.0106**
	(0.00150)	(0.00104)	(0.00472)
$Hwin^2$	-6.11e-05***	-7.51e-05***	-6.09e-05
	(1.34e-05)	(9.73e-06)	(4.62e-05)
Mon	*omitted*	-0.0540	0.163**
		(0.0404)	(0.0693)
Tue	-0.0518*	-0.106***	-0.144***
	(0.0283)	(0.0392)	(0.0196)
Wed	-0.137***	-0.0298	-0.124***
	(0.0195)	(0.0212)	(0.0251)
Thu	-0.0745*	-0.0587**	-0.0441
	(0.0381)	(0.0240)	(0.0553)
Fri	-0.00767	-0.0134	0.00617
	(0.0234)	(0.0145)	(0.00935)
Sat	-0.0218	-0.000351	0.102
	(0.0156)	(0.0102)	(0.0704)
Sun	*R*	*R*	*R*
Hday	0.0237	0.0140	0.0816**
	(0.0271)	(0.0234)	(0.0317)
Mday	0.0181***	0.00774***	-0.00519***
	(0.00490)	(0.00257)	(0.00184)
$Mday^2$	-0.000357***	-0.000139**	0.000187***
	(0.000135)	(7.05e-05)	(2.89e-05)
Dist	-0.000734***	-0.000728***	-0.00109***
	(0.000116)	(0.000111)	(0.000107)
$Dist^2$	7.59e-07***	6.73e-07***	9.55e-07***
	(1.41e-07)	(1.38e-07)	(1.36e-07)
Prec	-0.00249	0.00181	0.00923
	(0.0108)	(0.00834)	(0.00899)
Temp	0.000196	0.00275	0.0108***
	(0.00615)	(0.00547)	(0.00405)
$Temp^2$	-1.34e-05	-7.01e-05	-0.000251**
	(0.000143)	(0.000139)	(0.000113)
UCL * Temp	-0.00486	-0.0563**	0.0672
	(0.0189)	(0.0272)	(0.0436)
UCL * $Temp^2$	0.000151	0.00142**	-0.00140
	(0.000501)	(0.000668)	(0.00106)
Reloc	0.670***	0.588***	1.859***
	(0.143)	(0.0680)	(0.310)
Playoffs		-0.0311	0.00126
		(0.0334)	(0.0326)
Const	7.267***	9.097***	8.043***
	(0.108)	(0.0956)	(0.128)
Home team FE	*included*	*included*	*included*

Away team FE	*included*	*included*	*included*
Season FE	*included*	*included*	*included*
AIC	-209	-684	-392
BIC	227	-288	-45
N_{total}	1,506	1,561	2,001
$N_{censored}$	332	564	258

Notes: The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; HBL = Handball Bundesliga; R = Reference category.

Table B2. Tobit estimations excluding third division substitutes.

Var.	HBL	BBL	DEL
UCL	-0.0141	0.458*	-0.777*
	(0.170)	(0.277)	(0.438)
Local	0.00529***	0.00300***	0.00473***
	(0.00138)	(0.000803)	(0.000806)
$Perf_H$	0.00105	0.00455**	0.00620***
	(0.00261)	(0.00213)	(0.00159)
$Perf_A$	0.00806***	0.00127	0.00364**
	(0.00279)	(0.00212)	(0.00159)
Hwin	0.00905***	0.00967***	0.0111**
	(0.00159)	(0.00110)	(0.00530)
$Hwin^2$	-5.00e-05***	-7.48e-05***	-6.40e-05
	(1.40e-05)	(1.01e-05)	(5.16e-05)
Mon	*omitted*	-0.0589	0.165**
		(0.0406)	(0.0698)
Tue	-0.0553*	-0.104***	-0.149***
	(0.0287)	(0.0397)	(0.0200)
Wed	-0.143***	-0.0323	-0.130***
	(0.0211)	(0.0222)	(0.0253)
Thu	-0.0830**	-0.0665***	-0.0450
	(0.0378)	(0.0246)	(0.0577)
Fri	-0.0227	-0.0114	0.00732
	(0.0232)	(0.0151)	(0.00969)
Sat	-0.0202	-0.00197	0.104
	(0.0165)	(0.0105)	(0.0712)
Sun	*R*	*R*	*R*
Hday	0.0152	0.0110	0.0774**
	(0.0279)	(0.0236)	(0.0326)
Mday	0.0197***	0.00737***	-0.00510***
	(0.00532)	(0.00264)	(0.00188)
$Mday^2$	-0.000397***	-0.000127*	0.000190***
	(0.000147)	(7.21e-05)	(2.95e-05)
Dist	-0.000564***	-0.000741***	-0.00110***
	(0.000116)	(0.000115)	(0.000109)
$Dist^2$	5.52e-07***	6.85e-07***	9.50e-07***
	(1.40e-07)	(1.42e-07)	(1.39e-07)
Prec	-0.00590	0.00501	0.00716
	(0.0113)	(0.00864)	(0.00931)
Temp	-0.000215	0.00619	0.0112**
	(0.00656)	(0.00536)	(0.00442)
$Temp^2$	-4.01e-06	-0.000154	-0.000253**
	(0.000153)	(0.000137)	(0.000122)
UCL * Temp	-0.00578	-0.0654**	0.0613
	(0.0185)	(0.0283)	(0.0440)
UCL * $Temp^2$	0.000205	0.00162**	-0.00124

	(0.000489)	(0.000689)	(0.00107)
Reloc	0.658***	0.581***	1.853***
	(0.144)	(0.0709)	(0.311)
Playoffs		-0.0366	-0.00794
		(0.0337)	(0.0335)
Const	7.241***	9.069***	8.020***
	(0.113)	(0.0969)	(0.141)
Home team FE	*included*	*included*	*included*
Away team FE	*included*	*included*	*included*
Season FE	*included*	*included*	*included*
AIC	-148	-636	-317
BIC	266	-258	17
N_{total}	1,389	1,423	1,922
$N_{censored}$	325	473	258

Notes: The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; HBL = Handball Bundesliga; R = Reference category.

Table B3. Tobit estimations for the BBL and DEL excluding playoff games.

Var.	BBL	DEL
UCL	0.0370	-1.017**
	(0.275)	(0.475)
Local	0.00346***	0.00416***
	(0.000815)	(0.000788)
$Perf_H$	0.00446**	0.00381**
	(0.00201)	(0.00149)
$Perf_A$	0.00182	0.00307**
	(0.00194)	(0.00154)
Hwin	0.0108***	0.0142***
	(0.00106)	(0.00480)
$Hwin^2$	-8.00e-05***	-9.05e-05*
	(1.01e-05)	(4.70e-05)
Mon	-0.0488	0.206***
	(0.0405)	(0.0592)
Tue	-0.152***	-0.161***
	(0.0395)	(0.0210)
Wed	-0.0471**	-0.0984***
	(0.0222)	(0.0277)
Thu	-0.0546**	-0.0130
	(0.0273)	(0.0892)
Fri	-0.0161	0.0101
	(0.0140)	(0.00933)
Sat	-0.00158	0.186**
	(0.00990)	(0.0781)
Sun	*R*	*R*
Hday	0.00250	0.0877***
	(0.0234)	(0.0265)
Mday	0.00721**	-0.000429
	(0.00280)	(0.00189)
$Mday^2$	-0.000124	0.000102***
	(7.74e-05)	(2.98e-05)
Dist	-0.000706***	-0.00114***
	(0.000107)	(0.000108)
$Dist^2$	6.62e-07***	9.83e-07***
	(1.33e-07)	(1.37e-07)
Prec	-0.00116	0.00612

	(0.00814)	(0.00899)
Temp	0.00244	0.0115***
	(0.00514)	(0.00403)
Temp²	-5.31e-05	-0.000249**
	(0.000133)	(0.000114)
UCL * Temp	-0.0128	0.0837*
	(0.0295)	(0.0476)
UCL * Temp²	0.000185	-0.00171
	(0.000747)	(0.00115)
Reloc	0.700***	1.778***
	(0.0606)	(0.338)
Playoffs	*omitted*	*omitted*
Const	9.029***	7.908***
	(0.0912)	(0.130)
Home team FE	*included*	*included*
Away team FE	*included*	*included*
Season FE	*included*	*included*
AIC	-803	-569
BIC	-429	-245
N_{total}	1,429	1,794
$N_{censored}$	476	179

Notes: The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; R = Reference category.

Table B4. Tobit estimations excluding relocated games.

Var.	HBL	BBL	DEL
UCL	-0.0334	0.356	-0.853**
	(0.161)	(0.278)	(0.425)
Local	0.00247**	0.00290***	0.00471***
	(0.00108)	(0.000746)	(0.000783)
$Perf_H$	0.00366	0.00468**	0.00576***
	(0.00240)	(0.00198)	(0.00153)
$Perf_A$	0.00701***	0.00146	0.00364**
	(0.00245)	(0.00187)	(0.00154)
Hwin	0.00808***	0.00950***	0.0121**
	(0.00124)	(0.00102)	(0.00471)
Hwin²	-5.14e-05***	-7.19e-05***	-7.11e-05
	(1.12e-05)	(9.47e-06)	(4.62e-05)
Mon	*omitted*	-0.0598	0.168**
		(0.0406)	(0.0699)
Tue	-0.0535**	-0.0891**	-0.141***
	(0.0265)	(0.0357)	(0.0195)
Wed	-0.121***	-0.0343	-0.122***
	(0.0145)	(0.0209)	(0.0253)
Thu	-0.0763**	-0.0658***	-0.0667
	(0.0380)	(0.0240)	(0.0542)
Fri	-0.0151	-0.0123	0.00714
	(0.0219)	(0.0139)	(0.00940)
Sat	-0.0199	-0.00485	0.135*
	(0.0128)	(0.00935)	(0.0706)
Sun	*R*	*R*	*R*
Hday	0.0316	0.0134	0.0818***
	(0.0271)	(0.0226)	(0.0317)
Mday	0.00975***	0.00629***	-0.00526***

	(0.00358)	(0.00240)	(0.00184)
Mday²	-0.000121	-0.000105	0.000187***
	(9.64e-05)	(6.63e-05)	(2.89e-05)
Dist	-0.000737***	-0.000615***	-0.00113***
	(0.000110)	(0.000101)	(0.000107)
Dist²	7.38e-07***	5.63e-07***	9.94e-07***
	(1.34e-07)	(1.25e-07)	(1.35e-07)
Prec	0.00373	0.000817	0.00839
	(0.00911)	(0.00787)	(0.00903)
Temp	0.00200	0.00875*	0.00961**
	(0.00549)	(0.00497)	(0.00403)
Temp²	-0.000102	-0.000231*	-0.000223**
	(0.000124)	(0.000127)	(0.000113)
UCL * Temp	-0.00389	-0.0545*	0.0690
	(0.0176)	(0.0279)	(0.0426)
UCL * Temp²	0.000118	0.00138**	-0.00144
	(0.000466)	(0.000666)	(0.00103)
Reloc	*omitted*	*omitted*	*omitted*
Playoffs		0.0130	0.00447
		(0.0295)	(0.0326)
Const	7.411***	8.998***	8.025***
	(0.0878)	(0.0900)	(0.128)
Home team FE	*included*	*included*	*included*
Away team FE	*included*	*included*	*included*
Season FE	*included*	*included*	*included*
AIC	-520	-797	-393
BIC	-101	-419	-63
N_{total}	1,481	1,525	1,998
$N_{censored}$	329	551	256

Notes: The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; HBL = Handball Bundesliga; R = Reference category.

Table B5. Tobit estimations using Mundlak fixed effects.

Var.	HBL	BBL	DEL
UCL	-0.130	0.311	-0.980***
	(0.212)	(0.276)	(0.314)
Local	0.00397***	0.00318***	0.00466***
	(0.00135)	(0.000866)	(0.000831)
$Perf_H$	0.0101***	0.0130***	0.0101***
	(0.00296)	(0.00217)	(0.00158)
$Perf_A$	0.00986***	0.000328	0.00115
	(0.00296)	(0.00220)	(0.00160)
Hwin	-0.00132	0.00198**	-0.000134
	(0.00108)	(0.000986)	(0.00358)
Hwin²	-8.81e-06	-4.15e-05***	-3.72e-06
	(1.05e-05)	(9.54e-06)	(3.66e-05)
Mon	*omitted*	-0.0698	0.158***
		(0.0647)	(0.0594)
Tue	-0.0462	-0.119***	-0.134***
	(0.0317)	(0.0276)	(0.0189)
Wed	-0.134***	-0.0416**	-0.121***
	(0.0172)	(0.0210)	(0.0239)
Thu	-0.0863	-0.0667***	-0.0592
	(0.0693)	(0.0251)	(0.0447)
Fri	-0.0221	-0.0223	0.00760

	(0.0267)	(0.0178)	(0.0105)
Sat	-0.0341**	-0.0178	0.0956*
	(0.0163)	(0.0116)	(0.0544)
Sun	*R*	*R*	*R*
Hday	0.00386	0.00303	0.0762**
	(0.0356)	(0.0215)	(0.0333)
Mday	0.0135***	0.00387	-0.00555***
	(0.00432)	(0.00265)	(0.00186)
Mday^2	-0.000244**	-4.14e-05	0.000193***
	(0.000117)	(7.11e-05)	(2.90e-05)
Dist	-0.000694***	-0.000755***	-0.00100***
	(0.000115)	(0.000121)	(0.000105)
Dist^2	7.72e-07***	8.42e-07***	8.57e-07***
	(1.39e-07)	(1.46e-07)	(1.31e-07)
Prec	0.00637	0.00747	0.00769
	(0.0117)	(0.00947)	(0.00963)
Temp	-0.00433	0.000257	0.0109**
	(0.00668)	(0.00508)	(0.00481)
Temp^2	7.50e-05	-1.26e-05	-0.000245*
	(0.000149)	(0.000130)	(0.000133)
UCL * Temp	0.00676	-0.0481*	0.0824**
	(0.0233)	(0.0278)	(0.0330)
UCL * Temp^2	-0.000159	0.00116*	-0.00181**
	(0.000622)	(0.000673)	(0.000832)
Reloc	0.710***	0.647***	2.001***
	(0.0434)	(0.0345)	(0.145)
Playoffs		0.0287	0.0106
		(0.0313)	(0.0294)
Const	7.204	10.50***	11.37***
	(7.216)	(1.855)	(0.746)
Home team specific means of explanatory variables	*included*	*included*	*included*
Home team FE	*excluded*	*excluded*	*excluded*
Away team FE	*excluded*	*excluded*	*excluded*
Season FE	*included*	*included*	*included*
AIC	106	-381	-129
BIC	378	-114	129
N_{total}	1,506	1,561	2,001
$N_{censored}$	332	564	258

Notes: Random effects Tobit models with home teams as cross-sectional units and matchdays as time series units. The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Standard errors in parentheses. In the BBL model, home team specific means of *Playoffs, Temperature* and its interactions are excluded due to model convergence issues. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; HBL = Handball Bundesliga; R = Reference category.

Table B6. Tobit estimations including three dummy variables instead of *Local* (selected variables).

	X Days	*X* = 1	*X* = 2	*X* = 3	*X* = 4	*X* = 5	*X* = 6	*X* = 7	*X* = 14	*X* = 21
HBL	*X* Days Before	-0.011	-0.0005	-0.015	-0.032**	-0.042***	-0.030**	-0.032*	-0.082**	-0.016
		(0.017)	(0.016)	(0.017)	(0.014)	(0.015)	(0.015)	(0.017)	(0.033)	(0.045)
	Same Day	-0.021	-0.019	-0.021	-0.028	-0.032*	-0.037*	-0.049**	-0.105***	-0.042
		(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.022)	(0.036)	(0.047)
	X Days After	-0.013	-0.009	-0.005	-0.028**	-0.036***	-0.042***	-0.045***	-0.098***	-0.034
		(0.024)	(0.021)	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)	(0.033)	(0.045)
	Equalities of coefficients	F(1, 1426 = 0.01; p = 0.94)	F(1, 1426 = 0.13; p = 0.72)	F(1, 1426 = 0.25; p = 0.62)	F(1, 1426 = 0.06; p = 0.81)	F(1, 1426 = 0.15; p = 0.70)	F(1, 1426 = 0.84; p = 0.36)	F(1, 1426 = 1.32; p = 0.25)	F(1, 1426 = 2.06; p = 0.15)	F(1, 1426 = 3.22; p = 0.07)
BBL	*X* Days Before	-0.027**	-0.026**	-0.017	-0.022*	-0.016	-0.026**	-0.030**	-0.053***	-0.007
		(0.013)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.013)	(0.019)	(0.026)
	Same Day	-0.023*	-0.023*	-0.021*	-0.022*	-0.021*	-0.031**	-0.038**	-0.069***	-0.029
		(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.015)	(0.021)	(0.027)
	X Days After	-0.025	-0.017	-0.011	-0.008	-0.007	-0.023**	-0.024*	-0.059***	-0.017
		(0.017)	(0.015)	(0.013)	(0.013)	(0.012)	(0.011)	(0.012)	(0.019)	(0.026)
	Equalities of coefficients	F(1, 1489 = 0.01; p = 0.91)	F(1, 1489 = 0.28; p = 0.60)	F(1, 1489 = 0.14; p = 0.71)	F(1, 1489 = 0.79; p = 0.38)	F(1, 1489 = 0.40; p = 0.53)	F(1, 1489 = 0.08; p = 0.78)	F(1, 1489 = 0.45; p = 0.50)	F(1, 1489 = 0.34; p = 0.56)	F(1, 1489 = 1.42; p = 0.23)
DEL	*X* Days Before	-0.054***	-0.030**	-0.035***	-0.043***	-0.041***	-0.062***	-0.052***	-0.047***	-0.072***
		(0.016)	(0.014)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.017)	(0.026)
	Same Day	-0.050***	-0.049***	-0.052***	-0.055***	-0.056***	-0.075***	-0.079***	-0.092***	-0.123***
		(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)	(0.022)	(0.029)
	X Days After	-0.038***	-0.022*	-0.029**	-0.032***	-0.025**	-0.046***	-0.051***	-0.063***	-0.094***
		(0.014)	(0.013)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.016)	(0.025)
	Equalities of coefficients	F(1, 1941 = 0.57; p = 0.45)	F(1, 1941 = 0.20; p = 0.65)	F(1, 1941 = 0.13; p = 0.71)	F(1, 1941 = 0.56; p = 0.45)	F(1, 1941 = 1.51; p = 0.22)	F(1, 1941 = 1.99; p = 0.16)	F(1, 1941 = 0.01; p = 0.94)	F(1, 1941 = 2.52; p = 0.11)	F(1, 1941 = 5.10; p = 0.02)

Notes: Identical models as in Table 5 are estimated except for a different specification including three dummy variables instead of *Local*. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. Testing the equalities of *X* Days Before and *X* Days After coefficients reveal only weak evidence for statistically significant differences. Abbreviations: BBL = Basketball Bundesliga; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; HBL = Handball Bundesliga.

Table B7. Tobit estimations for the BBL testing the impact of broadcasts.

	BBL	
Var.	Subsample (season 2014/2015 -2016/2017)	Subsample dummy variable
UCL	0.683	0.331
	(0.474)	(0.267)
Local	0.00276***	0.00296**
	(0.00104)	(0.00121)
Seasons full TV		0.00451
		(0.0133)
Local * Seasons full TV		0.000266
		(0.00160)
$Perf_H$	0.00416*	0.00526**
	(0.00222)	(0.00208)
$Perf_A$	0.00215	0.00106
	(0.00204)	(0.00204)
Hwin	0.00779***	0.00975***
	(0.00117)	(0.00106)
$Hwin^2$	-6.25e-05***	-7.53e-05***
	(1.02e-05)	(9.87e-06)
Mon	-0.0278	-0.0579
	(0.0398)	(0.0429)
Tue	-0.0916**	-0.109***
	(0.0407)	(0.0395)
Wed	0.00117	-0.0339
	(0.0291)	(0.0215)
Thu	-0.0558*	-0.0555**
	(0.0307)	(0.0235)
Fri	-0.0103	-0.0140
	(0.0145)	(0.0147)
Sat	-0.0124	-0.00245
	(0.0110)	(0.0102)
Sun	*R*	*R*
Hday	0.00219	0.0129
	(0.0224)	(0.0236)
Mday	0.00990***	0.00848***
	(0.00276)	(0.00256)
$Mday^2$	-0.000203***	-0.000160**
	(7.57e-05)	(6.99e-05)
Dist	-0.000844***	-0.000740***
	(0.000120)	(0.000111)
$Dist^2$	8.71e-07***	6.84e-07***
	(1.48e-07)	(1.39e-07)
Prec	0.00483	0.00393
	(0.00898)	(0.00839)
Temp	0.00273	0.00391
	(0.00674)	(0.00562)
$Temp^2$	-5.60e-05	-7.89e-05
	(0.000169)	(0.000143)
UCL * Temp	-0.0867*	-0.0521*
	(0.0459)	(0.0276)
UCL * $Temp^2$	0.00206**	0.00133**
	(0.000967)	(0.000676)
Reloc	0.683***	0.581***
	(0.0710)	(0.0696)
Playoffs	0.0308	-0.0290
	(0.0352)	(0.0337)
Const	9.029***	9.085***
	(0.109)	(0.0986)
Equality of coefficients	$\chi2 = 0.05$, $p = 0.83$	
Home team FE	*included*	*included*
Away team FE	*included*	*included*
Season FE	*included*	*excluded*

AIC	-600	-677
BIC	-260	-302
N_{total}	951	1,561
$N_{censored}$	315	564

Notes: The dependent variable is the natural logarithm of game attendance. Variable descriptions are provided in Table 3. Results with individual cut-off points at 99% of venue capacity utilization. Robust standard errors in parentheses. Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. *Abbreviations*: AIC= Akaike information criterion; BBL = Basketball Bundesliga; BIC= Bayesian information criterion; DEL = Deutsche Eishockey Liga [German Ice Hockey League]; FE = Fixed Effects; R = Reference category.

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5.3 The impact of live broadcasting on stadium attendance reconsidered: some evidence from 3rd division football in Germany (Study 3)

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The impact of live broadcasting on stadium attendance reconsidered: some evidence from 3rd division football in Germany

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ABSTRACT

Research Question: If a sports competition is broadcasted live, consumers may opt for substituting gate attendance with watching that game live on TV (or online). This might be worrisome for teams, particularly those in lower divisions, whose game day revenues typically exceed broadcasting revenues. So far, however, the literature testing this claim empirically is inconclusive. We examine whether (at least parts of) this confusion might be traced back to shortcomings in the econometric modelling process.

Research Methods: We use attendance data for 1,138 games in German third division football from the 2015/16 to 2017/18 seasons and compare results for our demand equations between ordinary least squares (OLS) and endogenous treatment regressions (ETR). ETRs explicitly account for any selection bias, that is, the broadcasters' preference to select the most attractive games for live broadcasting (which are expected to also attract comparably larger gate attendances).

Results and Findings: While OLS models reveal a significant positive impact of live broadcasts on gate attendance, this effect reverses when estimating ETRs. Even though there is suggestive evidence for postponing ticket demand to some extent to later games, the overall negative effect remains robust and large.

Implications: Our findings highlight the relevance of controlling for the selection bias when analysing the impact of live broadcasting on stadium attendance. From a managerial point of view, our findings suggest that increasing the number of games broadcasted live in German third division football might not be advisable, since additional broadcasting revenues may not exceed predicted losses in ticket revenues.

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The impact of live broadcasting on stadium attendance reconsidered: some evidence from 3rd division football in Germany

Introduction

Broadcasting revenues in European professional football have increased significantly during recent years, constituting the most relevant income stream for top-tier European clubs and leagues today (Deloitte, 2016). Likewise, the number of live television (TV) broadcasts and online streams have increased considerably over time. In general, this development can also be observed for lower divisions in football. However, in contrast to top-tier leagues, lower divisions usually gain significantly less from broadcasting revenues. Moreover, while live games in most top-tier football leagues can commonly be accessed via subscription or pay-per-view only (e.g. Butler & Massey, 2019), less popular sports including lower division games are frequently broadcasted *free of charge* via TV and/or online streaming (e.g. Budzinski, Gaenssle & Kunz-Kaltenhäuser, 2019).

In this regard, league officials and club managers (from lower divisions) regularly argue that broadcasting in general and free-to-air broadcasting in particular may attract new consumers (TV viewers) at the local, regional and national levels and thus increase revenues *in the longer run* (e.g. Turner & Shilbury, 2005). Theoretically, however, some (existing) consumers may just opt for substituting gate attendance with watching that game live on TV (or online) for reasons of convenience, thus reducing demand *in the short run*. In the same vein, following Becker (1965), individual time and budget constraints might lead sport fans to watch certain games from home instead of allocating their limited time and money for live attendance. If either mechanism is true in practise, increasing the number of games broadcasted live (on TV or online) might not be advisable if the predicted losses in ticket revenues do not exceed the additional broadcasting revenues. This might be particularly worrisome for lower division leagues, where game day revenues typically still exceed broadcasting revenues.[1] Therefore, the objective of this study is to explore empirically whether and to what extent substitution in demand takes place in lower division football.

While several studies have previously examined the link between live broadcasting and stadium attendance for top-tier league games, empirical demand studies for lower division games are generally scarce. Moreover, only two studies exist (Falls & Natke, 2014; 2017) that have previously also considered the potential impact of online streaming on attendance. First and foremost, however, the existing literature testing the link between live broadcasting and stadium attendance is inconclusive (a comprehensive review is provided in the next section). In this regard, our paper intends to contribute to the literature by examining, whether (at least parts of) this confusion might be traced back to shortcomings in the econometric modelling process. More precisely, we use attendance data for a sample of 1,138 games in German third division football from the 2015/16 to 2017/18 seasons and compare the results for our demand equations between ordinary least squares (OLS) and endogenous treatment regressions (ETR). If the selection into 'treatment' (the game is broadcasted live) and 'control' (the game is not broadcasted live) is non-random, OLS or (in case of censored data) Tobit estimations may produce incorrect estimates. In contrast, however, ETRs explicitly account for any selection bias in this setting, that is, the broadcasters' preference to select the most attractive games for live broadcasting which are expected to also attract comparably larger gate attendances.[2]

While the estimates of our OLS models reveal a significant positive impact of live broadcasts on gate attendance, ETR results indicate that this effect reverses, suggesting reduced gate attendance for broadcasted games once the selection bias is controlled for. Even though there is suggestive evidence for postponing ticket demand to some extent to later games, the overall negative effect on stadium attendance remains robust and large. As such, method-wise, our findings highlight the relevance of adequately controlling for the selection bias when analysing the impact of live broadcasting on stadium attendance. From a managerial point of view, our findings suggest that increasing the number of games broadcasted live (on TV or online) in German third division football might not be advisable, since additional broadcasting revenues may not exceed predicted losses in ticket revenues.

The next section summarises the relevant literature. This is followed by a description of the data used in this study, as well as the measures and the estimation strategy employed. Afterwards, the findings of this study are presented. The last section concludes.

Literature review

Table 1 provides an overview of previous studies empirically exploring the link between live broadcasting and in-game attendance for various sports in different divisions. Overall, the evidence is inconclusive. Out of 30 studies reviewed here, 12 studies find a negative effect, four a positive effect and five a non-significant effect of live broadcasting on in-game attendance. Moreover, nine studies find mixed evidence, that is, different results depending on the measures used and the specifications employed.

We argue that (at least parts of) this confusion might be traced back to shortcomings in the econometric modelling process. In general, studies analysing substitution in sports demand have to deal with two important issues. *First*, studies focusing on top-tier leagues have to deal with individual cut-off points, that is, right censoring due to capacity constraints. As such, the 'true' ticket demand is unknown for sold-out games, which requires consideration in the estimation process. *Second*, and more importantly here, since broadcasters regularly choose those games for live broadcasting that also attract comparably larger gate attendances (Forrest, Simmons & Buraimo, 2005; Martins & Cró, 2018), studies have to deal with non-random selection in the econometric modelling process.

While considering the former issue (i.e., right censoring) is common practice in empirical demand studies, most of the aforementioned studies do not consider the latter (i.e., the issue of non-random selection) in the modelling process. For instance, Storm, Nielsen and Jakobsen (2018) find a positive impact of TV broadcasting on attendance in Danish handball and show that this effect is most likely biased by the broadcasters' selection. Others argue that endogeneity is not necessarily an issue and ignore any selection bias in their estimation (e.g. Falls & Natke, 2014; 2017). So far, only very few studies exist that approach this issue explicitly. For instance, Martins and Cró (2018) employ two-stage Tobit models and do not find any significant substitution effects for Portuguese first division games. We follow up on the latter work and explicitly compare the results with and without adequately modelling the broadcasters' choice in – as we argue below – an ideal setting for testing substitution effects in demand.

Table 1. Previous research on the impact of broadcasting on attendance.

#	Reference	Country	Sport	Competition	Period	Method	Dependent variable	Measure	Findings
1	Kaempfer and Pacey (1986)	USA	American football	college	1975-1981	OLS	ratio of annual average attendance to stadium size	(1) telecasts per given year per team; (2) telecasts per team since 1950; (3) TV exposures increased for 1978-1981	(1) significant positive; (2) not significant; (3) significant positive
2	Fizel and Bennet (1989)	USA	American football	college	1980-1985	OLS	ratio of annual average attendance to stadium size	(1) telecasts per given year per team; (2) telecasts per team since 1950	(1) significant negative; (2) significant positive
3	Peel and Thomas (1992)	England	football	first, second, third and fourth division	1986/1987	OLS	logarithm of attendance	(1) televised	(1) not significant
4	Welki and Zlatoper (1994)	USA	American football	NFL	1991	Tobit	attendance	(1) game is blacked out to local TV	(1) significant negative
5	Baimbridge, Cameron and Dawson (1995)	England	rugby	first division	1993/1994	OLS	logarithm of attendance	(1) televised	(1) significant negative
6	Baimbridge, Cameron and Dawson (1996)	England	football	first division	1993/1994	OLS	logarithm of attendance	(1) televised Sunday afternoon; (2) televised Monday evening	(1) not significant; (2) significant negative
7	Carmichael, Millington and Simmons (1999)	England	rugby	first division	1994/1995	OLS	logarithm of attendance	(1) televised Friday evening; (2) televised at other times	(1) significant negative; (2) not significant

#	Reference	Country	Sport	Competition	Period	Method	Dependent variable	Measure	Findings
8	Welki and Zlatoper (1999)	USA	American football	NFL	1986-1987	Tobit and OLS	attendance	(1) not televised in local market	(1) significant negative
9	García and Rodríguez (2002)	Spain	football	first division	1992/1993-1995/1996	OLS and IV (for endogenous price)	logarithm of attendance	(1) televised by public channels; (2) televised by a private channel	(1) significant negative; (2) significant negative
10	Humphreys (2002)	USA	baseball	MLB	1901-1999	OLS	total attendance per season	(1) spread of broadcasting games after 1951 (2) linear and quadratic time trend, beginning in 1952	(1) not significant (2) linear: significant negative; quadratic: significant positive
11	Price and Sen (2003)	USA	American football	college	1997	Tobit	attendance	(1) televised	(1) significant positive
12	Allan (2004)	England	football	first division	1995/1996-2000/2001	OLS	logarithm of attendance	(1) televised	(1) significant negative
13	Forrest, Simmons and Szymanski (2004)	England	football	first and second division	1992/1993-1997/1998	Tobit and OLS	logarithm of attendance	(1) division 1 televised on Sunday (2) division 1 televised on Monday (3) division 2 derby televised by ITV (4) division 2 derby televised by Sky (5) division 2 televised by ITV (6) division 2 televised by Sky on Friday (7) division 2 televised by Sky on Sunday	(1) significant negative in 3 of 6 seasons (2) significant negative in 1 of 6 seasons (3) significant positive in 1 of 5 seasons (4) significant positive in 1 of 2 seasons (5) significant negative in 4 of 5 seasons (6) significant negative in 1 of 2 seasons (7) significant negative in 2 of 2 seasons
14	Forrest and Simmons (2006)	England	football	second, third and fourth division	1999/2000-2001/2002	Prais-Winsten	logarithm of attendance	(1) televised	(1) significant negative for division 1

#	Reference	Country	Sport	Competition	Period	Method	Dependent variable	Measure	Findings
15	McEvoy and Morse (2007)	USA	basketball	college	2003/2004-2004/2005	OLS	attendance	(1) televised	(1) significant positive
16	Allan and Roy (2008)	Scotland	football	first division	2002/2003	Seemingly Unrelated Regression	logarithm of attendance by (i) season ticket holders, (ii) pay-at-the-gate supporters of the home team, and (iii) pay-at-the-gate supporters of the visiting team	(1) televised	(1) significant negative for pay-at-the-gate supporters of the home team
17	Buraimo (2008)	England	football	second division	1997/1998-2003/2004	Prais-Winsten	logarithm of attendance	(1) televised by Sky (2) televised by ITV analogue (3) televised by ITV digital	(1) significant negative (2) significant negative (3) significant negative
18	Buraimo and Simmons (2008)	England	football	first division	2000/2001-2005/2006	Tobit	logarithm of attendance	(1) televised on Sunday (2) televised on Monday (3) televised on other day (4) televised on public holiday (5) number of home telecast in the previous season	(1) significant negative (2) significant negative (3) not significant (4) not significant (5) significant negative
19	Buraimo, Forrest and Simmons (2009)	England	football	second division	1997/1998-2003/2004	Hausman-Taylor	logarithm of attendance	(1) televised by ITV analogue (2) televised by ITV digital (3) televised by Sky	(1) significant negative (2) significant negative (3) significant negative

#	Reference	Country	Sport	Competition	Period	Method	Dependent variable	Measure	Findings
20	Buraimo and Simmons (2009)	Spain	football	first division	2003/2004-2006/2007	Prais-Winsten	logarithm of attendance	(1) televised by public TV on weekday (2) televised by public TV on weekend (3) televised by subscription TV on weekday (4) televised by subscription TV on weekend	(1) significant negative (2) significant negative (3) not significant (4) not significant
21	Lemke, Leonard and Tlhokwane (2010)	USA	baseball	MLB	2007	Tobit and OLS	attendance and logarithm of attendance	(1) not televised locally (2) televised nationally	(1) not significant (2) not significant
22	Cox (2012)	England	football	first division	2004/2005-2007/2008	OLS	logarithm of gate revenue	(1) televised (2) televised; sample including more attractive matches only (3) televised; sample including less attractive matches only	(1) significant negative (2) significant negative (3) significant negative
23	Falls and Natke (2014)	USA	American football	college	2004-2009	Tobit and IV (for endogenous price)	attendance as per cent of stadium capacity and attendance	(1) televised or streamed online	(1) significant positive
24	Solberg and Mehus (2014)	Norway	football	first division	fan survey after 2010 season	Poisson	number of home games attended during the 2010 season by (i) season ticket holders and (ii) single tickets	(1) televised games in general act as an alternative to attending games at the stadium (2) number of televised home games of favourite club	(1) significant negative (2) significant negative

#	Reference	Country	Sport	Competition	Period	Method	Dependent variable	Measure	Findings
25	Mirabile (2015)	USA	American football	college	2004-2012	Tobit	game-day attendance divided by stadium attendance	(1) televised	(1) not significant
26	Falls and Natke (2017)	USA	American football	college	2007-2009	Tobit and IV (for endogenous price)	attendance as per cent of stadium capacity	(1) televised or streamed online on national level (2) televised or streamed online on regional level (3) televised or streamed online on local level	(1) significant positive (2) not significant (3) significant positive
27	Cox (2018)	England	football	first division	2004-2012	Tobit	logarithm of attendance	(1) televised	(1) significant negative
28	Storm, Nielsen and Jakobsen (2018)	Denmark	handball	first division	2011/2012-2015/2016	OLS and Tobit	logarithm of attendance	(1) televised on main channel (2) televised on secondary channel	(1) significant positive for Tobit (2) significant positive for OLS and Tobit
29	Martins & Cró (2018)	Portugal	football	first division	2010/2011-2014/2015	Tobit and IV	logarithm of attendance	(1) televised	(1) not significant
30	Nielsen, Storm and Jakobsen (2019)	Denmark	football	first division	2010/2011-2015/2016	OLS	logarithm of attendance	(1) televised ('match of the week' only)	(1) not significant

Abbreviations: ETR = endogenous treatment regression; FE = fixed effects; IV = instrumental variable regression; MLB = Major League Baseball; NFL = National Football League; OLS = ordinary least squares regression.

Empirical strategy

Sample selection

We analyse game-level attendance data from 1,138 third division football games in Germany (seasons 2015/16-2017/18).[3] Third division football in Germany constitutes an ideal setting for testing our hypothesis, that is, modelling whether (or not) the broadcasters choice influences any results on substitution effects in demand. *First*, games are either not broadcasted at all, exclusively via online stream or on both TV and online stream provided by free-to-air public service broadcasters. As such, there seems to be enough variation in order to identify the relation of interest. *Second*, the league is characterised by professional structures (as discussed by Wallrafen, Pawlowski & Deutscher, 2019) and comparably high fan interest. For instance, the average TV audience per game in the 2016/2017 season is 220,000. Moreover, the average stadium attendance is 5,987, still constituting 15 percent (28 percent) of the average attendance demand in the first (*Bundesliga*) and second divisions (*2. Bundesliga*) (DFL, 2018). *Third*, since there are no sell-outs, we do not need to account for demand above stadium capacity, thus facilitating our econometric modelling approach, as further discussed below.

Measures

As shown in Figure 1, attendance in third division football in Germany is skewed to the right, and thus, the natural logarithm of game attendance serves as the dependent variable in our models (*ln(Attendance)*).[4] To capture the impact of broadcasting on attendance, a dummy variable (*Broadcast*) indicates whether a match was broadcasted live, either on free TV or via a free of charge online stream. Table 2 provides an overview on the number of games broadcasted live.[5]

As can be seen, the fraction of broadcasted games differs between days of the week. Therefore, controlling for the day of the week (*Weekday*) is important. Overall, we expect lower in-game attendance for games played from Monday to Thursday (Hill, Madura & Zuber, 1982). At the same time, however, since the attractiveness of broadcasts is expected to be higher for games taking place during the week (Buraimo & Simmons, 2009), we also add an interaction term between *Broadcast* and *Weekday (Broadcast* ×

Weekday). Moreover, in line with Wallrafen et al. (2019), we test for possible substitution effects between third division games and top-tier division Bundesliga games broadcasted live *(Bundesliga)*.[6] Our variable captures concurrent Bundesliga games played on Saturdays at 3:30 pm – that is, the main kick-off time for first division football in Germany – since the parallel broadcast of multiple (usually five) Bundesliga games is extremely popular among German football fans and more than 50% of third division games in our sample overlap with this kick-off time.[7]

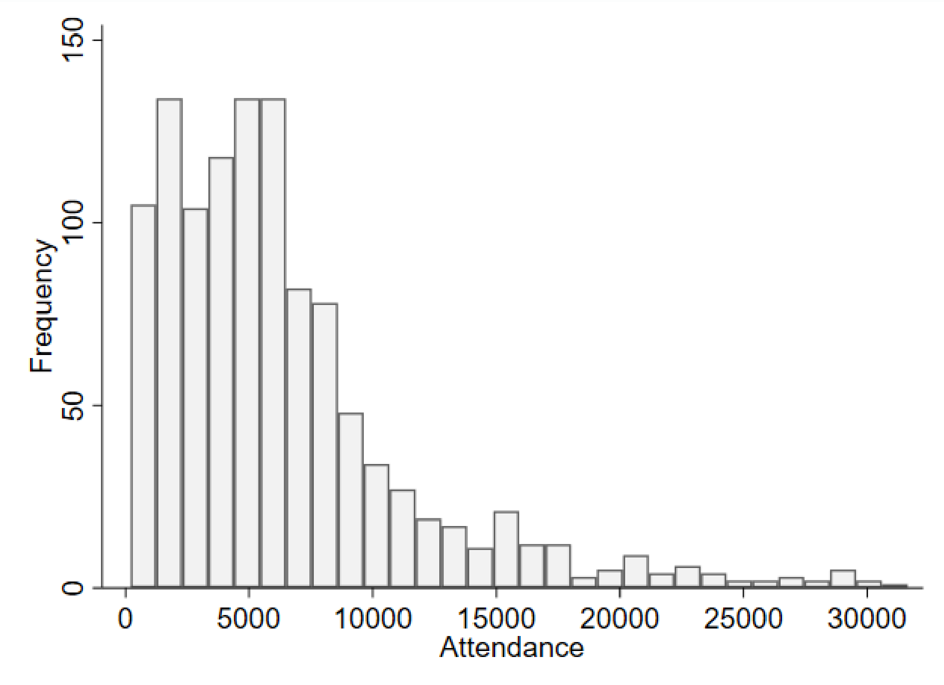

Figure 1. Distribution of attendance.

Table 2. Number of games broadcasted live on TV / online stream per day of the week.

	TV	TV & Online	Online	Neither TV nor Online	Fraction Broadcasted
Monday	2	2	3	3	0.50
Tuesday	6	6	16	40	0.29
Wednesday	5	5	20	39	0.34
Thursday	2	2	2	2	0.50
Friday	7	7	46	94	0.33
Saturday	316	316	398	334	0.54
Sunday	46	46	57	84	0.40
Total	384	384	542	596	0.48

Note. Total number of observations is 1,138.

A variety of further control variables capture game characteristics, costs of attendance and habit persistence effects of fans. Including the matchday (*Matchday*) of the season and its squared term (*Matchday²*), we expect that attendance decreases for games played in the middle of the season during winter months (Pawlowski & Anders, 2012). Moreover, since better recent performances of both home and away teams are expected to increase demand, we control for the accumulated number of points gained by both opponents in their previous five games ($Performance_H$, $Performance_A$) (Forrest & Simmons, 2002). Furthermore, derived from margin-adjusted betting odds, we include the home win probability (*Homewin*) and its squared term (*Homewin²*) to test the *uncertainty of outcome hypothesis* (UOH; see Rottenberg, 1956; Neale, 1964). Based on the assumption that attendance increases in outcome uncertainty, we expect an inverse U-shaped relationship. Moreover, we determine if teams serve as reserve squads for upper division teams (e.g. *VfB Stuttgart II* is a reserve squad for (the current second division team) *VfB Stuttgart*). Given the attractiveness of the respective top-tier teams, reserve teams ($Reserve_H$, $Reserve_A$) are expected to attract fewer fans both at home and on the road. To proxy for both local rivalry as well as the costs of attending for away team fans, we include the distance (measured in 100 kilometres) between the stadiums of the home and the away teams (*Distance*). While attendance is assumed to decrease with increasing distance between the stadiums, we expect this to appear in a nonlinear manner and, thus, also include its squared term (*Distance²*) (Baimbridge, Cameron & Dawson, 1996). Weather conditions are measured as average temperature (*Temperature*) and the occurrence of precipitation (*Precipitation*) during the day of the game. Good conditions, that is, high temperatures and no precipitation, are expected to increase attendance (García & Rodríguez, 2002; Nielsen, Storm & Jakobsen, 2019). To reflect persistence effects of fans (Borland & Lye, 1992), we include the natural logarithm of the average attendance of the opponent teams in the previous season ($ln(Habit_H)$, $ln(Habit_A)$) and expect a positive impact from last years' attendance on current attendance. In addition to this, we control for recently promoted and relegated teams ($Promotion_H$, $Promotion_A$, $Relegation_H$, $Relegation_A$) and interacted these variables with the habit persistence variables (Forrest & Simmons, 2006; Deutscher, Frick & Ötting, 2018). Finally, season and home team dummies capture time trends and heterogeneity between teams. Variable descriptions and related descriptive statistics are shown in Tables 3 and 4.

Table 3. Variable description.

Variable	Description
ln(Attendance)	Natural logarithm of game attendance
Broadcast	Game under consideration is broadcasted live on television / online stream (binary: yes = 1)
Weekday	Game played on Monday, Tuesday, Wednesday or Thursday (binary: yes = 1)
Bundesliga	Concurrent first division game on Saturday at 3.30 pm (binary: yes = 1)
Matchday	Match day under consideration
$Performance_H$	Number of points scored by the home team in the previous five games
$Performance_A$	Number of points scored by the away team in the previous five games
Homewin	Probability of a home win (derived from betting odds)
$Reserve_H$	Home team is reserve team of an upper division team (binary: yes = 1)
$Reserve_A$	Away team is reserve team of an upper division team (binary: yes = 1)
Distance	Distance between home and away teams' stadiums in kilometres
Temperature	Average temperature during the day of the game (degree Celsius)
Precipitation	Rain or snow during the day of the game (binary: yes = 1)
$ln(Habit_H)$	Natural logarithm of home teams' average attendance in previous season
$ln(Habit_A)$	Natural logarithm of away teams' average attendance in previous season
$Promotion_H$	Home team promoted in the season before from division 4 (binary: yes = 1)
$Promotion_A$	Away team promoted in the season before from division 4 (binary: yes = 1)
$Relegation_H$	Home team relegated in the season before from division 2 (binary: yes = 1)
$Relegation_A$	Away team relegated in the season before from division 2 (binary: yes = 1)

Table 4. Descriptive statistics.

Variable	Mean	SD	Min	Max
Attendance	6409.024	5280.734	201	31644
ln(Attendance)	8.431	0.882	5.303	10.362
Broadcast	0.476	0.500	0	1
Weekday	0.110	0.313	0	1
Bundesliga	0.519	0.500	0	1
Matchday	19.507	10.977	1	38
$Performance_H$	6.109	3.286	0	15
$Performance_A$	6.346	3.370	0	15
Homewin	59.967	12.103	17.332	90.248
$Reserve_H$	0.100	0.300	0	1
$Reserve_A$	0.099	0.299	0	1
Distance	3.743	1.714	0	8.525
Temperature	9.618	6.440	-7.500	26.700
Precipitation	0.511	0.500	0	1
$ln(Habit_H)$	8.454	0.825	6.560	10.032
$ln(Habit_A)$	8.453	0.825	6.560	10.032
$Promotion_H$	0.149	0.357	0	1
$Promotion_A$	0.149	0.357	0	1
$Relegation_H$	0.117	0.321	0	1
$Relegation_A$	0.116	0.320	0	1

Note. Variable descriptions are provided in Table 3. Total number of observations is always 1,138.

Estimation strategy

To test the impact of live broadcasting on stadium attendance, we initially estimate standard OLS regressions. As mentioned before, selection into 'treatment' (the game is broadcasted live) and 'control' (the game is not broadcasted live) is not random, since broadcasters are expected to select the most attractive games for live broadcasting (these games also attract comparably larger gate attendances). In the presence of non-random selection, simple OLS regression produce biased estimates. We account for such non-random selection by employing the maximum likelihood estimator, implemented by Maddala (1983), and estimating ETRs (Heckman, 1976, 1978). ETRs combine a non-linear (Probit) model to estimate selection into treatment (in our case specified as *Broadcast*) with a linear model for the outcome variable of interest (in our case specified as *ln(Attendance)*) and account for any correlation between the error terms of both models in the estimation process. A Wald test rejects the null hypothesis of *no* correlation between both error terms, confirming our preference of ETRs over OLS models.

To avoid the incidental parameter problem (Lancaster, 2000; Wooldridge, 2010), home team dummies are only included in the linear model. Moreover, while both models may generally contain identical variables (Vella & Verbeek, 1999), estimates tend to be more stable when an exclusion restriction is introduced (Kane et al., 2013). An exclusion restriction requires a variable in the nonparametric model that is unrelated to the outcome variable and, as such, excluded in the linear model. In our setting, we choose a variable capturing the share of home games that were previously broadcasted live in the ongoing season (*Home broadcasts*). Since the German *Rundfunkstaatsvertrag* (RSV; Interstate Broadcasting Treaty) obligates public service broadcasters to provide a wide and balanced range of telecasts (§11 II RSV), the probability of broadcasting a given game live is expected to decrease with the number of previously broadcasted games of the home team. Since, however, more 'attractive' home teams may still be broadcasted more often regardless of previous broadcasts, we include an interaction term with the home teams' average attendance in the previous season ($ln(Habit_H)$).[8]

Results

Table 5 reports the results of our OLS (first column) and ETR estimations (second and third column). Results for the ETR are split into two columns, that is, estimates for the nonlinear (treatment) model as well as the linear (outcome) model.

Table 5. OLS and ETR results.

	OLS	ETR	
Dependent variable	ln(Attendance)	Broadcast	ln(Attendance)
Broadcast	0.0520***		-0.326***
	(0.0191)		(0.0437)
Weekday	-0.0630*	-0.394***	-0.0944***
	(0.0346)	(0.140)	(0.0360)
Broadcast × Weekday	-0.110**		-0.121**
	(0.0534)		(0.0486)
Bundesliga	-0.102***	0.389***	-0.0455*
	(0.0231)	(0.101)	(0.0254)
Matchday	-0.0309***	-0.0404	-0.0316***
	(0.00616)	(0.0304)	(0.00697)
$Matchday^2$	0.000704***	0.00118*	0.000762***
	(0.000143)	(0.000699)	(0.000161)
$Performance_H$	0.0143***	-0.000216	0.0140***
	(0.00330)	(0.0153)	(0.00383)
$Performance_A$	0.00603*	0.0183	0.00907**
	(0.00335)	(0.0142)	(0.00372)
Homewin	-0.0234***	-0.0479*	-0.0274***
	(0.00639)	(0.0271)	(0.00730)
$Homewin^2$	0.000212***	0.000398*	0.000247***
	(5.31e-05)	(0.000228)	(6.10e-05)
$Reserve_H$	-1.493***	-1.426***	-1.543***
	(0.215)	(0.347)	(0.229)
$Reserve_A$	0.128***	-0.304*	0.0904**
	(0.0343)	(0.179)	(0.0393)
Distance	-0.189***	-0.374***	-0.226***
	(0.0190)	(0.0867)	(0.0216)
$Distance^2$	0.0185***	0.0328***	0.0218***
	(0.00231)	(0.0107)	(0.00263)
Temperature	-0.00114	0.000219	-0.00119
	(0.00250)	(0.0115)	(0.00283)
Precipitation	-0.0161	-0.0161	-0.0133
	(0.0171)	(0.0813)	(0.0190)
$\ln(Habit_H)$	-0.0116	0.538***	0.0794
	(0.105)	(0.138)	(0.103)
$\ln(Habit_A)$	0.261***	0.531***	0.316***
	(0.0188)	(0.0790)	(0.0228)
$Promotion_H$	-0.133	1.029	-0.287
	(0.509)	(1.214)	(0.501)
$Promotion_A$	0.963***	2.305**	1.143***
	(0.240)	(1.118)	(0.272)
$Relegation_H$	4.354**	-2.993	4.789**
	(2.068)	(3.273)	(2.138)
$Relegation_A$	-1.547**	-4.200	-1.903**
	(0.694)	(3.357)	(0.798)
$\ln(Habit_H) \times Promotion_H$	0.0120	-0.0671	0.0418
	(0.0568)	(0.149)	(0.0564)
$\ln(Habit_A) \times Promotion_A$	-0.0985***	-0.243*	-0.116***
	(0.0301)	(0.138)	(0.0338)
$\ln(Habit_H) \times Relegation_H$	-0.467**	0.293	-0.522**
	(0.229)	(0.354)	(0.236)
$\ln(Habit_A) \times Relegation_A$	0.151**	0.416	0.186**
	(0.0761)	(0.363)	(0.0868)
Home Broadcasts		14.32***	
		(5.286)	
Home $Broadcasts^2$		-18.61***	
		(5.915)	
$\ln(Habit_H)$ × Home Broadcasts		-1.514**	
		(0.603)	
$\ln(Habit_H)$ × Home $Broadcasts^2$		2.019***	
		(0.672)	

Intercept	7.369***	-7.019***	6.453***
	(0.911)	(1.657)	(0.910)
Season dummies	Yes	Yes	Yes
Home team dummies	Yes	No	Yes
R^2 / Wald χ^2	0.91	54.08***	
ρ		0.75	
N	1,138	1,138	

Note. Variable descriptions are provided in Table 3. Robust standard errors in parentheses. One of 30 home team dummies omitted to prevent collinearity (with $Reserve_H$). Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. Rho reports the correlation between the two regressions' error terms.

We start with discussing the factors that alter the likelihood of games being broadcasted, that is, the results in column two in Table 5. The probability of broadcasting decreases for games played from Monday to Thursday (*Weekday*) and increases for games scheduled concurrently with televised Bundesliga games (*Bundesliga*). While performances of home and away teams ($Performance_H$; $Performance_A$) do not influence selection into treatment, games involving reserve teams, both at home and on the road, reduce the likelihood of broadcasting a game live ($Reserve_H$; $Reserve_A$). Furthermore, we find nonlinear U-shaped relationships for matchday, home win probability and travel distance (*Matchday*; $Matchday^2$; *Homewin*; $Homewin^2$; *Distance*; $Distance^2$). Weather conditions are unrelated, whereas habit persistence and promoted away teams are statistically significant factors increasing the likelihood of broadcasting a game live ($ln(Habit_H)$; $ln(Habit_A)$; $Promotion_A$). Finally, the relationship between the share of previous home games broadcasted live and the likelihood of broadcasting a current game live (*Home Broadcasts*) appears to be inverse U-shaped. After a turning point at about 40%, the likelihood of broadcasting the game under consideration decreases, the higher the share of previously broadcasted games. Interestingly, however, this is not the case for more 'attractive' home teams that have a comparably higher level of habit persistence (see Figure 2).

With regard to stadium attendance, we start with discussing results for our relation of interest. While the OLS regression suggests a positive impact of live broadcasts on TV or online stream (*Broadcast*) on attendance, this effect reverses when accounting for non-random selection by employing ETR. Overall, the ETR model suggests that broadcasting a game free-to-air decreases attendance considerably, that is, by about 34 percentage points on average.[9] Moreover, the interaction term suggests that broadcasts reduce attendance even more when games are played during the week.[10]

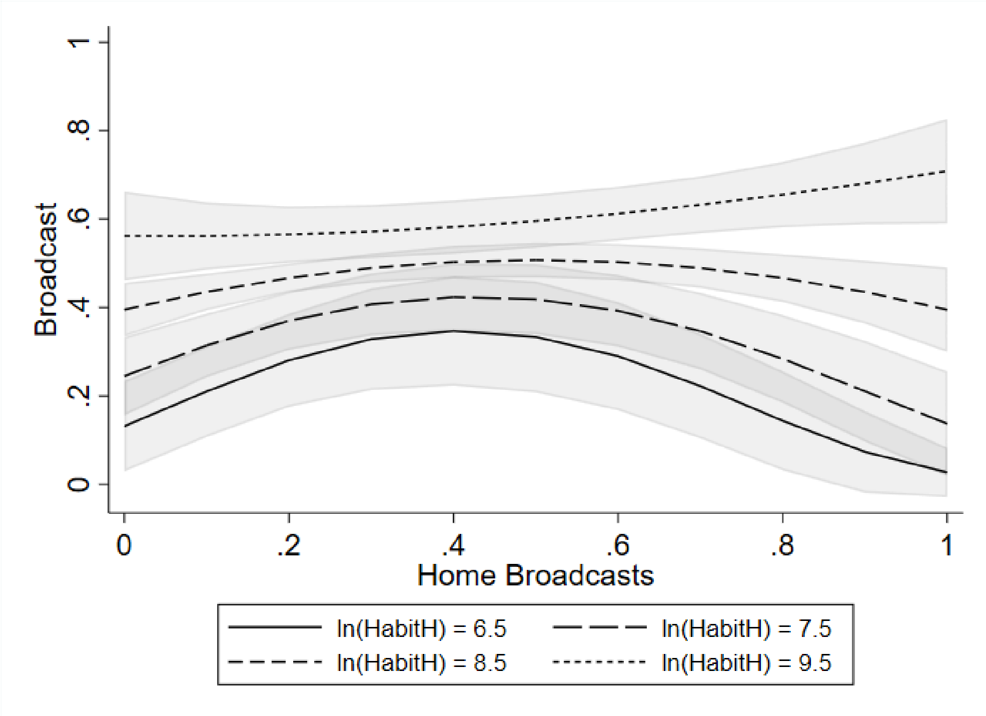

Figure 2. Predictive margins with 95% confidence intervals (shaded areas) on the impact of *Home Broadcasts* and *ln(*$Habit_H$*)* on the likelihood of broadcasting.

These findings come along with (mostly) expected findings for our control variables. In this regard, it is important to note that our control variables in both OLS and ETR models are of comparable sizes, underpinning the robustness of the latter. For instance, in line with Wallrafen et al. (2019), we find a negative impact of concurrently played Bundesliga games (*Bundesliga*) on attendance. In addition, like Pawlowski and Anders (2012), we find a U-shaped relation between *Matchday* and attendance, with the turning point at around matchday 21 (taking place around January), as well as that better performances of the home and the away team ($Performance_H$; $Performance_A$) increase attendance, suggesting a preference for better quality. In line with the literature (e.g. Coates, Humphreys, & Zhou, 2014; Pawlowski, Nalbantis, & Coates, 2018), estimates for the home win probability (*Homewin*; $Homewin^2$) reveal a U-shaped relationship with attendance, that is, in contrast to what the UOH suggests, attendance *decreases* with increasing levels of uncertainty. While reserve teams suffer from lower attendance at home ($Reserve_H$), hosting a reserve team ($Reserve_A$) attracts more fans. Furthermore, estimates on the distance between the stadiums of both opponents (*Distance*; $Distance^2$) reveal a U-shaped relation, with its minimum at around 519 km. Interestingly, weather conditions (*Temperature*; *Precipitation*) do not affect attendance at all. Finally, except for promoted home teams, habit persistence appears to be a significant driver of demand.

While our results suggest that significant substitution effects indeed exist for the very same game, fans may shift in-game attendance to subsequent (non-broadcasted) games. More precisely, fans, particularly those with a low involvement or neutral spectators, might decide to stay at home if the game is broadcasted live, while attending the subsequent (non-broadcasted) home game instead. To test this assumption, we re-estimated our models by adding a dummy variable (*Broadcast Previous Home Game*) to the specification discussed before, which measures '1' if the previous home game was broadcasted live. Results in Table 6 reveal a significant increase in attendance by 7.7 percentage points if the previous home game was broadcasted live. As such, we provide some suggestive evidence for postponing demand.[11] It is important to note, however, that the estimated increase in attendance after a broadcasted game does not overcompensate the estimated decrease of attendance in the recent game.

Conclusion

Our paper contributes to the literature on stadium demand by highlighting the relevance of adequately controlling for non-random selection of broadcasted games when analysing potential substitution between stadium attendance and TV (online stream) viewing. We document this relevance with an application to third division football games in Germany. In this regard, our findings suggest that live broadcasting of games is a double-edged sword for the clubs. While league officials and club managers regularly claim that broadcasting free-to-air opens up new markets and may increase demand in the *longer run*, this paper finds that watching a game on TV (or online) is a substitute for in-game attendance, thus substantially reducing ticket demand in the *short run*.

Even though there is suggestive evidence for postponing ticket demand to some extent to later games, the overall negative effect on stadium attendance remains robust and large. As such, the current trend of increasing the number of live broadcasts in lower division football in general might not be in economic favour to the clubs.[12] Only if increasing media rights revenues overcome such game day losses can broadcasting games

Table 6. ETR results for *Broadcast Previous Home Game*.

	ETR	
Dependent variable	Broadcast	ln(Attendance)
Broadcast		-0.326***
		(0.0424)
Weekday	-0.407***	-0.0975***
	(0.140)	(0.0361)
Broadcast × Weekday		-0.123**
		(0.0487)
Broadcast Previous Home Game	0.126	0.0768***
	(0.0964)	(0.0198)
Bundesliga	0.393***	-0.0429*
	(0.101)	(0.0253)
Matchday	-0.0459	-0.0342***
	(0.0305)	(0.00702)
$Matchday^2$	0.00129*	0.000810***
	(0.000701)	(0.000162)
$Performance_H$	-0.00111	0.0139***
	(0.0152)	(0.00381)
$Performance_A$	0.0179	0.00859**
	(0.0142)	(0.00373)
Homewin	-0.0478*	-0.0272***
	(0.0271)	(0.00729)
$Homewin^2$	0.000398*	0.000245***
	(0.000228)	(6.08e-05)
$Reserve_H$	-1.407***	-1.556***
	(0.346)	(0.229)
$Reserve_A$	-0.312*	0.0881**
	(0.178)	(0.0389)
Distance	-0.374***	-0.225***
	(0.0867)	(0.0215)
$Distance^2$	0.0330***	0.0217***
	(0.0107)	(0.00262)
Temperature	-0.000367	-0.00155
	(0.0115)	(0.00281)
Precipitation	-0.0133	-0.0119
	(0.0812)	(0.0190)
$\ln(Habit_H)$	0.511***	0.0623
	(0.138)	(0.103)
$\ln(Habit_A)$	0.529***	0.314***
	(0.0792)	(0.0227)
$Promotion_H$	0.990	-0.315
	(1.212)	(0.500)
$Promotion_A$	2.334**	1.151***
	(1.110)	(0.268)
$Relegation_H$	-2.793	4.080*
	(3.237)	(2.158)
$Relegation_A$	-4.341	-1.973**
	(3.367)	(0.804)
$\ln(Habit_H) \times Promotion_H$	-0.0659	0.0430
	(0.149)	(0.0565)
$\ln(Habit_A) \times Promotion_A$	-0.248*	-0.118***
	(0.138)	(0.0333)
$\ln(Habit_H) \times Relegation_H$	0.273	-0.443*
	(0.351)	(0.239)
$\ln(Habit_A) \times Relegation_A$	0.432	0.194**
	(0.364)	(0.0876)
Home Broadcasts	14.43***	
	(5.288)	
Home Broadcasts²	-18.71***	
	(5.927)	
$\ln(Habit_H) \times$ Home Broadcasts	-1.521**	
	(0.602)	

ln($Habit_H$) × Home Broadcasts²	2.030***	
	(0.673)	
Intercept	-6.797***	6.613***
	(1.663)	(0.907)
Season dummies	Yes	Yes
Home team dummies	No	Yes
R^2 / Wald χ^2	57.56***	
ρ	0.75	
N	1,138	

Note. Variable descriptions are provided in Table 3. Robust standard errors in parentheses. One of 30 home team dummies omitted to prevent collinearity (with *$Reserve_H$*). Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. Rho reports the correlation between the two regressions' error terms.

pay off in the longer run. However, testing any long-term effects empirically in the future – although promising from a managerial perspective in general – is much more difficult than the analysis conducted here, since controlling for the many confounding influences becomes extremely complex once the observation period extends beyond single games. Moreover, such analysis would require data allowing to distinguish between game day and season ticket holders as well as data about other game day revenues. Since season ticket revenues are not related to real attendance (season tickets are regularly paid before the season starts), no-show behaviour among season ticket holders (see Schreyer, 2019) would upward bias any estimated losses in *ticket* revenues. At the same time, however, other game day revenues (e.g. from concessions, merchandising, or parking) might still be affected.

Notes

1. For instance, for third division football in Germany covered in this research, game day earnings comprise about 22 percent of total revenues, while revenues from media rights cover merely 14 percent (DFB, 2018).
2. Cross tabulations for each season show that high-ranked teams are broadcasted comparably more often throughout the seasons. Moreover, we do not find any evidence for a time trend in this selection (such as that broadcasters explicitly select less attractive teams / games early in the season or else).
3. The gross sample includes 1,140 games. Two game are removed from the analysis. One game was played in absence of spectators as a sanction measure imposed by

the *Deutsche Fußball Bund*. For another game we are missing information on weather conditions. Accordingly, 1,138 observations remain in the sample.

4. Note that teams in our data always play in the same stadium and do not relocate home games to other venues.

5. Note that for the 2017/2018 season all games were additionally also available on pay TV. To avoid any confounding effect in our setting, we control for season dummies as explained further below.

6. Since very few clashes with UEFA Champions League or UEFA Europa League games involving Bundesliga clubs occurred during our observation window, we could not test rivalry from international club competitions.

7. Since regular football games include two halves with 45 min and a halftime break of 15 min, this variable takes the value of ‘1’ for games that were played within 105 min before or after the kickoff time of Bundesliga games.

8. As a robustness check, we also estimated a specification not complying with the exclusion restriction. Moreover, while estimation by maximum likelihood is the most efficient estimation procedure (Tucker, 2010; Wooldridge, 2010), we re-estimated these models using the Two-Step estimator. Our main findings remain with regard to both robustness checks (see Table A1 in the Appendix A).

9. Since we interacted the treatment variable with a control variable, the Stata command *etregress* does not directly estimate the average treatment effect (ATE). We use *margins* to estimate ATEs from the results of Table 5.

10. As a robustness check, we re-estimated all models using games broadcasted live on TV only (instead of TV or online stream). Moreover, estimating ETR we tested for interactions between *Broadcast* and *Bundesliga* as well as between *Broadcast* and the weather variables. While we find significant interaction effects for *Bundesliga* and *Temperature*, the results suggest that our main findings remain (see Table A2 and A3 in the Appendix A).

11. We also tested effects for the subsequent first and second home game after a broadcasted home game and still find increased demand. Results are available upon request.

12. In Germany, for instance, soccerwatch.tv and sporttotal.tv even broadcast German soccer games of low amateur leagues.

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Appendix A

Table A1. ETR results not complying with the exclusion restriction and by Two-Step estimator.

	ETR		ETR (Two-Step)	
Dependent variable	Broadcast	ln(Attendance)	Broadcast	ln(Attendance)
Broadcast		-0.314***		-0.383***
		(0.0471)		(0.126)
Weekday	-0.409***	-0.0930***	-0.367**	-0.0995**
	(0.139)	(0.0357)	(0.153)	(0.0402)
Broadcast × Weekday		-0.124**		-0.126**
		(0.0492)		(0.0552)
Bundesliga	0.389***	-0.0481*	0.485***	-0.0381
	(0.100)	(0.0255)	(0.100)	(0.0296)
Matchday	-0.0131	-0.0314***	-0.0322	-0.0323***
	(0.0286)	(0.00691)	(0.0319)	(0.00695)
$Matchday^2$	0.000671	0.000757***	0.00101	0.000786***
	(0.000669)	(0.000160)	(0.000716)	(0.000160)
$Performance_H$	-0.000272	0.0141***	-0.0115	0.0137***
	(0.0151)	(0.00379)	(0.0158)	(0.00371)
$Performance_A$	0.0195	0.00886**	0.0253*	0.00983***
	(0.0143)	(0.00371)	(0.0152)	(0.00377)
Homewin	-0.0429	-0.0273***	-0.0408	-0.0281***
	(0.0265)	(0.00728)	(0.0248)	(0.00602)
$Homewin^2$	0.000356	0.000245***	0.000343	0.000253***
	(0.000223)	(6.08e-05)	(0.000213)	(5.22e-05)
$Reserve_H$	-1.545***	-1.583***	-0.839***	-1.549***
	(0.326)	(0.229)	(0.246)	(0.178)
$Reserve_A$	-0.303*	0.0918**	-0.315*	0.0852*
	(0.180)	(0.0390)	(0.191)	(0.0448)
Distance	-0.368***	-0.225***	-0.364***	-0.231***
	(0.0854)	(0.0217)	(0.0905)	(0.0240)
$Distance^2$	0.0324***	0.0217***	0.0326***	0.0223***
	(0.0106)	(0.00262)	(0.0111)	(0.00283)
Temperature	0.00309	-0.00110	-0.00446	-0.00145
	(0.0114)	(0.00280)	(0.0117)	(0.00274)
Precipitation	-0.00517	-0.0127	0.0337	-0.00954
	(0.0815)	(0.0189)	(0.0867)	(0.0203)
$\ln(Habit_H)$	0.443***	0.0537	0.415***	0.0732
	(0.0850)	(0.102)	(0.153)	(0.103)
$\ln(Habit_A)$	0.517***	0.314***	0.520***	0.324***
	(0.0786)	(0.0230)	(0.0861)	(0.0264)
$Promotion_H$	0.473	-0.266	1.171	-0.0956
	(1.190)	(0.503)	(1.395)	(0.363)
$Promotion_A$	2.208*	1.136***	1.854	1.168***
	(1.141)	(0.270)	(1.244)	(0.289)
$Relegation_H$	-3.987	4.118*	-1.314	4.441*
	(3.249)	(2.106)	(3.880)	(2.664)
$Relegation_A$	-3.732	-1.883**	-2.922	-1.947**
	(3.439)	(0.792)	(3.778)	(0.879)
$\ln(Habit_H) \times Promotion_H$	0.00190	0.0373	-0.0814	0.0188
	(0.147)	(0.0568)	(0.174)	(0.0455)
$\ln(Habit_A) \times Promotion_A$	-0.230	-0.115***	-0.188	-0.118***
	(0.141)	(0.0335)	(0.156)	(0.0360)
$\ln(Habit_H) \times Relegation_H$	0.393	-0.446*	0.109	-0.484*
	(0.352)	(0.233)	(0.421)	(0.292)
$\ln(Habit_A) \times Relegation_A$	0.366	0.184**	0.282	0.190**
	(0.371)	(0.0863)	(0.410)	(0.0952)
Home Broadcasts			4.207	
			(5.749)	
Home $Broadcasts^2$			-7.984	
			(6.759)	

ln(Habit$_H$) × Home Broadcasts			-0.351	
			(0.672)	
ln(Habit$_H$) × Home Broadcasts^2			0.833	
			(0.781)	
Intercept	-6.310***	6.687***	-6.312***	6.496***
	(1.368)	(0.899)	(1.735)	(0.926)
Season dummies	Yes	Yes	Yes	Yes
Home team dummies	No	Yes	No	Yes
R^2 / Wald χ^2	44.62***			
ρ	0.72		0.81	
N	1,138		1,138	

Note. Variable descriptions are provided in Table 3. One of 30 home team dummies omitted to prevent collinearity (with *Reserve$_H$*). Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. Rho reports the correlation between the two regressions' error terms.

Table A2. OLS and ETR results for games broadcasted live on TV only.

	OLS	ETR	
Dependent variable	ln(Attendance)	TV	ln(Attendance)
TV	0.0555***		-0.322***
	(0.0194)		(0.0386)
Weekday	-0.0885***	-0.673***	-0.135***
	(0.0314)	(0.167)	(0.0327)
TV × Weekday	-0.0581		-0.118**
	(0.0591)		(0.0562)
Bundesliga	-0.105***	0.604***	-0.0309
	(0.0233)	(0.103)	(0.0270)
Matchday	-0.0298***	-0.121***	-0.0369***
	(0.00619)	(0.0299)	(0.00696)
Matchday^2	0.000680***	0.00292***	0.000883***
	(0.000143)	(0.000687)	(0.000162)
Performance$_H$	0.0140***	0.0152	0.0159***
	(0.00328)	(0.0156)	(0.00377)
Performance$_A$	0.00597*	0.0125	0.00792**
	(0.00335)	(0.0143)	(0.00367)
Homewin	-0.0227***	-0.0837***	-0.0298***
	(0.00647)	(0.0270)	(0.00712)
Homewin^2	0.000206***	0.000696***	0.000265***
	(5.37e-05)	(0.000229)	(5.99e-05)
Reserve$_H$	-1.483***	-2.217***	-1.448***
	(0.215)	(0.626)	(0.222)
Reserve$_A$	0.124***	-0.159	0.112***
	(0.0344)	(0.180)	(0.0390)
Distance	-0.187***	-0.490***	-0.232***
	(0.0189)	(0.0913)	(0.0216)
Distance^2	0.0182***	0.0492***	0.0229***
	(0.00231)	(0.0112)	(0.00260)
Temperature	-0.000913	-0.00932	-0.00216
	(0.00250)	(0.0117)	(0.00279)
Precipitation	-0.0154	-0.0725	-0.0147
	(0.0172)	(0.0817)	(0.0189)
ln(Habit$_H$)	-0.00635	0.620***	0.0954
	(0.106)	(0.153)	(0.0974)
ln(Habit$_A$)	0.258***	0.605***	0.319***
	(0.0192)	(0.0815)	(0.0219)
Promotion$_H$	-0.134	3.937***	0.0476
	(0.507)	(1.372)	(0.473)
Promotion$_A$	0.944***	3.127***	1.336***
	(0.241)	(1.156)	(0.274)
Relegation$_H$	4.830**	2.501	5.150**
	(2.082)	(3.187)	(2.118)
Relegation$_A$	-1.566**	-1.374	-1.749**

	(0.694)	(3.544)	(0.812)
ln(Habit$_H$) × Promotion$_H$	0.0121	-0.415**	-0.000624
	(0.0567)	(0.165)	(0.0538)
ln(Habit$_A$) × Promotion$_A$	-0.0966***	-0.337**	-0.140***
	(0.0302)	(0.144)	(0.0341)
ln(Habit$_H$) × Relegation$_H$	-0.520**	-0.306	-0.561**
	(0.230)	(0.345)	(0.235)
ln(Habit$_A$) × Relegation$_A$	0.153**	0.112	0.168*
	(0.0761)	(0.384)	(0.0887)
Home Broadcasts		8.940	
		(6.487)	
Home Broadcasts²		-13.06*	
		(6.779)	
ln(Habit$_H$) × Home Broadcasts		-0.793	
		(0.739)	
ln(Habit$_H$) × Home Broadcasts²		1.274*	
		(0.770)	
Intercept	7.329***	-7.345***	6.329***
	(0.918)	(1.747)	(0.862)
Season dummies	Yes	Yes	Yes
Home team dummies	Yes	No	Yes
R^2 / Wald χ^2	0.90	64.18***	
ρ		0.78	
N	1,138	1,138	

Note. Variable descriptions are provided in Table 3. Robust standard errors in parentheses. One of 30 home team dummies omitted to prevent collinearity (with *Reserve$_H$*). Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. Rho reports the correlation between the two regressions' error terms.

Table A3. ETR results for interactions with *Bundesliga* and *Temperature*.

	ETR		ETR	
Dependent variable	Broadcast	ln(Attendance)	Broadcast	ln(Attendance)
Broadcast		-0.389***		-0.272***
		(0.0471)		(0.0559)
Weekday	-0.371***	-0.139***	-0.363***	-0.135***
	(0.137)	(0.0321)	(0.135)	(0.0310)
Broadcast × Weekday				
Bundesliga	0.394***	-0.0888***	0.389***	-0.0435*
	(0.102)	(0.0333)	(0.102)	(0.0254)
Broadcast × Bundesliga		0.0944***		
		(0.0346)		
Matchday	-0.0415	-0.0319***	-0.0411	-0.0310***
	(0.0305)	(0.00693)	(0.0305)	(0.00695)
Matchday²	0.00121*	0.000773***	0.00120*	0.000751***
	(0.000701)	(0.000160)	(0.000703)	(0.000161)
Performance$_H$	0.000497	0.0144***	-0.00105	0.0145***
	(0.0153)	(0.00381)	(0.0153)	(0.00384)
Performance$_A$	0.0189	0.00862**	0.0182	0.00855**
	(0.0142)	(0.00374)	(0.0142)	(0.00373)
Homewin	-0.0474*	-0.0277***	-0.0502*	-0.0275***
	(0.0273)	(0.00749)	(0.0272)	(0.00733)
Homewin²	0.000392*	0.000248***	0.000417*	0.000247***
	(0.000230)	(6.25e-05)	(0.000228)	(6.14e-05)
Reserve$_H$	-1.424***	-1.571***	-1.404***	-1.540***
	(0.346)	(0.233)	(0.347)	(0.224)
Reserve$_A$	-0.296*	0.0907**	-0.302*	0.0834**
	(0.179)	(0.0392)	(0.178)	(0.0394)
Distance	-0.373***	-0.226***	-0.371***	-0.225***
	(0.0870)	(0.0215)	(0.0870)	(0.0215)
Distance²	0.0328***	0.0218***	0.0327***	0.0217***
	(0.0108)	(0.00262)	(0.0108)	(0.00261)

Temperature	0.000334	-0.00132	-0.000782	0.00201
	(0.0115)	(0.00281)	(0.0115)	(0.00343)
Broadcast × Temperature				-0.00636**
				(0.00272)
Precipitation	-0.0152	-0.0136	-0.0126	-0.0135
	(0.0812)	(0.0190)	(0.0813)	(0.0190)
ln($Habit_H$)	0.538***	0.0668	0.543***	0.0830
	(0.137)	(0.103)	(0.139)	(0.103)
ln($Habit_A$)	0.531***	0.313***	0.528***	0.313***
	(0.0791)	(0.0229)	(0.0789)	(0.0229)
$Promotion_H$	1.038	-0.302	1.066	-0.311
	(1.217)	(0.494)	(1.215)	(0.493)
$Promotion_A$	2.258**	1.165***	2.267**	1.186***
	(1.117)	(0.269)	(1.121)	(0.266)
$Relegation_H$	-3.008	4.167*	-3.091	4.677**
	(3.273)	(2.223)	(3.296)	(2.190)
$Relegation_A$	-4.295	-1.908**	-4.175	-1.887**
	(3.363)	(0.794)	(3.367)	(0.797)
ln($Habit_H$) × $Promotion_H$	-0.0685	0.0424	-0.0718	0.0454
	(0.149)	(0.0558)	(0.149)	(0.0556)
ln($Habit_A$) × $Promotion_A$	-0.237*	-0.118***	-0.239*	-0.122***
	(0.139)	(0.0335)	(0.139)	(0.0330)
ln($Habit_H$) × $Relegation_H$	0.294	-0.453*	0.304	-0.511**
	(0.354)	(0.246)	(0.357)	(0.242)
ln($Habit_A$) × $Relegation_A$	0.426	0.187**	0.414	0.184**
	(0.364)	(0.0865)	(0.364)	(0.0868)
Home Broadcasts	14.51***		14.79***	
	(5.278)		(5.302)	
Home Broadcasts^2	-18.81***		-19.14***	
	(5.917)		(5.945)	
ln($Habit_H$) × Home Broadcasts	-1.535**		-1.562***	
	(0.602)		(0.605)	
ln($Habit_H$) × Home Broadcasts^2	2.040***		2.074***	
	(0.672)		(0.675)	
Intercept	-7.035***	6.630***	-6.975***	6.415***
	(1.667)	(0.912)	(1.674)	(0.908)
Season dummies	Yes	Yes	Yes	Yes
Home team dummies	No	Yes	No	Yes
R^2 / Wald χ^2	55.11***		52.66***	
ρ	0.75		0.74	
N	1,138		1,138	

Note. Variable descriptions are provided in Table 3. Robust standard errors in parentheses. One of 30 home team dummies omitted to prevent collinearity (with $Reserve_H$). Significance levels: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. Rho reports the correlation between the two regressions' error terms.

6 Discussion

The previous chapter presented the empirical part of this dissertation. All three studies provide evidence on local and nonlocal competition and reveal new insights into substitution effects between and within sports. In the following chapters, the central findings are summarised (Chapter 6.1), and theoretical, methodological (Chapter 6.2), and practical implications (Chapter 6.3) are discussed. Finally, limitations of the presented studies and possible future research avenues are outlined (Chapter 6.4).

6.1 Central findings

The three studies included in this dissertation employ game-level attendance data in German sports leagues in order to test substitution in attendance demand. While Study 1 and Study 3 look at lower division football and substitution either within the same sport (competition to top-tier football) or within the same game, Study 2 considers top-tier leagues in handball, basketball, and ice hockey and substitution effects from professional football, that is, substitution between sports is analysed.

First of all, substitution in attendance is detected by all three studies, suggesting the presence of economic competition within and between sports (leagues) as well as negative consequences from broadcasting games. Thus, the first part of the central research question raised in Chapter 1, that is, whether (semi-) professional sports clubs face substitution in attendance demand, is consistently answered by all three studies.

Moreover, the second part of the central question (to what extent is attendance demand affected by substitution?) was particularly elaborated by employing sophisticated substitution measures. For instance, substitution effects in German leagues are found to unfold when spatial and temporal dimensions are taken into account simultaneously. In this regard, within the setting of fourth division football, nearby domestic first or second division football league games played on the same day cause, on average, a 10.5 percentage points decrease in attendance. Moreover, findings for the other top-tier leagues reveal that each additional day between a HBL (BBL) [DEL] game and the temporally closest game of the nearest first or second division football competitor leads to an increase in attendance by 0.4 (0.3) [0.5] percentage points. In other words, comparably larger substitution effects are found for games with comparably closer temporal proximity.

Considering nonlocal substitution effects, findings of the studies suggest that domestic league games constitute substitutes, that is, attendance of fourth (third) division football games decreases by 18.9 (4.6) percentage points on average when first division football games are concurrently broadcasted live. Likewise, findings of the studies also reveal that international top-tier club competitions constitute substitutes. In this regard, concurrently broadcasted UEFA Champions League games decrease attendance demand in fourth division football by 14.1 percentage points on average. Interestingly enough, the magnitude of substitution effects caused by concurrent UEFA Champions League games appears to be affected by temperatures on game days with regard to the BBL and DEL.[25]

By explicitly comparing different estimation methods and employing proper econometric modelling techniques, this dissertation provides possible explanations on inconclusive findings of previous studies. In this regard, findings on third division football, focussing on substitution from broadcasting the same game live on TV or online stream, reveal a negative impact on attendance demand by about 34 percentage points on average. Moreover, the substitution effect appears to be greater when broadcasted games are played during the week. Finally, testing shifts in game attendance to subsequent (non-broadcasted) games, findings reveal an increase of 7.7 percentage points on average if the previous home game was broadcasted live. However, this increase in attendance does not overcompensate the estimated decrease of attendance by previous substitution.

Summing up and answering the central research question, the findings of this dissertation show that sports leagues and clubs indeed face substitution in attendance demand. These effects are found with regard to an idiosyncratic setting where professional football overshadows the demand of lower football divisions and other top-tier leagues. In

[25] While competition to concurrently broadcasted first division football games is not analysed in Study 2 (i.e., substitution in HBL, BBL and DEL), competition to concurrently broadcasted UEFA Champions League games is not examined in Study 3 (i.e., substitution in third division football).

this regard, these results suggest that within the European system (operating with sporting promotion and relegation facilitating the existence of several clubs within a certain region), local competition causes sizeable substitution effects adversely affecting attendance. Compared to local substitution, nonlocal substitution (i.e., concurrently played games broadcasted live) appears to impact attendance by even greater effect sizes. Moreover, compared to fourth division football clubs, third division football clubs are found to be considerably less affected by competition to top-tier football. Finally, substitution takes place not only between clubs and leagues but also within the same game, that is, broadcasting a game live on TV or online stream. The inconclusive empirical evidence in this regard is unravelled by utilising the setting in Germany where lower division games are frequently broadcasted live nation-wide and free-to-air.

6.2 Theoretical and methodological implications

This dissertation contributes to the recent state of research in several ways (based on the research gaps identified within the literature review of this dissertation; see Chapter 3.4). The three studies conducted within the scope of this work provide empirical evidence on substitution type I, II, and IV.[26] Theoretical and methodological implications arise when considering the findings on substitution with regard to attending one instead of the other game live in the venue, attending a game live in the venue or watching *another* game live on broadcast, and attending a game live in the venue or watching the *same* game live on broadcast.

First, considering the choice to either attend one or the other game live in the venue, this dissertation extends the scarce empirical evidence on local substitution within and between sports in the European setting.[27] While previous studies, largely examining North American sports, predominantly focused on the pure presence of other competitors in the same area, a main objective of this work is to implement sophisticated substi-

[26] Findings of the three studies conducted suggest the presence of sizable substitution effects in European leagues with regard to substitution type I, II and IV, whereas the scope of this dissertation did not allow to test substitution type III.

[27] Study 2 is even the first to empirically test substitution type II, that is, substitution between sports in a European setting.

tution measures. In this regard, the studies conducted take into account spatial proximity and temporal overlaps of substitute games simultaneously. The novel measure employed within Study 1 examines games of nearby competitors played on the same day, suggesting that local substitution takes place when consumers are given the choice to attend either one or the other game. The further developed measure of Study 2 covers, in addition to this, intertemporal consumption plans of sports fans by taking into account nearby substitute games that overlap temporarily within a certain time frame, that is, several days before and after the game of interest. The statistical significance found with regard to both substitution measures suggests that analysing merely either spatial or temporal dimensions appears to be insufficient when attempting to describe the relevance of local substitution. Compared to American sports leagues, substitution arising from nearby competitors may be even more consequential in European leagues due to the absence of territorial restrictions, thus facilitating the existence of several clubs within regions.

Second, our findings confirm previous evidence on attending a game live in the venue or watching another game live on broadcast with regard to competition with *international* club competitions (i.e., UEFA Champions League games). While previous studies examined substitution within the same sport, that is, football, Study 2 is the first to analyse such substitution effects (substitution from international competitions broadcasted live) between sports in the European setting. In addition to this, the findings of Study 1 and Study 3 reveal the importance of considering competition with *domestic* club competitions (within the same sport) as previously neglected in empirical research with regard to European sports. Thus, competition to both domestic and international competitions must be taken into account when analysing substitution in attendance demand.

Third, with regard to the decision to either attend a game live in the venue or watch the same game live on broadcast, findings of Study 3 highlight the relevance of adequately controlling for non-random selection of broadcasted games. While previous studies predominantly neither mentioned nor explicitly considered potential selection bias, Study 3 suggests future studies to test for potential endogeneity when analysing substitution in this setting. Moreover, this study reveals evidence for postponing attendance demand. While empirical research, so far, neglected any shifts in demand to subsequent (non-broadcasted) games, overall adverse effects on attendance from substitution seem to reduce when considering these shifts and analysing this relationship more comprehensively. Finally, when examining substitution effects, the measures employed need to be updated to the course of time. This means, by utilising data on online streaming, changes over time in consumer demand due to emerging technologies must be taken into account.

6.3 Practical implications

The findings presented in the studies of this dissertation offer valuable insights for several stakeholders of the sports industry, such as clubs, leagues, or media companies.[28] First of all, the findings reveal that different sports leagues and their clubs in Germany indeed operate (at least to a certain extent) in the same market. While professional sports leagues (theoretically) constitute natural monopoly providers, the findings reveal that "no club is a monopoly in an absolute sense" (Forrest, Simmons & Feehan, 2002, p. 336). Beside certain fans with exclusive loyalty to their favourite club or disinterest with regard to alternative sports (leagues), the findings suggest that at least some neutral spectators are generally willing to substitute one game for another. Thus, club managers and league officials are advised to take economic competition with other clubs and leagues into consideration when developing any competitive strategies.[29]

Within the (European) sports industry, dominant top-tier football leagues hold economic power compared to lower football divisions and top-tier leagues in other sports. In this regard, professional football in Europe has considerably extended their portfolio during recent years. The already massive appeal among sport consumers was expended during recent years by introducing staggered kick-off times, adopting weekday slots, and introducing new competitions. While league officials and managers in smaller leagues al-

[28] Some of the following implications were already discussed in the respective studies of Chapter 5. They are again included in this chapter to assure a comprehensive overview.

[29] Apart from the central findings with regard to substitution effects, the studies conducted detect several variables affecting attendance demand, potentially triggering discussions about further managerial implications. For instance, while club managers in lower divisions in Germany critically discuss about the perceived unattractiveness of reserve teams in lower divisions, these teams, however, generate significant higher attendance figures on the road as found in Study 1 and Study 3.

ready claimed to suffer from an intensified competition for fan interests, it seems reasonable, based on sizable substitution effects found in this dissertation, to modify competition formats, matchday schedules, and kick-off times in order to avoid any competition to professional football. For instance, matchdays of professional and semi-professional (domestic) sports leagues are frequently scheduled on Fridays, Saturdays, and Sundays, causing many overlapping games between leagues. Moreover, since the season schedules of such leagues begin and end more or less at the same time of the year with no games taking place during the summer break, league officials may want to take advantage of these weeks if (supposed) competition to international tournaments (such as Olympic Games) can be avoided. Finally, considering competition within the same sport, league officials may be advised to implement direct compensation payments to lower divisions since top-tier football leagues benefit from talent that was formerly developed by these lower division clubs. In this way, top-tier leagues can continue to expand commercialisation strategies and support lower divisions at the same time.

Increasing the number of games broadcasted live in order to open up new markets and enhance demand (in the long run) might not be advisable for clubs if additional broadcasting revenues or supposed positive long-term marketing effects do not exceed predicted losses in ticket revenues (in the short run). Likewise, a high share of broadcasted games (or even total coverage) of a certain competition may also adversely affect media companies' interests. For instance, while broadcasting reduces attendance, the broadcast of a game may become less attractive since spectators constitute an appealing part of the product offered on TV (online stream). Moreover, "broadcasters seek to broadcast the matches with the greatest potential audience first, eventually the incremental audience arising from an additional match diminishes as the number of matches that are telecast grows" (Noll, 2007, p. 407).

Finally, defining markets is crucial for developing antitrust policies in any industry. In this regard, findings of this dissertation reveal that authorities are well advised to depart from a single-sport perspective when evaluating regulatory policies within the sports industry since clubs compete with each other *across* sports. Apart from competition for fan interests, sports (leagues) may also compete for further sports capital such as broadcasting revenues or ownerships.

6.4 Limitations and future research

There are some limitations to the research conducted in this dissertation. In this regard, four major limitations are discussed in the following. Based on these discussions, implications for future research avenues are presented.

First, Study 1 and Study 2 show that football clubs constitute competitors when they are located nearby. While substitution effects are found for clubs competing with *one* nearby football competitor, there may be *more* (than one) local substitutes from professional football (because of high densities of professional football clubs in certain regions) causing adverse effects on attendance. Therefore, there is reason to assume a downward bias of substitution effects found in the studies presented due to a rather narrow definition of nearby substitutes. Future studies may want to examine the impact of several local competitors simultaneously.

Second, while substitution to top-tier football seems obvious due to the supremacy of this sport in European countries (as described in Chapter 5), it at least appears reasonable to give serious consideration on the issue that substitution may also arise from other sports (leagues). If the leagues examined in this dissertation also compete with other leagues not considered in the studies conducted, there is reason to assume a downward bias of substitution effects. Thus, it may be a promising future research avenue to gain insights whether substitution can be confirmed or declined for other sports and leagues in the European setting.

Third, some spectators might deliberately shift their attendance to those games not overlapping with substitute games/ not broadcasted live on TV (online stream). In this case, individual game attendance is affected in the short term, however, the average attendance is unaffected in the long term. While Study 3 explicitly attempts to tackle any shifts in demand for broadcasted games, there may be an upward bias of substitution effects in Study 1 and Study 2. Consequently, approximating the actual sizes of consumers shifting attendance would be insightful.

Fourth, while game-level attendance data are employed in the three studies, more disaggregated attendance data may provide significant insights where substitution effects unfold. Such data might include information on the demand for specific price categories (e.g., business seats, regular seats, standings, etc.) or differentiation between single tickets purchasers and season ticket holders. Thus, future research may want to examine to what extent the demand for distinct price categories and ticket types are affected differently (in effect sizes).

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