Firm Survival in Professional Sports: Evidence from the German Football League

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Abstract

This paper investigates firm survival in professional football, arguing that the relegation and promotion system in football leagues is very similar to firm exits and entries in traditional goods and service markets. Empirically, we use a dataset containing information on how long football teams have participated in the German Premier League over the playing seasons 1981-82 to 2009-10. Controlling for club and market specific characteristics, such as a team's budget or its player composition, our findings suggest that younger firms are systematically exposed to higher risks of market exit in professional football, which is often referred to as 'liability of newness' in industrial organization.

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Keywords: Firm survival, liability of newness, duration analysis, sports leagues, relegation.

1 Introduction

A major difference between American and European sports leagues is that the former ones are closed in the sense that league members remain the same season after season. European leagues, in contrast, are characterized by a system of relegation and promotion, implying that the best teams from lower-tier leagues are promoted into upper-tier ones after each season; at the same time, the worst teams from upper-tier leagues are relegated into lower-tier ones. Some authors argue that the promotion and relegation system might have contributed substantially to the attractiveness of European sports leagues, and especially to European football (see, e.g., Szymanski 2006, Jasina and Rotthoff 2010). It has been further shown that teams in open leagues spend more on higher talents and are, therefore, less profitable than teams in closed leagues (see, e.g., Noll 2002, Ross and Szymanski 2002, Jasina and Rotthoff 2010).

From an economic perspective, the relegation and promotion system in European sports leagues is strikingly similar to firm exits and entries in conventional goods and service markets. With regard to the survival probability of firms in these markets, the literature on industrial organization and on small business economics *inter alia* has pointed out that firm age crucially affects a firm's survival probability, which is often referred to as '*liability of newness*' (see Stinchcombe 1965, Freeman, Carroll and Hannan 1983).[1] Accordingly, younger firms exhibit relatively high hazard probabilities, suggesting that they tend to exit the market more quickly than their older counterparts.[2] Such patterns are typically explained by theories from or-

[1]See Geroski (1995), Caves (1998) for excellent surveys on firm growth as well as on firm exit and entry. Manjón-Antolín and Arauzo-Carod (2008) provide a comprehensive survey on the empirical firm survival literature.

[2]For empirical evidence, see, e.g., Mata and Portugal (1994), Agarwal, Sakar and Echambadi (2002), Mata and Portugal (2002), Disney, Haskel and Heden (2003), Esteve Pérez, Sanchis Llopis and Sanchis Llopis (2004), Thompson (2005), or Geroski, Mata and Portugal (2010).

ganizational sociology (see Freeman et al. 1983), information cost theories (see Geroski 1995) or path dependent learning theories as proposed by Jovanovic (1982) or Ericson and Pakes (1995). However, one potential caveat of previous empirical research on firm survival is the measurement of market exit, which is typically taken for granted if a firm did not respond to a business survey (see, e.g., Mata and Portugal 2002, Geroski et al. 2010) or if it was not recorded in the official census for a time (see, e.g., Disney et al. 2003). In both cases, one does not necessarily measure firm exit, and the empirical analysis on firm survival might be ridden by a measurement error. In professional football, by way of contrast, we are able to precisely determine the point of time where a club is relegated into a lower-tier league, and this, in turn, allows to infer whether the measurement issue in previous studies is substantial or not.

This paper assesses whether a liability of newness can be observed in professional football, relying on a dataset from the German Football League (*'Bundesliga'*) between the playing seasons 1981-82 and 2009-10 (29 seasons). To investigate how many seasons a football team participates in the highest league and which determinants are most influential to explain a team's time-to-failure (i.e., relegation to the subsequent league),[3] we estimate a (parametric) hazard model including a team's 'newcomer' status along with club and market specific characteristics, such as its financial situation, a team's player composition (i.e., average team age, share of foreign players) or the local market concentration as measured by the number of clubs in the First Bundesliga within a specific geographic area.[4] Applying this framework, we follow a growing literature in industrial organization arguing that professional sports leagues are generally comparable to other, more conventional industries (see, e.g., Palomino and Sákovics 2004, Cyrenne 2009), being also

[3]In the following, we refer to these leagues as '*First Bundesliga*' and '*Second Bundesliga*' to distinguish relegation (promotion) from the highest (subsequent) league into the subsequent (first) league. Both leagues are subsumed under '*Bundesliga*'.

[4]To our knowledge, Dherbecourt and Drut (2009), analyzing promotion and relegation in four European football leagues between 2005-05 and 2008-09 in general, is the only contribution that might be regarded as similar to ours. Compared to this study, however, we provide an in depth analysis of one European league applying duration analysis for a much longer time period, apart from the fact that we are interested in one specific aspect of the relegation and promotion system, i.e., whether there is a liability of newness in professional football or not.

aware of the fact that there are some distinctive characteristics of football markets that should be accounted for in an empirical analysis of firm survival in professional football. For instance, football leagues exert a predefined entry and exit rate, and there also exists a considerable chance to re-enter the market (league). In our empirical application, we explicitly account for such differences incorporating the recent performance 'history' of a football club (e.g., number of re-entries, overall survival time or past performance).

Our findings suggest that liability of newness applies to our sample of German football teams. Moreover, a team re-entering the market more frequently tends to exhibit a shorter survival time. Apart from that, we observe that the time-to-failure is significantly affected by a team's economic environment (i.e., a team's budget and the thickness of the local market), its performance in previous seasons and team specific determinants, such as the age of the team members or the share of foreign players. This, in turn, suggests that a football team in the First Bundesliga is able to increase its survival probability, irrespective of whether it is exposed to a liability of newness or not. In qualitative terms, our findings are well in accordance with previous studies on conventional goods and service markets, indicating that the above mentioned measurement issues do not count too much in these contributions.

The paper is organized as follows. In the next section, we describe the institutional background behind the relegation and promotion system in the Bundesliga. There, we also discuss briefly the similarities and differences to firm entry and exit in conventional goods and service markets. In Section 3, we introduce the data and provide some descriptive statistics. Section 4 lays out a parametric hazard model to analyze the survival probability of football teams in the First Bundesliga; it further presents the empirical results and some sensitivity checks. Finally, Section 5 concludes.

2 The Promotion and Relegation System in the Bundesliga

The Bundesliga has been founded in 1963, and in terms of public perception, it is comparable to the *Premier League* in England, the *Primera División* in

Spain and Italy's *Seria A*. With an average of 41,466 spectators in the playing season 2008-09, it outperforms the average attendance rates of all other European football leagues (an average Premiere League game, for example, is attended by 35,341 spectators; see Kuper and Szymanski 2009).

In each of the 29 observed seasons from 1981-82 to 2009-10, the First Bundesliga consists of 18 teams. Each team has to play against each other, once at home and once away. This gives a total of 34 games for each team in each season. The only exception is the season 1991-92, where the German reunification made it necessary to integrate the leagues of the former German Democratic Republic into the Bundesliga, leading to an increase in the number of participating teams to 20 (with 38 rounds to play for each team in that season).

The worst performing teams of the First Bundesliga are relegated into the Second Bundesliga at the end of each season, and the most successful ones of the Second Bundesliga are promoted into the First Bundesliga. With regard to the number of relegated and promoted teams, one has to distinguish between three relegation schemes in our sample period. First, between 1981-82 and 1990-91 and from 2008-09 onwards, the worst (best) two teams of the First (Second) Bundesliga are relegated (promoted) directly into the Second (First) Bundesliga. The third best team of the Second Bundesliga has to play two relegation games against the third worst team of the First Bundesliga, and the winning team is permitted to play in the First Bundesliga in the subsequent season. Second, in order to reduce the number of participating teams back to 18 in 1991-92, only the best two teams of the Second Bundesliga were promoted, while the worst four teams of the First Bundesliga were relegated into the Second Bundesliga. Finally, from the early 1990s until 2007-08 the three teams at the top (bottom) of the table of the Second (First) Bundesliga were promoted (relegated) into the First (Second) Bundesliga at the end of a season.

The relegation and promotion system in football is strikingly similar to market exit and entry in conventional markets, with two very distinctive exceptions. First, while there is a pre-defined number of relegated and promoted clubs in football after each season, traditional markets are less static in the sense that the number of firms that have to leave or join the market is not defined a priori. Second, and perhaps more important, exit in conventional markets is typically associated with bankruptcy and, therefore, firms often have to leave the market forever. In football, by way of contrast, a club that is relegated into a lower-tier league only changes its market, and in this sense market exit is associated with a (potentially) temporary abandonment from the upper-tier league, giving the opportunity of market re-entry after performing well in the lower-tier league.[5] In our empirical analysis below, we address this issue by including the number of promotions (re-entries) and by investigating explicitly the number of re-exits as a robustness exercise.

3 Data

3.1 Data description

To investigate firm survival in professional football, we rely on a dataset on the First Bundesliga established by Oberhofer, Philippovich and Winner (2010). It covers 42 football teams playing at least one season in the First Bundesliga within the time period 1981-82 to the most recent season 2009-10. For each season, the dataset allows to identify the clubs that are promoted (relegated) into the First (Second) Bundesliga. We also record the number of years a team has participated in the First Bundesliga before the season 1981-82 and since the foundation of the Bundesliga (which is 18 seasons at the maximum). Further, we include information on a club's year of foundation, its annual budget, its performance as measured by the end of season points, the (average) geographic distance to all other clubs in the First Bundesliga, the number of re-entries during the observed period, as well as team specific characteristics, such as the average player's age and a team's share of foreign players.

The following data sources are used to complement the dataset of Oberhofer et al. (2010): Information on relegation and promotion is taken from the online sources `http://www.f-archiv.de` and `http://t-online.sport-dienst.de/vereine/`; financial figures are obtained from *Welt am Sonntag* and `http://t-online.sport-dienst.de`; geographical distance is calcu-

[5]For instance, Kuper and Szymanski (2009) and Szymanski (2010) have illustrated that about 97 percent of all football clubs in the four highest English football leagues in 1923 still existed in 2008.

lated using *google maps* (`http://maps.google.de`); the clubs' year of foundation is published in Gruene and Karn (2009) and at `www.bundesliga.de`.

3.2 Descriptive statistics

Our variable of interest, the duration of firm survival, is measured as a team's number of consecutive years after promotion into the First Bundesliga. It ends with the relegation into the Second Bundesliga or with the end of the observed time frame. Each re-entry of a team is counted as an additional participation, which is considered as independent from the previous durations.

Figure 1 plots the survival function of all teams in the First Bundesliga between 1981-82 and 2009-10. It displays the probabilities of surviving beyond a specific number of seasons according to a Kaplan-Meier (blue line) or a Nelson-Aalen (red line) estimator. For instance, Figure 1 shows that the probability of staying more than two years in the First Bundesliga after promotion amounts to about 55 to 60 percent, implying that a substantial part of the teams (around 40 or 45 percent) are relegated into the Second Bundesliga only after a few years. After two seasons, the survival function declines very steeply to a value of 20 to 23 percent for staying more than eleven seasons in the First Bundesliga. Then, it becomes relatively smooth reaching a value of around 12 to 15 percent after 33 seasons, and, after a sharp decline within two seasons, it ends up with a surviving probability of less than 10 percent to stay consecutively in the First Bundesliga for 35 seasons or more. Overall, Figure 1 clearly indicates that the hazard rate is relatively high in the first two seasons after promotion into the First Bundesliga. Based on this evidence, we later on define a newcomer as a team being one or two years in the market (First Bundesliga).

*** Figure 1 about here ***

Further characteristics of the football teams covered in our sample are provided in Table 1, where the teams are sorted in ascending order according to their maximum appearance in the First Bundesliga (Table A1 provides a correlation matrix for all variables used in the empirical analysis). Column

1 reports the maximum number of years a team has stood in the First Bundesliga. Accordingly, the maximum duration of participation is less than 10 years for 23 out of 42 teams, while only 9 teams consecutively survived more than 30 years. Perhaps surprising, there is only one team (*Hamburger SV*) that has participated in the First Bundesliga in all seasons since its formation in 1963.

Column 2 of Table 1 reports how often a team has been relegated into the Second Bundesliga within the sample period. Only eight teams were never relegated into the Second Bundesliga, while there are two teams (*MSV Duisburg* and *VFL Bochum*) that were relegated six times during the last 29 seasons. Similarly, column 3 shows the number of entries (including re-entries) in the First Bundesliga. We observe four teams with zero entries (*Bayer Leverkusen*, *VfB Stuttgart*, *Bayern Munich* and *Hamburger SV*), implying that these teams were in the First Bundesliga in 1981-82 and never dropped out since then; three teams experienced five promotions into the First Bundesliga (*1. FC Nuernberg* as well as the teams with six relegations mentioned before). According to columns 2 and 3, the First Bundesliga seems to be characterized by a small number of teams with relatively frequent market entries and exits. On the other hand, there is a considerable number of teams that were never relegated into the Second Bundesliga, especially in the group of teams with a relatively long participation in the First Bundesliga. To some extent, this might be explained by learning effects. We will come back to this issue when discussing our estimation results below.

*** Table 1 about here ***

Columns 4 to 8 summarize additional team characteristics used as control variables in the subsequent empirical analysis. Column 4 illustrates a team's annual budget, related to the average annual budget of all teams in the First Bundesliga. Apparently, there is a systematic distribution of financial resources to the right, implying that the majority of teams dispose of (relatively) low budgets, while only a few teams are very well endowed with financial resources (e.g., *Borussia Dortmund* and, in particular, *Bayern Munich*). Comparing the entries in column 5 with the ones in column 1 indicates that teams with relatively low financial resources are staying systematically shorter in the First Bundesliga than teams with higher budgets, and, within the group of longer staying teams (say, more than ten seasons), it seems that the frequency of exits is negatively related to a club's financial inputs.

Column 5 informs about the performance of the teams during their participation in the First Bundesliga. Specifically, we calculate the annual gap between a team's end of the season score and the corresponding score of the first team that has been relegated (not promoted) into the Second (First) Bundesliga. Column 5 provides average figures of this performance measure. For example, *Bayern Munich* achieved, on average, approximately 28 points more than the first team to be relegated into the Second Bundesliga, while *Alemannia Aachen*, in its only season of promotion in 2006-07, was 9 points ahead of the first team not to be promoted into the First Bundesliga. Interestingly, column 5 reveals that the average gap to a relegation position is always above 10 points for the group of teams that never have been relegated from 1981-82 to 2009-10, implying that these teams never faced a serious relegation threat during their participation in the First Bundesliga.

Column 6 reports the average local market concentration in the First Bundesliga. In particular, we count the number of a team's competitors in the First Bundesliga located within a geographical distance of 100 kilometers. For example, *Alemannia Aachen*, in its sole participation season, was faced with two competing clubs within a range of 100 kilometers (*Borussia Moenchengladbach* with 64 kilometers and *Bayer Leverkusen* with 80 kilometers). On average, a club is confronted with about two clubs in the local market, ranging from zero (e.g., *Stuttgarter Kickers*) to about seven competitors (*Fortuna Duesseldorf* and *Wattenscheid 09*).

Finally, Table 1 accounts for a recent strand of research emphasizing the role of employee characteristics on firm survival (see, e.g., Mata and Portugal 2002, Weber and Zulehner 2010). In this regard, we report a team's average share of foreign, non-German players (column 7) and the average players' age of a team (column 8). Accordingly, we observe an average share of foreign players of about 27 percent, with a minimum of four percent and a maximum of 62 percent;[6] the average age of a team is around 26 years, lying

[6]Notice that the share of foreign players increased drastically over the course of the years, which is due to the Bosman ruling in 1995 that brought a liberalization of the market for football players. Before the Bosman ruling, clubs in the First Bundesliga were allowed to appoint only three non-German players at a game. Afterwards, they basically had no such restriction with regard to foreign players from countries of the Union of European

within a relatively small range of about 24 years (*TSG 1899 Hoffenheim*) and around 29 years (*SpVgg Unterhaching*). Overall, it seems that teams with a higher share of foreign players exhibit a higher duration in the First Bundesliga, while age tends to affect a team's survival probability not in a systematic way.

4 Empirical Analysis

4.1 A survival model for promotion and relegation in professional football

We are interested in explaining the survival probability of a football team in the First Bundesliga depending on its newness status and other control variables. The survival criterion is fulfilled if team i is not relegated into the Second Bundesliga at year t. The sum over all years surviving consecutively in the First Bundesliga represents a team's total survival time or participation duration ('spell length'). Let us assume that a team's exit hazard at each season t follows a parametric proportional hazard function given by

$$h_i(t|\mathbf{x}_i) = h_0(t)\exp(\mathbf{x}_i\boldsymbol{\beta}_x), \tag{1}$$

where i denotes the i^{th} team (see, e.g., Kalbfleisch and Prentice 2002, Cleves, Gould, Gutierrez and Marchenko 2008).[7] Notice that our dataset is available as a panel containing information on league membership and other covariates for each team and each season (budget, share of foreign players, etc.). However, focusing on a team's duration in the First Bundesliga as the dependent variable requires to summarize the time variation of the $\mathbf{x}$-variables into one cross sectional measure of each variable. In our case, we follow Cameron and

Football Associations (UEFA); in addition, they were enabled to advance up to five non-European foreign players at each game. Since the playing season 2006-07, teams are allowed to rely on an unlimited number of (European and non-European) foreign players, but the squad has to contain at least twelve players that are Germans or instructed at German clubs.

[7] Survival analysis has also been used frequently to investigate various aspects of professional football, for instance the duration of coaches (see Scully 1994, Pestana Barros, Frick and Passos 2009) or the career duration of players (see Frick, Pietzner and Prinz 2007).

Trivedi (2005) and take the averages of our $\mathbf{x}$-variables. Overall, we employ a cross section of 96 observations (spells).

The specification in equation (1) is classified as proportional hazard model since at time t, $h_i(t)$ is proportional to h_0 (referred to as baseline hazard). Further, the conditional mean is parameterized as a row vector of explanatory variables $\mathbf{x}$ and the corresponding column vector of regression coefficients $\boldsymbol{\beta}$. As in the case of other models with non-negative outcomes (e.g., count data), the exponential function assures that $h_i(t)$ remains positive. To specify the baseline hazard $h_0(t)$, we use the most common functional forms, i.e., the exponential, the Weibull, the log-logistic and the log-normal distributions. The most suitable functional form is chosen according to the Bayesian information criterion (BIC).

Equation (1) allows to analyze the particular relegation hazard team i is faced with at each period in time t. To study explicitly a team's time-to-failure we re-formulate our baseline equation (1) in terms of its log-time metric

$$\ln(t_i) = \mathbf{x}_i\boldsymbol{\beta}_x + \ln(\tau_i),^{8} \tag{2}$$

where the distribution of the error term depends on the assumed distribution of $\tau_i = \exp(-\mathbf{x}_i\boldsymbol{\beta}_x)t_i$. τ_i is usually assumed to be distributed under the above mentioned functional forms. Equation 2 is often referred to as accelerated-failure time (AFT) model (see Cleves et al. 2008).

With regard to our baseline specification of firm survival in professional football, $\mathbf{x}_i$ captures the following variables. As our interest lies on the role of liability on newness on a team's survival probability, we firstly incorporate a dummy variable taking entry one if a team has been promoted one or two seasons ago, and otherwise zero.[9] We should observe a negative sign on this variable if teams in the First Bundesliga are exposed to a liability of newness. In this case, recently promoted teams exhibit a reduced time-to-failure. The other variables in the $\mathbf{x}$-vector serve as controls, whose inclusion are motivated by the descriptive evidence provided in Table 1 and by the

[8] See Cleves et al. (2008) for an extensive discussion on the proportional hazard and accelerated-failure time models formulations of standard proportional hazard models.

[9] Below, we use time frames of only one as well as three years to check the sensitivity of our results with regard to the definition of newness.

related research on survival analysis in professional football (see Scully 1994, Frick et al. 2007, Dherbecourt and Drut 2009, Pestana Barros et al. 2009).

The first candidate to explain a team's survival in a football league is the financial input a club is willing or able to provide for hiring new players, paying (higher) player and trainer compensations, or improving a team's surrounding conditions. In this case, the club budget constitutes a financial constraint affecting a firm's success and, therefore, also its survival probability (see, e.g., Hondo 2000). Since the labor force (number of players and supportive staff) might not be very different among the football clubs, a club's budget might further represent a measure of firm size.[10] In this regard, previous research on industrial organization has shown that smaller firms are exposed to higher exit risks (see, e.g., Mata, Portugal and Guimarães 1995). All else equal, these arguments point to higher participation durations for clubs with a relatively better financial constitution.

Second, as is obvious from the descriptives in Table 1, there is a small group of teams in the First Bundesliga that were never involved in any relegations hazards (e.g., *Bayern Munich* or *Werder Bremen*). Other ones seem to struggle against relegation in virtually every season. This indicates that performance differences are highly persistent in professional football. To account for such influences, we add the average past performance of a team, calculated as a team's end of season points minus the relegation threshold in a given season. In line with recent literature, we would expect a higher survival probability for teams with a better past performance, and vice versa (see, e.g., Esteve Pérez and Mañez Castillejo 2008).

Third, we follow Oberhofer et al. (2010) who demonstrate that a team's capabilities in terms of scored and conceded goals within a game are inversely related to the distance to the playing venue. In this case, we would predict a lower participation duration for teams that are relatively dislocated in the market. To account for such effects, we use the number of competing teams within a distance range of 100 kilometers (see Table 1). However, our remoteness variable also informs about local market concentration, which

[10] Our dataset also contains additional information on firm size, such as the stadium capacity or the average number of spectators, but it turns out that these variables are closely correlated with financial figures, so that we decided using only a club's budget to measure its firm size.

might exert a negative impact on the spell length if a team has to compete intensively with other clubs for a given amount of local resources (e.g., a given scope of football demand or sponsorship). For example, Hondo (2000), using a sample of new manufacturing firms, reports increased exit hazards within geographically concentrated industries. Overall, it is not apparent which effect is the dominating one, and, therefore, we are not able to provide an unambiguous prediction about the impact of remoteness/local market concentration on a team's survival probability.

Next, we insert two variables indicating possible learning effects with regard to relegation experiences, (i) the number of re-entries in the First Bundesliga, and (ii) club age, defined as the year of the current season minus a club's year of foundation. If learning effects are important in football leagues, we should find a positive impact on the participation duration for both variables (see, e.g., Jovanovic 1982). Finally, we include (i) a team's share of foreign players, and (ii) the average age of its players to control for a possible influence of a team's player composition on its survival probability. Here, we do not have a clear cut expectation about the signs of the estimated parameters (e.g., older teams might have more routine on the one hand, but might be weaker in physical terms on the other one), but the evidence from Table 1 together with the corresponding discussion from above suggests that at least the share of foreign players should be systematically associated with a team's survival time in the First Bundesliga.

4.2 Estimation results

Table 2 summarizes our empirical findings. To identify the functional form of the baseline hazard empirically, we estimate the baseline specification of our model in equation (2) using the four most common distributions, i.e., the exponential (column 1), the Weibull (column 2), the log-logistic (column 3) and the log-normal distribution (column 4). At the bottom of the table, we report the BIC for each specification. Obviously, the log-normal distribution seems to describe our time-to-failure data for relegation in the First Bundesliga most accurately. Notice further that we observe more than one spell for the majority of teams (which is the case if a team re-enters the league), which enables us to estimate a shared frailty proportional parametric hazard model and, thus, to control for unobserved heterogeneity.[11] Column 5 reports the corresponding results, where we assume an inverse Gaussian frailty distribution (the estimation results are virtually identical under the alternative formulation of a gamma distributed frailty). However, the insignificant estimate of θ reported at the bottom of Table 2 suggests that unobserved heterogeneity is not really at stake in our sample of German football teams. Therefore, we restrict our attention to the results of the log-normal distribution in column 4, which, according to the BIC criterion, represents our preferred specification.

*** Table 2 about here ***

Table 2 reports the marginal effects evaluated at the mean (MEM) of our $\mathbf{x}$-variables (see Bartus 2005, for further details on how to calculate the MEM in survival analysis). As can be seen from the table, the financial standing of a football team has a statistically significant impact on the participation duration, which is in line with our expectations mentioned above. At face value, doubling the relative budget (i.e., the share of one team's own budget to the average budget of its competitors) is associated with an increase in the expected time-to-failure of about 3.9 years. Further, we find that teams with a better past performance are able to stay longer in the First Bundesliga, as predicted. For market concentration, we are not able to estimate significant effects at least in our preferred specification. However, using alternative distributional assumptions for the baseline hazard (columns 1 and 2), we observe significantly positive effects, suggesting that teams in thicker local markets exhibit longer participation durations.

The survival time is observed to be much shorter for clubs with relatively much re-entries into the First Bundesliga. The corresponding parameter estimate is around -0.8 and statistically significant, implying that one additional re-entry into the First Bundesliga is associated with decrease in survival time

[11] Shared frailty proportional parametric hazard models allow individual observations to share the same frailty value, thus, introducing dependence between the respective individual observations (Gutierrez 2002). Algebraically, a shared frailty hazard model is given by $h(t_{ij}|x_{ij}, \alpha_i) = \alpha_i h(t_{ij}|x_{ij})$, where i denotes the group (club) and j represents the individual observation (spell) within the group. α_i is shared within each group (club) and is assumed to follow an inverse-Gaussian or gamma distribution (Cleves et al. 2008). In this regard, the shared frailty proportional parametric hazard model is very similar to the standard random effects estimator for panel data.

of about 0.8 seasons. In other words, a team that is more often involved in relegation and promotion activities over the course of the years does not really improve its chances of staying for a longer time period in the First Bundesliga. As far as a re-entry can be associated with *learning-by-doing*, one might conclude that such effects are hardly present in professional football. However, a club's age might be also regarded as learning in the sense that teams with a longer historical tradition might be more familiar with the specific conditions of the football business. We estimate a significantly positive coefficient for club age, which seems to confirm such *learning effects* at least in the First Bundesliga. With regard to the composition of a team's workforce, we firstly find a significantly positive impact of the share of foreign players on the participation duration in the First Bundesliga. Second, team age exerts an insignificant effect on the survival time, but it turns out significant and negative under alternative distributional assumptions of the baseline hazard (columns 1). Regarding this variable, our evidence suggests that survival time in the First Bundesliga is mainly affected by the physical constitution of the players, and to a lesser extent by their routine.

As far as our main relationship of interest is concerned, Table 2 clearly shows that liability of newness applies in professional football. In other words, being a newcomer (i.e., a team promoted in the First Bundesliga at least two seasons ago) increases a team's relegation hazard substantially. In particular, the marginal effect of being a newcomer is well above the one of of financial resources and also above the ones of the other variables. One implication would be that a newly promoted club is forced to more than double its budget relative to that of its competitors to offset the disadvantage of being a newcomer. Put differently, non-newcomers exhibit more or less the same expected duration in the First Bundesliga with less than half of the financial resources that a recently promoted club is able or willing to provide.

*** Figure 2 about here ***

To obtain more insights into the effects of liability of newness on the survival time in professional football, Figure 2 graphically displays the estimated hazard functions for different values of selected covariates, holding the other $\mathbf{x}$-variables at their means. Panel (a) of the figure compares the estimated hazard function for newcomers versus established teams. It can be seen that newcomers exhibit higher exit hazards throughout, but the difference in exit hazards is most pronounced in the first seasons after promotion. Second, panel (b) plots the hazard functions for three different realizations of a club's relative financial inputs, (i) the budget of the average team in the First Bundesliga, (ii) 50 percent of it, and (iii) 150 percent of it. Not surprising, we observe highest (lowest) relegation hazards for teams with relatively low (high) financial endowments. The remaining panels of Figure 2 depict the effects of the relative average performance (panel (c)) and the number of re-entries (panel (d)) on the time-to-failure. In line with the discussion from above, panel (c) graphically shows that differences in the relative performance are able to explain differences in the hazard rates across football clubs. Finally, panel (d) of the figure reveals that the relegation hazard for teams which never re-entered the market are comparable to the one of teams that re-entered the Bundesliga only once, while clubs re-entering the market three times are faced with a considerably higher relegation threat than the ones with only a few re-entries.

4.3 Robustness

In the empirical analysis above, we defined a newcomer as a team that has been promoted into the First Bundesliga at least two seasons ago. One might ask whether our estimation results are affected by this definition of newness. Therefore, we check the sensitivity of our results applying a one year and a three year time frame rather than relying on a two year definition of newness. The corresponding findings, which are based on the log-normal distribution as the preferred specification in Table 2, are reported in columns 1 and 2 of Table 3. Obviously, our results are well in accordance with the findings in Table 2. Again, we observe a significantly negative impact of newness on a team's survival time in the First Bundesliga, and the parameter estimates of the other covariates are broadly similar to the original ones.

*** Table 3 about here ***

Next, instead of focusing on the participation duration in the First Bundesliga, one might be more interested in a team's exit probability at a given season. This implies to estimate a binary choice (logit or probit) model, defining a dummy variable with entry one if a team is relegated into the Second Bundesliga, and zero otherwise.[12] One particular advantage of a binary choice model is that it allows to exploit variation over time (seasons), and, thus, to rely on more observations than in the survival analysis. On the other hand, a discrete choice model is not able to explain variation in participation duration since it treats every team-year information as (conditionally) independent observation. Therefore, we would expect somewhat upward biased standard errors in this specification.

To estimate a binary choice model, we regress the above mentioned exit dummy on a variable indicating newness along with other controls. Rather than defining an indicator variable for newness (as in Section 4.2), the panel structure of our dataset now allows to include directly the number of survived seasons as our newness measure. The corresponding parameter estimate informs about the exit probability for participation of one additional season in the First Bundesliga.

Column 3 of Table 3 displays the estimation results of a pooled probit model.[13] We rely on 524 observations as we are able to exploit the cross-sectional and time dimension of the dataset. Again, we report the marginal effects of the estimated parameters. Most importantly, our estimation results in Table 3 indicate that a liability of newness exist in the First Bundesliga. The estimated marginal effect is significantly negative, and implies that one additional year of participation in the First Bundesliga decreases the probability of relegation into the Second Bundesliga by about 0.2 percent. Further, we observe significantly negative effects of a club's financial inputs and also its relative performance in the past, which seems to confirm the evidence from Table 2. Accordingly, doubling the budget relative to the one of the competitors lowers the probability of relegation by about 21 percent, and, if a club has performed relatively well in the previous season we predict a

[12]See Doms, Dunne and Roberts (1995) for an early application to market exit of firms in general, and Dherbecourt and Drut (2009) for firm survival in professional football.

[13]Alternatively, we also estimate a random effects probit model as well as (pooled and random effects) logit models. It turns out that the random effects are rejected, so that the pooled model has to be preferred over the random effects specification. Further, based on the BIC measure we would favor the probit model over the logit specification. Hence, and for the sake of brevity, we only report the results of the pooled probit model in column 3 of Table 3. The corresponding results of the random effects and logit models are available from the authors upon request.

decrease in exit probability of about 0.3 percent. The remaining variables in Table 3 are statistically insignificant throughout, which does not really comes at a surprise as the binary choice model delivers somewhat inflated standard errors in this application.

One further possibility to examine market exit in professional football would be to focus on a team's number of relegations rather than on its survival time (per spell). In this case, we would ask how often a team has experienced a relegation into the Second Bundesliga and how this frequency is influenced by its newness status. Obviously, this question is quite different to that of survival analysis answering the question on how long a team is participating in the league, but it might be viewed as a suitable way to infer whether our findings on liability of newness still hold under alternative definitions of market exit. Empirically, we estimate a count data model by regressing a team's number of exits on its number of consecutive years in the First Bundesliga and the other control variables from our binary choice model in column 3. The only exception is re-entry into the First Bundesliga, which is left out from this exercise as it is by definition equal to the number of (re-)exits minus one. As in the binary model, we rely on the full panel of teams in the First Bundesliga, leaving us with 524 observations.

Column 4 of Table 3 reports the results of a zero inflated Poisson model.[14] Our estimation results indicate that a team's number of exits is significantly and negatively affected by its survival time. In qualitative terms, this result is well in accordance with the ones of the alternative (survival time and binary choice) models. Further, and in line with the estimation results of the binary choice model in column 3, we estimate significant effects of a team's budget and its performance in the past.

Overall, the evidence from Table 3 let us conclude that our estimation results with regard to liability of newness in professional football seems to be robust over alternative measures of newness and over different specifications of our empirical model.

[14] There, we also estimate a simple Poisson model, but a Vuong test suggests that we should account for zero inflation. Moreover, testing the Poisson model against the negative binomial model does not reject the assumption of equidispersion. Therefore, our specification tests indicate that we should rely on the zero inflated Poisson model in this robustness exercise. Again, the results of the alternative count models are available from the authors upon request.

5 Conclusions

There is a remarkable strand of literature in industrial organization demonstrating that the survival probability of firms is inherently affected by a firm's age. Accordingly, new entrants and young firms are typically faced with higher exit hazards than their older, incumbent competitors. This stylized fact is known as *liability of newness.*

Analyzing empirically liability of newness in conventional markets often raises the problem that information on market leaving firms is typically not or only hardly available, potentially indicating a measurement error with regard to a firm's survival probability. For example, market exit is often taken for granted if a firm has not responded to a business survey or has not been recorded in the official census for a time. There are many reasons why a firm is not responding to a survey (e.g., managers are not willing to complete a questionnaire), and, therefore, it might be the case that systematically too much firm exits are counted in such studies.

In this paper, we rely on professional sports to analyze liability of newness. We argue that the relegation and promotion system in European football might be viewed in many regards as similar to firm exits and entries in conventional goods and service markets. Obviously, firm performance in professional football is easily available even if a club left the market. In our case, we use a dataset from the German Premier League ('First Bundesliga'), covering comprehensive information on 42 football teams over the seasons 1981-82 to 2009-10 (i.e., 29 seasons). Empirically, we apply methods from survival analysis, binary choice and count data models to answer our question of interest.

We find that liability of newness clearly applies to our sample of German football teams. Further, teams re-entering the market more often tend to exhibit a lower survival time. Apart from that, we observe that the time-to-failure is affected by a team's economic environment (i.e., a team's budget and the number of competitors in the local market), its performance in the past and its structure of the workforce (i.e., players' age and number of foreign players). Overall, it seems that a team's newness status and also its financial resources are most important to explain the survival time in the highest German Football League. With regard to liability of newness, our estimation results seem to confirm previous evidence from conventional goods and service markets. This, in turn, indicates that the above mentioned measurement issue is not too severe when estimating the survival probability of newly established firms.

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*** Table A1 about here ***

Table 1: Characteristics of football teams in the First Bundesliga, averages over 1981-82 to 2009-10

Club	Max. years of survival (1)	Number of exits (2)	Number of entries (3)	Relative budget (4)	Average performance (5)	Local market concentration (6)	Share of foreign players (7)	Average team age (8)
Alemannia Aachen	1	1	1	0.36	9.00	2.00	0.32	25.80
Blau-Weiß Berlin	1	1	1	0.61	1.00	0.00	0.13	25.20
Darmstadt 98	1	1	1	0.40	0.00	1.00	0.05	26.80
Kickers Offenbach	1	1	1	0.52	0.00	2.00	0.04	26.00
SSV Ulm 1846	1	1	1	0.43	1.00	1.00	0.43	25.70
VfB Leipzig	1	1	1	0.52	3.00	0.00	0.17	25.80
1.FC Saarbruecken	1	2	2	0.78	0.00	1.00	0.13	26.45
Stuttgarter Kickers	1	2	2	0.54	5.00	2.00	0.13	26.20
TSG 1899 Hoffenheim	2	0	1	1.00	12.50	1.50	0.48	23.75
SpVgg Unterhaching	2	1	1	0.32	7.50	2.00	0.19	28.95
FC Homburg	2	2	2	0.51	1.50	1.00	0.15	26.13
Energie Cottbus	3	2	2	0.53	4.33	0.00	0.62	27.57
FC St. Pauli	3	3	3	0.55	2.17	1.00	0.27	26.53
Dynamo Dresden	4	1	1	0.76	2.50	0.00	0.14	26.75
Eintracht Braunschweig	4	1	1	0.55	7.25	0.00	0.11	26.55
Wattenscheid 09	4	1	1	0.54	3.75	7.00	0.17	26.28
SC Freiburg	4	3	4	0.58	6.06	0.00	0.47	25.36
Arminia Bielefeld	5	5	4	0.59	5.88	0.00	0.36	27.21
FSV Mainz 05	7	1	2	0.51	2.17	1.17	0.48	26.47
SV Waldhof Mannheim	7	1	1	0.60	7.00	2.71	0.11	25.69
Hannover 96	8	2	3	0.71	5.50	0.33	0.22	25.79
Uerdingen	8	3	3	0.51	4.25	6.63	0.19	27.44
1. FC Nuernberg	9	5	5	0.55	4.66	0.00	0.32	25.71
1860 Muenchen	10	1	1	0.81	9.20	1.20	0.40	27.25
Hansa Rostock	10	3	3	0.71	2.30	0.00	0.27	26.58
Karlsruher SC	11	4	3	0.71	4.52	2.22	0.17	25.38
Vfl Wolfsburg	13	0	1	1.08	12.62	0.62	0.53	26.81
Hertha BSC Berlin	13	3	3	0.95	7.92	0.00	0.23	26.54
Fortuna Duesseldorf	16	3	2	0.58	4.00	6.83	0.24	26.98
Schalke 04	19	2	3	0.98	7.64	5.99	0.18	26.34
MSV Duisburg	19	6	5	0.74	4.67	5.79	0.28	27.17
Vfl Bochum	22	6	5	0.63	8.07	5.39	0.35	26.62
Werder Bremen	29	0	1	1.14	19.59	0.00	0.27	26.65
Bayer Leverkusen	31	0	0	1.07	15.97	5.62	0.30	25.82
VfB Stuttgart	33	0	0	1.23	16.21	0.72	0.29	26.03
1. FC Kaiserslautern	33	2	1	0.95	13.60	0.97	0.30	27.12
Eintracht Frankfurt	33	3	3	0.86	5.02	0.30	0.34	26.71
Borussia Dortmund	34	0	0	1.35	16.14	5.59	0.27	26.31
Borussia Moenchengladbach	34	2	2	0.93	5.98	5.30	0.41	26.16
1. FC Koeln	35	4	4	1.09	8.11	5.08	0.35	25.81
Bayern Munich	45	0	0	2.08	28.07	0.41	0.29	26.47
Hamburger SV	47	0	0	1.25	15.28	0.21	0.33	26.19
Average	*13.50*	*1.86*	*1.93*	*0.74*	*6.22*	*2.36*	*0.29*	*26.39*

Table 2: Estimation results of baseline duration model

Variable	Exponential[a] (1)	Weibull[a] (2)	Log-logistic[a] (3)	Log-normal[a] (4)	Lognormal[b] inv. Gaussian (5)
Newcomer (First 2 seasons)	−4.341***	−5.821***	−4.590***	−4.886***	−4.886***
	(0.717)	(0.850)	(0.771)	(0.635)	(0.670)
Relative budget	4.076***	3.164***	3.874***	3.882***	3.882***
	(0.921)	(0.873)	(1.048)	(0.860)	(1.020)
Average performance	0.218**	0.247***	0.214**	0.198**	0.198***
	(0.096)	(0.091)	(0.101)	(0.079)	(0.061)
Local market concentration	0.133**	0.189***	0.074	0.078	0.078
	(0.065)	(0.063)	(0.082)	(0.059)	(0.080)
Number of re-entries	−0.878***	−0.991***	−0.719***	−0.774***	−0.774***
	(0.290)	(0.272)	(0.241)	(0.214)	(0.234)
Club age	0.018*	0.014	0.017*	0.017**	0.017*
	(0.010)	(0.009)	(0.009)	(0.008)	(0.010)
Share of foreign players	4.826***	3.711*	2.594*	2.647**	2.647
	(1.859)	(2.049)	(1.330)	(1.280)	(1.654)
Average team age	−0.402*	−0.397	−0.184	−0.203	−0.203
	(0.238)	(0.245)	(0.263)	(0.234)	(0.205)
Shape parameter (–, p, γ, σ, σ)	–	2.067***	0.312***	0.533***	0.533***
θ	–	–	–	–	0.000
# of Observations	96	96	96	96	96
McFadden-R^2	0.4000	0.5210	0.4990	0.5089	0.4983
BIC	248.53	203.01	196.03	192.42	196.98

Notes: Marginal effects reported. [a]Club-clustered standard errors in parentheses. [b]Standard errors in parentheses *, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

Table 3: Robustness

Variable	Alternative newness measures (1)	Alternative newness measures (2)	Alternative models: Pooled probit (3)	Alternative models: Zero-inflated Poisson (4)
Newcomer[a]	−3.827***	−6.183***	−0.002*	−0.041**
	(0.479)	(0.802)	(0.001)	(0.021)
Relative budget	4.838***	3.056***	−0.209***	−1.668**
	(0.900)	(0.849)	(0.032)	(0.662)
Average performance	0.229***	0.182***	−0.003**	−0.026*
	(0.076)	(0.064)	(0.001)	(0.014)
Local market concentration	0.049	0.098	0.0002	0.142
	(0.074)	(0.069)	(0.004)	(0.153)
Number of re-entries	−0.951***	−0.944***	0.012	–
	(0.247)	(0.194)	(0.011)	–
Club age	0.012	0.004	0.00003	−0.012
	(0.012)	(0.008)	(0.0004)	(0.017)
Share of foreign players	2.914*	4.746***	−0.024	0.358
	(1.761)	(1.319)	(0.078)	(1.258)
Average team age	−0.433*	−0.155	0.005	0.042
	0.243	0.218	(0.009)	(0.110)
# of Observations	96	96	524	524
McFadden-R^2	0.4745	0.5643	0.2128	0.0171
BIC	202.72	175.86	408,89	1703.92

Notes: Marginal effects reported. Club-clustered standard errors in parentheses. [a] Columns 1 and 2 use newness dummy variables for only the first season and the first 3 seasons, respectively, while for the probit and the zero inflated poisson model in columns 3 and 4 newcomer is measured using the actual survival time. *, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

Table A1: Correlation matrix and overall sample characteristics

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Years of survival	(1)	1.0000								
Newcomer (First 2 seasons)	(2)	−0.5573	1.0000							
Relative budget	(3)	0.6732	−0.3240	1.0000						
Average performance	(4)	0.6931	−0.5532	0.6376	1.0000					
Local market concentration	(5)	0.0941	−0.0459	0.1083	0.0480	1.0000				
Number of re-entries	(6)	−0.4661	0.2877	−0.2040	−0.2146	−0.0351	1.0000			
Club age	(7)	0.0051	0.0401	−0.0017	0.1020	−0.0678	0.1464	1.0000		
Share of foreign players	(8)	−0.0923	−0.0112	0.0368	0.1600	−0.1410	0.5984	0.0537	1.0000	
Average team age	(9)	−0.0398	−0.0140	−0.0986	0.0468	0.1261	0.0196	−0.0784	0.0805	1.0000
Mean		7.125	0.510	0.736	6.216	2.361	1.667	84.917	0.291	26.392
Std. Dev.		10.718	0.503	0.287	5.381	2.592	1.262	21.141	0.172	1.026
Min		1	0	0.285	0	0	0	26	0.036	23.6
Max		47	1	2.079	28.069	8	5	138.5	0.625	29.2

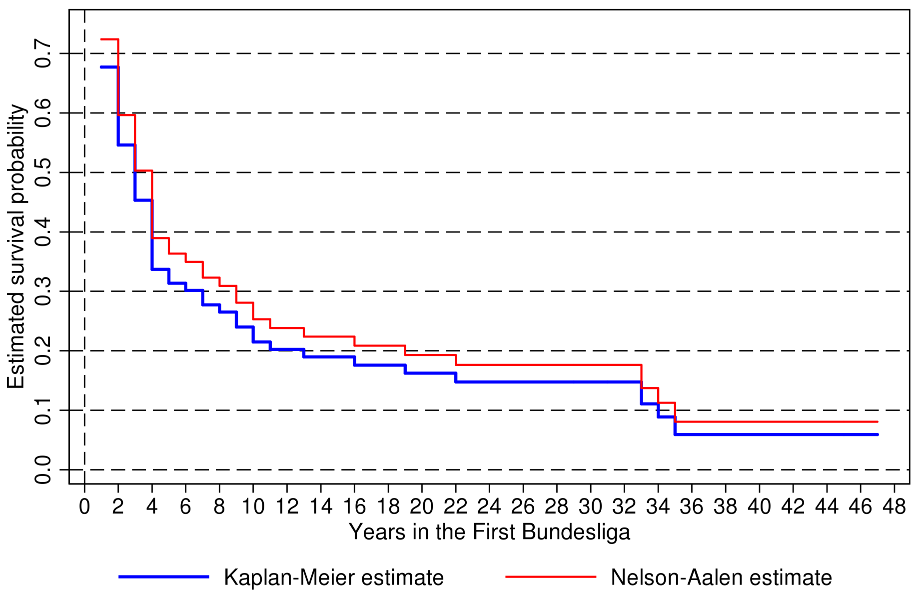

Figure 1: Survival function for football teams in the First Bundesliga, 1981-82 to 2009-10

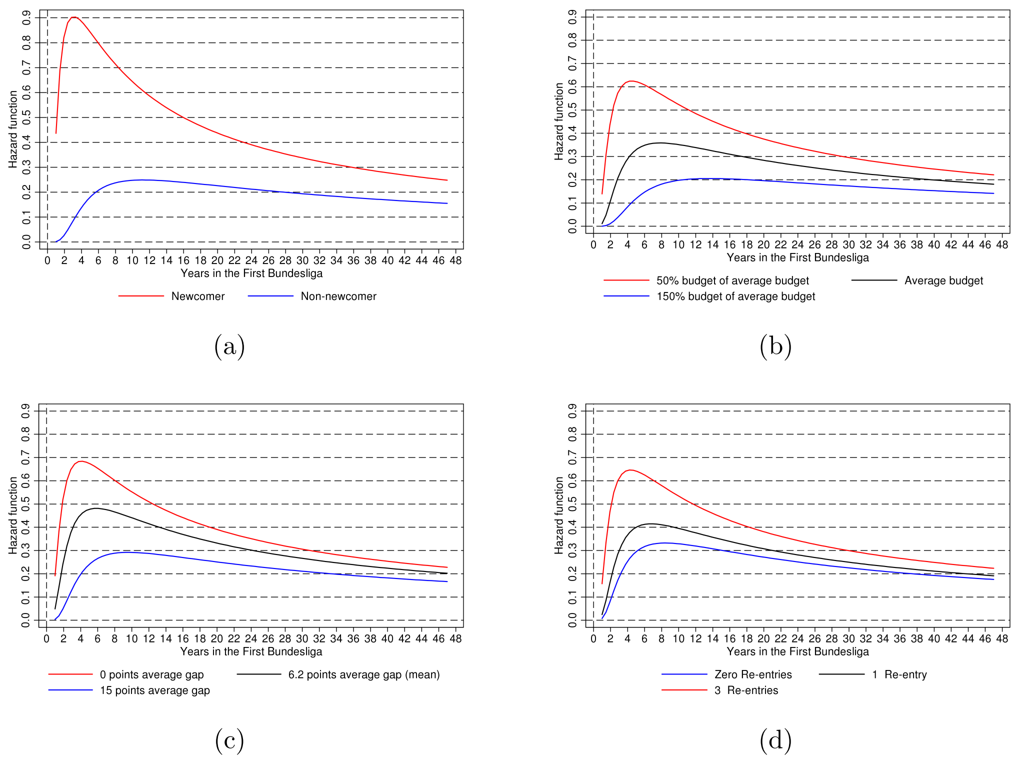

Figure 2: Estimated hazard functions for (a) newcomers vs. non-newcomers, (b) different levels of relative budgets, (c) different average performances in the First Bundesliga, and (d) different numbers of re-entries into the First Bundesliga.