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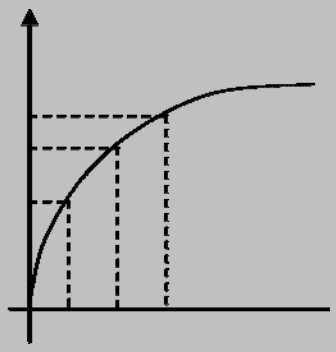

The Influence of Performance Parameters on Market Value

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The Influence of Performance Parameters on Market Value

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Abstract

Research question:

We uncover the influence of performance parameters on market value of football players in German Bundesliga. Hereby, the analyses should in some places reach beyond the current state of research by, for example, using relative operating times or running kilometres in the analysis.

Research methods:

To this end, we analysed all players in the season 2015/16 who had at least one significant participation in a game. Because of the unclear functional form of the links of the market value of players to the influencing variables, we carried out the analysis using Boosted Regression Trees in order to be able to map and interpret both different scale levels and non-linearities.

Results and Findings:

We found the highest relative influence in the ranking of TV money from the preseason (>50%) and goals and high pass rate (each >10%). Partial-dependence plots recover the nonlinear influence of variable on the market value of players.

Implications:

It seems that the market value depends significantly less on sports performance than assumed. On the one hand, the preselection of the players in the respective clubs causes a clear difference in the market values of the individual players. In addition, the often-assumed linearity for some variables is just as little as the quadratic correlation, which is often assumed for old age, which is why classical OLS estimates cannot be sufficiently argued.

Introduction[1]

If ‘money makes the world go around’ (Lehmann & Weigand, 1997) and money scores goals (Frick, 2005), clubs that employ strong players should be more successful and earn higher revenues. Therefore, they should be willing to pay higher wages for better performance. However, the question is how can player performance be measured? Recent research in sports economic literature tended to focus on the so-called market value of a player, rather than their individual performance parameters such as goals and pass rate (Frick, 2007; Bryson, Frick & Simmons, 2013; Gerhards, Mutz & Wagner, 2014a; Herm, Callsen-Bracker & Kreis, 2014; Müller, Simmons & Weinmann, 2017; Peeters, 2018). Several researchers have found a positive correlation between the market value and actual observable player salaries (Bryson et al., 2013). This finding raises the question of what factors determine market value. We address this question by analysing the links between performance parameters, team membership, individual player parameters, and market value.

The rest of the study is organized as follows: First, our study poses the question of how the frequently-used term ‘market value’ can be interpreted from a theoretical perspective. Next, we provide insights into the modern valuation theory as a theoretical background for our analysis. We then report the findings from our empirical analysis, where we propose to study the determinants of the market value of players by means of boosted regression trees. Finally, we discuss our empirical results in the following section.

Theoretical Background

The Transfermarkt Platform

The platform of transfermarkt.de (hereafter referred to as ‘Transfermarkt’) is a website operated by Transfermarkt GmbH & Co. KG (Transfermarkt, 2018). According to the IVW

[1] The authors would like to thank Dr. Michael Barth for the hints in the technical review of the algorithm for boosted regression, and Prof. Dr. Olbrich for the friendly support of the research project.

(German Audit Bureau of Circulation), the platform is one of the most frequently visited sports websites in Germany (Ackermann & Follert, 2018). In addition to reports by sports journalists and updates of comprehensive, statistical data on individual players, teams, and leagues, the business model consists of a discussion forum (Weber-Klüver, 2008). Private users can discuss and propose the market values of individual soccer players. The platform has nearly 400,000 registered members (Ackermann & Follert, 2018), and market value analysis is the centrepiece of the website. Market values are part of the individual profile pages for players.[2] The profile pages contain personal data and statistics on player performance such as the number of goals scored and in a certain time frame, past club changes, and injury history. The profiles of the players also list rumours concerning possible transfers.

Market-value Analysis Methods

Market values proposed by private users must be substantiated and are based—for example—on current age, contract term, performance data, and injury history (Müller et al., 2017). Transfermarkt users are explicitly advised to focus on comparable players (Transfermarkt, 2013a). A reason for the proposed change in value must be provided (Peeters, 2018). While definitions and guidelines exist, these are stipulated by members of the forum, not by its management or administrators (Transfermarkt, 2013a; Transfermarkt, 2013b; Transfermarkt, 2017). Since the proposed definitions and guidelines have not been deleted by management, their validity can be assumed (Ackermann & Follert, 2018). So-called sponsors aggregate the proposed values and establish a single value which is agreed upon with management (Herm et al., 2014). This valuation hierarchy follows Surowiecki's 'wisdom of

[2] Within the theory of valuation, market values result from methods based on neoclassical finance theory. It must be clarified that the so called 'market values' of Transfermarkt do not resemble these market values. Additionally, market values do not exist in the imperfect labor markets of reality. The value of goods in general and human capital in particular is therefore always subjective (Böhm-Bawerk, 1921; Mises, 1998).

crowds' principle (Surowiecki, 2004), that states that misjudgements by individual evaluators will be outweighed by the mass of valuations (Gerhards et al., 2014a).

However, the question is whether market values compiled by Transfermarkt can be used for valuing human capital.[3] One can argue that the 'purchase' of a soccer player is a relevant case of valuation, since it can be characterized as an investment in human capital. Whether the market values established by Transfermarkt can be used by clubs along with actual observable economic data ahead of player transfers is however doubtful. Clubs need to calculate a decision value (Matschke, 1972; Matschke, 1975) to be able to determine their own financial concession limit before commencing transfer negotiations (Follert, 2017).

Fundamental Principles of Valuation

Modern valuation theory distinguishes between three main functions: The decision function, the mediation function, and the argumentation function (Matschke, Brösel, & Matschke, 2010; Olbrich, Quill, & Rapp, 2015). In terms of the suitability of a specific valuation process for decision-making purposes, there are principles of valuation that form the basis of a decision-oriented valuation. (Olbrich et al., 2015). The *principle of payments* states that only future payments due to the owner are of importance for the assessment of the utility accruing through the object of the valuation (Moxter, 1983). Valuation theory deals primarily with the valuation of companies. Companies must be *valued as an entity*, since only this approach considers synergies within the company. Generally, a whole business enterprise is more valuable than the sum of its assets.[4]

[3] Concerning the valuation of human capital see Hering (2005); Scholz (2007); and Dilger (2008).

[4] Obviously, the *valuation of an entity* is not relevant concerning the valuation of individual human capital. It is, however, relevant for the valuation of a whole team, because a single player cannot play without the rest of the team. Regarding this principle, refer to Schmalenbach (1911/1912); Mirre (1913); and Schmalenbach (1917/1918).

The principle of *future orientation* (Kreutz, 1909; Schmalenbach, 1917/1918; Münstermann, 1966) involves disregarding the past and focusing on the future. Consequently, projected future earnings as an expression of expected utility form the core of this calculation (Hering, Toll, & Kirilova, 2014; Olbrich et al., 2015; Herbener & Rapp, 2016). Ultimately, future orientation is dependent upon assumptions and expectations that are most often subject to a high level of uncertainty (Rapp, Haßlinger, & Olbrich, 2018a).

The principle of *subjectivity* (Kreutz, 1909; Liebermann, 1923; Busse von Colbe, 1957; Rapp, Olbrich, & Venitz, 2018b) refers to the subjective nature of any valuation, meaning that a value is dependent on the subject and the purpose of valuation. An individual's action is always determined by personal preferences and the individual alternatives and restrictions (Kirchgässner, 2013), meaning the target function and the decision field. Therefore, the value of goods as well as the value of human capital—for instance a soccer player—is determined by the individual decision field and the target function of the valuation-subject (Matschke, 1972; Matschke, 1975). The decision field for the valuation subject indicates its specific alternative courses of action (Bitz, 1981; Bamberg et al. 2012), while the target system shows its preferences and the intensity of the pursuit for those preferences (Laux, Gillenkirch, & Schenk-Mathes, 2014).

Transfermarkt's Market Values from the Perspective of Valuation Theory

Concerning the valuation of a soccer player, compliance with the *principle of payments* means that only the future payments that accrue directly to the club through the player are relevant for the generation of utility, because only these payments give rise to direct satisfaction of needs and can fulfil consumer wishes (Toll & Hering, 2017). Possible payments could for instance be generated by the player's share in the team's overall sporting success. This is measurable by, for example, prize money won (e.g. in the Champions

League), television broadcasting rights, jersey sales attributable to the player, and the sale of other promotional items (Rapp, 2014). The measurable share of limited additional match ticket sales attributable to the popularity of the player is also conceivable (Ackermann & Follert, 2018). The calculation for the valuation by Transfermarkt includes factors that satisfy the *principle of payments,* such as the player's salary and his marketing potential (Transfermarkt, 2017). However, other factors that do not result in payments directly are also relevant concerning the valuation. One of these is the player's susceptibility to injury (Ackermann & Follert, 2018). It is clear that Transfermarkt sees the market value of a player as an objective net asset value independent of the specific situation of an individual club.

According to theory, a valuation needs to comply with the principle of *future orientation*. The subject of the valuation is assigned a current value by discounting the projected future earnings. However, Transfermarkt does not furnish particulars of discounting (Ackermann & Follert, 2018). The guidelines only require stronger future orientation than the current market value analysis. This means that aspects that are currently predominantly related to the past and the present are taken into consideration (Transfermarkt, 2017). An example of historical parameters for the market value analysis is performance data of past seasons. Only the remaining term of the player's contract and his age can attest to the *future orientation* of the parameters (Ackermann & Follert, 2018). Given the mix of approaches relating to the past, present, and future of a player, the answer to whether the principle of *future orientation* complies with in the market value analysis must therefore be negative (Ackermann & Follert, 2018).

By definition, the guidelines of Transfermarkt contradict the principle of *subjectivity* through an attempt at pseudo-objective market value determination (Ackermann & Follert, 2018). On the Transfermarkt platform, the 'market value' of a player is determined by the participants in the market value analysis, who very rarely have access to internal club

information. Non-compliance with the principle of *subjectivity* makes determining the decision value by discounting the net cash flows impossible for two reasons. First, the payments are club-specific figures that cannot be accurately estimated by outsiders without the club's involvement (Ackermann & Follert, 2018). Second, the correct subjective discount rate cannot be determined, as the club's best possible alternative would have to be identified (Ackermann & Follert, 2018). An additional infringement on the principle of *subjectivity* comes to light in the reference to comparable players (Transfermarkt, 2013a). Since the market value analysis by Transfermarkt does not satisfy the *principle of payments*, the principle of *future orientation* or the principle of *subjectivity*, it cannot be used for decision-making purposes in the case of the purchase of a new player. In particular, the violation against the principle of *subjectivity* shows that market values provided by Transfermarkt cannot be seen as subjective decision values from the perspective of the soccer club as the valuation-subject. The members of Transfermarkt are not able to show the economical price limit in case of the purchase of a player.

As can be seen from the discussion above, the figures determined by Transfermarkt are not values in the economic sense, since they cannot be calculated subjectively from the club's perspective. These figures merely constitute estimates by external experts that are perfectly suitable for argumentation purposes. Through purposeful use of argumentation values, a club can influence the opposition in its favour during transfer negotiations. Widespread use of these values in the trade press, among soccer fans, and at club level indicates a broad acceptance that gives an impression of universality. Additionally, the club can draw on numerous studies that examine the meaningfulness of the market value analysis. The market value analysis can be utilized as an estimate by experts of the quality of a player, which as a quantified value represents a club's external willingness to pay. Clubs could use

this to verify the apparent objectivity of the value of a player based on the market value analysis (Ackermann & Follert, 2018).

The Understanding of Transfermarkt's Market Values in this Study

As pointed out in the previous chapters, the 'market values' provided by Transfermarkt cannot be used for an actual economic decision-making. They are more suitable to provide argumentation values that can help a soccer club to influence another party within a negotiation. Furthermore, Gerhards et al. (2014a) proved a positive correlation between the sum of the market values of a team and its success. This could possibly be utilized as an argument during a negotiation concerning a transfer fee. The market values can be understood as an estimate by experts of the quality and the sporting possibilities that is converted into a monetary value, no more and no less. It could be useful to analyse the relationship between these market values and other parameters, for example the performance of a team or a player, similar to the same practice as in sports economics. Using Transfermarkt's market values, researchers should clearly emphasize that they are not comparable to subjective values from the individual perspective of a soccer club and are suitable for argumentation purposes and not economic purposes. Generally, financially strong clubs have a higher concession limit than weaker clubs, because they are also able to make higher payments to the player (salary) and to the previous club (transfer fee). Therefore, the best players often switch to these clubs. The performance of a player can be estimated by third parties using the statistical data that is provided by Transfermarkt. The market values of the platform could therefore be interpreted from an economic point of view as a price for optimal player allocation (Ackermann & Follert, 2018).

Market Value and Performance

In recent years, there has been a controversial discussion in German media concerning players' salaries and transfer fees (Frick, 2011). From a non-economic point of view, those amounts seem to be exaggerated and irrational. However, when adopting a differentiated view on the economic factors that drive the salaries and the transfer fees, the clubs' individual decisions can be explained (Follert, 2018). The influence of market valuations on high salaries have been discussed in economic literature before. Based on the work of Rosen (1981) and Adler (1985), Pommerehne and Frey (1993) investigated the drivers for the income of artists and the prices for paintings in their work 'Why is a Rauschenberg so expensive?' (Pommerehne & Frey, 1993). Frick (2001) explained the difference between the salaries of superstars and 'water carriers' in team sport. Prinz, Weimar, and Deutscher (2012) investigated the determinants of the salaries of NBA superstars. Several other studies determined factors that influence sports players' salaries (Wallace, 1988; Lehmann & Weigand, 1999; Hakes & Sauer 2006, 2007; Deutscher & Büschemann, 2016), and other works investigated the determinants of transfer fees in European soccer (Dobson & Gerrard, 1999; Dobson et al., 2000; Frick & Lehmann, 2001; Eschweiler & Vieth, 2004; Fees et al., 2004). For a detailed overview, see Frick (2007).

While the determinants of players' salaries and transfer fees has obviously already been sufficiently studied, there is a gap in the literature pertaining to the critical factors that influence players' market values. Wicker, Prinz, Weimar, Deutscher, and Upman (2013) analysed the effect of the individual effort of a player on his market value. This study considers other determinants of the market values provided by Transfermarkt, especially players' performance, but also their age or position in a team. The relationship between the market value and the performance of a player is probably closely related, although other components may also be added to the presentation level (see advertising contracts by Maria

Sharapova, Finanzen100, 2016). An alternative idea is given by Kirschstein and Liebscher (2018) who used as performance indicators the ‘fifaindex’ scores and related them to market values from Transfermarkt.

Ziebs (2004) and Partosch (2013) also provided evidence that performance is not the only predictor of a player’s market value, mentioning the club's prestige and its participation in international competitions, which draws increased attention to players in these clubs. Since the demand is relative to the supply of superstars (Rosen, 1981), these players are imperfect substitutes (Prinz & Weimar, 2016). The shortage of these valuable ‘powerful players’ should therefore be reflected in the market value.

In addition to the general assumption (Ziebs, 2004; Gerhards & Wagner, 2008; Joswig, 2009) of the connection between market value and performance, market value is considered as both the status quo and the expected value of future benefits (Gerhards et al., 2012; Wagner, 2010). Market value is also considered by some authors as a team level indicator of the performance potential of a team, in addition to its forecasting function (Gerhards et al., 2012, 2014a, 2014b; Gerhards & Wagner, 2008; Wagner, 2014; 2016).

Lehmann and Weigand (1997) used a discriminant analysis to analyse clubs that belonged to the German soccer league for at least one season in the period 1981-1996. In terms of performance variables, the number of points scored per game and the number of goals scored in the season were appropriate dividing variables. Furthermore, the overall market value of the professional/player and the most expensive new entries were well-dividing variables. The total market value was the sum of all players in the squad and thus heavily distorted (Lehmann & Weigand, 1997), although Joswig (2009) stated that the size of the team has practically no influence on the placement of the club in the final table. Further regressions showed that the overall market value of a team had a significant influence on their points ratio, with a doubling of the market value accompanied by an average increase in the

points ratio of 9% (Lehmann & Weigand, 1997). Implementing an alternative definition of success (at least 445 points within 10 seasons), Ziebs (2004) showed in a similar approach to that of Lehmann and Weigand (1997) that the rank median, the points ratio, the seasonal points, and the club's participation in international competitions are well-defined variables. The results revealed the existence of a group of top clubs with significantly higher market values and greater sporting success (Ziebs, 2004, Lehmann & Weigand, 1997). Studying the 2007/2008 season, Joswig (2009) used a correlation analysis to show that the rank in the final table serves as an indicator of the performance of a team and that a higher median of the squad with a better ranking in the final table is therefore associated with greater sporting success of a club. They also made curve adjustments to the 214 clubs in the top 12 European leagues after the 2012 UEFA ranking (Gerhards et al., 2014a) and a quadratic relationship between the average market value of a team and the end-of-season score (decreasing marginal utility). Dobson and Gerrard (1999) found that on an individual level, a player's upfront expenses had a significant impact on transfer fees. An example is ‘Kenya and Ochieng’ in 2017. Another multinational Study (Serna Rodríguez, Ramírez Hassan & Coad, 2018) used Bayesian model averaging (BMA) through Markov chain Monte Carlo model composition (MC) and found performance (unspecific measured), age and participation in the national team as driver for market value.

The factor coincidence plays an important role in the prognosis of individual games (Dietl et al., 2005). According to Quitzau (2003), in 50% of the cases, the outcome of a game is randomly determined. Single games are quite dependent on these influences, compared to repeated games, and such effects are similar in the course of a one season (Dietl, Hasan, & Korthals, 2005; Joswig, 2009). Therefore, Wagner (2016) uses the market value method as a performance forecast using simple benchmarking of competing teams (Gerhards et al., 2014b).

Method

Data Set & Variables

The data are based on the 2015/2016 season of the German Bundesliga and include all 602 players of the Bundesliga. The market values of the players as well as the variables of age, number of matches, and the most played position were taken from the Transfermarkt portal. For each club, a TV ranking variable which is based on the 5-year calculation in German Bundesliga is also considered (see http://www.fernsehgelder.de/2015-16/ranking/). The use of a TV ranking variable is based on the consideration that the measured variable implies a chain of effects that take place prior to the season, making this influence exogenous concerning the examined data. The theoretical chain follows the idea that a club's rating (the last five years) lead to a high TV-based income (ranking according to amount). This, in turn, implies an increased financial fortitude of the club (presumably, cash flow will increase), allowing for higher investments in new players. Investments, in turn, should lead to higher market values for the players in the current season.

The individual performance data of the players were taken from the website https://fussball.hermesworld.com/games. For each player, the absolute playing time, the absolute running distance, the number of won and lost tackles, the number of successful and failed passes, as well as the number of goals and assists during the season were recorded. Player ratings according to *Kicker* sports magazine were taken from their website[5]. Table 1 shows the independent variables. The dependent variable is represented by the average market value (in Euro) that a player scored in the 2015/16 season.

[5] The Kicker sports magazine awards a note if a player played at least 30 minutes.

Table 1

Overview and explanation of the independent variables including the dimensions.

Variable	Measurement	Skale	Unit
Age	Age at the beginning of the season	metric	Years
Assists	Assists	metric	Number
Distance	Running distance per 90min (total distance relativized to working time)	metric	Kilometer
Goals	Number of goals	metric	Number
Passes	Pass rate (ratio of arrived passes to played passes)	metric	Quota
Position	Most played position within the season	nominal	1 = Defense, 2 = Midfield, 3 = Offense
Tackles	Tackle quota (won duels to led duels)	metric	Quota
Time	Operating time during the season	metric	Minutes
TV Ranking	Points from the TV ranking from the last 5 seasons calculated	metric	z-transformed points from the TV-Ranking of the Bundesliga

For the analysis, only players who belonged to the same club on all 34 matchdays are eligible. Due to the lack of consistent data, goalkeepers are excluded as well as players who have not had a representative mission during the season in question (see footnote 1). The remaining dataset contains a complete sample of 328 players.

First, there is a high correlation between the average grade of a team and its placement (rho = 0.83) or points scored at the end of a season (r = -0.89). However, this does not necessarily present an accurate picture of a team's performance. The analysis of the differences between the clubs—using one-way ANOVA with the variable club as an influencing variable on the variable note—shows a significant difference between the 18

clubs ($F[17,310] = 9.787$, $p < 0.001$). The subsequent review by means of post-hoc tests shows that four main clubs (FC Bayern München, Borussia Dortmund, Bayer Leverkusen, and Borussia Mönchengladbach) make the difference. This means that the Kicker score is a variable that distinguishes top clubs from others in terms of a discriminant factor. Additionally, a multiple regression shows that both the total sample and the random subsamples (the sample was halved randomly and then the analyses was re-run) show that the addition of the Kicker grade does not cause a marked change in significance (with a difference of less than 1%). Therefore, the grade for the further boosted regression analysis is not considered. However, these tests did show that there is an endogeneity problem between the Kicker score and the other variables. For the rest of our analysis, we use the Kicker score only to limit the sample to those players who had at least one significant bet in the season. These are just the players who have received an average rating for the season.

Boosted Regression Trees

The explorative analysis of possible influencing factors on the market value of a player takes place with the help of boosted regression trees, which is a statistical learning algorithm (Friedman, 2001; 2002).[6] The method is based on the principle of regression trees. A regression tree is grown by means binary hierarchical splits. Every split partition the space of the predictors into disjoint areas. For every area, the market value of a player is predicted by means of a region-specific constant (the mean of the predictand in the respective region). The splits are identified by searching over the values of the predictors to minimize the region-specific squared prediction error. In this way, a splitting predictor along with its realisation that is used to form a split is identified. This search-and-splitting algorithm is then repeated to grow a full-fledged regression tree (for a textbook exposition of this process of tree growing,

[6] Other studies that apply boosted regression trees in economics are Bai & Ng (2009); Buchen & Wohlrabe (2014); Emrich & Pierdzioch (2016); Emrich & Pierdzioch (2017).

see James, Witten, Hastie & Tibshirani, 2017). The algorithm is continued until a certain termination criterion like the minimum number of observations per final region or a maximum number of tree depth is reached (James et al., 2017). As a result, every observation of the predictors can be exactly allocated to one of the several regions that form a regression tree, and predictions of the market value of players can then be made. Because individual regression trees are high variance predictors due to their complex hierarchical structure, boosting refers to creating and combining multiple trees to increase predictive accuracy (James et al., 2017). Specifically, boosting is a forward step-wise algorithm that forms an ensemble of trees by using information embedded in the negative gradient vectors implied by previous trees in the ensemble. Boosted regression trees are an alternative to parametric modelling approaches. One of their advantages is that regression trees are extremely suitable to model nonlinearities and to take into account potential interaction effects between predictors (e.g. possible interactions could be between players position and goals or assists). Because boosted regression trees are a data-driven approach to such nonlinearities and interaction effects, a researcher does not have to specify them in advance.

The analyses were performed using the R add-on package gbm.step for the R programming environment (Version 3.5.1) with the suggested parameters Tree complexity = 5, Learning rate = .01, Bag.fraction = .5, and the Tolerance method ‘fixed’ (Elith, Leathwick & Hastie, 2008; Hastie, Tibshirani, & Friedman, 2001). Elith et al. (2008, p. 807) state that the function gbm.step implements cross-validation to determine the optimal number of trees and explain the use of the other parameters.

Results

The distribution of the dependent variable shows that most players have an average market value[7] of less than € 10 million. The players with the highest market values have a market value of approximately € 65 million (mean = € 5.8 million, median = € 2.9 million, SD = € 8.6 million.). Figure 1 shows the frequency distribution of the market value and table 2 shows the descriptive statistics of the predictors included in the model.

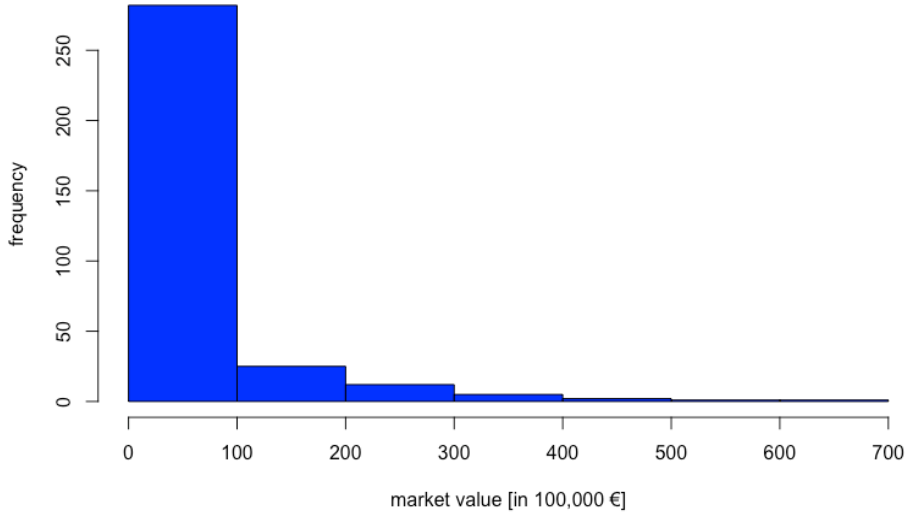

Figure 1: *Frequency distribution of average market values of German Bundesliga Season 2015/2016 (in € 100,000).*

[7] Average market value, as it was averaged over a season.

Table 2: *Descriptive statistics of the independent variables (N=328)*

Variable	Description	M (SD)	Median
Time	Operating time during the season	1566.00 (885.68)	1610
Goals	Number of goals	2.23 (3.72)	1
Passes	Pass rate (ratio of arrived passes to played passes)	.74 (.10)	0.75
Tackles	Tackle quota (won duels to led duels)	.50 (.08)	0.50
Distance	Running distance per 90min (total distance relativized to working time)	10.47 (1.01)	10.49
Assists	Assists	1.65 (2.08)	1.00
Age	Age at the beginning of the season	24.95 (3.80)	25.00
TV Points	z-transformed points from the TV-Ranking of the Bundesliga	.75 (.72)	0.84

The optimal number of trees calculated by the algorithm is 1250 (see figure 2; Elith et al., 2008). One of the main results are the relative influences of each variable. Those measures are based on the frequency a variable is used in the split algorithm. This result is weighted by the contribution to the model's transcription and averaged across all trees. The relative influence of the variable adds up to 100%, with a higher number meaning a bigger influence in the model (Elith et al., 2008, p. 808). In our model, the relative influence (table 3) shows that the variable ‘TV points’ is the highest predictor for market value. All performance variables had an impact of less than 10%, with the variable position even less than 1%. The sample was divided into a training dataset (75%) and a test dataset (25%). The results are evaluated by using the test dataset and comparing the predicted and the observed values in the

test dataset by means of NRMSE (normalized RMSE; 62.9). The result of the correlation is significant: r = .7766; t = 10.957, df = 79, p-value < .05.

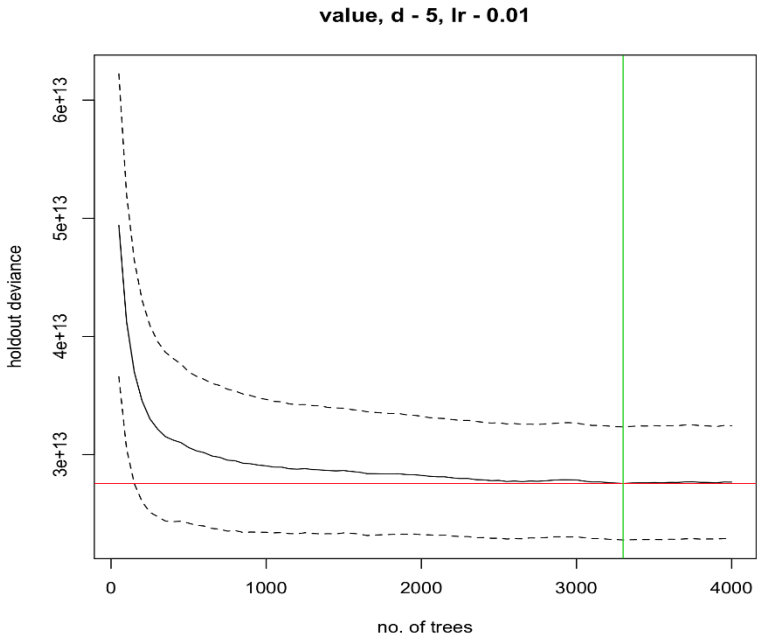

Figure 2: *Optimal number of trees*

Table 3: *Relative Influences of predictors (in %)*

Variable	Percentage [%]
Club	50.91
Goals	10.78
Passes	10.06
Assists	9.71
Time	7.18
Age	4.30
Distance	3.93
Tackles	2.69
Position	.44

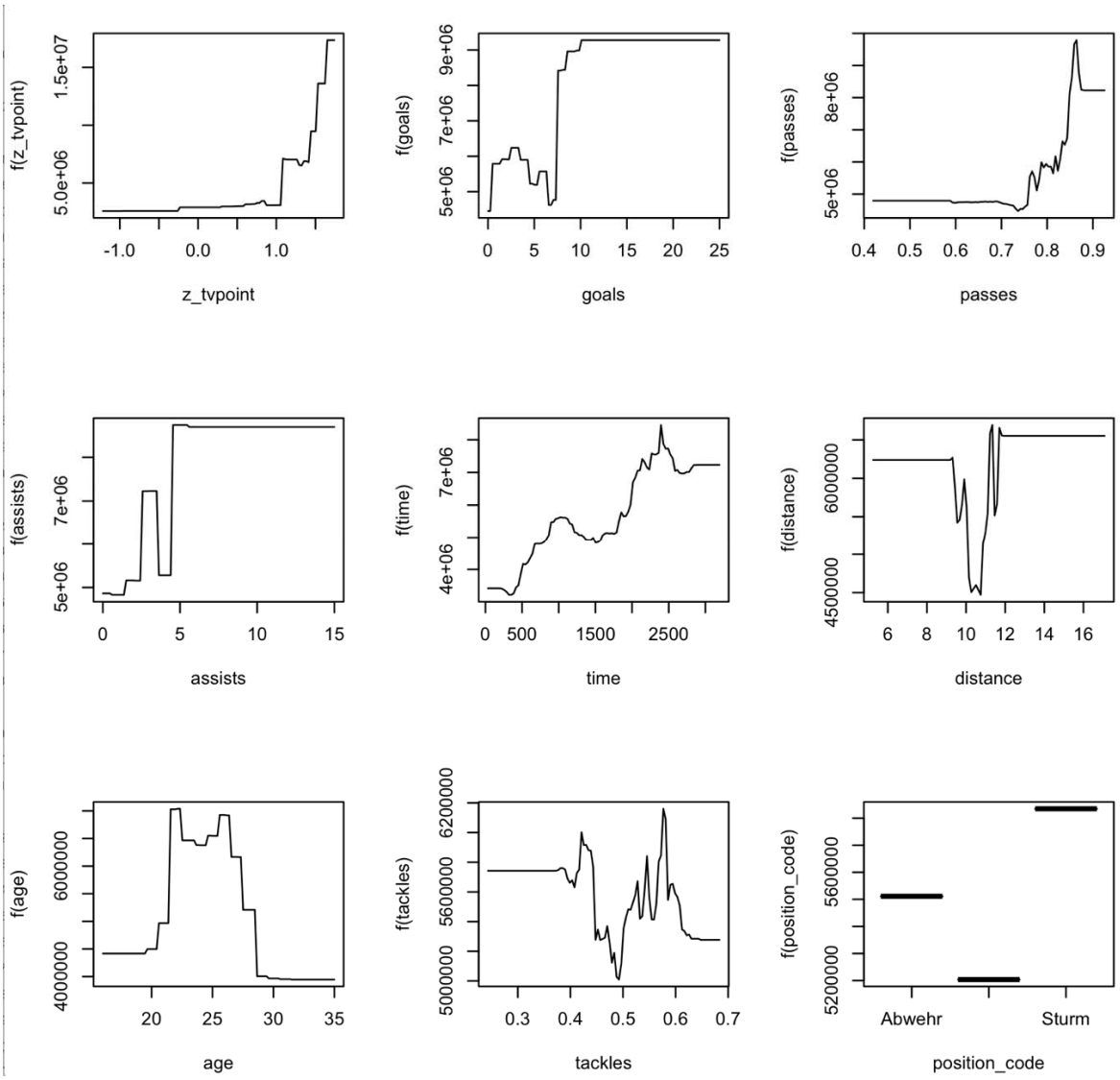

Figure 3: *Partial dependence plots*

Figure 3 shows the two-dimensional partial plots. These plots show that a linear use of influence would be inappropriate. We now take a closer look at the individual plots in order of relative influence. The *TV points* variable has the highest relative influence. As mentioned in our theoretical explanation above, a higher amount of TV money leads to an increase in market value. The number of *goals* affects the market value, while the increase of five goals is the steepest. The *pass rate* only shows an influence on the market value from about 75% and increases here to a maximum of approximately 88%. The absolute number of *assists* does not have much influence at first but increases with an increasing number of templates. *Time played* throughout the season has a nearly linear impact on the average market value. As

expected, the market value initially rises until about the age of 23 years and then gradually decreases with *age*. The analysis of the *distance* variable shows that a certain mileage is conducive, but beyond a certain point leads to a decreasing market value. We can assume that in this case, other components are missing. The influence of the won duels is mainly U-shaped, with the influence of the *tackles* variable being the highest in about 60% of the won duels. *Position* has the lowest relative influence, with forwards have a higher market value than defenders and midfielders. The result is probably due to goals scored.

Discussion

This study showed that the performance components often used in coaches' analyses to legitimize either victory or defeat has a significantly smaller impact on the average market value of a player than on the club itself, which acts as a kind of radiation effect. This results in a market concentration on four (or possibly five) top clubs, of which the market value clearly stands out from the rest of the clubs. Since most of these performances placed these clubs in the lead in both the preseason and the end of the season in question, a 'Matthew effect' (Fiedler, Welpe, Lindlbauer, & Sattler, 2008; Bask & Bask, 2015; Barth, Güllich, & Emrich, 2018) can also have an impact. As an example, tackling shows that efficiency leads to a maximization of the market value. Too much can be just as inhibiting as too little, as can be seen when considering performance variables such as mileage or tackling (Spence, 1973).

Future research on this topic could address which other factors—besides the parameters tested in our study—influence the market value of players. An interesting factor that is becoming more and more important in the sports media world is the reputation of a player. A possible way of measuring this factor is the social media activity of a soccer player, which can be seen as an indicator of the player's marketability. While the market values provided by Transfermarkt are estimated from an external point of view by the platform's

users, future research in sports economics could give insights concerning the calculation of subjective values that can be used by clubs as concession limits during transfer negotiations. At the moment, economic literature lacks on an operationalization of investment theory-based valuation of human capital in general and the valuation of soccer players in particular (Ackermann & Follert, 2018).

A limitation of this study is that only one season was considered, which is why long-term effects could not be studied in the analysis.

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