# A team's human capital and its sporting success. An analysis of the first and second German soccer league

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## ABSTRACT

The importance of the human capital tied up in the players appears to be decisive for the success of a professional soccer club. On the one hand, this article analyses whether professional soccer clubs are more successful in sporting terms the greater the human capital of their players. Using the Transfermarkt.de values as a proxy for human capital and the final table positions as well as the points scored as a proxy for sporting success, we show for the 1st and 2nd Bundesliga with the help of a random intercept model that those clubs achieve greater sporting success that have a higher human capital value. On the other hand, – and this is the more important result – the impact of human capital tied up in different player positions has different effects on sporting success. Our analysis of the human capital allocated to the player positions based on the LASSO method shows that investments in human capital are most important in the goal and midfield positions in Bundesliga 1 and in defence in Bundesliga 2. Thus, our study makes an important contribution to identifying the success factors of professional soccer clubs.

**Keywords**

*human capital, success, Bundesliga, soccer, positions' influence*

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## Introduction

In professional soccer, the pursuit of sporting success is closely intertwined with strategic investment in player talent. One potential proxy for evaluating the quality and potential of a team could be the aggregated market value of its players, which reflects not only their past performance and current skill level but also their projected contribution to future success. The online platform Transfermarkt.de provides comprehensive data on team market values, and a preliminary observation of this data for the German 1st Bundesliga suggests a strong correlation between a club's market value and its competitive performance in the league standings.

Against this backdrop, the exceptional performance of Bayer Leverkusen in the 2023/24 Bundesliga season among other examples raises important questions. Despite possessing a significantly lower total squad market value than perennial powerhouse FC Bayern Munich, Bayer Leverkusen achieved superior sporting results. This apparent deviation from the expected pattern invites a deeper investigation into the dynamics between financial valuation, human capital, and actual performance outcomes.

This study is therefore motivated by the need to understand the strategic relevance of players' human capital – as proxied by their market value – for the sporting success of soccer clubs. It aims to empirically assess whether a club's performance can be predicted by the extent of its human capital and to what degree this relationship holds across different segments of the team. Specifically, the analysis will differentiate between the contributions of human capital in various functional areas of the squad (goalkeeping, defence, midfield, and attack) to determine whether some segments exert a stronger influence on sporting outcomes than others.

By quantifying these relationships, this research seeks to contribute to both the academic discourse on resource-based view of competitive advantage in sports and the practical decision-making of soccer club management regarding talent acquisition and resource allocation.

## Market value and sporting success in soccer: Current state of research

Numerous empirical studies analyse the influence of a so-called market value of players besides other economic factors on the sporting success of a national soccer team or of individual soccer clubs in a league (e.g., Gasparetto & Barajas, 2022; Scelles & Andreff, 2019). For example, by analysing the determinants of the sporting success of teams in the twelve most important national soccer leagues, Gerhards et al. (2014) found that there is a strong correlation between the average market value, measured in Transfermarkt.de values (TM values) before the start of the season, and the sporting success of a team. This correlation is confirmed, for example, by the studies of Klobučník et al. (2019), who analyse the matches of all clubs in the top soccer leagues in the countries of the European Union in the period between 2007/08 and 2016/17, and by Reade & Garcia-del-Barrio (2023), who refer to 9,130 matches in the Big 5 leagues.

Studies that focus primarily on one league, such as the study by Ziebs (2004), who examines the sporting success of Bundesliga clubs in the 1990/91 to the 1999/2000 seasons, Lepschy et al. (2020), whose study focuses on Bundesliga matches in the 2014/15-2016/17 seasons, and Scelles & Khanmoradi (2023), whose study focuses on the Iranian Premier League in the seasons from 2009 to 2022, come to identical conclusions. The positive correlation between the market value of the team and sporting success is indirectly confirmed by the studies by Hall et al. (2002) for the Premier League and Frick (2004) for the German Bundesliga.

For the national teams, for example, the studies by Peeters (2018), who analyses 1020 national team matches, and Massaro et al. (2020) confirm a positive correlation between TM values and sporting success. Lepschy et al. (2021) come to different conclusions in their study of success factors at the 2014 and 2018

World Cups. According to this study, market value is not a relevant factor, which the authors believe is the result of the characteristics of the single elimination tournament used in the World Cups.

Regarding the influence of individual parts of the squad such as goalkeepers, defence, midfield and attacking players on sporting success, a review of the research provides the following findings: Many studies exist that examine the characteristics and actions of players as possible determinants of player success in soccer. Such determinants include physical fitness (Arnason et al., 2004), running performance (Klemp et al., 2022), dribbling speed (Wilson et al., 2020) and ball possession (Wang et al., 2022). However, the influence of the filling of player position categories like midfield or attack positions on the outcome of the game has been analysed only hesitantly at best. For example, AlMulla et al. (2023) developed a model based on a neural network to predict the winners of soccer matches in the Qatar Stars League. They conclude that, based on information about the technical and physical performance of the players, defenders have a stronger influence on the outcome of the match than players in midfield or attack. However, no other relevant studies on the influence of player position on the outcome of a match can be identified in the context of this study.

The studies mentioned above often have an imprecise use of the term market value in common. Franceschi et al. (2024) show that market value, the subjective value of a player for a club, and the Transfermarkt.de value, which can be interpreted as the result of the so-called "wisdom of crowds" (Surowiecki, 2004), are often equated. However, market value expresses the price a club must presumably pay to sign a player. Due to institutional conditions, this depends on the remaining term of the player's contract with the transferring club. The subjective value of a player for a club results from his marginal product for that club and often differs from the market value. Thus, the market value may be zero at the end of a player's contract, but the subjective value may be very high. According to Follert & Gleißner (2024), the subjective value of a player to a club depends on what the club expects the player to bring in terms of additional revenue in the future. A club's decision to buy a player is therefore an investment decision, in which the analysis of past transfer price data is largely irrelevant.

The values that the website Transfermarkt.de refers to as market values do not represent market values in the strict sense, because these do not exist in imperfect human capital markets. Rather the Transfermarkt.de values can be interpreted as external expert estimates of a player's performance (Ackermann & Follert, 2018). In other words, the Transfermarkt.de values are an external assessment of the human capital incorporated in the respective player. In this way, these values, which assume that players have an objective value, can reflect the value of the human capital that the player has for a specific club only to a limited extent. This becomes particularly clear when considering specific human capital in Becker's sense (Becker, 1962, 1994): the specific human capital of an individual player, which consists, for example, of knowledge that enables perfect interaction between a particular fullback or winger, necessarily has a different value for each club.

Against the background of the overview of the relevant research, although there are studies that investigate the influence of players' human capital in general on sporting success in the Bundesliga, the influence of the various player positions on sporting success in the 1st and 2nd divisions has not yet been investigated.

This paper aims to close this research gap, at least to some extent, by examining the importance of human capital as a club resource on sporting success in the 1st and 2nd German men's Bundesliga for the seasons from 2012/13 to 2022/23. In this context, the study investigates whether investing in a squad with a relatively high level of human capital compared to other leagues has the same positive effect on sporting success as investing in a squad with a relatively low level of total human capital. Foremost, it explores which player position has the strongest impact on a team's sporting success.

## Theoretical background and derivation of the hypotheses

Human capital theory can be used to explain the varying success of soccer clubs (Gerrard & Lockett, 2018; Massaro et al., 2020). This theory goes back to the work of Schultz (1961) and Becker (1962, 1994), in which investments in training processes, i.e. education and training, are related to investments in physical capital. Human capital encompasses the entirety of an individual's abilities and skills which, unlike physical capital, are inextricably linked to the person in question. As a result, human capital is only accessible to the production process of companies if the holder of this capital offers his or her work performance on the market and makes it available to the organisation.

Becker (1994) distinguishes between general and specific human capital: Thus, according to Becker (1994), specific human capital as a result of investment in the form of training increases marginal productivity only for the company providing the training. If the investment also increases an individual's marginal productivity in other companies, it is considered to be general human capital. Accordingly, specific human capital exists if the labour force can only be used efficiently within the company and loses value outside the company (Williamson, 1985; Williamson et al., 1975).

The concept of human capital has been applied in the field of sports, in particular to examine and explain the salary of professional players and coaches in various sports. The question of how the professional sports labour market rewards human capital in terms of the performance attributes of players or managers is examined for both team and individual sports. For example, Scully (1974), Zimbalist (1992) and Blass (1992) examine determinants of baseball players' salaries, and Crosby (2021) examines the influence of human capital, measured in terms of length of experience, on the remuneration of managers in baseball. Similar studies can be found for basketball (e.g., Scott et al., 1985) and hockey (e.g., Idson & Kahane, 2000; Jones & Walsh, 1988). In addition, there are studies on the effects of human capital – measured, for example, in terms of performance in the four types of strokes – on the salary of professional golfers (Botha et al., 2021; Shmanske, 2000). Of course, comparable studies have also been conducted for soccer (e.g., Hill et al., 2025; Lucifora & Simmons, 2003).

This study should be viewed in this context: Applying the concept of human capital to soccer players means that general human capital includes skills such as fitness or ball reception techniques, while specific human capital refers to aspects such as team-specific understanding of the game or non-codified tactical guidelines.

For the players are decisive for the sporting success of a club, human capital theory suggests that a high level of human capital in players is conducive to the club's sporting success (Gerrard & Lockett, 2018). Research suggests that the human capital tied up in a player is reflected in the TM values (Franceschi et al., 2024). The current state of research, as outlined in the previous section, shows a statistically demonstrable effect of the TM value of players on the sporting success of the club at both national and international levels. Against this background, the sum of the TM values of a club's players can be used as a proxy for the human capital available in a club. This value is referred to below as the human capital value or total human capital value.

The following facts must be considered in this context: Firstly, we have already briefly discussed above that the value of a player's human capital differs from club to club. The use of this variable is based on the assumption that the human capital of individual players declines if they do not fit in properly within the club, which applies to players who are not new to the team but have already played at least one season with that club. For players who have just joined the club, the TM values do not fully reflect the human capital embodied in a player for the club in question, because the human capital values are recorded at the beginning of each season. However, since it can be assumed that general human capital far outweighs specific human capital, and because expectations also

play a role in the valuation of human capital, this error should be limited for new players.

On the other hand, we consider the sum of the TM values of all players in a club to be the aggregate human capital of that club. The human capital of individual players reflects their individual characteristics, such as e.g. performance data, experience, age and development potential. Since this human capital is influenced by the conditions within the club, as just mentioned, the sum of the human capital values represents a variable that not only integrates several individual factors relevant to success at club level but also reflects the interdependencies between players.

The theoretical approach and the findings of the empirical studies mentioned above make it possible to derive the following hypotheses, whereby the conditions in the first two German professional soccer leagues (1st Bundesliga and 2nd Bundesliga) in the seasons from 2012/13 to 2022/23 will serve as the object of investigation:

H1: The higher the investment in the total human capital value of the squad (aggregated human capital of the individual players) of a club in the 1st or 2nd Bundesliga, the higher its sporting success (points at the end of the season). This effect can be demonstrated a) when comparing the seasons (2012/13-2022/23) within the clubs and b) when comparing the clubs with each other.

Therefore, we analyse for the 1st and 2nd Bundesliga for all seasons from 2012/13-2022/23 whether there is an empirical correlation between the investments in the total human capital values of the squads and the points scored in the season. A forecast of the additional sporting success could be calculated using the determined effect, the investment volume and the total human capital. By analysing the effect between the clubs, it is also possible to determine whether clubs with a higher total human capital value score significantly more points in the first and second divisions and are therefore more successful in sporting terms.

Furthermore, as we have seen from the study of AlMulla et al. (2023), based on the data of Qatar Stars League, defence might have a higher effect on sporting success compared to other positions. A high quality of defence, measured by the amount of human capital tied up in it, should therefore lead to a higher sporting performance. Hypothesis 2 derives from this:

H2: The higher the aggregated human capital value of the defence compared to the aggregated human capital values of the other branches of the squad (goal, midfield, attack), the greater the sporting success of the team (points at the end of the season).

## Methods

We use the total human capital values of the teams, i.e. the sums of the individual TM values of a team's players, as independent variables. Therefore, we assume that this total TM value translates the human capital of all players into monetary terms and thus represents the collective benefit to the club's sporting success from the squad. To analyse the second hypothesis, the TM value is aggregated separately for each position: goal, defence, midfield and attack.

To make sporting success, the phenomenon to be explained, measurable and accessible for statistical analysis, we use the points scored in the respective season as a proxy. This is based on the idea that a club's points reflect its average sporting performance in the previous season in relation to the other competitors.

The corresponding data on total human capital values as of 15 July of the respective year and points were researched on the platform Transfermarkt.de (Transfermarkt.de, 2023a, 2023b). All data of the participating clubs of the 1st and 2nd Bundesliga in the period of the seasons from 2012/13-2022/23 were included. A total of 396 cases were analysed. The exact time in the season at which the TM values aggregated for the position categories were recorded is not explicitly stated on Transfermarkt.de.

We used the software R (R Core Team, 2024) to carry out the statistical analyses. The effects of total human

capital on sporting success (points) were analysed using a random intercept model (level 1: points per club and season, level 2: club level). To test the effect of total human capital (H1) within the clubs, this variable was centred within the clubs and integrated into the model as a level 1 predictor. In addition, the mean total human capital aggregated per club (mean value per club) was included as a level 2 predictor. As the mean score for promoted/relegated clubs may differ from those clubs that have stayed in the league, this status was also included in the model as a factor with the values a) promoted, b) relegated and c) staying in the league as the reference category. In principle, a change in the average number of points per league and season is also possible (e.g. by changing the win/draw/loss ratios). For this reason, the season was included in the model as a time variable. Based on a model including all possible interaction effects, those higher interaction effects that were not statistically significant were removed from the model. As a result, only the interaction effects in which the promotion/relegation factor was integrated were excluded from the final analysis. In the final model, the effects of human capital on points were estimated separately for both leagues (due to the interaction effects). The model was estimated using the restricted maximum likelihood function (REML). The degrees of freedom were approximated using the Satterthwaite method.

To analyse the second hypothesis, the effects of the aggregated human capital of the respective positions (goal, defence, midfield, attack) on sporting success (points per season) are estimated. Due to the interrelationships between the positions (only the total available capital can be allocated to the respective positions), we did not centre the aggregated human capital within the clubs. Analogous to the model for H1, the predictors time, league and the factor promotion/relegation were considered. To estimate the effects separately for each league, the corresponding interaction effects were included.

Due to the high multicollinearity between the predictors representing the aggregated human capital of the respective positions, the LASSO method (least absolute shrinkage and selection operator, (Tibshirani, 1996) was used for variable selection. To account for unobserved, team-specific heterogeneity, random intercepts on the team level were included. The model was fitted by the so-called glmmLasso function from the equally-named R-package, which is based on a modified full gradient algorithm (Groll & Tutz, 2014). The optimal penalty parameter based on the post-LASSO variant provided in the package was selected via the Bayesian information criterion (BIC; Schwarz, 1978) as a parsimonious selection criterion. Using the LASSO method, the predictors time, league and the interaction effect of the predictor league with the aggregated human capital of the position goal (league*goal) were removed from the model. The paths of the individual coefficients are shown in Fig. 1. A significance level of α=5% was used for all statistical tests.

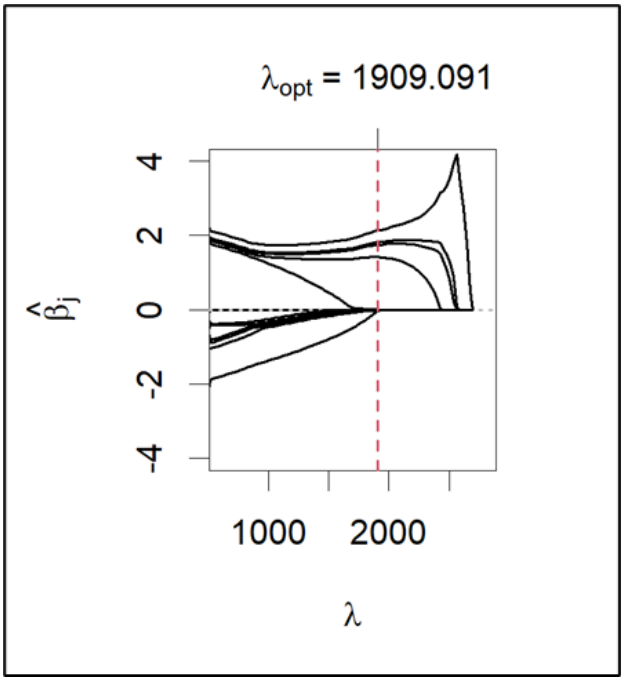


**Figure 1** *Path diagram from the LASSO method. The optimal lambda penalty type parameter is labelled (own illustration).*

## Results

A total of 28 different clubs were represented in the 1st Bundesliga in the seasons analysed. Nine of these

clubs were in the top flight for all seasons. Of these, FC Bayern Munich finished all seasons as German champions. Borussia Dortmund was the second-best performer with an average third place in the period under review. Eintracht Braunschweig and VfL Bochum only played one season in the first league during this period. On average, the clubs played 6.42 seasons in the 1st Bundesliga. In the 2nd Bundesliga, 38 different clubs were considered, almost 25% more than in the first league. Both the average number of seasons in the league (4.7 seasons) and their variance (2.8) are lower than in the 1st Bundesliga. Only FC St. Pauli and SV Sandhausen are represented over the entire period under review.

In the following Table 1, the striking values in relation to the predictor variables and the criterion 'points' within the period under review were analysed. The mean values of the total squad values of all teams and the points scored, their standard deviation as well as the maximum and minimum values were determined for each league.

**Table 1**
Descriptive Statistics: Total Human Capital Values and Points

| Statistical Dimensions | Total human capital (in million Euros) | | Points | |
|---|---|---|---|---|
| | 1st Bundesliga | 2nd Bundesliga | 1st Bundesliga | 2nd Bundesliga |
| **Mean** | 200.369 | 20.851 | 46.838 | 46.136 |
| **Max** | 948.950 | 86.850 | 91.000 | 76.000 |
| **Min** | 25.150 | 9.700 | 16.000 | 19.000 |
| **Std.** | 183.240 | 11.257 | 14.905 | 10.797 |

Total human capital is stated in millions of euros.

If the individual seasons within the observation period are considered separately, further aspects can be noted. The highest overall squad value in the first division is that of FC Bayern Munich in the 2022/23 season with a squad value of 948.95 million euros and Hamburger SV in the second division in 2018 with 86.85 million euros. The lowest overall squad value measured was recorded by SV Darmstadt 98 with 25.15 million euros in the first division in 2015 and SV Sandhausen with 9.7 million euros in 2012 in the second division.

The striking aspects of the criterion points earned during the season are also recorded in Table 1. Overall, the highest and lowest values can be found in the first league. Here, FC Bayern Munich achieved the maximum with 91 points in 2012 and FC Schalke 04 achieved the minimum with 16 points in 2020. In the second division, Hertha BSC ended the season in 2012 with the league's highest score of 76 points, while Jahn Regensburg was relegated with the league's lowest score of 19 points. It is noticeable that the average standard deviation is 10.8 versus 15.4 and the average difference between the highest and lowest values is lower in the second league at 40.6 versus 63.2. This suggests that there will be greater tension for the spectators, as the final results of the teams in the second league are closer together than in the first.

The results of the multi-level analysis of the effects of total human capital on sporting success (points) can be seen in Table 2.

**Table 2**
Effects of Total Human Capital on Success

| **Fixed Effects** | **Estimate** | **SE** | **t (df)** | **p-value** |
|---|---|---|---|---|
| Intercept | 35.08 | 1.15 | 31.455 (57.5) | <.001 |
| Total human capital value [within clubs, club-centered L1 predictor] | 7.71e-02 | 1.58e-02 | 4.871 (344.8) | <.001 |
| League (2) [Ref.: 1. League] | 0.77 | 1.90 | 0.582 (87.5) | .405 |
| Total human capital value [between clubs, aggregated L2 predictor] | 6.56e-02 | 0.42e-02 | 15.615 (43.7) | <.001 |
| Time | -0.74 | 0.15 | -4.777 (345.9) | <.001 |
| Factor promotion/relegation (relegation) [Ref: League retention] | 12.25 | 1.98 | 6.194 (382.0) | <.001 |
| Factor promotion/relegation (promoted) [Ref: League retention] | -12.79 | 1.80 | -7.093 (378.4) | <.001 |
| Total human capital value (within the clubs) * League (2) | 1.59 | 0.24 | 6.530 (347.1) | <.001 |
| Total human capital value [within clubs] * Total human capital value [between clubs] | -1.31e-04 | 0.33e-04 | -3.941 (344.2) | <.001 |
| Total human capital value [between clubs] * League (2) | 0.36 | 0.07 | 5.283 (234.7) | <.001 |
| Total human capital value [within clubs] * League (2) * Total human capital value [between clubs] | -3.59e-02 | 0.60e-02 | -5.960 (345.1) | <.001 |
| **Random Effects (variance)** | | | | |
| Club | 4.39 | | | |
| Residuals | 50.88 | | | |
| **Descriptive Statistics** | | | | |
| ICC (null model) | 0.37 | | | |
| N Observations | 396 | | | |
| N Clubs | 47 | | | |

The total human capital value is given in millions of euros. Success is measured by the total number of points at the end of a season. Supplementary explanations of the predictors are shown in square brackets. Factor levels are shown in round brackets. "Ref." = reference category, "SE" = standard error.

The estimated effect of total human capital is significant both when analysing within clubs (at level 1) and when comparing clubs (at level 2). An investment of one million euros in total human capital leads to an average increase in success of 0.08 points in the first division when comparing within clubs and 0.07 points when comparing clubs with each other. These two effects interact: For the second division,

the (main) effects are significantly more pronounced. The investment of one million euros leads to a greater increase in points compared to the first division (interaction effects: Total human capital value [within clubs] * league as well as season value [between clubs] * league). The differences in human capital value are lower in the second division than in the first division (standard deviation 1st division = €183.240 million; standard deviation 2nd division = €11.257 million). Therefore, we can expect that the effect within the first division will be smaller. In this respect, this confirms the findings of Gerhards et al. (2014) regarding a decreasing marginal benefit of human capital.

To analyse H2, we used a LASSO model to estimate the contributions of the human capital of the individual positions goal, defence, midfield and attack to sporting success. This model's results can be seen in Table 3.

**Table 3**
Effects of Human Capital Aggregated Within Positions on Sporting Success

| **Fixed Effects** | **Estimate** | **SE** | **z-value** | **p-value** |
|---|---|---|---|---|
| Intercept | 39.34 | 0.88 | 44.894 | <.001 |
| Time | 0 | - | - | - |
| Defence | 2.85e-03 | 2.74e-03 | 1.043 | .297 |
| Midfield | 40.75e-03 | 2.63e-03 | 15.479 | <.001 |
| Attack | 1.65e-03 | 2.62e-03 | 0.630 | .529 |
| Goal | 321.60e-03 | 15.19e-03 | 21.168 | <.001 |
| League (2) [Ref.: 1. League] | 0 | - | - | - |
| Defence * League (2) | 805.88e-03 | 31.80e-03 | 25.346 | <.001 |
| Midfield * League (2) | -69.54e-03 | 27.09e-03 | -2.567 | .010 |
| Attack * League (2) | 10.04e-03 | 31.11e-03 | 0.323 | .747 |
| Goal * League (2) | 0 | - | - | - |
| Promoted/relegated (relegated) [Ref.: League retention] | 14.61 | 0.29 | 51.269 | <.001 |
| Promoted/relegated (promoted) [Ref.: League retention] | -14.78 | 0.25 | -58.339 | <.001 |
| **Random effects (variance)** | | | | |
| Club | 38.25 | | | |
| **Descriptive Statistics** | | | | |
| N Observations | 396 | | | |
| N Clubs | 47 | | | |

The player positions are differentiated between goal, defense, midfield and attack. Sporting success is measured by the total number of points at the end of a season. The total human capital value of the respective positions is given in millions of euros. Supplementary explanations of the predictors are shown in square brackets. Factor levels are shown in round brackets. 'Ref.' = reference category, 'SE' = standard error.

Based on the results, the effects of an investment in the goal and midfield positions are most pronounced in the 1st division. However, in the 2nd league the human capital allocated to the defence position has

a higher impact on sporting success compared to the human capital allocated to the other positions (interaction effect defence * league). Besides that, investments in the midfield seems to have a lower return in the 2nd league than in the 1st league (interaction effect midfield * league).

## Discussion

The results of the multi-level analysis examining the impact of total human capital on sporting success reveal two central effects with significant theoretical and practical implications. First, the analysis demonstrates a clear pattern of diminishing marginal returns on human capital investment. Specifically, the effectiveness of additional investment is lower for clubs that already possess high levels of total human capital (*interactive effect total human capital value within the clubs * total human capital value between the clubs*). This suggests that clubs with comparatively modest squads benefit more from additional investment than those with already expensive teams. This finding reflects the principle of decreasing marginal utility: the higher a club's existing human capital in relation to its competitors in the same league, the smaller the impact of each additional unit of investment on sporting performance.

Second, a temporal trend emerges across the seasons analyzed (2012/13 to 2022/23), more specifically we detected a negative time effect indicating a general decline in the average number of points per team per season when statistically controlling for other relevant predictors. This trend is likely attributable to shifts in the distribution of match outcomes (i.e., win/draw/loss ratios), which may point to an increase in competitive balance within the league. From a sporting perspective, such a development implies that league competitions have become more balanced and potentially more engaging for spectators over time.

These findings provide empirical support for Hypothesis H1, which posits a positive relationship between investment in human capital and sporting success. Clubs with greater total human capital tend to perform better, and this relationship is particularly pronounced in the context of promotion and relegation. On average, teams relegated from the first division score 12 points more and teams promoted to the first division score 13 points less. This is presumably since clubs relegated from the 1st Bundesliga have a total human capital value that is relatively high compared to the second division and clubs promoted to the 1st Bundesliga have a total human capital value that is relatively low compared to the first division. These discrepancies underscore the importance of relative squad value within a given league context and further reinforce the central claim of Hypothesis H1.

Regarding Hypothesis H2, which concerns the positional distribution of human capital, the results are more nuanced. For the first division, the analysis does not confirm the hypothesis that defensive positions exert the greatest influence on team performance, a finding that contradicts earlier findings by AlMulla et al. (2023). The additional investment or acquisition of a goalkeeper has a relatively larger effect on team performance than an investment in other positions. However, the observed influence of the goalkeeping position should be interpreted with caution, as the small number of goalkeepers within a squad can disproportionately affect the aggregated human capital value for that position.

In contrast, the data support Hypothesis H2 in the context of the second division, where investments in defensive positions (*interaction effect defence * league*) are associated with a significant performance advantage. This pattern aligns with the findings of AlMulla et al. (2023) and suggests that positional effects on performance are not uniform across league levels. Notably, the influence of an investment in midfielders appears to be lower in the second division than in the first, further highlighting the importance of context-sensitive analyses in understanding the dynamics of human capital in professional soccer.

In this model, relegated clubs also scored 15 points more and promoted clubs 15 points less compared to the clubs that remained in the league. This is probably also because the clubs relegated from the first division have a relatively valuable squad compared to the other

second-division clubs. Likewise, clubs promoted to the 1st Bundesliga have a relatively favourable squad. The results of the model therefore also support hypothesis H1, as the result here also shows that clubs with a more valuable squad in relation to their competitors are more successful in sporting terms.

In conclusion, the study confirms that investment in human capital remains a key determinant of sporting success. However, the effectiveness of such investment varies depending on both the absolute and relative value of existing squad capital, the competitive environment, and positional allocation. These findings have important implications for club management, particularly in terms of resource allocation, talent acquisition, and strategic planning during promotion and relegation. Furthermore, the observed increase in competitive balance over time offers valuable insights for policymakers and league organizers aiming to maintain or enhance the attractiveness and unpredictability of professional soccer competitions.

## Limitations and implications for further research

Limitations of this study can be identified regarding the variables used. The use of the total human capital value of the squads in the form of the simple summation of the human capital values of the individual players as an independent variable is not unproblematic for two reasons: Firstly, the number of squad members is not considered, which means that larger squads inevitably have a higher total human capital value. Here, an attempt is made to eliminate this problem by estimating the effects within the team. However, it occurs when the composition of the team is changed depending on whether the team is playing internationally or nationally, for example. Taking this into account could be a starting point for further research.

Besides that, we simplistically assume that the total human capital value of a team is the sum of the human capital values of the individual players. This is unsatisfactory insofar as it can be assumed that in teams whose players have been playing together for a longer period or which have better coaches, integration mechanisms are at work that promise better utilisation of the players' individual human capital values than in the case of teams that have been working together for a short time. This effect is also reduced, at least over time, by the fact that players who are unable to realise their full potential in a team – for whatever reason – must expect a reduction in their human capital value, which also reduces the overall human capital value of the team. In this context, we assume that the composition of the teams is efficient in the medium term, i.e. that the management entities of the club, i.e. the sporting director or the coach, are replaced if the sporting results fall short of expectations.

We used the overall squad values as of 15 July of each year. Transfers that take place after the squad has been assessed at the start of the season can have an impact on the club's sporting success. In future analyses, the total human capital values from the sum of the individual human capital values of all players used in the season could be used to avoid this distortion.

Since the total human capital values are recorded at the beginning of the season, the direction of the effect on sporting performance is clear: a club has a certain total human capital value at the beginning of the season, which it uses to be successful in the upcoming games of the season. If this occurs, the club's economic situation should also improve, enabling it to invest in players and start the next season with a higher total human capital value, which in turn improves the team's chances of success. If the squad does not achieve the desired success in the first half of the season, it can be assumed that the club will attempt to adjust and improve its squad by investing accordingly.

The results can be concretised by including further predictors or criteria. As an alternative to the total human capital values, the player salaries paid can be used as a proxy for the extent of the players' human capital and thus as an independent variable. The human capital of the different positions as a factor for describing squad compositions can be supplemented by other factors such as origin, age or diversity in experience. In this way, it can be determined how the indi-

vidual resources 'players' can be optimally summarised to form the resource bundle 'squad'. Thus, the interdependencies between resources and their determinants for an optimal performance result could be analysed in further studies.

Regarding the secondary model for investigating the influence of the different positions, this work provides the result that the goal and midfield positions in the first division and the defence position in the second division are particularly relevant for sporting success within the period under consideration. There can be many reasons why the influence of the human capital of the player positions on success differs between the leagues. For example, it is conceivable that the leagues differ considerably in terms of the heterogeneity of player performance in the designated playing positions. Further research should therefore break down the high collinearities between the positions on the one hand and examine the reasons for the relevance of the different positions in more detail on the other.

## Conclusion

Within the theoretical foundations laid down in this paper, the players as carriers of their human capital were considered as a central resource of a club. Using TM values as a proxy for the extent of the human capital available in a player or club, we can show that those clubs in the 1st and 2nd Bundesliga that have a higher total human capital value at the start of the season are higher ranked in the final league table and achieve an increased number of points won.

Furthermore, it could be shown that the composition of the positions in the team has a considerable influence on sporting success. While in the 1st Bundesliga the goal and midfield positions are of primary importance, in the 2nd Bundesliga it is the defence.

In further research, these results should be deepened with the help of possible more concrete variables, the application of other forms of correlation and the inclusion of further variables. The variables used in this study should also be further specified and analysed. In addition, the transferability of the results to other European professional leagues should be analysed.

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