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What shapes player performance in soccer? Empirical findings from a panel analysis

Benno Torgler[a,b,c,*] and Sascha L. Schmidt[b,d,e]

[a]*The School of Economics and Finance, Queensland University of Technology, Level 8, Z Block, Garens point Campus, 2 George Street, Brisbane, QLD 4001, Australia*
[b]*CREMA – Center for Research in Economics, Management and the Arts, Switzerland*
[c]*CESifo, Munich, Germany*
[d]*European Business School, International University Schloss Reichartshausen, Chair of Management and Consulting, Rheingaustraße 1, 65375, Oestrich Winkel, Germany*
[e]*Institute of Management, University of St. Gallen, Dufourstrasse 40a, 9000 St. Gallen, Switzerland*

In this article, we investigate the pay–performance relationship of soccer players using individual data from eight seasons of the German soccer league *Bundesliga*. We find a nonlinear pay–performance relationship, indicating that salary does indeed affect individual performance. The results further show that player performance is affected not only by absolute income level but also by relative income position. An additional analysis of the performance impact of team effects provides evidence of a direct impact of team-mate attributes on individual player performance.

I. Introduction

The application of economic thinking to the business of sports has gained increased attention in the last few years. A sub-field of this research focuses on soccer, a sports discipline with a global reach, which has become increasingly commercialized over recent decades.[1] Unlike the economics of North American sports like baseball, basketball or American football, which have been analysed since the 1950s (e.g. Scully, 1974, 1995; MacDonald and Reynolds, 1994; Hamilton, 1997; Richards and Guell, 1998; Bodvarsson and Brastow, 1999; Kahn, 2000; Rosen and Sanderson, 2000), the economics of soccer are still in their infancy. In the literature that does exist, soccer is investigated on both the club level (for an overview, see Dobson and Goddard, 2001) and the international level (e.g. Hoffmann *et al*., 2002; Houston and Wilson, 2002; Torgler, 2004, 2007a). However, even though increased commercialization of soccer has led to more transparency and new data sources,[2] compared to the information on North

*Corresponding author. E-mail: benno.torgler@qut.edu.au
[1] For instance the FIFA World Cup has become a major spectacle and one of the world's largest sporting events, having been broadcast in 2002 in more than 200 countries and regions around the world, covering over 41 100 h of programming and reaching an estimated 28.8 billion television viewers (see FIFA Media Information, 21 November 2002, http://fifaworldcup.yahoo.com).
[2] In England, for example, clubs listed on the stock exchange must publish their annual reports (Kern and Süssmuth, 2003).

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American sports activities, data on soccer is scarce. Indeed, as Dobson and Goddard (2001) point out, despite soccer's 'prominent public profile, and despite the fact that its weekly or daily audience (including television viewers) run into millions, academic economists have devoted relatively little attention to professional football' (p. xv).

One of the most interesting research questions for soccer, in which player salaries are relatively high, is whether salary structures and player performance are correlated. According to Dobson and Goddard (2001), studies investigating this relationship are 'virtually nonexistent at the microeconomic level, because in most countries individual players' wage details are not disclosed' (p. 221). Admittedly, some work has been done in this direction, as will be further elaborated in the next section; however, our method differs from that of most extant research efforts in that it concentrates on the determinants of *individual* soccer *performance* measured in goals and assists, rather than the determination of salary itself. To achieve this focus, we use a broad sample from the German soccer league (*Bundesliga*) that covers eight seasons between 1995–1996 and 2003–2004.[3] To our knowledge, our article thus provides insights not offered by previous studies: First, we intensively investigate *player performance* rather than *team performance* as a dependent variable, using a rich set of control variables in a *time-series analysis* over several seasons. In addition, we evaluate different aspects of a possible pay–performance relationship never yet investigated in detail. That is, after checking whether there is a nonlinear effect, rather than focusing only on absolute income level, we also investigate the impact of the *relative* income level and position that may influence player performance. This approach assumes that what may matter for soccer players is not only salary in absolute terms but also salary in relation to team-mates. Finally, we investigate the impact of team colleagues on player performance, an aspect that has seemingly been considered in only three previous studies, two focused on a cross-sectional analysis of ice hockey (Idson and Kahane, 2000; Kahane, 2001, in which salary structure is a dependent variable) and another on cycling (Torgler, 2007b, in which performance is a dependent variable).

The remainder of this article is organized as follows: Section II provides a short overview of the relevant literature, after which Section III outlines our theoretical approach and develops our predictions. Section IV presents the empirical results, while Section V concludes the article.

II. Overview of the Literature

The economics of soccer draw upon traditional economic research such as labour economics, industrial organization, law and economics, political economy or consumer economics (for an overview see, e.g. Dobson and Goddard, 2001; Fort, 2003). Nevertheless, the investigation of soccer is often an interdisciplinary attempt that includes a broad range of academic disciplines beyond economics, including sociology, law, psychology or political science (e.g. Garland *et al.*, 2000). Most particularly, the emergence of professional athletes has led to increasing scholarly attention on employment issues like player earnings and performance. In addition, thanks to new data sets collected in, for example, Germany, Spain and Italy, some recent studies also investigate soccer's labour market. Overall, the empirical research available today, which focuses primarily on the European leagues, can be classified into two groups of soccer studies that look at the pay–performance relationship of players and clubs. Table 1 provides a detailed overview of these studies.

The first group of empirical soccer studies investigates players' salary or market value as a dependent variable and searches for factors that shape it (Lehmann and Weigand, 1999; Hübl and Swieter, 2002; Lucifora and Simmons, 2003; Eschweiler and Vieth, 2004; Garcia-del-Barrio and Pujol, 2004). These studies examine the extent to which club-specific factors (e.g. revenues from sponsorship, qualification for international competition) or player-specific factors (e.g. age, origin, reputation, appearance and player position in the team) influence player salaries or estimated market value/transfer price. For the German soccer league, Hübl and Swieter (2002) and Eschweiler and Vieth (2004), as well as Lehmann and Weigand (1999), confirm a positive pay–performance relationship. In addition, Hübl and Swieter (2002) explore a concave relationship between player age/number of games played in one season and player salary. Using data for the Spanish soccer league, Garcia-del-Barrio and Pujol (2004) identify two segments in the labour market supply and the presence of a winner-take-all effect leading to the strong bargaining power of superstars. Lastly, Lucifora and Simmons (2003), in a study of

[3] It was impossible to include 1997 because player salary information was unavailable.

Table 1. Summary of previous findings on pay–performance relationship

Authors	Research question	Dependent variable	Independent variable	Time intervals (seasons)	Number of observations	Key results
Hübl and Swieter (2002)	To what extent do club-specific or player-specific factors influence players' salaries?	Players' annual salary	Club-specific: Revenues from jersey sponsoring, qualification for international competition in last season Player-specific: Age, tenure (number of games in *Bundesliga*), player in national team (yes/no), origin, player position (goal keeper, defender, mid-fielder)	1994/95–2000/01	547 players	Extent of players' salaries is significantly dependent on player-specific factors, concave relationship between age/number of games within *Bundesliga* and salary
Lehmann and Weigand (1999)	To what extent do club-specific or player-specific factors influence players' salaries?	Players' annual salary	Club-specific: Annual sponsoring revenues, annual number of spectators, qualification for international competition in last season Player-specific: Origin, player position (goal keeper, defender, mid-fielder, striker), tenure (number of games in *Bundesliga*)	1998/99	Salaries from 468 players	Extent of players' salaries is significantly dependent on player-specific and club-specific factors
Lucifora and Simmons (2003)	What shapes players' earnings function in the Italian league? Is there a superstar effect?	Players' salary	Variables representing player experience including age and appearances, performance (goals, strike, assists), position, reputation (internationals), team-specific effects (home attendance, coaching attributes)	Salary: 1995/96 Others: 1994/95	533 players	Existence of a convex structure across some performance measures (goal/scoring rates and assist rates) controlling for other factors

(*continued*)

Table 1. Continued

Authors	Research question	Dependent variable	Independent variable	Time intervals (seasons)	Number of observations	Key results
Eschweiler and Vieth (2004)	To what extent do club-specific or player-specific factors influence transfer prices?	Transfer price per player	Club-specific: Revenues from main sponsor, average number of spectators from prior season, qualification for international competition in next season Player-specific: Age, tenure (number of games)	1997/98–2002/03	254 transfers (full sample), 82 transfers within *Bundesliga* (sub-sample)	Extent of transfer price is significantly dependent on club- and player-specific factors
Garcia-del-Barrio and Pujol (2004)	Are there two segments in the labour market supply in the Spanish league? Is there a winner-take-all effect?	Estimated proxy of the market value of a soccer player	Index of performance, reputation, superstar, age, international appearance, games in the Champions League/UEFA, position	2001/02	369 players	Existence of two segments in the labour market supply, presence of a winner-take-all effect and thus strong bargaining power of superstars
Littkemann and Kleist (2002)	What factors influence team success in the German *Bundesliga*?	Team success measured in points earned (3 for a win, 1 for a draw)	Performance of players (marks from *Kicker Sportmagazin*), coordination between team units, context of the match (location, teams' current position in *Bundesliga* ranking, number of spectators)	2000/01	582 games	Player and team unit performance, relative team strength and the location of the match significantly influence team success. Significant supporting influence is exerted by the choice of an offensive team strategy
Forrest and Simmons (2002)	What is the relationship between team wage bills and team performance using data from Italy, England and Germany?	Team success measured in points ratio (3 for a win, 1 for a draw)	Team wage bills, coaches' win percent ratio	1998/99–1999/2000	36 wage bills from teams	Strong team salary–performance relationship for the leagues in Italy and England, but less obvious for Germany
Szymanski and Kuypers (1999)	Is there a pay–performance relationship for English soccer?	Average log odds of league position	Main independent variable: log of club average wage expenditure		40 over the period 1978–1997 and 20 over 1950–1960	Significant correlation between pay and performance

the players' earnings function in Italian soccer, find a convex structure across some performance measures (goal/scoring and assist rates) once other factors are controlled for.

The second group examines the pay–performance relationship from the other direction by taking team performance as the dependent variable (Szymanski and Kuypers, 1999; Forrest and Simmons, 2002). For example, in an investigation of whether club expenditures have a positive impact on team success in the English soccer league, Szymanski and Kuypers (1999) find a significant correlation between team pay and performance. Forrest and Simmons (2002), using data from Italian, English and German soccer leagues, find a similarly strong team salary–performance relationship for the leagues in Italy and England but only a marginally significant wage–performance relationship for the German *Bundesliga*.

These empirical results from European soccer studies are generally in line with many professional sport studies from North America (Zimbalist, 1992, 2002; Scully, 1995; Buchanan and Slottje, 1996; Quirk and Fort, 1999; Hall *et al*., 2002) that support a positive pay–performance relationship. However, the reported findings for North American team sports are mixed. Whereas some research suggests that large market teams dominate small market teams, other studies indicate that mistakes in assessing talent prior to long-term contract assignments, as well as institutional restrictions on player mobility that create a monopsonistic player labour market, work against a positive relationship between wage and success in team sports (Simmons and Forrest, 2004).

III. Theoretical Approach and Predictions

German Bundesliga

The *Bundesliga* is one of Europe's 'big five' soccer leagues (for an overview, see Dobson and Goddard, 2001). Interestingly, as Table A1 in the Appendix indicates, between 1995 and 2004, the *Bundesliga* consistently had the highest goal per game ratios of all five leagues. Dobson and Goddard (2001, p. 31) report that in 1999 Germany was the most 'cosmopolitan' league, with only 58% of the players being German. For the 2000 season, the *Bundesliga*, (which has officially existed since 1902; see www.germantv.info/index.php?id=main for an overview) had 31 882 spectators, the highest average home attendances of all leagues.

The league structure is similar to that of other European leagues, but differs from US sports leagues in several key aspects (for a detailed overview, see Hoehn and Szymanski, 1999). First, because the structure is open (meaning annual promotion and relegation), the teams compete in many hierarchical competitions simultaneously. Of the 18 teams that now make up the *Bundesliga*, three teams are relegated and promoted each season. Furthermore, in contrast to US sport markets that try to maintain a competitive balance between clubs through a rookie draft system, longer player contracts and salary caps, there is an active transfer market.

In the past, German clubs had the legal structure of a private social club (*Verein* is a nonprofit organization), but some were also owned by industrial enterprises (e.g. Bayer Leverkusen). However, over the last few decades, more clubs have been commercialized; for instance, in the 2000/01 season, Bayern Munich had a total revenue of around 150 million EURO (Haas *et al*., 2004). Moreover, clubs interact increasingly with the financial markets. For example, in 1997, members of Borussia Dortmund voted to transform the club into a shareholding company (Hoehn and Szymanski, 1999).

Data set

This article is based on a unique data set of professional soccer player information covering a total of eight seasons between 1995/96 and 2003/04. This resource provides an unbalanced panel of 1040 players, which includes 2833 observations, with an average of 2.7 seasons per player. Because of annual promotion and relegation, 28 different clubs participated in the league during these eight seasons.

Player performance and player background data were collected by the firm IMP in Munich (the official data provider for the German Football League and several broadcasters). Not only do these data allow the development of several seasonal variables at the individual player level, but IMP also provides personal characteristics like age, nationality or position for all players who played during the different seasons. Because data on player salaries in Germany are not publicly available, previous studies on the *Bundesliga* have used proxies derived from press reports (Lehmann and Weigand, 1999; Swieter, 2000; Forrest and Simmons, 2002; Hübl and Swieter, 2002). Thus, most are based on data collected by the *Kicker Sportmagazin*, the most prominent soccer magazine in Germany (Lehmann and Weigand, 1999; Swieter, 2000; Forrest and Simmons, 2002; Hübl and Swieter, 2002;

Table 2. Correlation between different data sources for the 2003/04 season

		Salary	Market value	Pre-seasonal value	Post-seasonal value
Salary (*Transfermarkt*)	Pearson correlation	1	0.735**	0.754**	0.541**
	Sig. (two-tailed)	–	0.000	0.000	0.000
	n	168	168	108	118
Market value (*Transfermarkt*)	Pearson correlation	0.735**	1	0.816**	0.832**
	Sig. (two-tailed)	0.000	–	0.000	0.000
	n	168	168	108	118
Pre-seasonal value (*Kicker Sportmagazin*)	Pearson correlation	0.754**	0.816**	1	0.666**
	Sig. (two-tailed)	0.000	0.000	–	0.000
	n	108	108	168	103
Post-seasonal value (*Kicker Sportmagazin*)	Pearson correlation	0.541**	0.832**	0.666**	1
	Sig. (two-tailed)	0.000	0.000	0.000	–
	n	118	118	103	118

Note: **Correlation is significant at the 0.01 level (two-tailed).

Littkemann and Kleist, 2002; Eschweiler and Vieth, 2004; Haas *et al*., 2004). The internet portal *Transfermarkt.de* also uses its online community of 70 000 members to collect salary data for a limited number of players and years; however, few studies (for exceptions, see Eschweiler and Vieth, 2004) have worked with this data set because of the low number of observations.

Thus, in line with previous studies, we also use the salary proxy provided by *Kicker Sportmagazin*, whose editorial staff assesses each *Bundesliga* player's market value prior to a new season using individual (position in team, previous season performance and transfer price) and team characteristics (ticket sale earnings, merchandizing and sponsoring). Most importantly, these data have been collected in a consistent and systematic manner for several years.[4]

To reduce possible causality problems, we use the players' values from the *previous* season (dependent variable = current season), which allows us to use salary as an independent variable.[5] Otherwise, player salary would reflect output aspects, because players receive bonuses according to the team's success during the current season, which would lead to a reverse causality. Furthermore, teams that are doing well may spend more money on better players to improve their chances of performing in international contests (Simmons and Forrest, 2004). For example, working with National Hockey League data, Zimbalist (2002) shows that mid-season payrolls are more strongly correlated with percentage of games won than are payrolls at the beginning of the season when there is incentive to improve the chances of making it to the playoffs.

To check the extent to which the market value estimations used in our article correctly reflect actual salaries, we investigate the correlation between players' effective reported salaries and (a) their estimated market values as provided by *Transfermakt.de* and (b) the pre-season and post-season market values for the 2003/04 season[6] provided by *Kicker Sportmagazin* and used in the study. Table 2 presents the correlation matrix, which indicates a strong correlation between the two data sources. These results encourage us to work with the *Kicker Sportmagazin* data set because it encompasses a large number of seasons and players.

Theoretical predictions

This article investigates three primary research questions. The first extends Simmons and Forrest's (2004) investigation of whether a quadratic relationship exists between wage and team performance. These authors measure team performances in different North American leagues (National Basketball Association, National Football League, National Hockey League and Major League Baseball) by win percent ratios and the probability of qualification

[4] These data are then used in a so-called manager game (*Kicker-Managerspiel*), in which individuals (aged 18+) can participate. Compared to the performance data, the salary variable has some missing values. However, imputing missing values on the basis of the other independent variables produces similar results.
[5] See also discussion in Section IV.
[6] Historical data are not provided by *Transfermarkt.de*, as the site has only just begun to collect this information.

for playoff competition. For the European soccer leagues, they analyse team performances according to points achieved divided by maximum possible points and the probability of obtaining a top six position. In the European leagues in general, wages represent salaries paid to *all staff members*, not just players. Simmons and Forrest's (2004) results indicate that the relative wage bill, defined as team *i*'s wage bill divided by the league average in a given season, raised the team performance in all seven leagues investigated. The squared term was statistically significant for all leagues except the *Bundesliga* and Major League Baseball.

This finding supports the theory of diminishing returns for wages; that is, teams can improve their performance by spending more on wages than other teams, but at a decreasing rate. For those five leagues in which the quadratic form was supported, the turning point lay inside the sample range, indicating that an increase in relative wages beyond the turning point can actually lead to a harmful reduction of team performance. Moreover, the number of such cases was quite substantial in the National Football League and National Hockey League, but very small in the English and Italian soccer leagues.

The question thus remains as to whether the nonlinear effect that Simmons and Forrest (2004) were unable to find for Germany at the *team level* is observable at the *individual level*. Therefore, we include not only a player's salary from the previous season but also its squared term. We first suppose that monetary rewards are an instrument for enforcing extrinsic work motivation; in other words, soccer salaries on average offer high individual incentives to perform. However, players are assumedly motivated not only extrinsically by money payments but also intrinsically. That is, like the artistic and scientific professions,[7] professional sport has certain internalized standards of excellence, which can be viewed as a type of motivation to achieve personal and team goals. Thus, when soccer players are supposed to be highly motivated to play soccer, external interventions can induce psychologically unstable situations (Frey, 1997). As a result, players may become over motivated, meaning they would still play soccer even if one motivation were reduced. Thus, rational players could respond by reducing that part of their motivation over which they have control; that is, they could lower their intrinsic work motivation. Some evidence from labour economics does indeed support such a crowding-out effect (e.g. Holmström and Milgrom, 1990; Barkema, 1995).

Our second research question is based on the assumption that soccer players compare themselves to other players, especially their team-mates. Thus, individual salary position relative to that of other team-mates may impact performance and so warrants empirical investigation. Yet little such investigation has been done. As Senik (2004) points out with surprise in his overview of the literature, 'in spite of the large theoretical literature on relative income and comparison effects [...] empirical validation of this conjecture is still scarce' (p. 47). In addition, focusing on relative income position may throw light on the behavioural implications of positional concerns or envy, a 'subtle and powerful feeling, motivating everything from political movements to murders, (Zeckhauser, 1991, p. 9) that stems from comparisons with like individuals (Elster, 1991; Schoeck, 1966). Not surprisingly, envy is extremely widespread in the workplace. In fact, Elster (1991) reports that model workers in China spend their bonus on a good meal for everybody to avoid harassment by fellow employees. Similarly, managers keep their own bonuses down for fear of other workers and to avoid the envy of other executive officers. However, empirical measurement of the impact of relative income position and positional concerns or envy on worker performance has been hindered by a lack of available data on individual performance or salaries.

In contrast, the availability of a good proxy on salary data and our access to professional soccer players' performance data provide us a unique opportunity to empirically assess the effect of both absolute and relative income on individual performance. Differences in salary distribution among team-mates, particularly, allow us to test for the presence of positional concerns. The interesting question is whether envy has a positive or negative impact on individual performance. That is, comparisons with team-mates may lead to better performance by giving players an incentive to achieve similar status rather than being satisfied with achieving less. As a result, comparisons may even provoke a 'positional arms race' that leads to overworking (Landers *et al*., 1996). On the other hand, an envious person may 'prefer that others have less, and he might even sacrifice a little of his own wealth to achieve that end' (Zeckhauser, 1991, p. 10). In fact, Elster (1991) criticizes the experimental evidence for ultimatum games (rejection of a proposal that deviates too much from an equal split) as too characterized by fairness, suggesting that '[...] 'envy' would sometimes be more appropriate for analogous behaviour in real life'

[7] In general, both arts and sports have many similarities such as community impacts, demand interdependencies and the presence of superstars (Seaman, 2003).

(p. 66). Thus, the welfare of an envious person increases by destroying some of another's assets, even at personal cost (*cutting off one's nose to spite one's face*). Moreover, performance may decrease due to frustration ('it *could* have or *should* have been me') and a certain resignation.

Our third research question concentrates on the impact of team effects. According to the literature, individual productivity – and thus player performance – varies in different settings as co-workers offer different levels of assistance (Idson and Kahane, 2000). Therefore, teamwork, an important topic in labour economics, is desirable because it allows realization of gains from complementarities in production and facilitates gains from specialization in the form of accumulated task-specific human capital, which may be valuable to other team members (Lazear, 1998). In addition, Hamilton *et al*. (2003) find that team composition has a strong impact on team productivity. However, empirical studies on this phenomenon are also rare, due again to the difficulty of obtaining data (Idson and Kahane, 2000).

Our data set, however, enables investigation of the impact of team-mates on player performance. In line with Idson and Kahane (2000) and Torgler (2007b), we measure this impact on individual i by calculating the average values for the team-mates (excluding the values for player i). Thus, we concretely investigate whether team-mates' average ages, exchanges and sending-offs in a game affect individual performance. We anticipate, for example, that more exchanges may be correlated with higher individual performance because of an increase in the team-mates' average physical strength. Similarly, higher exchange values may also be an indicator of good second line-up players. On the other hand, sending-offs should be negatively correlated with performance. This latter expectation is based on Torgler's (2004) finding for the World Cup tournament in Korea/Japan that expulsions have a strong negative impact on the probability of winning a game because losing a team-mate reduces team strength. Specifically, the team structure must be reorganized, which, because soccer skills are highly specialized, can reduce players' and team-mates' comparative advantages.

It is also useful to control for a players' experience or physical condition. Therefore, as a proxy, we consider the variables AGE and AGE SQUARED. We expect that the relationship between a player's age and performance will be nonlinear. That is, even though age may be connected to greater experience in the game, as players get older, their physical abilities like speed and athleticism decline. Thus, we predict a positive sign for the variable AGE and a negative one for AGE SQUARED. Another possibility would be to measure experience rather than age by using years of experience in the league, number of career appearances or years of professionalism as proxies. However, not only are such data unavailable, but players are highly mobile. In our data set, they stayed on average less than three seasons in the *Bundesliga*. Furthermore, data on career appearances in other leagues were also unavailable.

Using two different dependent variables helps us investigate whether team effects work in different ways. For example, it may be anticipated that goals scored will be more subject to team effects, as they signal the last stage in a team's ball relay. Similarly, changing teams may affect individual performance because such a change is often connected to a higher salary, which leads to higher extrinsic motivation to perform better. In addition, players must 'make their mark' in a new team and may be checked out in detail by other team and staff members. On the other hand, change is also connected to transaction and adaptation costs (professional and personal) that may negatively affect player performance. That is, when joining a team of players who know each other well, new players must gain acceptance to be integrated in such a manner as to perform optimally. Similarly, family members may also need to make adjustments that could even affect players' mental abilities and perhaps also their performance. Thus, because a clear prediction is difficult to generate, we use a dummy – the player's value for one season after the change – to check for such an impact.

As we observe changes over time, we also use as a reference group three dummy variables associated with a soccer player's field position (DEFENCE, MIDFIELD and ATTACK). Controlling for player position in the field is important because it helps to control for the heterogeneity linked to their positions. Thus, for obvious reasons, goalkeepers have been neglected in the estimations. Table 3 presents a summary of the variables used and the effects expected.

Econometric specification

To test our predictions, we propose the following baseline equation:

$$\begin{aligned}\mathrm{PERF}_{it} = {} & \beta_0 + \beta_1 \mathrm{CTRL}_{it} + \beta_2 \mathrm{ABSAL}_{i(t-1)} \\ & + \beta_3 \mathrm{RELSAL}_{i(t-1)} + \beta_4 \mathrm{TEAM}_{it} \\ & + \mathrm{TEAMD}_i + \mathrm{TD}_t + \mu_i + \varepsilon_{it}\end{aligned}$$

where PERF_{it} is the performance of player i at time t measured in goals (in one case) or assists (in another)

Table 3. Variable definitions and predictions

Variables	Definition	Expected effect on player performance
Salary		
ABSOLUTE VALUE$_{(t-1)}$	Absolute monetary value of a player in the previous season	Positive
SQ ABSOLUTE VALUE$_{(t-1)}$	Squared value of the absolute monetary value of a player in the previous season	Negative
RELATIVE VALUE$_{(t-1)}$	Difference between team-mates' average values and players' individual values in the previous season	Mixed
Socio-demographic		
AGE	Player' ages	Positive
AGE SQ	Squared value of players' ages	Negative
Situation		
CHANGED TEAM	Dummy variable value 1, if a player is new to a team (changed team after previous season)	Mixed
Team-mates		
AGE	Average age value of team-mates	Mixed
EXCHANGES	Average number of exchanges of team-mates	Positive
SENDING-OFFS	Average number of sending-offs of team-mates	Negative

for every season played, and $ABSAL_{i(t-1)}$ is the player's lagged absolute salary. To check for non-linearity, we also consider the squared value of the absolute salary. $RELSAL_{i(t-1)}$ is the player's lagged relative salary measured as the difference between team-mates' average salaries and players' individual salaries. $TEAM_{it}$ denotes a vector that contains the values for the team-mates of each player i at time t, calculated in such a manner as to remove each individual i value. For example, we first calculate the average age of the whole team, excluding the age of individual player i. We then follow the same procedure to construct the variables EXCHANGES and SENDING-OFFS. The regression also contains several control variables $CTRL_{it}$ such as AGE, AGE SQUARED, CHANGED TEAM (a dummy that measures whether a player changed team after the previous season), player position in the game (ATTACK, MIDFIELD and DEFENCE) and team dummy variables ($TEAMD_i$). In addition, TD_t is a set of season dummies that control for possible differences in player environment, μ_i is the individual effect of player i and ε_{it} denotes the error term.

IV. Econometric Results

In Tables 4 and 5, we present two different types of empirical methodology – pooling and fixed effect estimations using two dependent performance variables (GOALS and ASSISTS). The use of two different methods enables us to test the robustness of the results. In the pooled estimations, we include team and time dummy variables, using SEs adjusted for the clustering of individual players to take into account specific unobservable player characteristics. Such clustering thus deals with heteroscedasticity.[8] We also use number of minutes played as a weighted variable. As is apparent, salary has a statistically significant impact on individual performance. The squared term also indicates a nonlinear effect. However, the direction of the link between income and performance is still unclear. As Hall *et al*. (2002) stress, this income-performance link 'plays a central role in the theory of team sports but is seldom investigated empirically' (p. 149). Rather, by investigating player or team income as the dependent variable and searching for the factors that shape it, most studies implicitly assume that the causality runs from performance to revenues or salaries. In contrast, Dobson and Goddard (1998), using a data set covering 77 football leagues between 1946 and 1994, find evidence of reverse causality; specifically, that the influence of lagged revenue on current performance is greater than the influence of lagged performance on current revenue. Similarly, Hall *et al*. (2002), in an investigation of the relationship between team pay and performance using English soccer data, find that the relationship runs from payroll to performance and not vice versa. Davies *et al*. (1995), who focus on professional

[8] The advantage of this class of estimators is that they do not require a precise modelling of the source of heteroscedasticity. Clustering tend to increase the reported SDs, which reduces the statistical significance levels of the estimated coefficients.

Table 4. Determinants of performance

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Dep. V.: Goals		Dep. V.: Goals		Dep. V.: Assists		Dep. V.: Assists		Dep. V.: Goals		Dep. V.: Assists		Dep. V.: Goals		Dep. V.: Assists	
	Weighted OLS[a]				Weighted OLS[a]											
	Clustering on players		Fixed effect		Clustering on players		Fixed effect		2SLS[b]		2SLS[b]		2SLS[c]		2SLS[c]	
Independent variables	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value
Salary																
ABSOLUTE $VALUE_{(t-1)}$	0.599**	7.48	0.184**	2.58	0.473***	5.24	0.112*	1.74	1.023***	5.76	0.675***	4.54	2.025***	10.93	1.395***	8.81
SQ ABSOLUTE $VALUE_{(t-1)}$	−0.015**	−2.43	−0.010**	−2.30	−0.011*	−1.90	−0.004	−1.12	−0.040***	−3.44	−0.022**	−2.24	−0.101***	−8.35	−0.062***	−6.00
Socio-demographic																
AGE	0.467*	1.96	1.327***	4.05	0.190	0.90	1.177***	3.98	0.271	1.50	0.254*	1.68	−0.604***	−2.75	−0.359*	−1.91
AGE SQ	−0.008*	−1.70	−0.025***	−5.65	−0.003	−0.82	−0.022***	−5.51	−0.005	−1.39	−0.004	−1.58	0.011***	2.68	0.006*	1.92
Situation																
CHANGED TEAM	−0.024	−0.09	−0.042	−0.25	0.163	0.89	0.139	0.92	−0.272*	−1.73	−0.051	−0.38	−0.425**	−2.12	−0.144	−0.84
Position																
DEFENCE	−6.053***	−16.80	−0.109	−0.27	−2.445***	−13.57	−0.134	−0.37	−3.426***	−21.22	−1.444***	−10.70	−2.658***	−11.99	−0.821***	−4.33
MIDFIELD	−4.708***	−12.47	0.302	0.90	−0.111	−0.51	0.445	1.48	−2.566***	−18.11	0.181	1.53	−2.197***	−11.31	0.439***	2.64
Team	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Season	Yes		Yes		Yes		Yes		No		No		Yes		Yes	
Players	No		Yes		No		Yes		No		No		No		No	
Prob > *F*	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
R^2	0.449		0.094		0.281		0.075									
F-test for excluded IVS									264***		264***		321***		321***	
Anderson canon. corr. LR statistic									255***		255***		299***		299***	
Number of observations	2833		2833		2833		2833		2833		2833		1564		1564	

Notes: Robust SEs. [a]Weighted variable: number of minutes played. [b]Played for the German national team in a specific season or being a foreigner as an instrument. [c]Estimation for only having played in the national team as an instrument.
*, ** and *** denote statistical significance at the 10, 5 and 1% level, respectively.

Table 5. Further 2SLS estimates and determinants of performance

	(9)		(10)		(11)		(12)		(13)		(14)		(15)		(16)	
	Dep. V.: Goals		Dep. V.: Assists		Dep. V.: Goals		Dep. V.: Assists		Dep. V.: Goals		Dep. V.: Goals		Dep. V.: Assists		Dep. V.: Assists	
									Weighted OLS[c]				Weighted OLS[c]			
	2SLS[a]		2SLS[a]		2SLS[b]		2SLS[b]		Clustering on players		Fixed effect		Clustering on players		Fixed effect	
Independent variables	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value
Salary																
ABSOLUTE VALUE$_{(t-1)}$	2.202***	8.40	1.573***	7.04	0.971***	6.78	0.828***	6.90	0.061	0.47	−0.089	−0.73	−0.007	−0.05	−0.224**	−2.03
SQ ABSOLUTE VALUE$_{(t-1)}$	−0.113***	−6.63	−0.074***	−5.09	−0.035***	−4.03	−0.028***	−3.92	−0.013**	−2.28	−0.010**	−2.23	−0.009*	−1.73	−0.005	−1.14
RELATIVE VALUE$_{(t-1)}$									−0.518***	−4.33	−0.295***	−2.70	−0.463	−4.05	−0.366***	−3.72
Socio-demographic																
AGE	−0.697***	−2.85	−0.453**	−2.17	0.663***	2.79	0.148	0.74	0.507**	2.12	1.232***	3.79	0.220	1.06	1.088***	3.70
AGE SQ	0.012***	2.79	0.008**	2.17	−0.011**	−2.54	−0.002	−0.67	−0.008*	−1.89	−0.024***	−5.32	−0.004	−1.01	−0.021***	−5.14
Situation																
CHANGED TEAM	−0.454**	−2.19	−0.174	−0.98	−0.114	−0.59	0.025	0.15	−0.082	−0.33	−0.098	−0.59	0.109	0.63	0.087	0.58
Position																
DEFENCE	−2.580***	−10.70	−0.742***	−3.61	−3.667***	−17.43	−1.322***	−7.50	−6.176***	−17.10	−0.096	−0.24	−2.538***	−14.05	−0.127	−0.36
MIDFIELD	−2.160***	−10.65	0.476***	2.76	−2.705***	−14.37	0.320**	2.03	−4.763***	−12.80	0.303	0.92	−0.152	−0.71	0.441	1.48
Team-mates																
AGE									−0.190*	−1.82	−0.044	−0.52	−0.095	−1.20	−0.045	−0.60
EXCHANGES									0.926***	5.96	0.651***	4.94	0.760***	5.60	0.487***	4.09
SENDING-OFFS									−2.075**	−2.29	−1.694**	−2.39	−1.198*	−1.72	−1.343**	−2.10
Team	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Season	Yes		Yes		No		No		Yes		Yes		Yes		Yes	
Players	No		No		No		No		No		Yes		No		Yes	
F-test salary									34.84***		8.25		24.10***		5.88***	
Absolute value $(t-1)=$ relative value $(t-1)$									54.81***		4.57		27.46***		4.85**	
F-test team-mates									15.72***		10.53***		13.91***		7.39***	
Prob > *F*	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
R^2									0.468		0.114		0.303		0.095	
F-test for excluded IVS	153***		153***		440***		440***									
Anderson canon. corr. LR statistic	150***		150***		396***		396***									
Number of observations	1564		1564		1599		1599		2833		2833		2833		2833	

Notes: Robust SDs. [a]Number of games played for the national team per season as an instrument. [b]Lagged salary value $(t-2)$ as an instrument. [c]Weighted variable: number of minutes played.
*, ** and *** denote statistical significance at the 10, 5 and 1% level, respectively.

rugby league matches between 1964 and 1993, use attendance rather than revenues but find similar results for the direction of causality. Thus, we empirically investigate any potential causality problem.

To check the robustness of our results, we use several different instruments. In Tables 4 and 5, we report 2SLS estimations together with several diagnostic tests. In specifications (5) and (6), we use a pooled estimation that controls only for team effects[9] using as an instrument whether a player played for a national team in a specific season or was a foreigner. In specifications (7) and (8), we use only whether a player played for the national team in a specific season as an instrument, thereby focusing solely on domestic players. In specifications (9) and (10), instead of a dummy variable, we use number of games played for a national team per season as an instrument for player salary. Specifications (7)–(10) are thus based on both team and season fixed effects. Finally, we include two pooled 2SLS regressions (specifications (11) and (12)) using lagged $(t-2)$ values of our salary variables as instruments. Tables 4 and 5 also report the results of an Anderson canonical correlation LR for whether the equation is identified as a measure of instrument relevance. The test shows that the null hypothesis can be rejected, indicating that in all cases the model is identified and the instruments are relevant. Tables 4 and 5 further show that the *F*-tests for the instrument exclusion set in the first-stage regression are statistically significant in all cases. In addition, the salary coefficients remain statistically significant for all eight 2SLS estimations, suggesting little reverse causation between performance and salary.

In specifications (13)–(16), we add in team-mates' age, exchanges and sending-offs, as well as the relative income of the players (Table 5). The joint hypothesis that none of the salary variables (absolute and relative income position) has a coefficient that differs from zero can clearly be rejected. Rather, a strong impact can be observed for the relative income position. Moreover, when we control for absolute individual salary level, an even larger difference in the average team-mates' salary leads to a crowding out of individual performance. The results also indicate that team effects matter. Based on a *F*-test for joint significance we can conclude that team factors play a significant role in the determination of individual performances. We also observe an increase in the *R*-squared as well as strong effects for the variables EXCHANGES and SENDING-OFFS.

These results suggest that, other variables being equal, players on a team with more exchanges perform better. Moreover, in line with the findings of a previous study focused on team performance in the World Cup (Torgler, 2004), sending-offs negatively affected individual performance. In general, these two findings are in line with our predictions. Only age of team-mates (statistically significant in only one estimation but with a negative sign) seems not to have a robust impact on individual performance. The results also indicate a tendency for the team-mate effect to be more important for goals than assists.

Given the other variables, we find a statistically significant impact of age and its square in some regressions (especially those focusing on goals). Specifically, age tends to influence performance, especially when the focus is on a human capital performance function having a conventional concave form – that is, rising with age but at a decreasing rate as physical condition worsens. The first equation indicates that the turning point in the age-performance profile is 31 years. Beyond this point, greater experience (e.g. knowledge of the game and tactical ability) are overshadowed by worsening physical performance (e.g. speed, fitness and greater vulnerability to injuries) that leads to a lower ability to score goals. Interestingly, Lucifora and Simmons (2003), who focus on an age-earning rather than an age-performance function in the Italian league, find an earlier turning point (age 28).

Changing team, however, does not apparently affect individual performance: the sign is negative and, in almost all estimations, not statistically significant. It may be that both players and team-mates are used to changes. For example, the mean change rate among all players observed in our data set was 12.7%, a rate that certainly increases once players who change between different international leagues are taken into account. Finally, and not surprisingly, player position does indeed impact performance. As regards the dependent variable GOALS, the pooled estimation shows that attackers have the best possibilities of performing better, followed by midfield and defence players. On the other hand, when the focus is on assists, differences between midfielders and attackers disappear, while the difference for defence players remains. However, the individual fixed effect estimations indicate that

[9] In both cases yes = value of 1.

changing position does not affect a player's performance.

V. Conclusions

Using a panel analysis of a rich empirical data set for eight seasons of the German *Bundesliga* from 1995/96 to 2003/04, we investigate the determinants of individual performance in soccer, specifically the relationship between pay and performance. Contrary to most previous soccer studies, we take as the dependent variable neither team performance nor team or individual salary but rather *individual* performance as measured by two important proxies – goals and assists per season. Besides investigating whether player salary affects performance, we also check for a nonlinear pay–performance relationship in the *Bundesliga*. Even after we take into account that salary may be endogenous, our empirical results confirm such a relationship.

In addition, based on the assumed importance of salary not only in absolute terms but in relation to team-mates, we investigate the impact of relative income level on player performance. Because empirical evidence on the behavioural implications of relative income and comparison effects is scarce (despite a wide body of related literature), we measure relative income position in terms of the difference between team-mates' average salaries and players' individual salaries. However, the consequences for the pay–performance relationship are difficult to predict. As discussed earlier in Section III, relative income effects may lead to either an improvement or a reduction in player performance. Interestingly, once absolute income level is controlled for and the focus is shifted to two different performance variables, our results clearly indicate that a larger difference is connected to lower performance.

Lastly, we investigate the impact of team effects. Although it can be argued that the importance of team effects in a team sport (or team environment like a project organization) is obvious, studies that empirically quantify such effects are rare. However, our results indicate that team effects are observable. Specifically, they suggest that, *ceteris paribus*, a player on a team with more exchanges and less sending-offs performs considerably better than players not on such a team. Another tendency suggested by the results is that team effects are more important for goals than for assists. We also find a nonlinear age effect (especially for the variable GOALS); that is, after the apparent turning point of age 31, greater experience is overshadowed by lower physical performance. However, these results were not fully robust (i.e. age and age squared were not statistically significant in all estimations).

Based on our research findings, it would be interesting to assess whether similar observations could be made for other soccer leagues, other team sports – for example, basketball, (ice) hockey, baseball, cycling or handball – or even for business practice. As regards the latter, small firms are perhaps the closest setting to team sports (Idson and Kahane, 2000); however, results may also apply to relatively independent departments or project teams in larger firms, in which an expectation of positional concerns or envy and a nonlinear salary–performance relationship seems reasonable. Indeed, along these lines, Frank and Sunstein (2001) report evidence that perceptions of relative position have large effects on employee work morale. Similarly, Elster (1991) provides real life examples of envy-avoidance and envy-reduction mechanisms. In addition, the effects of team-mate exchanges observed in our analysis raise some interesting questions; for instance, whether the analogy to teams in a corporation can be drawn. Thus, among others issues, it would be interesting to investigate whether higher turnover in a working team enforces healthy competition among team members or dilutes individual performance by destroying team cohesiveness. In sum, as this article demonstrates, professional sports data offer a valuable opportunity for empirical investigation of under-explored areas in economics that have important implications for business and the workplace in general.

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Appendix

Table A1. Performances in the top five European leagues

	Serie A (Italy)			La Liga (Spain)			EPL (England)			Bundesliga (Germany)			Ligue 1 (France)		
Season	Goals	Games	GPG	Goals	Games	GPG	Goals	Games	GPG	Goals	Games	GPG	Goals	Games	GPG
1995–1996	814	306	2.66	1244	462	2.69	988	380	2.6	831	306	**2.71**	863	380	2.27
1996–1997	805	306	2.63	1264	462	2.73	970	380	2.55	911	306	**2.98**	884	380	2.33
1997–1998	847	306	2.77	1009	380	2.65	1019	380	2.68	882	306	**2.88**	722	306	2.36
1998–1999	845	306	2.76	1003	380	2.64	959	380	2.52	866	306	**2.83**	723	306	2.36
1999–2000	765	306	2.5	996	380	2.62	1058	380	2.78	856	306	**2.8**	785	306	2.57
2000–2001	845	306	2.76	1095	380	2.88	992	380	2.61	897	306	**2.93**	767	306	2.51
2001–2002	806	306	2.63	961	380	2.53	1001	380	2.63	893	306	**2.92**	716	306	2.34
2002–2003	789	306	2.58	1016	380	2.67	999	380	2.63	821	306	**2.68**	837	380	2.2
2003–2004	816	306	2.67	1015	380	2.67	1012	380	2.66	909	306	**2.97**	884	380	2.33

Source: www.soccer-europe.com