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Impact of Managerial Quality on Organizational Performance. Evidence from German Soccer

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THE IMPACT OF MANAGERIAL QUALITY ON ORGANIZATIONAL PERFORMANCE: EVIDENCE FROM GERMAN SOCCER*

Bernd Frick♣ and Robert Simmons♦

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Abstract: In this paper we use a novel panel data set from the German premier soccer league (Bundesliga) as a case to show how variations in managerial compensation impact positively upon organizational (team) success. Using stochastic frontier analysis, we find that a team that hires a better quality coach can expect to achieve a higher league points total by reducing technical inefficiency. However, our results also suggest that the market for head coaches may be allocatively inefficient in that coaches are paid below their marginal revenue products.

Key words: efficiency, head coaches, soccer

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1. Introduction

This paper investigates technical and allocative efficiency in a particular managerial market: the market for soccer head coaches in the first division of the Bundesliga, Germany's professional soccer league. Using stochastic production frontier analysis, we shall show that both coaching and playing inputs contribute to team success in the league.

A substantial empirical literature has established a positive correlation between spending on team payrolls and team performances in European soccer and major North American sports (Berri and Jewell, 2004, Hall, Szymanski and Zimbalist, 2002, Kahane, 2005, Simmons and Forrest, 2004, Szymanski, 2000, Szymanski and Kuypers, 1999, Szymanski and Smith, 1997). The motivation for this relationship is that player quality is easily observed and players are easily traded, at least in European soccer. Given these features of a competitive market, it is to be expected that player salaries reflect marginal revenue products. Simmons and Forrest (2004) find that the payroll-performance relation is both flatter and has lower R^2 in North American sports leagues compared to European soccer and attribute this weaker relationship to the various product and labour market interventions applied in North American sports. In North America, restrictions on free agency and binding salary caps mean that, for some players, pay is below marginal revenue product (Krautmann, 1999). The relative weakness of the player payroll-performance relationship in North America has prompted Berri et al. (2006) to suggest that omitted variable bias might be a problem and the analysis of European soccer is by no means exempt from this criticism.

One variable hitherto omitted from studies of the relationship between team payrolls and team performance in sports leagues is a measure of coaching input. Folklore from within European soccer suggests that performance of head coaches matters for team performance, primarily through organizational and motivational ability. The most successful head coach in our sample is Otmar Hitzfeld who obtained considerable success at Borussia Dortmund and Bayern Muenchen, leading these teams to a total of six domestic championship titles and each to a Champions' League trophy. Not surprisingly Hitzfeld had the highest relative salary in each season during his most recent spell with Bayern Muenchen. It would be surprising if coaches lacked any capability to affect team outcomes; indeed, if this were so then players would simply turn up on sports fields and organise themselves.

We have at our disposal data not just on measures that serve as proxies for head coach performance and ability but also on head coach salaries in the top Bundesliga division, over a 22 year period. The availability of coach salary data enables us to pose the central question of whether the market for head coaches is allocatively efficient. Previous studies of impacts of measures of coach ability and performance have focussed on technical efficiency of sports teams and have been unable, through lack of data, to pursue the deeper question of market efficiency.

We can pose the fundamental question of whether or to what extent the salaries of head coaches match the performances of the organizations for which they work. Soccer head coaches have roles that resemble that of CEOs. They propose hiring and firing decisions to the board of directors (most often through a Director of Football) and they impose team playing strategies and make tactical adjustments within games. Head coaches have important motivational roles to try to raise individual player and team performance. Coaches take credit from fans and media when results are good i.e. the team wins games, but also take blame when games are lost. A long sequence of poor results tends to lead to head coach dismissal and, unlike conventional businesses, results are posted each weekend during the season. Hence, for soccer coaches, problems of hidden action are likely to less important than in other businesses (Dawson and Dobson, 2002).

A considerable literature has developed on the relationship between organizational performance and managerial compensation, mostly with causality from performance to pay (see e.g. Conyon and Murphy, 2000 for US and UK and Kraft and Niederprum, 1999 for Germany). The reverse relationship between managerial quality and organizational performance has received far less attention. This is not surprising. The data requirements needed to properly separate out substitutability and complementarity amongst the host of inputs to firm outputs in complex, modern organizations are usually too great to overcome and the risk of omitted variable bias is bound to be high. Moreover, a simple relationship between CEO pay and organizational performance does not hold where managers are awarded substantial stock options. These have been introduced both in Europe and North America in order to link managerial compensation to particular organizational performance measures and resolve principal-agent problems such as managerial shirking. In European soccer, head coaches are rarely rewarded by stock options as most clubs are not publicly quoted. Hence, the relationship between managerial pay and team performance should emerge more cleanly for European soccer.

As Kahn (2000) has persuasively argued, the sports industry is a useful sector within which to test interesting hypotheses in the area of personnel economics. In professional team sports, organizational goals and outcomes are much clearer than in most other sectors. Teams usually wish to maximise sporting performance given available resources with which to acquire playing and managerial talent. Increased sporting performance usually translates into higher revenues and profits for team owners. In North American team sports in particular, there exists a plethora of individual performance and salary data often publicly available on the internet. In Europe, where soccer is easily the dominant team sport, such data have more restricted availability but nevertheless interesting research can still be done.

The remainder of the paper proceeds as follows. In Section 2, we review our data and estimation methods. We first model a deterministic production function and then move on to propose a superior stochastic frontier estimation method. Section 3 displays our preferred stochastic frontier results while Section 4 proceeds to discuss the implications for allocative inefficiency in the market for head coaches. Section 5 concludes.

2. Data

Our data come from a Sunday newspaper (Die Welt) that publishes team wage bills and head coach salaries immediately before the start of a season. These data span 22 seasons of Bundesliga 1 from the 19th (1981/82) through to the 40th season (2002/03). Supplementary data on team playing records were obtained from Kicker soccer magazine. With the single exception of 1991/92, Bundesliga 1 contains 18 teams[1].

[1] In 1991/92, following unification of East and West Germany, the top two teams from the first division of the former German Democratic Republic were admitted to Bundesliga 1 and the number of teams was temporarily increased to 20. At the end of the 1991/92 season, four teams

Since 1992/93, at the end of each season the three lowest placed teams are demoted and replaced by the three highest placed teams from the second tier, Bundesliga 2[2]. One particularly notable structural change in German soccer is the change in number of points awarded for a win from two to three installed in 1995/96 largely as an incentive to encourage more attacking, entertaining play. Our team performance measure is log of points divided by maximum in any season. We have two possibilities for treatment of team points covering the regime change. One is to introduce a dummy variable to indicate the newer three points for win measure. However, this procedure would incorporate two things: the new points method and the potential for incentives for a more attacking playing strategy. We shall follow the alternative method of converting all seasons to a common points system with two points for a win throughout. We can then use the dummy variable for change in points system to test for possible impacts of changes in playing strategy which might follow from increased incentives to attack with three points for a win rather than two.

Data were collected for team points (as proportion of maximum attainable in a given season), team wage bill, coach salary, coach career points from Bundesliga games as proportion of maximum possible, number of Bundesliga seasons experienced by coaches, length of tenure in Bundesliga 1 since 1981/82 or most recent promotion (SPELL) and whether or not the team fired its head coach during the season in question. These data give us an unbalanced panel of 398 team-season observations featuring 39 clubs. Six of these (Bayern Muenchen, Werder Bremen, Borussia Dortmund, Hamburger Sportverein, Bayer Leverkusen and VfB Stuttgart) have appeared in Bundesliga 1 over the entire sample period and have a maximum tenure value of 22; five clubs (Blau-Weiss Berlin, Darmstadt 98, VfB Leipzig, Kickers Offenbach and SSV Ulm) were relegated after just one season. Descriptive statistics for continuous variables are reported in Table 1.

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were relegated to Bundesliga 2 while only two were promoted, restoring the traditional league size of 18.

[2] Prior to 1991/92, a two game playoff between the team placed 16th in Bundesliga and the team placed 3rd in Bundesliga 2 settled, by aggregate score, one of the places in Bundesliga 1 for the subsequent season.

Table 1. Descriptive Statistics for Bundesliga Teams: 1981/82 to 2002/03 (n = 398)

	Mean	*Standard Deviation*	*Minimum*	*Maximum*
Team inputs				
Relative wage bill	1.000	0.533	0.230	4.147
Relative coach salary	1.000	0.507	0.226	3.079
Head coach measures				
Coach career points ratio	0.435	0.215	0	0.850
Coach career experience	4.37	4.82	0	27
Team measures				
Spell	7.17	6.06	1	22

3. Empirical results

3.1. Deterministic Frontier Estimation

We begin by estimating a simple OLS production function, with team relative wage bill (LOG RELATIVE WAGE BILL) as the sole input and with team fixed effects. The team payroll for each team is deflated by the Bundesliga 1 average for that season to control for payroll inflation over the sample period. The results in Table 2 show diminishing returns to player wage bill, with a payroll-points elasticity of 0.2. When the coach relative salary, LOG RELATIVE COACH SALARY, is included, its coefficient is only marginally significant (p value = 0.06) and hence the fit of the equation is only slightly improved. The elasticity of points with respect to salary for coaches is a modest 0.06 and is much less than the team payroll elasticity.[3] Hence, it cannot be argued that team payrolls and head coach salaries are close substitutes in production of team performance.

However, the deterministic model may be misspecified as it assumes full efficiency. More precisely, random departures from the frontier are attributed to stochastic elements ('luck') and not inefficiency. Stochastic frontier models offer the potential to

[3] A translog specification was also estimated but comprehensively rejected in favour of Cobb-Douglas; squared and cross-product terms each had t-statistic less than one.

separate departures from the frontier due to random factors from departures due to inefficiency.

Table 2. OLS frontier estimation of a Cobb-Douglas production function

Variable	**(1)**	**(2)**
Log relative wage	0.200 (5.94)	0.175 (4.87)
Log relative salary		0.057 (1.89)
R^2 (*within*)	0.09	0.10
R^2 (*overall*)	0.37	0.38

Note: absolute t-statistics in parentheses; team fixed effects included.

3.2 Stochastic Frontier Estimation

Following Battese and Coelli (1995), a log-linear Cobb-Douglas production function for a set of firms indexed by i over a number of periods t can be represented as:

$$Y_{it} = x_{it}\beta + (v_{it} - u_{it}) \qquad i = 1,\ldots..N;\ t = 1,\ldots.T \qquad (1)$$

where Y_{it} is the natural log of output, x_{it} is a vector of inputs, also in logs and β is a coefficient vector to be estimated[4]. The remainder of the equation is an error term comprising two parts. v_{it} is a random error term with standard i.i.d properties. u_{it} is a non-negative random error term, also i.i.d but further assumed to follow a normal distribution truncated at zero; this last term captures potential inefficiencies in production. If these are found to be zero in estimation then we can revert to standard econometric procedures to estimate a production function with panel data, as in Table 1. But if these inefficiencies are found to be significantly different from zero then production function estimates that assume efficiency could well be biased.

A number of papers have applied stochastic frontier methods to various sports. The majority of studies are concerned with the efficiency by which teams translate inputs into outputs and very few studies use pecuniary measures to proxy inputs (see Dawson et al. (2000a) and Kahane (2005) for notable exceptions).

[4] Again, we also estimated a more flexible translog functional form and, as with the OLS model in Table 1, found that this was rejected in favour of Cobb-Douglas.

The estimated technical inefficiency terms could themselves be correlated with a further set of explanatory variables. Ignoring this interdependence could lead to biased estimates. The modelling of technical inefficiencies was explored by Battese and Coelli (1995). Studies from professional sports that follow this two-stage approach include Dawson et al. (2000a, 2000b), Kahane (2005) and Hofler and Payne (2006). Assume that u_{it} has a distribution truncated at zero and given by $\sim N(m_{it}, \sigma_u^2)$. Mean inefficiency can be modelled as a function of specific firm-level influences by:

$$m_{it} = z_{it}\delta + w_{it} \tag{2}$$

where z_{it} is a vector of firm-specific influences on inefficiency in firm i in period t and δ is another vector of coefficients to be estimated. The error term w_{it} is assumed to be $\sim N(0, \sigma_w^2)$ truncated at $- z_{it}\delta$ for consistency with the assumption that u_{it} is non-negative and truncated at zero.

In the second stage of the model, we have five covariates. Most fundamentally, we follow Kahane (2005) in removing coaching inputs to the technical efficiency part of the model. The simple reason for this is that coaches do not directly produce output. In any case, we do not observe coaching inputs directly, just the monetary reward for coaching effort. Our view is that coaches enhance efficiency by facilitating the production of the players who produce points for their teams.

Two additional measures reflecting managerial ability that might conceivably impact on technical inefficiency are coach experience (number of seasons experience as head coach in the Bundesliga, COACH EXPERIENCE) and coaching win-loss records (proportion of possible points earned as head coach, COACH POINTS RATIO). These measures would be predicted to reduce technical efficiency as they are increased. This is largely due to selection and sorting; the least efficient managers are likely to be identified through their poor performance, given the playing resources available to them, and consequently fired[5]. However, in a competitive market neither of these two

[5] We should stress that it is technical inefficiency rather than absolute level of performance which is the key variable in the second stage of our model. Absolute ability should be reflected in the head coach's salary. A head coach can be associated with a low level of performance yet be highly technically efficient according to our econometric evidence. Conversely, a head coach could be associated with a high level of performance yet be technically inefficient. In the former case, a coach is highly likely to be fired due to director and fan (mis)perception of incompetence. In the latter case, the head coach might receive an unduly high level of praise.

variables should have significant coefficients as experience and win records ought to be fully incorporated in coach salaries. Significance of either variable is then evidence of allocative inefficiency in the market for head coaches.[6]

Teams that are promoted may, even allowing for lower wage bills, struggle to compete effectively in the top tier of soccer as they adjust to new playing surroundings, new teams and different playing styles and strategies at the higher level. We might predict that promoted teams face a learning curve as they adjust to the higher level of soccer. Learning effects are incorporated by the variable SPELL which is the number of seasons in Bundesliga 1 that have accrued since last promotion. Therefore a team like Bayern Muenchen which has never been demoted has a value of SPELL that is equal to number of seasons it has spent in Bundesliga 1 since 1981/92. A team such as SSV Ulm which only has one season in Bundesliga 1 has a spell value of one.

Managerial turnover in European soccer is rather frequent. In our sample, single-case head coach dismissals occur in a total of 141 out of 398 team-season observations[7]. A team that fires its head coach during the season is denoted by the dummy variable DISMISS. The underlying reasons for coach dismissal are not explored here, although poor team performance is the usual proximate cause. All we seek to capture is the unsettling impact of head coach departure on team organization and morale through team inefficiencies. We predict that head coach dismissals will be associated with increased team inefficiency specifically as a current season impact[8].

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[6] There is an analogy with Szymanski's (2000) treatment of racial discrimination in English football. Szymanski estimated a deterministic production function with team relative payroll (including both player salaries and coach salaries within an aggregate measure). He then added relative number of black players on teams as an additional variable and found a significant coefficient. In a competitive market for players, this coefficient should be zero. Similarly, Kahane's (2005) study of hockey found that teams that hired more French-Canadians exhibited greater inefficiency, controlling for player wage bill as a determinant of the production frontier.

[7] It should be stressed that these are dismissals and not voluntary quits.

[8] In dismissing a head coach during the season a team could have two views on the likely gains. One short-term view is that the change in head coach is a quick fix which can quickly restore life to an ailing team. Game-level empirical evidence from European soccer suggests only limited short-term improvement in match results (e.g. Köning (2003) and Bruinshoofd and ter Weel (2003) on Dutch soccer). Alternatively, teams may take a longer view and assess that a new head coach can bring better performance in the future even though current performance may be disappointing. A team may be judged to be already condemned to relegation due to poor performance under a dismissed head coach and fortunes may be judged to improve eventually under a new appointment.

Equations (1) and (2) can be estimated using the maximum likelihood method proposed by Battese and Coelli (1993) and made available in Coelli's (1996) computer program FRONTIER 4.1 or in STATA. The maximised log-likelihood function gives estimates of σ^2 and γ where $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u/(\sigma_v^2 + \sigma_u^2)$. The γ parameter is particularly important as it shows the proportion of the sum of the two error variances that is accounted by technical inefficiencies. If this parameter is not significantly different from zero then we cannot reject the null hypothesis of zero technical inefficiencies and we would revert to standard panel data econometric procedures to estimate our team production function.

Table 3. Stochastic frontier estimation of a Cobb-Douglas production function

	Paramete r	***Coefficient (t statistic)***
Team Inputs		
Log relative wage bill	β_1	0.225
		(9.81)
Intercept	β_0	-0.465
		(10.92)
Head Coach Measures		
Log relative coach salary	δ_1	-0.084
		(2.09)
Career points ratio	δ_2	-0.186
		(2.63)
Team Level		
Spell	δ_3	-0.011
		(2.92)
Dismiss	δ_4	0.296
		(4.83)
Inefficiency model intercept	δ_0	0.185
		(1.94)
Variance parameters		
Total error variance	σ^2	0.041
		(19.55)

Proportion of error variance due to technical inefficiencies	γ	0.730
		(2.27)
Mean technical efficiency		0.791
Log likelihood		153.7

Table 3 reports stochastic frontier estimates. Our dependent variable is again log points ratio and the production function has a Cobb-Douglas form[9]. The coefficient γ is positive and significant at the one per cent level. Hence team inefficiencies are important in explaining variations in points ratios and we therefore reject estimation of a standard production frontier in favour of a stochastic frontier model. A further consideration is whether the efficiency terms are time-varying or time-independent. Dawson et al. (2000a, 2000b) found evidence of time-varying inefficiency in their studies of English soccer but the specific version of exponentially decaying technical inefficiency terms over time was rejected for the Bundesliga 1, with the critical parameter η not significantly different from zero.

The elasticity of points ratio with respect to relative wage bill is now 0.23, significant at one per cent and five per cent levels respectively, suggesting strongly diminishing returns. Acquiring a better quality head coach, with a higher relative salary, has the beneficial effect of reducing team inefficiency. This is shown in the sign and value of the parameter δ_1. In addition, the significant δ_2 parameter shows that for given relative coach salary, a head coach with greater managerial win record is also associated with reduced inefficiency. However, the δ_3 parameter on coaching experience was insignificant (t statistic = 1.18) and was dropped from the analysis. It seems that experience of winning dominates experience per se as a key managerial characteristic which helps improve technical efficiency and move the team towards its potential output.

The other δ parameters are all statistically significant at the one per cent level. The significantly negative δ_3 parameter shows that a team that has enjoyed a longer continuous spell in Bundesliga 1 than a rival will, ceteris paribus, enjoy reduced inefficiency. This possibly reflects a cumulative learning experience for clubs with

[9] The more flexible translog form was again tested and rejected due to jointly insignificant coefficients on squared and cross-product terms.

prolonged tenure in the top division of German soccer. In contrast, recently promoted clubs have smaller values of SPELL and hence greater inefficiency scores.

A team that fires its head coach in a season will suffer increased technical inefficiency. Given the turbulence that usually surrounds a head coach departure this is to be expected, although the departure may itself reflect some underlying problems such as loss of customer (fan) support, financial failure and lack of co-operation between team-mates. This does not imply that firing head coaches is irrational as teams may believe that long-term gains (by acquiring a better head coach) will outweigh short-term losses of efficiency.

The stochastic frontier estimates therefore reveal an important role for head coach quality in moving teams closer to their production frontiers, where coach salary is taken to be a proxy for coaching ability and performance. However, the result that coaches with greater prior win records can also reduce technical inefficiency, even controlling for coach salary is indicative of underpayment for coaches. In a competitive market, coach win records should be fully incorporated into coach salaries and the δ_2 parameter should be insignificantly different from zero.

We can see whether coach win records are fully captured by coach salary by estimating a simple regression of log relative salary with log relative wage bill, coach experience and coach win record as covariates. Head coach fixed effects are included. The estimates, with t statistics in parentheses, are shown below.

Log relative salary = -0.326 + 0.273Log relative wage bill + 0.041Coach experience +
(7.27) (5.09) (6.37)

0.142Coach win ratio R^2 (overall) = 0.43
(1.47)

We find that coach experience is a significant predictor of relative head coach salary. This is consistent with sorting and matching in the market for head coaches. But the coach performance measure, career points ratio, is not a significant predictor of head coach salary. To counter the objection that coach win ratio might be fully captured by coach experience we see that the correlation coefficient between these two variables is only 0.45. We interpret these regression results as supporting evidence of allocative inefficiency in the market for Bundesliga head coaches.

4. Discussion

What explanations can be offered for this apparent allocative inefficiency in the market for German head coaches? First, unlike players, the overwhelming majority of Bundesliga 1 head coaches is of German nationality. As at 2006, there were only two (out of 18) non-German coaches working in Bundesliga 1 (Van Marwijk (Dutch) at Dortmund and Koller (Swiss) at Bochum). Second, German head coaches rarely move abroad, again unlike players. So Bundesliga 1 head coaches lack mobility and do not enforce outside options when negotiating salary levels. Third, most German teams insist on hiring only those coaches who have acquired a diploma from the German Sports University located in Cologne. Fourth, Bundesliga coaches that are fired have a high probability of finding a similar position at another club, largely because teams are seemingly reluctant to hire non-Germans.[10] Weak Bundesliga coaches are then shielded from competition. All in all, these restrictions combine to deliver some monopsony power for Bundesliga 1 teams that contrasts strongly with the more open and competitive market for players.

5. Conclusions

From stochastic frontier modelling, we find that relative spending on playing talent and on head coach talent combine effectively to reduce technical efficiency and improve league performance. The literature on personnel economics would benefit from further examination of such complementarities in other settings.

Our modelling exercise in this paper produces several key results. First, the stochastic frontier estimates showed that extra spending on managerial talent vested in a head coach has the impact of moving teams closer to the points ratio-relative wage bill frontier. If a more successful coach can be hired, as indicated by a higher career points

[10] Dawson and Dobson (2002) analyse the remarkable propensity of fired coaches in English football to be re-hired by other English clubs.

ratio, then we find that the team's technical inefficiency is reduced, even after controlling for coach salary. Technical inefficiency is not lowered by hiring a more experienced head coach as this is already captured fully by coach salary. Our interpretation of the significance of coach win records is that coaches are underpaid in the German head coach market. The rationale offered for this finding is lack of mobility of German head coaches on the supply-side, with preferences for positions in the Bundesliga rather than outside Germany, reinforced by the implicit requirement of clubs that coaches must have a diploma from an accredited German Sports University. This operates as a barrier of entry to foreign-born coaches.

Our principal finding of allocative inefficiency in the market for Bundesliga head coaches comes from a stochastic frontier approach normally used purely to reveal, and determine causes of, technical inefficiency. The use of an analysis of technical inefficiency to form inferences about allocative inefficiency is, as far as we are aware, novel and we recommend that such an approach be extended to other cases in personnel economics so as to explore interactions between technical inefficiency and executive compensation.

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