TALENT AND/OR POPULARITY: WHAT DOES IT TAKE TO BE A SUPERSTAR?

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We show that both talent and popularity significantly contribute to stars' market values in German soccer. The talent-versus-popularity controversy on the sources of stardom goes back to Rosen (1981) and Adler (1985). All attempts to resolve the controversy empirically face the difficulty of accurately identifying talent. In professional sports, rank-order tournaments help in ascertaining talent. Analyzing a team setting, we use 20 different performance indicators to estimate a player's talent according to his ability to increase the team's winning probability. (*JEL* J31, J44, L83)

The phenomenon of Superstars, wherein small numbers of people earn enormous amounts of money and dominate the activities in which they engage, seems to be increasingly important in the modern world (Rosen 1981, 845).

I. INTRODUCTION

This, the opening sentence of Sherwin Rosen's seminal paper "The Economics of Superstars," applies today more than ever. Technological change has increased the scope and the intensity of the so-called winner-takes-all markets in the last decades. The central question addressed in this article is: What does it take to be a superstar? Why do some artists, media stars, professional athletes, or executives earn disproportionately high salaries while others receive comparatively low remuneration? In the literature, there are basically two competing—but not mutually exclusive—theories of superstar formation proposed by Rosen (1981) and Adler (1985).[1] Although Sherwin Rosen explains how small differences in talent translate into large differences in earnings, Moshe Adler argues that superstars might even emerge among equally talented performers due to the positive network externalities of popularity.

Empirical tests of the different driving forces of superstar salaries have proved to be very difficult because an objective measure of a star's talent is often hard to find and even harder to quantify (Krueger 2005). For example, what characterizes the talent of a pop music star? The literature offers different approaches. Hamlen (1991, 1994) uses the physical concept of "voice quality," which measures the frequency of harmonic content that singers use when they sing the word "love" in one of their songs—but is such a "high-quality" voice really a deciding factor for success in pop music? Krueger (2005) measures star quality by the number of millimeters of print columns devoted to each artist in *The Rolling Stone Encyclopedia of Rock & Roll.* Nevertheless, as he admits, this measure reflects the subjective importance the editors of the *Encyclopedia* implicitly devote to each artist, which may correlate both with the artist's talent and with his/her popularity. In

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1. There are, of course, other superstar theories as well (e.g., Borghans and Groot 1998; Frank and Cook 1995; Kremer 1993; MacDonald 1988). The basic principles of Rosen (1981) and Adler (1985) have remained present throughout, however.

ABBREVIATION
OLS: Ordinary Least Squares

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team settings, the difficulty of accurately measuring star talent is even greater, as individual contributions to team output are mostly unclear. However, the empirical relevance of stars within teams is undoubted. Star CEOs in top management teams, lead singers of rock bands, and star athletes on sports teams are just a few examples of superstars embedded in teams.

This article argues that rank-order tournaments in professional sports allow a more accurate determination of talent than in the arts. Even though each athlete's performance is also affected by random events (luck) or other factors like weak fitness, in individual sports it can typically be assumed that the most talented athlete enjoys the highest probability of winning. As we examine superstars in a team setting, namely in professional soccer, we first estimate a team production function to identify the playing characteristics that significantly influence the probability of a team winning. To do so, we use the detailed statistics of the *Opta Sports Data Company*, which counts and classifies every touch of the ball during the game by each player. In a second step, we use the individual performance statistics of all variables that have proved to be critical for winning as indicators of the player's talent. We estimate the impact of talent, popularity, and various controls on the player's market value, employing individual panel data from the highest German soccer league. A player's popularity is measured by the annual press publicity he receives in over 20 different newspapers and magazines, purged of the positive influences of on-field performance so that our popularity indicator captures the nonperformance-related celebrity status of a player.

We find empirical evidence that both talent and nonperformance-related popularity increase the market values of soccer stars. The marginal influence of talent is magnified near the top end of the scale, as postulated by Rosen's star theory. Although one additional goal scored per season increases a player's market value by €0.06 million at the mean, the impact increases to €0.25 million at the 95% quantile. Using team revenue data, we find that the magnitude of the talent effect is plausible given the large returns to scale in German soccer.

The remainder of the article is organized as follows. Section II illustrates the two alternative theories of superstar formation and their hypotheses. Section III presents the relevant empirical literature. In Section IV, we explain the difficulty of adequately measuring talent and the advantages the sports industry offers. The popularity measure is described in Section V. Section VI includes the main empirical analysis that relates the stars' market values to their characteristics before we conduct two sensitivity analyses in Section VII. Section VIII discusses the results and their possible implications.

II. THEORIES OF SUPERSTAR FORMATION

Marshall (1947) has already pointed out that innovations in technology and mass production will lower the per-unit price of quality goods and ultimately allow higher-quality goods to obtain a greater market share. In 1981, Sherwin Rosen named this effect the "superstar phenomenon." Extraordinary salaries earned by superstars are driven by a market equilibrium that rewards talented people with increasing returns to ability. The key to the high earnings of superstars lies in the vast audience they are able to reach because of scale economies. Superstars arise in markets in which the production technology allows for joint consumption. For example, if one person watches a tennis game on television, this does not diminish someone else's opportunity to watch it as well. In superstar industries, production costs do not rise in proportion to the size of the seller's market. This enables a few or just one supplier to serve the whole market.

However, large economies of scale do not guarantee high salaries for a small number of stars unless the market demand becomes highly concentrated on their services. In the superstar literature, the demand for superstar services is basically driven by two distinct but not mutually exclusive factors: superior talent, according to Rosen (1981), and network externalities of popularity, according to Adler (1985).

First, market demand may be concentrated on superstars because of their superior talent. Rosen (1981) argues that poorer quality is only an imperfect substitute for higher quality. Thus, people prefer consuming fewer high-quality services to more of the same service at moderate quality levels: "(...) hearing a succession of mediocre singers does not add up to a single outstanding performance" (Rosen 1981, 846). Most people tend not to be satisfied with the performance of a less talented but cheaper artist when they are able to enjoy a top performance, even if the costs are somewhat higher (Frey 1998). This sort of imperfect substitutability applies in particular to status goods or gifts: To celebrate a special occasion, people search not for an average restaurant meal or bottle of wine, but for the best (Frank and Cook 1995). According to Rosen (1981), small differences in talent among performers are magnified into large earnings differentials. Rosen stars are simply better than their rivals. In professional sports, they attract fans with their outstanding performances.

Network externalities of popularity offer a second explanation of why demand may be highly focused on the services of a few superstars. In contrast to the network externalities in the typical standardization literature,[2] the network externalities of superstars are not confined to issues of technological compatibility or a larger variety of complements. Moshe Adler, rather, suggests a cognitive and social form of network externalities. Adler (1985) argues that the marginal utility of consuming a superstar service increases with the ability to appreciate it, which depends not only on the star's talent, but also on the amount of star-specific knowledge the consumer has acquired. This specific knowledge—called consumption capital—is accumulated through past consumption activities or by discussing the star's performance with likewise knowledgeable individuals. The latter effect gives rise to positive network externalities. The more popular the artist is, the easier it becomes to find other fans. Economies of searching costs imply that consumers are better off patronizing the most popular star as long as others are not perceived to be clearly superior.

> *Stardom is a market device to economize on learning costs in activities where "the more you know the more you enjoy." Thus stardom may be independent of the existence of a hierarchy of talent (Adler 1985, 208–09).*

Adler (1985) considered the emergence of a superstar from a group of equally talented artists to be simply because of luck, for example, initially being known by slightly more people. Adler (2006), however, recognizes that luck cannot be the only mechanism. Aspiring superstars do not usually entrust selection ahead of their peers to pure chance. Instead, they consciously use publicity, such as appearances on talk shows, and coverage in tabloids, magazines, newspapers, and the Internet to signal and strengthen their popularity. Adler (2006) emphasizes that consumption capital is acquired not only through past consumption activities and discussions, but also by reading about the star's performance in newspapers, in magazines, and on the Internet. On the one hand, publicity directly reduces the costs of learning about star services and on the other hand, it is also a good indicator of the star's popularity in society.

Both Rosen (1981) and Adler (1985) agree that superstars provide services of superior perceived quality. But according to Rosen (1981), the star's talent alone determines the perceived quality. Adler (1985) argues that factors other than talent, like popularity, matter too. Thus, Adler's superstar theory does not contradict Rosen's star model, but rather supplements it. In team sports, for example, superstars may have personal appeal or charisma, an element that attracts fan interest even after controlling for their contribution to the team's (increased) playing quality.

III. RELEVANT EMPIRICAL LITERATURE

In this section, we give a brief introduction to the empirical literature on superstar emergence. A first body of literature (Hamlen 1991, 1994; Krueger 2005; Lucifora and Simmons 2003) relates star remuneration to talent proxies but does not include separate explanatory variables distinguishing the Adler effect. A second strand of literature (Chung and Cox 1994; Giles 2006; Spierdijk and Voorneveld 2009) tests whether superstar market outcomes could be merely the result of a probability mechanism determining that "outputs will be concentrated among a few *lucky* individuals" (Chung and Cox 1994, 771, emphasis in original), regardless of talent. This concept is, in its spirit, similar to the ideas of Adler (1985), although the question regarding the underlying reason for the consumer's decision to buy a star's service remains unanswered (Schulze 2003).

A third body of related literature uses both talent and popularity proxies in its empirical framework. Lehmann and Schulze (2008), as well as Franck and Nüesch (2008), test the influence of on-field performance and media publicity on the emergence of superstars in German soccer. Regressing salary proxies of 359 players on three performance measures (goals, assists, and tackles) and the number of citations in the online version of the soccer magazine *Kicker*, Lehmann and Schulze (2008) discover that neither performance nor publicity can explain the

2. See, for example, Katz and Shapiro (1985) or Farrell and Saloner (1985).

salaries of superstars at the 95% quantile. Franck and Nüesch (2008) find contrary evidence: both talent, as measured by expert opinions, and popularity increase the demand for star players. Both Lehmann and Schulze (2008) and Franck and Nüesch (2008) use cross-sectional samples and consider the talent indicators as exogenously given without proving their relevance for a soccer game.

Salganik, Dodds, and Watts (2006) use an experimental study to investigate the talent and popularity hypotheses in an artificial cultural market. The participants (14,341) downloaded previously unknown songs either (a) with or (b) without knowledge of the previous participants' choices, the participants having been randomly assigned to one of these two experimental conditions. In this experiment, knowing the choices of other customers contributed to both the inequality and the unpredictability of the artificial music market. Social influence increases the skewness of the market distribution and the unpredictability of success. The latter is analyzed as the extent to which two "worlds" with identical songs, identical initial conditions, and indistinguishable populations generate different outcomes. As the outcome is unpredictable even when consumers had no knowledge about download statistics, they conclude that no measure of a song's quality can reliably predict success.

IV. TALENT DETERMINATION

One of the main obstacles to testing superstar theories is the "inherent difficulty of objectivity measuring talent or quality in a meaningful metric apart from economic success" (Connolly and Krueger 2006, 696). Throsby (1994, 19) writes:

> *While it is quite plausible to take estimated earnings functions and to attribute at least some of the (often large) unexplained residual to differences in talent, such a hypothesis remains untestable when no independent measure of talent is forthcoming.*

Hamlen (1994, 405) calls a "sour grapes conclusion" any conclusion drawn when scholars believe they have found empirical evidence of the superstar phenomenon by examining only measures of success and failing to compare these to some objective and external measure of quality or ability. "A proper test of the superstar phenomenon requires that the measure of 'quality' ('ability') be an external measure" (Hamlen 1994, 399). As innate talent is unobservable, Rosen (1981) argues that any cardinal measure of talent must rely on measurements of actual outcomes.

The first issue in talent determination is its *validity*. Although some pop fans love the music of Madonna, others may hate it. In the popular music industry, talent is hard to define. Some music appeals to a subset of listeners but not to others because, in the arts, there is "an intrinsically subjective component to quality" (Connolly and Krueger 2006, 697). Both Rosen (1981) and Adler (1985), however, assume identical consumers who demand the same unspecified artistic activity. They argue that a diversity of tastes does not change the basic mechanisms of superstar formation, but simply confines a seller's market. Consumers of similar taste constitute a market with its own stars. As stated previously, Hamlen (1991) uses the harmonic content of the voice as a singer's talent indicator. Harmonic content is a clearly quantifiable variable that measures the "richness" and "depth" of the singer's voice. Still, does harmonic content of the voice really matter? In classical music or opera, presumably yes. In the case of pop or rock music, however, we have strong doubts about the relevance of the harmonic content of the voice. More important factors for the success of such singers are probably charm, sex appeal, or the show on stage. Hence, one possibility for dealing with heterogeneous tastes is to use specific talent indicators only within a genre; otherwise, how is it possible to compare a chamber orchestra with a heavy metal band? Nevertheless, quality perceptions often differ even within a particular genre.

A second obstacle in empirical superstar studies is the *measurement* of talent. The absence of "natural units" for measuring talent is a major limitation of empirical superstar studies in the arts (Connolly and Krueger 2006). Even if all pop fans agreed that charisma on stage is the most important ability of a pop star, scholars would still face the difficulty of capturing charisma on a metrical scale. Talent is inherent and thus hard to quantify.

In professional sports, the empirical problems described above are less serious because valid talent measures are easier to find than in other fields like the arts or entertainment activities (Schulze 2003). In professional sports, the winners are determined by a set of well-established tournaments relying either on objective quality indicators and/or on institutionalized voting procedures by proven expert judges. Although different effort levels and uncontrollable factors like incorrect refereeing decisions or pure luck might also affect the final result, the competition is generally won by the most talented athlete. In individual sports, the winning probability is, therefore, a valid and measurable indicator of the athlete's talent. Even though a high likelihood of winning marks great sporting success, it does not necessarily imply enormous salaries as well. Or inversely, even less talented and thus less successful athletes might earn superstar wages.[3] So, there is no danger of a tautological Rosen star definition.

In team settings, talent determination is more complex. It requires a proper evaluation of the team production technology because teams—and not individuals—compete in rank-order tournaments. In this article, the (Rosen) talent of a soccer star is considered the player's ability to increase the winning chances of his team. This definition of talent represents pure on-the-field prowess. Other facets of a star that attract fans, such as his celebrity or pop icon status, are as Adler (1985, 211) writes, "factors other than talent."

Using team-level data for all games in the highest German soccer league during five seasons (2001/2002–2005/2006), we empirically estimate a team production function in order to identify all playing elements that significantly increase (or reduce) the team's winning probability. To do so, we make use of a large series of performance categories, namely shots on target; shots off target; shots hitting the frame of the goal; clearances, blocks, and interceptions; saves to shots ratio of the goalkeeper; number of times the ball was caught by the goalkeeper; number of times the ball was dropped by the goalkeeper; number of red and yellow cards; number of fouls, number of "dangerous" fouls (conceded in the own third of the playing area), penalties, and handballs conceded, as well as the success rate of passes, flicks, crosses, dribbles, and tackles, respectively. These data are provided by the *Opta Sports Data Company*, which counts and classifies every touch of the ball by each player during the game based on live and off-tape analysis of every match by a team of specialist analysts.

We find evidence that team success is positively affected by the number of goals and assists; the number of clearances, blocks, and interceptions; the number of shots on target; the saves to shots ratio of the goalkeeper; and the (average) success rate of crosses. The number of shots off target, the number of red and yellow cards, and the number of penalties conceded reduce the winning likelihood of a team. All other performance indicators do not significantly influence the game's result. For a more detailed description of the team production estimation as well as a table showing the results, we refer to a previous working paper version of this article (Franck and Nüesch 2009).

We consider all field plays that significantly affect the team's winning chances as characteristics of the unobserved (good or bad) talent of a player. The descriptive statistics of the individual talent variables are illustrated in Table 1. In the following section, we explain how we measure the nonperformance-related popularity of a player, before both talent and popularity are related to the player's market value.

V. NONPERFORMANCE-RELATED POPULARITY

In line with Adler (2006), we proxy a player's popularity based on press publicity. Using the *LexisNexis* database, which contains more than 20 different quality nationwide newspapers (including *Frankfurter Allgemeine Zeitung, Süddeutsche Zeitung, Stuttgarter Zeitung, Hamburger Abendblatt, Die Welt, taz, Berliner Morgenpost, Financial Times Deutschland*) as well as weekly magazines (including *Der Spiegel, Stern, Bunte*), we count the number of articles in which a player is mentioned at least once. The search string included the first and last names of the player, as well as the name of the club he was engaged by during the corresponding season, starting from July 1 at the beginning of the season and lasting until June 30 at the end of the season.

If talent is measured by the player's on-field performance and popularity by the player's press publicity, the concepts of talent and popularity are likely to be positively correlated because of

3. The Russian tennis player Anna Kournikova serves as a good illustration here. She did not achieve any significant success in single tournaments and her overall singles ranking was never better than eight. Nevertheless, in 2002 she was the second highest earner in female tennis behind Venus Williams, the number one at the time. In Kournikova's case, sponsorships and other lucrative commercial opportunities have arisen not from a consistent record of successful performances on the tennis court, but instead as a consequence of an image of sexual attractiveness and an associated media profile.

TABLE 1
Variables and Descriptive Statistics

Variable	Description	*M*	*SD*
Dependent variable			
Market value	Logarithm of a player's market value at the end of the season according to the *Kicker* soccer magazine	14.28	0.73
Independent variables			
Talent variables			
Goals	Goals	2.52	3.77
Assists	Assists	1.79	2.25
Shots on target	Number of shots on target	8.41	10.08
Shots off target	Number of shots off target	10.37	10.07
Clearances, blocks, interceptions	Clearances, blocks and interceptions	66.96	76.08
Saves to shots ratio	Save to shots ratio of the goalkeeper	0.06	0.19
Cross success rate	% successful crossings	0.21	0.17
Red cards	Number of red cards	0.18	0.43
Yellow cards	Number of yellow cards	3.29	2.61
Penalty conceded	Number of fouls conceded in penalty area	0.19	0.48
Popularity variable			
Nonperformance-related press citations	Residuals of a regression of the logarithm of citations in over 20 German newspapers and weekly magazines on individual talent measures	0.00	1.24
Control variables			
Age	Player's age	25.93	4.06
Age squared	Squared term of age	688.76	215.48
Appearances	Appearances in the considered season	20.94	9.24
Previous appearances	Accumulated appearances before the considered season	70.75	79.61
Relegation	Club was relegated at the end of the season	0.03	
Number of players		605	
Observations		1,370	

Notes: The model also includes an intercept as well as position and team fixed effects.

the performance-related publicity. To clearly differentiate between Rosen's and Adler's superstar theory, we need a popularity measure that is unrelated to the performance of the player. Thus, we proxy a player's *nonperformance-related* star attraction by the residuals ε_{it} of the following equation:

$$(1) \qquad \ln(\text{Press citations}_{it}) = \alpha + \beta x'_{it} + \varepsilon_{it},$$

where the logarithm of the number of articles mentioning the player's name is regressed on the critical individual on-field performance measures x'_{it} according to the previous section.[4] The ordinary least squares (OLS) estimation results of Equation (1) are illustrated in Table A1 in the appendix of this article. Most on-field performance measures significantly increase press coverage, with the highest magnitudes for goals, the saves to shots ratio of the goalkeeper, and assists. The residuals of Equation (1) characterize a player's publicity that cannot be explained by his sporting performance on the pitch; for example, media publicity that is a result of the star having an affair or consciously presenting himself not only as a soccer star but as a pop icon as well.[5]

4. We are grateful to an anonymous referee for proposing this procedure.

5. The ceteris paribus condition in multiple regression analysis is technically the same as if one were to introduce the residuals of a regression of the considered explanatory variable on all other explanatory variables (Wooldridge 2003, 78–79). The estimated popularity effect would therefore be the same if we directly introduced the logarithm of press citations into the model. The size of the talent effect would be comparably lower, however, as the positive correlation with performance-related popularity would be partialed out. By introducing the nonperformance-related publicity of a player that—per construction—does not correlate with a player's performance, we are able to estimate *unrestricted* talent effects. In other words, we use the residuals of Equation (1) as a measure of a player's popularity, because we want to net out the influence of performance on publicity, but not the other way around.

VI. SUPERSTAR DETERMINANTS

A. Data Sample and Dependent Variable

The different theories of superstar formation are tested using panel data for players appearing in the highest German soccer league during five seasons (2001/2002 until 2005/2006). Although many detailed statistics on individual productivity are available for players in top European leagues, individual salary data are (unlike for the US Major Leagues) unfortunately not available. German soccer clubs are not required to publish player salaries. In 1995, the well-respected soccer magazine *Kicker*, however, began to publish estimates of the market values of the players appearing in the highest German soccer league. As the market value proxies have been estimated in a systematic manner for several years by an almost unchanged, qualified editorial board, they are likely to be consistent and have, therefore, been used in several empirical studies so far (e.g., Franck and Nüesch forthcoming; Haas, Kocher, and Sutter 2004; Kern and Süssmuth 2005; Torgler and Schmidt 2007). In line with most of the previous studies,[6] we also use the market value proxies provided by the *Kicker* soccer magazine. *Kicker* is the only source that provides systematic panel data and its reliability is judged to be high in the review articles of Torgler and Schmidt (2007) and Frick (2007). We additionally test the reliability of the market value data by comparing a *Kicker* subsample with a cross section of market values provided by a second independent source, the webpage www.transfermarkt.de. The market value proxies of the two sources are highly correlated (correlation is 0.89) and the estimation results are very similar if the *Transfermarkt* data are employed, as we show in our first sensitivity analysis in Section VII. The fact that separate regressions using different data sources lead to the same results increases confidence in the reliability of our results.

Citing the examples of full-time comedians and soloists, Rosen (1981) considered stars as individual service providers with enormous earnings. The earnings of painters, authors, or athletes in individual sports are directly determined by the market potential of their services. So, market value and remuneration are, generally speaking, the same. In our case, superstars cannot provide the service alone. Soccer stars are part of teams and receive certain salary payments, bonuses, or signing fees that do not necessarily correspond to their market potential. The predetermined (base) salary, for example, does not increase if the player performs exceptionally well. Bonus payments are typically contingent on a large set of confidential terms and conditions. Signing fees or transfer values depend on (among other factors) the bargaining power of the buying and selling clubs. Thus, market values should better reflect the value generation potential of a player than pure salaries. The *Kicker* market value proxies incorporate not only salaries but also signing fees, bonuses, transfer fees, and possibly even a remaining producer surplus. However, the market value proxies do not include individual endorsement fees.

In line with Rosen (1981), we define superstars as the players at the top end of the market value distribution. Although the median player is valued at €1.25 million, star players at the 95% quantile are exchanged for €5.5 million. Seventy-five percent of the players in the highest German soccer league have a market value of one million Euros and above. Table 2 illustrates the market values at different quantiles.

For the empirical model, we use the natural logarithm of the market values expressed in Euros and adjusted for inflation. During the considered time frame (2001 until 2005), the players' market values have remained rather stationary in German soccer.

B. Control Variables

Besides the indicators of individual talent and popularity described in Sections IV and V, we also use several control variables to eliminate

TABLE 2
Quantiles of the Market Value Distribution

Quantiles	*Kicker* Market Values (€)
1%	200,000
5%	500,000
10%	750,000
25%	1,000,000
50%	1,500,000
75%	2,500,000
90%	4,500,000
95%	5,500,000
99%	8,000,000

6. Other studies use cross-sectional samples of remuneration estimates of players published in *Welt am Sonntag* (Lehmann and Weigand 1999), in *Sportbild* (Lehmann and Schulze 2008), or on the webpage www.transfermarkt.de (Franck and Nüesch 2008).

alternative explanations, such as age, experience, tactical position, and team effects. An overview of all variables is given in Table 1. As several studies (e.g., Lucifora and Simmons 2003; Torgler and Schmidt 2007) show that a soccer player's age has a positive but diminishing impact on his salary, we control for age and age squared. In addition, we hold the number of present and past appearances in the highest German league constant to account for the experience of a player. Furthermore, we incorporate team dummies, as (unobserved) team heterogeneity may exert a significant influence on a player's market value (Idson and Kahane 2000). Somebody who is on the squad of the team that wins the championship enjoys much greater publicity and financial rewards than someone on a team that is relegated to the next lower league. Position dummies are used to control for specific effects resulting from the tactical position of a player.

As the *Kicker* soccer magazine publishes the estimated market values at the beginning of a new season, we use the values of the next season as dependent variable. This implies that we have missing observations for the dependent variable whenever a player leaves the league because *Kicker* estimates the market values only for the players engaged by a top-division German team. If so-called sample attrition is driven by unobservable factors that also influence the dependent variable in the main equation, our estimates may be distorted by selection bias. Thus, the validity of the results largely depends on whether the attrition status is random after conditioning on a vector of covariates. As in German soccer, the weakest three teams, including most of the squad members, are relegated to the next lower league and, therefore drop out of the sample, we include a dummy variable *Relegation* that equals 1 if the player's team is demoted (0 otherwise) as an additional control variable. Controlling for a player's talent, popularity, and experience, as well as the team's relegation status, we cannot reject random attrition status using the test for sample attrition bias proposed by Fitzgerald, Gottschalk, and Moffitt (1998).[7]

C. Identification Strategy

OLS estimates tell little about tail behavior, because they lead to an approximation to the mean of a conditional distribution. The OLS procedure will therefore not be able to capture the superstar phenomenon correctly. The quantile regression approach (Koenker and Bassett 1978), however, allows one to characterize a particular point in the conditional (asymmetric) distribution. It minimizes an asymmetrically weighted sum of absolute errors where the weights are functions of the quantile of interest (θ):

$$(2) \quad \min_{\beta} \frac{1}{n} \left\{ \sum_{i: y_{it} \geq x'_{it}\beta} \theta |y_{it} - x'_{it}\beta| + \sum_{i: y_{it} \leq x'_{it}\beta} (1-\theta)|y_{it} - x'_{it}\beta| \right\}.$$

The application of quantile methods to panel data can be problematic (Koenker 2004). Although, in the linear regression model, fixed effects methods can account for the constant unobserved heterogeneity of a player as a linear intercept, quantile regressions require a constant *distributional* individual effect. If the number of time periods is high and the number of cross-sectional observations is low, the estimation of such a *distributional* individual effect is possible by including cross-sectional dummies (Koenker 2004). In our setting, however, the inclusion of player dummies would clearly lead to the incidental parameters problem, because we have a large number of cross-sectional observations and only one to five time periods. Thus, we use a pooled regression approach to estimate the conditional distribution of the dependent variable. As the observations of the same player are unlikely to be independent, the standard asymptotic-variance formula (Koenker and Basset 1978) and the standard bootstrap approach to estimate the standard errors cannot be applied. Instead, a given bootstrap sample is created by repeatedly drawing (with replacements) the same player from the sample of players. In doing so, we allow for serial error correlation between the observations of the same player. As we run 1,000 bootstrap replications, the estimates of the robust standard errors are rather stable (Koenker and Hallock 2000).

D. Results

Table 3 illustrates the estimation results. Besides the 95% quantile regression, we also present the pooled OLS estimates, as well as

7. A table showing the detailed results of this test is included in the working paper version of this article (Franck and Nüesch 2009).

TABLE 3
Determinants of a Star's Market Value

Dependent Variable	**Logarithm of Individual Market Values According to *Kicker***					
Estimation Approach	**OLS**		**Fixed Effects**		**95% Quantile Reg.**	
	β-coef.	***SE***	**β-coef.**	***SE***	**β-coef.**	***SE***
Talent variables						
Goals	0.039**	0.009	0.040**	0.009	0.045**	0.016
Assists	0.039**	0.007	0.038**	0.008	0.020	0.011
Shots on target	0.006	0.004	0.002	0.003	0.017*	0.008
Shots off target (in 10^{-1})	0.018	0.027	0.001	0.001	−0.087	0.047
Clearances, blocks, intercept. (in 10^{-1})	0.012**	0.003	0.005	0.005	0.017*	0.007
Saves to shots ratio	0.366**	0.136	0.938	0.745	0.488*	0.231
Cross-completion rate	−0.043	0.092	−0.156	0.096	−0.140	0.161
Red cards	0.035	0.030	−0.056	0.032	0.117	0.083
Yellow cards	0.001	0.006	0.004	0.007	0.003	0.011
Penalties conceded	0.018	0.026	0.000	0.030	0.022	0.045
Joint sig. of talent (*F* statistic)	17.87**		11.78**		7.04**	
Popularity variable						
Nonperformance-related press citations	0.135**	0.017	0.125**	0.019	0.119**	0.025
Controls						
Intercept	11.313**	0.584	11.345**	1.240	14.042**	1.173
Age	0.207**	0.045	0.386**	0.089	0.065	0.086
Age squared	−0.004**	0.001	−0.011**	0.002	−0.002	0.002
Appearances	0.026**	0.003	0.014**	0.004	0.014**	0.005
Previous appearances (in 10^{-2})	−0.018	0.029	0.259**	0.093	−0.024	0.051
Relegation	−0.134	0.094	−0.137	0.112	0.395	0.298
Position fixed effects	Yes		Yes		Yes	
Team fixed effects	Yes		Yes		Yes	
Pseudo-R^2	0.63		0.46 (within)		0.44	
Number of observations	1,370		1,370		1,370	

Notes: The sample includes players who appeared for at least half an hour in the highest German soccer league during the seasons 2001/2002 until 2005/2006. As the dependent variable is missing if the player left the league after the season, we tested for potential attrition bias. Attrition probability is, however, not affected by the player's mean market value, conditional on the explanatory variables. Standard errors in the OLS and FE procedures are White-robust and clustered at the player level. The standard errors of the quantile specification are clustering adjusted standard errors based on 1,000 bootstrap replications.

Significance levels (two-tailed): *5%; **1%.

the results of a player fixed effects regression for the purpose of comparison.

We find clear evidence that both a player's talent and his nonperformance-related popularity increase his market value. This finding is robust across all specifications. Regarding the talent indicators, we see that the number of goals; the number of shots on target; the number of clearances, blocks, and interceptions; and the saves to shots ratio of the goalkeeper significantly increase the star's market value at the 95% quantile.

If a star player at the 95% quantile scores one more goal per season, his market value increases by 4.5%. The coefficients in the quantile regressions are similar in magnitude to those in the OLS or fixed effects specification. Thus, the relative marginal effects are more or less constant. The absolute size of the marginal talent effect is magnified, however, as we move up the market value distribution.[8] An additional goal scored by a superstar at the 95% quantile increases his market value by €0.25 million (0.045×5.5 million), whereas the absolute increase of an additional goal scored by an average player is worth only €0.06 million (0.040×1.5 million).

8. The magnification does not apply to the popularity effect, however, as we measure a player's popularity with the logarithm of the nonperformance-related press citations. Hence, the popularity coefficient has to be interpreted as elasticity. Adler (1985) does not necessarily assume a convex relationship between a star's salary and popularity.

If a mediocre goalkeeper improves his saves to shots ratio by 1%, his market value increases by €0.006 million (0.01 × 0.37 × 1.5 million). A 1% improvement on the part of a star goalkeeper, however, leads to an increase of €0.027 million (0.01 × 0.49 × 5.5 million).[9] At first glance, these findings seem counterintuitive as it should not matter who scores the goals or prevents the opposition team from scoring. Going back to the superstar theory of Rosen (1981), the magnification effect can be explained by the imperfect substitutability of higher and lower talent. Thus, from the consumer's perspective, one player scoring ten goals is not the same as ten players scoring one goal each. This implies that additional talent is magnified into larger earning differences at the top end of the scale than at the bottom end. We have to be cautious, however, with generalizations regarding the exact magnitudes of the quantile effects: a player who happens to be in a specific quantile of a conditional distribution will not necessarily find himself in the same quantile if his independent variables change (Buchinsky 1998).

Whenever correlational designs are used, concerns about internal validity such as possible reverse causality may be raised. The issue of reverse causality (impact of market values on talent or popularity) is, however, appeased by the lag structure of our model. The independent variables are determined during a given season, whereas the dependent variable is estimated after the end of that season but prior to the start of the following season. The market values should therefore be influenced by the player's talent and popularity and not vice versa. As we have a typical microeconomic data set with a large cross-sectional dimension and a small time dimension, adaptions of Granger causality tests to panel data, for example, those formulated by Holtz-Eakin, Newey, and Rosen (1988), are not suitable in our context. Granger causality is an intrinsically dynamic concept (Attanasio, Picci, and Scorcu 2000).

VII. SENSITIVITY ANALYSES

In this section, we perform two sensitivity analyses. First, we test the robustness of the results if the market value proxies of a second independent source are used. Second, we examine the plausibility of the talent coefficients by relating on-field performance to the team's winning percentage and the winning percentage to the team's revenue.

A. Different Data Source of the Players' Market Values

At the end of the 2004/2005 season, we collected a cross-sectional sample of market value estimates of all players who appeared in the season for at least half an hour (in total, 427 players) from www.transfermarkt.de. As *Transfermarkt* does not provide archive data, market values of players in earlier or later seasons were unfortunately not available. Similarly to the *Kicker* market values, the market values from *Transfermarkt* are estimated by industry experts and include not only salaries but also signing fees, bonuses, and transfer fees. Table 4 shows that the significantly positive talent and popularity effects remain robust when taking *Transfermarkt* as the data source for the dependent variable. The coefficients are slightly higher than in the *Kicker* panel sample, but the general empirical findings of the last section are confirmed throughout. Thus, our results are not driven by peculiarities of the *Kicker* proxies.

B. Revenue Performance Sensitivity

The basic unit of competition in our context is the team. The star's talent is valuable to the team because it increases the team's winning percentage, which in turn is positively associated with the team's revenue potential. As we have access to detailed revenue data for the German soccer teams,[10] we want to test the plausibility of the returns to talent in the previous section by estimating revenue performance sensitivity at the team level. In doing so, we follow a procedure outlined by Scully (1974). They suggested first calculating the effect of different on-field performance measures on the team's winning percentage and then considering the impact of the team's winning percentage on team revenues.[11] In line with Scully (1974), we do not examine the influence of popularity on team revenues because, unlike with talent, there

9. The magnitudes of the effects prove plausible when analyzing team revenues and revenue performance sensitivity in German soccer (see second robustness analysis in Section VII).

10. These data have been provided by courtesy of René Algesheimer, Leif Brandes, and Egon Franck. For a first empirical analysis of these data, see Algesheimer, Brandes, and Franck (2009).

11. Mullin and Dunn (2002) use a similar approach.

TABLE 4
Cross-Sectional Estimates of the Determinants of a Star's Market Value Using a Second Data Source

Dependent Variable	**Logarithm of Individual Market Values According to *Transfermarkt***			
Estimation Approach	**OLS**		**95% Quantile Reg.**	
	β-coef.	***SE***	**β-coef.**	***SE***
Talent variables				
Goals	0.080**	0.012	0.095**	0.022
Assists	0.071**	0.017	0.079**	0.029
Shots on target	−0.024	0.023	−0.053	0.137
Shots off target	0.023	0.022	0.051	0.135
Clearances, blocks, interceptions	0.003**	0.001	0.002	0.002
Saves to shots ratio	0.726**	0.240	0.067	0.486
Cross-completion rate	−0.029	0.172	−0.147	0.289
Red cards	0.111	0.078	0.268	0.215
Yellow cards	0.022	0.016	0.043	0.029
Penalties conceded	0.011	0.065	−0.131	0.117
Joint sig. of talent (F statistic)	16.30**		5.78**	
Popularity variable				
Nonperformance-related press citations	0.255**	0.042	0.300**	0.059
Controls				
Intercept	5.306**	1.041	9.204**	2.119
Age	0.607**	0.076	0.418**	0.157
Age squared	−0.011**	0.001	0.008**	0.003
Appearances	0.019**	0.005	0.007	0.009
Previous appearances (in 10^{-1})	−0.015**	0.005	−0.013	0.010
Position fixed effects	Yes		Yes	
Team fixed effects	Yes		Yes	
Pseudo-R^2	0.70		0.56	
Number of observations	427		427	

Notes: The sample includes all players who played for at least half an hour in the highest German soccer league during the season 2004/2005. Standard errors in the OLS are White-robust. The standard errors of the quantile specification are based on 1,000 bootstrap replications.
Significance levels (two-tailed): *5%; **1%.

is no clear measure of team-level popularity. It is unclear how individual publicity should be aggregated at the team level.

In our first step, we relate the team's winning percentage to the talent indicators as described in Table 1, but aggregated at the team level. Running a team fixed effects regression including all teams appearing in the highest German soccer league between 2001/2002 and 2005/2006 (90 observations and 24 different teams), we find significantly positive coefficients for the number of goals scored (coef. = 0.0067, SE = 0.0013) and the saves to shots ratio (coef. = 0.6493, SE = 0.1212). No other performance measures have a distinct influence on the team's winning percentage.[12] In a second step, we use proprietary team revenue data and relate the revenue to the team's winning percentage. The underlying hypothesis is that fan interest and hence revenue is positively affected by team wins (Scully 1974). As the clubs usually renegotiate sponsoring and broadcasting contracts at the beginning of the season, we use the winning percentage of the last season as the explanatory variable. Even match day revenue is largely influenced by the previous season's percentage of wins because season ticket holders represent around 55% of total match attendance (Bundesliga Report 2009). Of course, a team's revenue is driven not only by sporting

12. A table of detailed regression results is included in the working paper version of this article (Franck and Nüesch 2009). This regression differs from the team production estimation in Section IV because it employs seasonal (not match-level) data and uses a smaller set of explanatory variables.

success, but also by other factors such as the size of the market, the team's (nonperformance-related) star attraction, or stadium capacity. By estimating a team fixed effects model, we control for all team aspects that are likely to be time-constant—for example, the team's market potential. Furthermore, we explicitly control for the team's stadium capacity (measured in 1,000s) because it may change substantially over time due to stadium reconstruction. Previous studies found that stadium capacity significantly influences (gate) revenues (e.g., Berri, Schmidt, and Brook 2004; Brandes, Franck, and Nüesch 2008). We run separate models for total revenue and for the subcategories of match day revenue, sponsoring revenue, broadcasting revenue, and the revenue from various sources such as transfer fees, rental income, and catering and merchandizing income.

Table 5 reveals that a 1% increase in the team's winning percentage increases total revenues by 1.18%. The highest revenue performance sensitivities are found (in decreasing order) for broadcasting revenue (175%), match day revenue (163%), and sponsoring revenue (137%). Stadium capacity clearly affects the team's match day revenue but has no significant impact on other revenue categories such as sponsoring or broadcasting revenues. Following Scully (1974), we approximate the marginal revenue product of goal scoring and the saves to shots ratio by multiplying the coefficients of the team production function by the coefficients of the revenue function. As the coefficients of the latter are determined in a log-level model, we multiply the product by the average revenue of a team. Thus, the average marginal revenue product for one additional goal scored is 0.0067 multiplied by 1.18 multiplied by the average team revenue (€66.2 million), which equals €0.52 million. Similarly, we can derive the marginal revenue product if the goalkeeper's saves to shots ratio improves by 1%. In doing so, we achieve a marginal revenue product of €0.51 million (0.01 × 0.6493 × 1.18 × 66.2 million). From the market value regressions in Section VI, we know that one additional goal scored increases the star's market value by €0.25 million and that a 1% improvement in the saves to shots ratio of a star goalkeeper increases his market value by €0.03 million. Hence, even though the marginal effects of the talent variables on the star's market value seem to be rather large, they are still substantially lower than the (average) marginal revenue products of

TABLE 5
Revenue Performance Sensitivity

Dependent Variables	**Ln(Total Revenue)**		**Ln(Match Day Revenue)**		**Ln(Sponsoring Revenue)**		**Ln(Broacasting Revenue)**		**Ln(Miscellaneous Revenue)**	
Estimation Approach	**Team Fixed Effects**									
	β-coef.	***SE***	**β-coef.**	***SE***	**β-coef.**	***SE***	**β-coef.**	***SE***	**β-coef.**	***SE***
Winning percentage$_{t-1}$	1.181**	0.412	1.632**	0.410	1.368**	0.422	1.749*	0.659	0.286	1.362
Stadium capacity$_t$	0.005	0.008	0.022*	0.008	0.010	0.009	−0.009	0.008	0.005	0.010
Intercept	17.081**	0.406	14.304**	0.496	15.407**	0.492	16.273	0.476	15.894**	0.692
League average (in millions €)	66.2		12.2		18.8		18.9		16.3	
R^2 (within)	0.16		0.43		0.17		0.20		0.01	
Number of observations	75		75		75		75		75	

Notes: Team fixed effects estimations. The sample includes all teams appearing in the highest German soccer league during the seasons 2001/2002 until 2005/2006 except the teams that were promoted for the corresponding season. Standard errors are White-robust and clustered at the team level to adjust for serial error correlation.
Significance levels (two-tailed): *5%; **1%.

the same variables. Especially the contributions of goalkeepers seem to be undervalued, a finding already shown by Frick (2007). It is dangerous, however, to put much emphasis on the exact magnitudes of the effects because they react sensitively to the chosen estimation strategy and the explanatory variables included. We know, for example, that not only goal scoring and the saves to shots ratio matter for winning, but also that their strong influence may hide the effects of other important on-field performance measures such as clearances, blocks, and interceptions, and shots on target, to mention just some examples. Thus, the marginal revenue products of goal scoring and the saves to shots ratio tend to be overestimated, as they also incorporate the positive aspects of other important performance characteristics that influence winning. Nevertheless, we can still say that the large impact of a player's talent on his market demand seems to be justified given the high revenue potential and the significant revenue performance sensitivity in the highest German soccer league.

VIII. DISCUSSION

An empirical validation of the different superstar theories proposed by Rosen (1981) and Adler (1985) requires valid and quantifiable talent measures. This article argues that tournaments in professional sports help to determine the (relative) talent of an athlete, which is otherwise unobserved and therefore hard to identify. The label of "winner" does not entail a subjective impression, but rather results from a clearly defined competition in a controlled environment. In team settings, in which teams and not individuals compete against each other, the situation is a little more complicated. In this case, a player's talent is considered his contribution to the team output. Thus, we first estimated a team production function to detect critical playing elements that affect team success, which are taken as talent indicators in the market value regression. A player's nonperformance-related popularity is defined by the residuals of a regression of the logarithm of individual press citations relating to the player's performance. Running a 95% quantile regression, we find evidence that both talent and nonperformance-related popularity contribute to the market value differentials in the highest German soccer league. As the market value proxies we used do not include individual endorsement fees, our estimates may be considered as lower bounds. Endorsement fees usually react very sensitively to the athlete's talent and popularity.

Of course, further work is required to test the generalizability of our results. A more in-depth examination of the factors determining the consumer's decision to buy access to a superstar service would be very beneficial. In this article, we considered (Rosen-style) talent as the individual's ability to impact the likelihood of winning a sports competition. In contrast, all nonsporting factors, like celebrity status in the media, were seen as aspects of (Adler-style) popularity that also attract fans with something more to consider than the pure quality of the game. Adler (1985) sees star popularity as a way of economizing on the costs of accumulating consumption capital, which itself increases the perceived quality of the star's service. In this article, we directly relate the demand for a star's services to the star's popularity and neglect consumption capital as the theoretical link. But the relevance of consumption capital definitely deserves the future attention of both theorists and empiricists.

Even though the economic concept of superstars was first developed to describe the enormous salaries of individual service providers in the entertainment industries,[13] skewed earning distributions can be found in many work contexts, the most prominent of which is the area of top management compensation. Although we have not specifically addressed the issue of "management stars" in our article, the set-up and framing of our approach could provide input for the specific body of literature on the drivers of top management salaries. Our study analyzes an individualistic phenomenon (the determinants of a star player's remuneration) in an institutional setting in which teams, and not individuals, are the basic unit of competition. This, of course, complicates the identification of an individual's contribution to the team output. However, this team production context captures a basic element of managerial work, as the superstars in management also emerge from a team production setting, where firms and not individuals are the relevant units of competition in markets.

In 1982, Sherwin Rosen expanded his superstar theory to managerial reward distributions across ranks in and among hierarchical firms. He argues that the enormous salaries of CEOs are justified if the (superior) abilities of CEOs

13. Rosen (1981) uses examples of full-time comedians and classical musicians, and Alder (1985) mentions singing and painting as artistic activities that generate superstars.

filter through the entire corporation producing improved efficiency at every level. Thus, a small increment in a CEO's abilities would generate not an incremental but a multiplicative increase in the firm's overall productivity (Rosen 1982). Empirical studies, however, contest a pure Rosen-type explanation of CEO salaries: Bertrand and Mullainathan (2001) show that CEOs are paid not only for their performance but also based on luck, which means that CEOs receive pay premiums associated with profit increases that are entirely generated by external factors such as changes in oil prices and exchange rates. Further empirical studies find considerable "popularity" effects: Lee (2006) shows that the press coverage of a CEO increases his/her salary even after controlling for the firm's performance. Malmendier and Tate (2009) and Wade et al. (2006) relate a CEO's reputation to the CEO's compensation and subsequent firm performance. Both papers find that CEOs receive higher remuneration after winning a prestigious business award and that the ex post consequences for firm performance are negative. Hence, superstar CEOs tend to be paid not only for their managerial ability but for other factors beyond performance as well. Furthermore, the correlations between a star manager's talent and popularity and between firm performance and popularity are, unlike in professional sports, not necessarily positive but indeed often negative. Celebrity CEOs may indulge in activities that provide little firm value, such as writing books, sitting on outside boards, or playing golf (Malmendier and Tate 2009). In addition, CEOs receiving great media praise may become overconfident about the efficiency of their past actions and about their future abilities (Hayward, Rindova, and Pollock 2004). Hayward and Hambrick (1997) show that CEOs who enjoyed high press publicity paid larger premiums for acquisitions due to CEO hubris.

Even though both talent and popularity effects seem highly relevant for top management compensation, the specific literature mostly fails to make a clear distinction between the two effects, probably because valid and measurable indicators of managerial ability are hard to find. Our article suggests that future empirical research on top management compensation should first try to proxy managerial ability by estimating a firm production function before other drivers of CEO salaries like popularity can be properly isolated.

APPENDIX

TABLE A1

Popularity Regressed on On-Field Performance

Dependent Variable	**Ln(Press Citations)**	
Estimation Approach	**Pooled OLS**	
	β	***t* Value**
Goals	0.295**	5.220
Assists	0.157**	4.760
Shots on target	−0.010	−0.130
Shots off target	0.116*	2.200
Clearances, blocks, and interceptions	0.137**	3.760
Saves to shots ratio of the goalkeeper	0.225**	5.290
% successful crossings	0.021	0.860
Number of red cards	0.052*	2.160
Number of yellow cards	0.070*	2.350
Penalty conceded	−0.010	−0.420
Intercept	2.628**	0.084
R^2	0.24	
Number of observations	1,370	

Notes: The β coefficients illustrate the change in the dependent variable if the regressor varies by one standard deviation. *t* values are computed using the White-heteroskedasticity robust standard errors clustered at the player level. The sample includes players appearing in the first German soccer league for more than half an hour during the seasons 2001/2002 until 2004/2005.

Significance levels (two-tailed): *5%; **1%.

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