RESEARCH ARTICLE

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Econometric modelling of market prices of football clubs' sponsors' stocks

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Abstract

Sports sponsorship is very popular because it is the easiest way for companies to create a positive image and reflects their willingness to be socially responsible. Depending on their policy, firms engaging in sports sponsorship set themselves a related target: sometimes winning is important; other times it is merely the fact that an event takes place. Simply sponsoring an event can create added value for the sponsor, for example through advertising (showing the logo of the firm during matches broadcast on TV). The aim of this article is to test the hypothesis that sports results (more specifically, football match results) have a significant impact on the stock quotation of the clubs' sponsors. We thus attempt to answer the following question: Is the company's sports sponsorship policy effective? To that end, we use the (G)ARCH type models with daily data for companies quoted on the European stock exchanges. The results of football matches have been taken from the web page www.betexplorer.com for the periods under study.

Keywords:

Stock price valuation, ARCH type models, sports results.

JEL classification:

G12, G31, L83.

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Modelización econométrica de los precios de mercado **de las acciones de los esponsors de los clubs de fútbol**

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Resumen

La esponsorización deportiva es muy popular debido a que es la manera más fácil de crear una imagen positiva de la compañía esponsorizadora. Además, refleja perfectamente la política de las empresas que desean ser socialmente responsables. Dependiendo de la política que lleven a cabo, las empresas que esponsorizan deportes establecen para ellas mismas un objetivo deportivo: Algunas veces ello significa ganar; otras, la atención se centra en un único evento deportivo. Incluso el evento en cuestión puede crear valor añadido para la compañía, por ejemplo mediante anuncios (mostrando el logo de la compañía durante un partido retransmitido por televisión). El objetivo de este artículo es contrastar la hipótesis de que los resultados deportivos (en concreto de los partidos de futbol) tienen un impacto significativo en la cotización de los esponsors de clubs futbolísticos. Por tanto, trataremos de dar respuesta a la siguiente cuestión: En lo que se refiere a la esponsorización deportiva, ¿es efectiva la política de la compañía esponsorizadora? Para ello se utilizan modelos del tipo (G)ARCH con datos diarios de compañías que cotizan en las bolsas europeas. Los resultados de los partidos de futbol han sido tomados de la página web www.betexplorer.com para los periodos temporales objeto de estudio.

Palabras clave:

Valoración de precios de acciones, modelos de tipo ARCH, resultados deportivos.

1. Introduction

Nowadays sport is a huge business, and not only as a source of entertainment but also for investors deciding where to allocate their money. Sport generates new financial instruments for investments: player transfers, which are the subject of transactions between clubs and it can involve huge sums of money. However, the main motivation for financing sport is for the sponsor to build a strong and recognizable brand. Companies may sometimes invest their money in sport due to altruistic reasons but such situations should be treated as occasional events rather than a managerial trend.

Sloane (2015) wrote that an abundance of data makes sport the ideal laboratory for testing different economic theories. The first mention of the relationship between sport (particularly football) and economics was published in 1971 also by Sloane (1971), though two years earlier he had written about the labour market in professional sports (Sloane, 1969). Over the years, the issue of sport economics grew in significance: the football industry appeared, clubs became companies, football matches became products, spectators became buyers of a product and players became intangible assets of companies. And traditional football fans started to be treated as a prehistoric ethnic group. In the literature, football economics is divided into many professional parts. Among others, there are articles concerning the valuation of performance rights or clubs, measuring relationships between sporting events and changes in the stock exchange or measuring the impact of sporting successes on stock exchanges.

The major sports clubs are officially working with sporting equipment producers: for example, Nike is a technical partner of Manchester United, FC Barcelona, Juventus Turin, Arsenal and Inter Milan, while its biggest competitor, Adidas, is working with AC Milan, Real Madrid, FC Bayern Munich, Liverpool FC, Newcastle FC and Chelsea FC. Such cooperation seems to be logical and natural, but what about the other companies engaged in the financing of sport? The sponsor should expect some benefits from their cooperation with a sports club. The nature of such benefits could be twofold: on the one hand, sponsorship can help promote a company or event connected with that company; and in case of public companies listed on the stock exchange, their financial engagement in sport could affect their stock prices. This change in stock prices could be the result of investors' behaviour, influenced by either an irrational or a rational interpretation of sports information.

The aim of this article is to test the hypothesis that sports results have a significant impact on the stock quotation of sport clubs' sponsors. We thus attempt to answer the following question: Is the company's sports sponsorship policy effective? We

estimate (G)ARCH type models with daily data of companies quoted on the European stock exchanges. The results of football matches have been taken from the web page www.betexplorer.com for the period under study.

2. The football market in Europe. Empirical background of the econometric modelling

Football — also referred to as "soccer" in the United States — is the most popular sport in the world (Reilly and Williams, 2003). It has a very rich history and has been played in every nation, without exception. Many articles and research papers have been published demonstrating football's popularity over other types of sport (see, for example Szymanski and Kuper, 2009, and the references therein). While football is treated almost as a religion in some parts of the world, the centre of world football is Europe. The revenue generated by the Football Money League (the 20 biggest clubs) exceeded 7.41 billion Euro in the 2015/2016 season and is still growing. Simultaneously, a rapidly growing number of companies is seeking to benefit from football's popularity, especially in Europe. The elite sponsors in Europe will generate combined revenues of 2.85 billion Euro in the 2016-2017 season[1].

Table 1. **Top 5 brands in football by spend on t-shirt sponsoring**

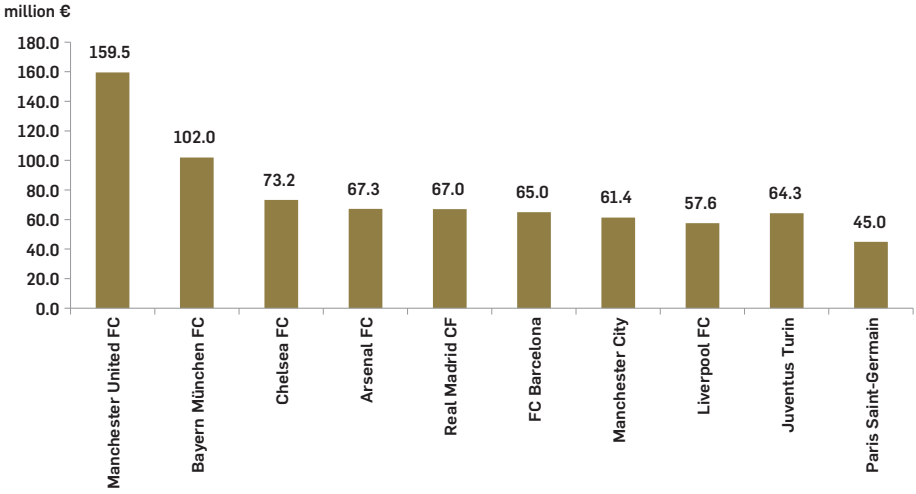
Rank	Company	Club(s)
1	Emirates	Hamburger SV, Benfica, AC Milan, Paris Saint-Germain, Real Madrid, Arsenal FC
2	Chevrolet	Manchester United FC
3	Etihad Airways	Manchester City FC
4	Deutsche Telecom	FC Bayern Munich
5	Yokohama	Chelsea FC

SOURCE: SPORTBUSINESS.COM (2016)

A number of firms are also making deals with clubs to expose their brand or to increase sales of new products, including Coca-Cola, Orange, Audi, Carlsberg and Heineken. Unfortunately, not many are quoted on stock exchanges, which makes it difficult to verify whether sporting results have an impact on their market prices. The biggest share of money transferred to sport through t-shirt sponsorship flows to the English Premier League (1.51 billion Euro), the German Bundesliga (512.3 million Euro) and the Italian Serie A (287.3 million Euro).

[1] http://www.sportbusiness.com/sponsorship-insider/elite-european-football-generates-%E2%82%AC285bn-sponsorship-2016-17-exclusive-report-0

Figure 1. **Top 10 football clubs by combined shirt sponsorship and kit supplier revenue in the 2016/2017 season**



SOURCE: SPORTBUSINESS.COM (2016).

The biggest clubs in Europe, in financial terms, are concentrated in four countries: England, Germany, Italy and Spain.

Only one club listed in Deloitte's Top 20 is outside the big 5[2]: FC Zenit Saint Petersburg. Admittedly, France is represented by only one club (Paris Saint-Germain) but it occupies a high position (6) in the revenue ranking. Analysing the availability of the data required to test our hypothesis, we chose to focus on: Borussia Dortmund KGaA GmbH (sports and entertainment branch), the owner of the club (main sponsor); Deutsche Telecom AG (telecommunication branch), the sponsor of Bayern Munich; Standard Chartered Plc (banking and finance branch), the sponsor of Liverpool FC; and Fiat Chrysler Automobiles (automotive retail branch), the sponsor of Juventus Turin.

There is another aspect regarding the amounts of money connected with the football market: player transfers. During the 2016 summer transfer window, nearly 74% of the money involved in total worldwide transfers was spent by the big 5 clubs.

This is a key reason for examining the relationships between the clubs representing this group and changes in the prices of sponsors' stocks listed on the stock exchanges.

[2] Big5 – the biggest leagues in the world by revenue: England, Germany, Italy, Spain and France.

3. The dependency of rates of return on sporting events and related information

The literature includes research on relationships between rates of return of quoted stocks and qualitative or noneconomic factors. Most of them use econometric methods to support hypotheses that stock prices depend on sporting events, results or bookmakers' odds.

Sharpe was the first to use the econometric model to analyse movements in rates of return, with the capital market equilibrium model (Sharpe, 1963). The model describes rates of return of stocks using simple regression with the market rates of return (represented by the main market index) as the regressor. The main objective of the estimation process in this equation is to estimate the beta parameter. Beta is also referred to as the market risk coefficient and it is often used by analysts to calculate the cost of capital in the capital asset pricing model (CAPM).

Another model using economic factors to explain movements of share prices is the arbitrage pricing model (APM) (Roll and Ross, 1980). The approach is based on using many risk factors to explain rates of return, and so not only the market rate of return is used as an independent variable in such models. Parameters are estimated by means of multiple regression using ordinary least squares (OLS). What these two models have in common is that only the economic factors are taken into account.

For years many authors have attempted to improve the predictive power of the APM and Sharpe's model. OLS entails a number of very important assumptions that simple dynamic econometric models often cannot fulfil. Using multiple regression OLS models when the disturbances are heteroscedastic leads to inefficient and inconsistent estimates of the beta parameters and biased estimates of the standard errors, which in turn can produce non-reliable significance tests and confidence intervals. This problem is solved by the autoregressive conditional heteroscedasticity models (ARCH) using maximum likelihood methods to estimate the model's parameters. Bollerslev, Engle and Wooldridge applied the ARCH-type models for CAPM to bills, bonds and stocks (Bollerslev *et al.*, 1988).

Football enterprises as objects of econometric researches are rather the new problem in finance. The first related article was published by Stadtmann (Stadtmann, 2004) in 2004 and it focused on the econometric modelling of how news influences quotations of Ballspielverein Borussia 09 e.V. Dortmund (BVB) stocks. Since then, many such papers have examined different markets. Table 2 shows a number of selected papers focusing on this subject.

Table 2. **The review of selected research in the field of sports finance (the influence of sports information on stock exchange prices)**

Author	Research focus	Variables used	Method	Conclusion
Stadtmann (2004)	BVB	Stock exchange index, games results, players' contracts, transfers, players sold, coaches' contracts	Multiple regression	Low predictive power
Ashton, Gerrard, and Hudson (2003)	All British clubs	FTSE index, games results	GMM	High predictive power
Douque and Ferreira (2005)	FC Porto, Sporting Lisbon	Index PS20, games results, daily trading volume, risk free rate	ARCH-GARCH	At the end of the season. the relationship becomes significant
Berument, Ceylan and Gözpınar (2006)	Beşiktaş, Fenerbahçe, Galatasaray	Index ISE100, international games results	GARCH	The relationship was confirmed only for Beşiktaş
Edmans, Garcia, Norli (2007)	50 national teams	International games results	GARCH	The relationship only confirmed for developed countries
Klein, Zwergel and Heiden (2009)	European national teams	International games results	Regression	Lack of significant results
Baur and McKeating (2009)	Components of DJ Stoxx FI	Games results	Panel regression	Greater effect for big clubs' IPO
Samagaio, Couto and Caiado (2009)	20 British clubs	Salaries, transactions volume, players' costs, games results	Structural model	Sports results are connected with financial results
Benkraiem, Le Roy and Louchichi (2010)	11 British clubs	Games results, date of the match, match referee	EGARCH	Sports results have a significant impact on stock prices
Aglietta, Andreff and Drut (2010)	Components of DJ Stoxx FI	Share of the club in the market, revenues from advertising, popularity in the media	Regression	High dependency between TV revenues and players' salaries
Demir and Danış (2011)	Beşiktaş, Fenerbahçe, Galatasaray	Index ISE100, expected and unexpected games results	Regression	Low predictive power
Bell, Brooks, Matthews and Sutcliffe (2012)	19 British clubs	Stock exchange index, games results, goal difference, match place, betting odds	Regression	Low predictive power
Berument and Ceylan (2012)	Chile, Turkey, England, Spain	Stock exchange indexes, games results	EGARCH	Sports results have an impact on stock prices and on the relationship rate of return-volatility
Bell, Brooks, and Markham (2012)	All British clubs	FTSE index, games results	Statistic tests	Firing the manager has an impact on the rates of return
Leitão, Armada and Ferreira (2012)	Components DJ Stoxx FI	DJ Stoxx FI quotations	Granger Causality test and cointegration tests	There was a relationship between Birmingham and Celtic
Saraç and Zeren (2013)	Beşiktaş, Fenerbahçe, Galatasaray	Index ISE100, games results, betting odds, goal difference, type of games, match place, derby	Regression	Goal difference has a positive impact on rates of return of all three clubs. There is also a negative relationship with international games
Majewski (2014)	BVB quotations, DJ Stoxx Football Index	Games results, transfers, matchday	Statistic test, GARCH models	Games results have an impact on changes in rates of return of BVB stocks, rates of return of DJ Stoxx FI are sensitive to Borussia Dortmund results

SOURCE: (MAJEWSKI, 2014).

Researchers analysing possible relationships between sports results and other noneconomic factors often use econometric GARCH-type models. Not every result has implications for financial theory and practice– a few of models have a low predictive power. Table 2 also shows also that every dynamic econometric model yielded significant results and so suggested further directions for research. Many previous papers show that results of football matches have a strong impact on stock quotations. We thus try to use variables describing football match results.

4. Methodology

The idea of the research is based on the assumption that there is a statistically significant relationship between rates of return and match results. We assume that every official game victory and every loss has a strong impact on the movement in stock prices – positive for victories and negative for losses. The quotations of companies' stock prices from January 2004 to March 2017 are taken into analysis. We analysed movements in the stock prices of three big sponsors financially connected with clubs listed in the Top 20 (Deutsche Telecom AG, Standard Chartered Plc, Fiat Chrysler Automobiles) and one owner of Borussia Dortmund KGaA GmbH. The period of time under study is from 2004 to 2014, for which we collected all sports results of Bayern Munich (4), Borussia Dortmund (11), Liverpool FC (9) and Juventus Turin (10) from their national leagues: Bundesliga, Premier League and Serie A[3], respectively.

The research was conducted in the following steps:

- Data collection.
- Model estimation.
- Selection of the best model.

The rate of return of stocks is explained by the following variables in all the models:

- R_{t-1} one-day lagged rates of return.
- R_{t-2} two-day lagged rates of return.
- R_{t-3} three-day lagged rates of return.
- W team wins (dummy variable).
- L team losses (dummy variable).
- D team draws (dummy variable).
- MD matchday (dummy variable).
- M Monday (dummy variable).
- T Tuesday (dummy variable).
- We Wednesday (dummy variable).
- TH Thursday (dummy variable).
- F Friday (dummy variable).

[3] Numbers in brackets indicate their positions in Deloitte's Football Money League rating of revenues.

We assume that if we are attempting to explain the dependency of rates of return on sports results we should eliminate other potential effects – for example, day-of-the-week effect. But the key focus of the research is finding the relationship between rates of return and football results.

Most papers presented in Table 2 show a significant relationship between rates of return of clubs listed on the stock exchanges and their sports results, and that the best models were those using autoregressive conditional heteroscedasticity.

The base equation for the estimation of rates of return of the analysed clubs is as follows:

$$y_t = \gamma_0 + \Sigma_{k=1}^{n} \gamma_k X_{kt} + \varepsilon_t , \quad (1)$$

where:

y_t – rate of return of a sponsor's stocks in period t;
X_{kt} – the value of k-th regressor in period t;
ε_t – the random component, *idd* and normally distributed $N(0,1)$.

The best fit is usually obtained with ARCH-type models. Significant results are obtained for the first two types: ARCH(q) and GARCH(p,q), as shown in Table 2. The basic ARCH(q) model is expressed as (Engle, 1982):

$$h_t = \alpha_0 + \Sigma_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 , \quad (2)$$

where:

h_t – conditional variance;
$\varepsilon_t / I_{t-1} \sim N(0, h_t)$
I_t – the information set available at time t;
$\alpha_0 > 0$, $\alpha_i \geq 0$, $i=1,...,q$, and $\Sigma_{i=1}^{q} \alpha_i < 1$.

The ARCH process is the specialized case of a more general model called GARCH. GARCH stands for Generalized ARCH and it adds lags in variance to equation (2). The GARCH(p,q) is expressed as (Bollerslev, 1986):

$$h_t = \alpha_0 + \Sigma_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \Sigma_{j=1}^{p} \beta_j h_{t-j} , \quad (3)$$

where $\alpha_0 > 0$, $\alpha_i \geq 0$, $\beta_j \geq 0$, $i=1,...,q$, $j=1,...,p$, to guarantee the non-negativity of the conditional variance.

The best fit of rates of return movement will attest to the possibility of successfully using non-economic factors in econometric modelling.

The estimation procedure was maximum likelihood (L), the log of L being given by:

$$\ln L = -\frac{N}{2}\ln 2\pi - \frac{1}{2}\Sigma_{t=1}^{N}\ln h_t(\theta) - \frac{1}{2}\Sigma_{t=1}^{N}\frac{R_t^2}{h_t(\theta)}, \quad (4)$$

where:

N – the length of the series;

$h_t(\theta)$ – the variance function expressed by the equation $h_t(\theta) = e^{\alpha_1+\alpha_2\cdot\ln\varepsilon_t}$

R_t – residuals from the regression.

The estimation was carried out using the GRETL program.

5. Empirical results

As stated above, we decided to use data representing four clubs from the world Top 20 and their sponsors in order to test the hypothesis that sports results have a significant impact on the stock quotation of sports clubs' sponsors or owners. Tables 3-7 list the estimation results.

Table 3. GARCH estimation for Fiat Chrysler Automobiles' rates of return and Juventus Turin's results

Observations used: 2004-01-06 -2017-03-22 (N = 3439)
Hessian-based standard errors
Unconditional model variance = 0.000716924
Likelihood test for (G)ARCH: Chi-square(1) = 86.5986 [1.32943e^{-020}]

Variable	Coefficient	Standard error	*z*-value	*p*-value	Significance
Constant	0.000607	0.000437	1.390	0.1645	
R_{t-2}	0.069018	0.017815	3.874	0.0001	***
alpha(0)	0.000593	1.91888e^{-05}	30.89	1.57e^{-209}	***
alpha(1)	0.173187	0.0278118	6.227	4.75e^{-010}	***
Average	0.000585	standard deviation	0.026619	Log likelihood	7640.264
AIC	-15270.53	BSC	-15239.81	HQC	-15259.56

AIC – Akaike criterion; BSC – Schwarz criterion; HQC – Hannan-Quinn criterion;
, **, * indicate significance at the 10%, 5% and 1% level, respectively.*

As can be seen, there are no significant relationships between Fiat's rates of return from the Milan Stock Exchange and Juventus Turin's sports results. We found only one significant relationship: between present rates of return and two-day lagged rates of return. The specification that provides the best fit is the ARCH(1) (see Table 8).

Table 4. GARCH estimation for Standard Chartered Plc's rates of return and results of Liverpool FC

Observation used: 2004-01-02:2017-03-22 (N = 3438)
Hessian-based standard errors
Unconditional model variance = 1.68776e^{+010}
Likelihood test for (G)ARCH: Chi-square(1) = 1293.17 [3.4416e^{-283}]

Variable	Coefficient	Standard error	*z*-value	*p*-value	Significance
constant	0.001311	0.000416	3.149	0.0016	***
M	-0.016593	0.000935	-17.74	2.10e^{-070}	***
Tu	-0.001932	0.000836	-2.311	0.0208	**
W	0.013214	0.001695	7.797	6.34e^{-015}	***
D	0.016869	0.002010	8.392	4.76e^{-017}	***
L	0.013606	0.002008	6.776	1.24e-011	***
alpha(0)	0.000315	1.19586e-05	26.32	1.02e-152	***
alpha(1)	1.00000	0.0624353	16.02	9.79e-058	***
Average	0.000128	Standard deviation	0.029142	Log Likelihood	7927.844
AIC	-15837.69	BSC	-15782.40	HQC	-15817.94

AIC – Akaike criterion; BSC – Schwarz criterion; HQC – Hannan-Quinn criterion;
, **, * indicate significance at the 10%, 5% and 1% level, respectively.*

The case of Liverpool FC and its sponsor shows that the relationship between sports results and changes in Standard Chartered Plc's stock prices is significant – parameters corresponding to variables W, D, and L are statistically significant at the 1% level. Additionally, there is a day-of-the-week effect. We decided to estimate another econometric model, with different covariates, because of the fact that the signs of parameters corresponding to variables describing sports results are all positive. This could mean that it is not the match results that have an impact but simply the sporting event itself. Thus, we replaced the dummy variables describing match results with the variable MD (matchday). The results of the estimation are presented in Table 5.

Table 5. GARCH estimation for Standard Chartered Plc's rates of return and results of Liverpool FC (with a sporting event dummy variable)

Observation used: 2004-01-02:2017-03-22 (N = 3438)
Hessian-based standard errors
Unconditional model variance = 1.27597e^{+009}
Likelihood test for (G)ARCH: Chi-square(1) = 1282.53 [7.06099e^{-281}]

Variable	Coefficient	Standard error	*z*-value	*p*-value	Significance
Constant	0.001049	0.000355	2.952	0.0032	***
M	-0.016183	0.000890	-18.18	6.89e^{-074}	***
MD	0.014634	0.001256	11.65	2.32e^{-031}	***
alpha(0)	0.000300	1.09256e^{-05}	27.41	2.09e^{-165}	***
alpha(1)	1.00000	0.059608	116.78	3.63e^{-063}	***
Average	0.000128	standard deviation	0.029142	Log likelihood	7921.329
AIC	-15830.66	BSC	-15793.80	HQC	-15817.49

AIC – Akaike criterion; BSC – Schwarz criterion; HQC – Hannan-Quinn criterion;
, **, * indicate significance at the 10%, 5% and 1% level, respectively.*

The change in the specification of the independent variables has not improved the value of the log-likelihood but it has had a significant influence on the economic interpretation of the obtained results. Rates of return of Standard Chartered Plc's stocks were regressed on Mondays and matchdays (both are dummy variables). Mondays had a negative impact on rates of return and every matchday boosted rates of return. ARCH(1) models yielded the best fit for the case of Liverpool FC (see Table 8).

Table 6. GARCH estimation for Deutsche Telecom's rates of return and results of FC Bayern Munich

Observation used: 2004-01-08:2017-03-22 (N = 3363)
Hessian-based standard errors
Unconditional model variance = 0.00022724
Likelihood test for (G)ARCH: Chi-square(2) = 313.962 [6.66698e^{-069}]

Variable	Coefficient	Standard error	*z*-value	*p*-value	Significance
const.	3.51164e^{-05}	0.000237	0.1482	0.8822	
R_{t-3}	-0.051794	0.017514	-2.957	0.0031	***
alpha(0)	0.000156	5.79597e^{-06}	26.93	8.76e^{-160}	***
alpha(1)	0.147021	0.022329	6.584	4.57e^{-011}	***
alpha(2)	0.166002	0.027114	6.122	9.22e^{-010}	***
Average	0.000015	standard deviation	0.015087	Log likelihood	9490.136
AIC	-18968.27	BSC	-18931.55	HQC	-18955.14

AIC – Akaike criterion; BSC – Schwarz criterion; HQC – Hannan-Quinn criterion;
, **, * indicate significance at the 10%, 5% and 1% level, respectively.*

The best fit for the rate of returns of the main sponsor of FC Bayern Munich was the model with one independent variable R_{t-3} (three-day lagged rates of return) and ARCH(2) model for the rest of the model. However, we did not find any relationship between rates of return and sports results.

Table 7. GARCH estimation for BVB KGaA GmbH's rates of return and results of Borussia Dortmund

Observation used: 2003-10-29:2017-03-22 (N = 3451)
Hessian-based standard errors
Unconditional model variance = 0.00060744
Likelihood test for (G)ARCH: Chi-square(2) = 968.993 [3.85309e^{-211}]

Variable	Coefficient	Standard error	*z*-value	*p*-value	Significance
const.	0.000258	0.000309	0.8336	0.4045	
L	-0.008358	0.001834	-4.556	5.21e^{-06}	***
R_{t-1}	-0.095767	0.019277	-4.968	6.77e^{-07}	***
alpha(0)	1.99215e^{-05}	3.27920e^{-06}	6.075	1.24e^{-09}	***
alpha(1)	0.125028	0.0133045	19.397	5.59e^{-021}	***
beta(1)	0.842176	10.015736	53.52	0.0000	***
average	0.000120	standard deviation	0.023435	Log likelihood	8560.228
AIC	-17106.46	BSC	-17063.43	HQC	-17091.09

AIC – Akaike criterion; BSC – Schwarz criterion; HQC – Hannan-Quinn criterion;
, **, * indicate significance at the 10%, 5% and 1% level, respectively.*

Very interesting results were obtained for BVB's rates of return. Admittedly BVB is not a sponsor of Borussia Dortmund but it does finance the football club's activity. That may be why we obtained a very clear relationship between rates of return and match results. Every defeat of Borussia Dortmund led to a decrease in the rates of return of BVB's stocks. The best analytical form of the model was GARCH(1,1) model (Table 8).

Finally, Table 8 shows a brief summary of the results obtained from all the models estimated.

● Table 8. **Econometric models for football clubs' sponsors' rates of return and sports results**

Company	Type of model	Variables	Significant independent variables	Significance level	Likelihood log.	AIC
Fiat Chrysler Automobiles	ARCH(1)	R_{t-1}, R_{t-2}, R_{t-3}	R_{t-2}	***	7638.966	-15263.93
	ARCH(1)	R_{t-2}, *M, T, We, TH, F*	R_{t-2}	***	7641.592	-15265.18
	ARCH(1)	R_{t-2}, *MD*	R_{t-2}	*	7640.606	-15269.21
	ARCH(1)	R_{t-2}, W, D, L	R_{t-2}	*	7641.097	-15266.19
	GARCH(1,1)	R_{t-1}, R_{t-2}, R_{t-3}	none		7860.903	-15705.81
	GARCH(1,1)	R_{t-2}, *M, T, We, TH, F*	none		7863.342	-15706.68
	GARCH(1,1)	R_{t-2}, MD	R_{t-2}	*	7862.228	-15710.46
	GARCH(1,1)	R_{t-2}, *W, D, L*	R_{t-2}	*	7862.322	-15706.64
Standard Chartered Plc	ARCH(1)	R_{t-1}, R_{t-2}, R_{t-3}	The criterion of convergence was not reached			
	ARCH(1)	R_{t-1}, R_{t-2}	R_{t-2}	***	7781.849	-15551.70
	ARCH(1)	R_{t-2}, *M, T, We, TH, F*	R_{t-2}, *M*	***	7862.020	-15706.04
	ARCH(1)	R_{t-2}, *MD*	R_{t-2}	***	7780.947	-15549.89
	ARCH(1)	R_{t-2}, *W, D, L*	R_{t-2}	***	7782.376	-15548.75
	GARCH(1,1)	R_{t-1}, R_{t-2}, R_{t-3}	The criterion of convergence was not reached			
	GARCH(1,1)	R_{t-1}, R_{t-2}				
	GARCH(1,1)	R_{t-2}, *M, T, We, TH, F*				
	GARCH(1,1)	R_{t-2}, *MD*				
	GARCH(1,1)	R_{t-2}, *W, D, L*				
Deutsche Telecom	ARCH(1)	R_{t-1}, R_{t-2}, R_{t-3}	R_{t-3}	***	9449.719	-18885.44
	ARCH(2)	R_{t-1}, R_{t-2}, R_{t-3}	R_{t-3}	***	9490.214	-18964.43
	ARCH(1)	R_{t-3}, *M, T, We, TH, F*	R_{t-3}	**	9448.798	-18879.60
	ARCH(1)	R_{t-3}, *MD*	R_{t-3}	**	9448.160	-18884.32
	ARCH(1)	R_{t-3}, *W, D, L*	R_{t-3}	**	9448.218	-18880.44
	GARCH(1,1)	R_{t-1}, R_{t-2}, R_{t-3}	none		9625.597	-19235.19
	GARCH(1,1)	R_{t-3}, *M, T, We, TH, F*	*M, T, We*	**,*,**	9629.065	-19238.13
	GARCH(1,1)	R_{t-3}, *MD*	none		9625.700	-19237.40
	GARCH(1,1)	R_{t-3}, *W, D, L*	none		9626.192	-19234.38

BVB KGaA GmbH	ARCH(1)	R_{t-1}, R_{t-2}, R_{t-3}	R_{t-1}, R_{t-2}, R_{t-3}	***	8220.609	-16427.22
	ARCH(1)	R_{t-1}, R_{t-2}	R_{t-1}, R_{t-2}	***	8217.877	-16423.75
	ARCH(1)	R_{t-1}	R_{t-1}	***	8215.972	-16421.94
	ARCH(1)	R_{t-1}, *M, T, We, TH, F*	R_{t-1}, *T, We, TH*	***	8224.031	-16430.06
	ARCH(1)	R_{t-1}, *MD*	R_{t-1}, *MD*	***	8222.958	-16433.92
	ARCH(1)	R_{t-1}, *W, D, L*	R_{t-1}, *D, L*	***	8227.899	-16441.80
	ARCH(2)	R_{t-1}, *L*	R_{t-1}, *L*	***	8374.599	-16735.20
	GARCH(1,1)	R_{t-1}, R_{t-2}, R_{t-3}	R_{t-1}	***	8545.386	-17074.77
	GARCH(1,1)	R_{t-1}, R_{t-2}	R_{t-1}	***	8547.322	-17080.64
	GARCH(1)	R_{t-1}	R_{t-1}	***	8549.912	-17087.82
	GARCH(1,1)	R_{t-1}, *M, T, We, TH, F*	R_{t-1}, *M, T, We, TH*	***	8561.925	-17103.85
	GARCH(1,1)	R_{t-1}, *MD*	R_{t-1}, *MD*	***	8559.802	-17105.60
	GARCH(1,1)	R_{t-1}, *W, D, L*	R_{t-1}, *D*	***	8561.144	-17106.29

, **, * indicate significance at the 10%, 5% and 1% level, respectively.*

The first criterion in model selection is that the model should have significant parameters (at the 1% level if possible); the second is the log likelihood value (the highest) but taking into account the value of AIC.

6. Conclusion and final remarks

First of all, it should be noted that every case study should be treated individually and it cannot be generalized that every sports sponsor will experience the influence of sporting events or results on its stock exchange prices. Sometimes stock prices react to the results of football matches, sometimes simply the fact that the sporting event took place causes changes in prices, and sometimes stock prices do not react at all.

In our research, we obtained two groups of results: no reaction and reaction of stock prices. We thus underline that not all analysed cases indicated the existence of relationships between sports results and rates of return of sponsors' stocks. The first group includes FC Bayern Munich with Deutsche Telecom and Juventus Turin and Fiat Chrysler Automobiles, for which we found no relationship between sports results or events and rates of return of the clubs' sponsors. The second group is composed of Borussia Dortmund with BVB KGaA GmbH and Liverpool FC with Standard Chartered Plc. In the case of Liverpool, it does not matter whether the team wins or loses; every sporting event this team takes part in has an impact on the rates of return of Standard Chartered Plc. In the case of BVB, on the other hand, every loss has a negative impact on rates of return of BVB stocks.

We did not expect that every analysed case would indicate a strong relationship between rates of return of stocks and variables relating to the sport activity of the club. The results obtained show that such relationships are not random and should be taken into account by analysts and researchers working in the field of sports finance.

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