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Sporting Success and Capital Market Performance: An Event Study of Borussia Dortmund

By Arne Feddersen and Wolfgang Maennig*

Abstract

This contribution examines whether the share price of the Borussia Dortmund GmbH & Co. KgaA (BVB) behaves according to the (capital) market efficiency hypothesis of Fama (1970). The weak form of capital market inefficiency, according to which past share prices cannot be used for predictions in order to achieve above-average returns, is not refuted. By contrast, the hypothesis of medium-level market efficiency, according to which all publicly available and relevant information is immediately reflected in the share prices, is rejected. Based on daily quotation of share prices, the stock market price of the BVB shares adjusts to a deviation from the long-term equilibrium by (only) 5.4 % on the first day. Based on weekly calculations, the adjustment stands at 17 % in the first week. The investment motives of the shareholders and the relatively low volume of trade can hardly explain the medium-level capital market inefficiency. Missing learning effects of participating actors due to the short time of notice of BVB shares could be a more fruitful explanation.

Zusammenfassung

Der vorliegende Beitrag untersucht, ob die Entwicklung des Aktienkurses der Borussia Dortmund GmbH & Co. KgaA (BVB) der (Kapital-)Markteffizienzhypothese von Fama (1970) entspricht. Die schwache Form der Kapitalmarkteffizienz, nach der sich vergangene Kurse nicht zu Prognosen nutzen lassen, um eine überdurchschnittliche Rendite zu erzielen, kann nicht widerlegt werden. Allerdings ist die mittelstarke Kapitalmarkteffizienz, nach der alle öffentlich verfügbaren und relevanten Informationen sofort in den Kursen eskomptiert werden, abzulehnen. Unter Verwendung von Tagesdaten ergibt sich, dass am ersten Tag lediglich 5,4 % der Anpassung an das langfristige Gleichgewicht erfolgt. Unter Verwendung von Wochendaten ergibt sich, dass lediglich 17 % der langfristigen Anpassung in der ersten Periode erfolgt. Die Investitionsmotive der Anleger und das relativ geringe Handelsvolumen können die fehlende mittelstarke Kapitalmarkteffizienz kaum erklären. Die bislang nur geringen Lerneffekte könnten eine erfolgreichere Erklärungsmöglichkeit sein.

JEL-Classification: G12, G14, L83

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1. Introduction

Up until 1998, German football clubs were organised as associations in accordance with Paragraph 21 of the German Civil Code (BGB). However, the legal construct of an association, tailored as it is towards a non-commercial mode of business, today seems to correspond only to a very limited degree to the demands of modern professional football. In addition to the clearly commercial orientation of the German Football League, it has also been pointed out that the organisational structure of an association is not as a rule suited to the professional management of a football enterprise (WGZ-Bank, 2001, 50). Moreover, as a legal form the association does not permit any financing via capital markets.

As a logical consequence of this, the General Meeting of the German Football Association (DFB) passed a resolution ("keynote paper") on 24 October 1998 which created the legal preconditions to convert the professional player departments of football clubs into joint stock companies. Since then, a number of German Football League clubs have taken advantage of this opportunity (e.g. Bayer 04 Leverkusen Fußball GmbH, VfL Wolfsburg GmbH and FC Bayern München AG).

The only football club to go one step further and risk registration on the stock market has been Borussia 09 e.V. Dortmund (BVB).[1] The first notation of the BVB's shares took place on 31 October 2000 at a value of 11.00 € each, which corresponded to the issuing price. At the close of the first day's trading the share stood at 10.05 € (Dahlke / Rott, 2001, 3). At the end of the observation period on 22 April 2002 the BVB's shares were being traded at 5.20 €, corresponding to a loss in value of 52.7 % compared with the issue price.[2] However, it is also true to say that the general stock market environment also declined over the same period, with the DAX falling from 6,975 points on 31 October 2000 to 5,205 points on 22 April 2002 (–24.8 %).[3]

This study intends to provide an empirical analysis of BVB share price developments. In particular we hope to clarify whether and to what extent sporting success, which tends to have a positive effect on marketing and profit

[1] The legal form chosen by the club was that of the association limited by shares (KgaA). BVB Dortmund's professional players department was incorporated into the Borussia Dortmund GmbH & Co. KgaA, with the Borussia Dortmund Management Company (Borussia Dortmund Geschäftsführungs-GmbH) functioning as a complementary organisation with the parent club as sole shareholder.

[2] The BVB's shares registered their lowest value on 21 December 2001 with a price of 4.65 €, making the maximum loss in share price 57.7 %.

[3] Over the same period the EURO STOXX 50 lost 27.5 %, the *CDAX* 24.2 %, the MDAX 9.4 % and the Nemax50 78.1 %. The Bloomberg Football Index *KICK* lost 44.7 %.

potentials, has an immediate and complete influence on share price developments in accordance with the market efficiency hypothesis (Fama 1970).

Now one might justifiably ask why the development of the shares of a German soccer club is so interesting as to merit a paper being written about it. And why should it be less interesting to write a paper testing the market efficiency hypothesis using the share of DaimlerChrysler or other global players? The fact that makes a football share interesting for this topic area is related to a general problem of event studies containing news. This problem has to do with the exact determination of the time the news is announced. In papers which have analyzed the share development of "normal" enterprises, the news usually comes in the form of business data, e.g. dividend payments, incoming orders, turnover figures, planned acquisitions, and mergers. In this case it is difficult to determine the exact announcement time, because rumors already exist. But from the point of view of the market efficiency hypothesis, the time the rumor began to circulate is of crucial importance. This moment cannot perhaps be determined clearly enough for it to be used as an explanatory variable in an econometric analysis. In the context of our analysis we shall in particular examine the influence of sporting success on the development of a football share, hence in this paper the sporting achievements of Borussia Dortmund in the German Football League are regarded as news. In this case the problems of determining the time of announcement do not arise, because the time when such information becomes available is clearly defined.[4] All the games played on one day in the German Football League season are clearly finished before the next opening of the stock exchanges, thus giving sufficient time for any effects resulting from the matches to be incorporated into the share price. Hence football club shares are suitable objects for the investigation of the market efficiency hypothesis.

So far only a few empirical studies on the shares of football joint stock companies have been published. Lehmann / Weigand (1998) undertook a panel analysis of the share prices of English professional football clubs. Dahlke / Rott (2001) analysed BVB shares not from an econometric point of view but rather from the context of the general problems of football shares and the specific problems affecting Borussia Dortmund. Other works on the subject of football shares deal primarily with the legal frame conditions. This study thus represents, as far as we are aware, the first econometric analysis of the share price of football clubs outside of Great Britain.

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[4] Naturally expectations regarding the result of a game may also have an influence on the development of the share price prior to the game, but because the result of a soccer game is marked by a sufficient uncertainty, the publication of the result can be regarded as an almost exact determination of the announcement time

2. Football shares from a theoretical perspective

2.1 Return prospects of the BVB shareholders

The primary interest of a shareholder is generally directed towards the return on his or her financial commitment, and we also assume this to be the case of football shareholder as well. These returns depend primarily on the buying price as well as the level of current yield. Return potential thus results from the issue yield (in new issue subscriptions), the dividend payments and share price development (Lehmann / Weigand, 1998, 107).

If we ignore transaction costs, the data mentioned in the introduction produces an issue yield of zero (Dahlke / Rott 2001, 2).[5] No dividends have so far been paid out for BVB shares (Borussia Dortmund, 2001), and the prospects for future payments are bleak (Lehmann / Weigand, 1998, 108). The only remaining significant potential for future returns thus resides in the development of the share price, which will be the main focus of our attention below.

2.2 Peculiarities of football shares

In comparison to firms in other sectors, football shares demonstrate a number of differences in terms of their legal or statutory frame conditions which are of significance for the assessment of future share price developments (Dahlke / Rott, 2001, 6 f.).

Thus in its above-mentioned resolution, the DFB stipulated that if joint stock companies are established – either in the form of a limited company (GmbH), a public limited company (AG) or as an association limited by shares (KgaA) – the parent club must remain in existence and continue to exert significant influence on its subsidiary.[6] The parent club must retain at least 50 % of the shares plus the casting vote in the case of a limited company or public limited company.[7] If the subsidiary is run as a share-limited association, the parent club must ensure its influence by appearing either as a general partner (with sole liability) or as the sole shareholder of a limited general

[5] According to Erhardt (1997) the average issue yield in Germany was 14 % in the case of issues monitored by banks.

[6] For further information on the details of the legal forms in German football and the exact regulations for the Borussia Dortmund KgaA cf. WGZ-Bank (2001, 37 – 48) as well as Dahlke / Rott (2001, 7).

[7] In exceptional cases enterprises that have provided continuous and significant funding for the football activities of the parent club for over 20 years are permitted to hold a share of more than 50 %. So far only the clubs Bayer Leverkusen and VfL Wolfsburg have taken advantage of this ruling, with the Bayer AG and Volkswagen AG as the respective majority shareholders in professional football departments which have been transformed into limited companies (WGZ-Bank, 2001, 43).

partnership (Komplementär-GmbH) or of a public limited general partnership (Komplementär-AG) (WGZ-Bank, 2001, 42). This means that there is no possibility of the subsidiary being taken over by another party. However, this also means that no "takeover fantasies" can arise in the market, which may have positive effects on share price developments (Lehmann / Weigand, 1998, 108).[8]

In addition football enterprises are also limited in their rights of disposal in important marketing areas, particularly with regard to television rights. "In this way the opportunities for profit making are reduced, as are the yield prospects for those clubs that would benefit from decentralised marketing. This dependency and the tie to the league organisation result in a limitation not only to the rights of the enterprise but also to the rights of the individual shareholders" (Dahlke / Rott, 2001, 7; own translation).

When compared with enterprises in other markets, the requirements for a high degree of coordination in the field of marketing and other areas (e.g. game schedules, championship regulations) are particularly exacting, which means that football enterprises and their activities can only partially be explained via the model of the maximising individual business. It therefore seems more appropriate to undertake an analysis of the activities of football enterprises from within the context of a cartel or joint venture model (Flynn / Gilbert, 2001). The specificities of football shares which we have just described will later be taken into consideration in the selection of the variables to be used in the framework of our econometric analysis.

3. Theoretical Framework

3.1 Foundations of the capital market efficiency hypothesis

A perfect capital market is characterised by (Copeland / Weston, 1988, 330 – 332)

- the absence of transaction costs,
- perfect competition, also on the product markets on which it is based,
- information provided cost-free and available immediately to all individuals, and
- benefit-maximising individuals with rational expectations.

The assumptions are less restrictive for an efficient capital market (Theurillat, 1996, 12 – 15): Let Φ_t represent the amount of information available at time t and relevant to the setting of the share price. And let Φ_t^m represent the

[8] In view of the lack of danger of a hostile takeover, the football joint stock companies also probably have little incentive to look after their share values.

amount of information utilised at time t by market participants ($\Phi_t^m \subseteq \Phi_t$ and $\Phi_t^m \leq \Phi_t$). An efficient capital market thus implies that all available relevant information is reflected completely and immediately within it: $\Phi_t^m = \Phi_t$ (Fama, 1976, 136).

Fama (1970, 384) differentiates between three forms of capital market efficiency, identifiable in accordance with the amounts of information on which they are based and amenable to separate empirical tests. In the weak form of capital market efficiency the amount of information Φ_t^m consists merely of past price realisations. This results in the information vector $\Phi_t^m = \{p_{t-1}, p_{t-2}, p_{t-3} \ldots\}$. Given weak efficiency the individual price contains at all times all the information which can be deduced from its own sequence and hence from its historical development. Thus, past share prices cannot be used for predictions designed to achieve above-average returns. In order to undertake an empirical examination of market efficiency in its weak form, one has to establish the existence of dependencies between sequential share price differences (Schnittke, 1989, 14).

Medium-level capital market efficiency assumes that both the past share prices as well as all publicly available and relevant information have been included in the calculation ($\Phi_t^m = \{p_{t-1}, p_{t-2}, p_{t-3}, \ldots I_1, I_2, I_3, \ldots\}$). In a market that meets the demands of medium-level efficiency, it is not possible to achieve above-average returns because the share prices immediately adjust to the new level (Schnittke, 1989, 15). One of the main focuses of tests of medium-level market efficiency is on the adjustment speeds of the share prices to newly available relevant information (Fama, 1970, 388).

In the case of high efficiency, not only are the past share prices and publicly available information reflected in the prices but also all other relevant knowledge. Here the information vector consists not only of the previously mentioned information but also of so-called insider information as well as all other knowledge, including ideas just formed (Schneider, 1980, 553). Accordingly, it is not possible on highly efficient markets to use monopolistic information to achieve above-average returns, because the share prices adjust immediately to the new information. This high level of capital market efficiency cannot be proven empirically, given that not all of the necessary information is available.[9] On the basis of this consideration we shall only test for weak and medium-level efficiency in the following examination of the capital market efficiency of the BVB shares.

[9] An argument against its empirical relevance is also that even strict legal regulations against insider trading, such as those envisaged in German and American law, cannot prevent insiders from making considerable, albeit illegal, profits with the aid of their knowledge (Schneider, 1980, 553).

3.2 The Model

There are two common choices for modeling an event study – the constant mean return model and the market model. For our purposes we have selected the market model, which is used frequently in the literature. The market model is based on Sharpe (1963) and represents thereby a simplification of the complex portfolio selection model of Markowitz (1952). The market model assumes a stable linear relation between the security return and the market return (MacKinlay 1997, p. 15), i.e. the performance of the security of a certain firm or sector is set in relationship to the performance of the whole market or a (however defined) reference market. Accordingly the market model – in its basic form – can be defined as follows (MacKinlay, 1997, 18):

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{1}$$

where R_{it} and R_{mt} are the returns on security i and the stock index at period t, and ε_{it} is the disturbance term. From equation (2) the so-called "abnormal performance" can be derived (MacKinlay, 1997, 20):

$$\varepsilon_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \ . \tag{2}$$

With the help of this abnormal performance, the influences of new information on the share price can be tested. If the adjustment of the share price takes place in a way that at the time of the announcement no further abnormal performance is registered, the validity of the capital market efficiency hypothesis is established (Peters, 1987, 19).

The market model presented above is also referred to as a single index model, because only the relationship of the observed share to a reference market is analysed. This however results in the criticism that the single index model is an oversimplified model. A synthesis between the accurate, but excessively complex portfolio selection model and the single index model is undertaken in the so-called multi-index models. In addition to the relations between share and global index the correlation with classified indices and / or industry indices is also analysed (Klein, 1999, 94).

In order to determine the influence of the sporting performance on the share price of the BVB share and to test the validity of the medium-level capital market efficiency, we have set up the subsequent model along the lines of the multi-index models:

$$\begin{aligned} \ln P_t = {} & \alpha + \beta \ \ln CDAX_t + \gamma \ \ln KICK_t + \delta \ \ln WTP_t + \omega \ SEASON + \\ & \mu \ TRANSFER + \eta \ CONTRACT + e_t \end{aligned} \tag{3}$$

The absolute share price of the BVB P_t share is used as a dependent variable. The selected model corresponds to a multi-index model, because apart

from the relationship between the share and the Composite DAX (*CDAX*), the relationship with an industry index (*KICK*) is also analysed. In addition the model also contains announcements or news[10] as the variable for the weighted relative league table position (*WTP*) as well as the dummy variables *SEASON, TRANSFER* and *CONTRACT.*

4. Data

The data for the share price, the share indices, the data of the sporting success, and the data of the announcements of the sporting events are discussed in this section.[11] The sample period used in this paper begins on 31 October 2000 – the date of issue – and ends on 22 April 2002. In order to do justice to the various possible causal relations two different samples were studied: one for daily data and a second for weekly averages of the individual variables.

4.1 Share Prices and Indices

On daily basis the respective closing price of the BVB share was used. For the weekly sample the average (arithmetic mean) of the daily closing prices was calculated and used as dependent variable.

CDAX is composed of all the German Official Trading assets, as well as those of the Regulated Market and the New Market that are listed in the electronic trading system (Xetra) of the Frankfurt Stock Exchange (Deutsche Börse, 2002, 6). This index appears to be the most suitable, since it takes into consideration the development of the stock exchange environment as a whole. Other share price indicators such as the DAX, the (no longer existing) NEMAX or the EURO STOXX 50 seem less suited, since the businesses of which they are comprised differ significantly in their overall structure from that of the Borussia Dortmund GmbH & Co. KgaA. The football-specific stock exchange environment is represented by the Bloomberg *KICK*-Index, which consists of 19 shares issued by football joint stock companies from Great Britain (n.n**.,** 2002, 28).

[10] For examples of models which contains news and stock prices see e.g. Pearce and Rolley (1983), Pearce and Rolley (1985), Röder (2000) or Balduzzi, Elton and Green (2001).

[11] An appendix describing the data and their sources in detail is available from the authors.

4.2 Sport-related Data

According to Invico (1998), the price of a share is equivalent to the sum of the discounted future dividends per share. Since the dividends depend directly on the size of the profits, the development of the share price is therefore crucially affected by the profits of the enterprise Borussia Dortmund.

The revenues of a football club consist of the ranges broadcasting rights, sponsoring, ticketing, merchandising and transfer fees[12] which are strongly dependant on sporting success: the German Football League is centrally marketed by the association of the German Football League, Deutsche Fußball-Liga GmbH (DFL). 50 % of the revenues are paid in equal parts to the clubs. The remaining 50 % are disbursed variably according to the respective table position. Of this, 75 % are distributed according to the average place in the table over the last three years and 25 % according to the current table position.

In order to take this into consideration as a variable for sporting success, the relative league table position of the BVB was chosen, placing the BVB's points in relation to the points of the league leaders.[13] Given that the position in the league table at the start of the football season provides relatively little indication of the final position at the end of the season, the relative position in the table was weighted, whereby we proceeded from the assumption that at the start of the season shareholders would be oriented more towards the final league table position of the previous season, rather than the relatively uninformative current position. The influence of the previous season's final position was assumed to decrease as the current season progresses. The variable for the weighted relative league table position (*WTP*) was calculated in detail as follows:

$$WTP_{MP} = \frac{MP}{34} T_A + \frac{34 - MP}{34} T_P \; ; \qquad \text{where } MP = 1, \ldots, 34 \tag{4}$$

with

$$T_A = P_{A,BVB} / P_{A,TOP}$$

and

$$T_P = P_{P,BVB} / P_{P,TOP}$$

T_A is the actual relative league table position and T_P the relative final position at the end of the previous season. MP (matches played) represents the individual days on which matches are played in the current season.

[12] In the season 2002 / 03 (2001 / 02) the shares of the particular kinds of revenues as a proportion of the total revenue was as follows (BVB 2003, p. 23): broadcasting rights 40.1 % (44.9 %), sponsoring 36.1 % (27.3 %), ticketing (14.4 % (17.4 %), merchandising 9.1 % (9.2 %), transfer fees 0.3 % (1.2 %).

[13] The respective league tables are taken from DFB (2003).

$P_{A,BVB}(P_{P,BVB})$ is the BVB's current points total (the total points of the BVB at the end of the previous season) and $P_{A,TOP}(P_{P,TOP})$ is the points total of the current league leaders (of the previous season's league champions).

In addition, the dummy variable *SEASON* was introduced to take possible differences in the reaction of BVB shares during the football season and during the rest of the year into account. This variable has the value of one during the football season and zero during the other months.

4.3 Announcement Data

During the observation period a number of events occurred outside of the context of directly measurable sporting success but which nevertheless could possibly have an influence on (future) sporting success and hence on the development of the BVB share price.

Firstly, during the observation period, Borussia Dortmund signed some talented and internationally highly sought-after players. The sign of the effect on the share price is not evident beforehand, because in addition to hopes for better sporting performance (to which a degree of uncertainty is attached[14]), these signings are also associated with (relatively certain) transfer fees paid to the players' former clubs and with salaries to be paid to the individual players. The share price reaction thus depends to a large degree on the shareholders' perception of the expected costs and benefits. In addition to signing new talent, the potential performance of a football team also depends on the players already on the team. Hence the long-term retention of players who are both talented and well-established members of the team also has an effect on the potential future success of the football club. For this reason it is also necessary to examine the effect of players' contract renewals on the price of the BVB shares.

In order to represent the effects of transfers and signing new talent described in Chapter 4.5 further dummy variables were included in the model. The variable *TRANSFER* assumes the value of one on the day of announcement of the transfer, and otherwise has the value of zero. The transfers in question here are those of Thomas Rosicky (12.8 million. €), Jan Koller (10.7 m. €), Marcio Amoroso (7.9 m. €), Ewerthon (3.7 m. €) and Sebastian Kehl (transfer fee unknown).[15] The dummy variable *CONTRACT* takes on a

[14] First of all in sport it is not certain that the signing of an exceptional individual player will result in an improvement in the performance of the team as a whole. Secondly there is also the possibility that the player may suffer injury.

[15] Cf. Borussia Dortmund (2000) on the amounts of the transfer fees. With regard to the transfer of Marcio Amoroso from AC Parma it should also be taken into consideration that this transfer also formed part of a swap. In return Borussia Dortmund signed

value of one on days on which a core player's contract is renewed and otherwise has a value of zero. During the period of observation the contracts of the following players were renewed: Guiseppe Reina (until 2005), Dede (2005), Heiko Herrlich (2005), Christian Wörns (2006), Lars Ricken (2006) and Jens Lehmann (2004). The contract renewal of coach Matthias Sammer (2006) on 20 December 2001 was also taken into consideration.

4.4 Descriptive Statistics

As mentioned earlier, the BVB shares were originally valued at 11.00 € on 31 October 2000, and were later traded at 5.20 € at the end of the observation period on 22 April 2002. Following an initial fall in price to 7.32 € on 19 July 2001, the shares recovered to a level of 9.75 € on 22 August 2001. This was followed by massive losses, which paralleled the fall on the stock exchange as a whole. The BVB share price reached its lowest level of 4.65 € on 21 December 2001. The maximum reduction in share price value is therefore 57.7 %.

In the same period the stock exchange environment likewise worsened substantially. The *CDAX* fell from 561.25 to 425.60, which corresponds a loss of "only" 24.2 %. The Bloomberg *KICK*-Index had a value of 200.25 on 31 October 2000, losing 44.7 % to 110.78 by 22 April 2002.[16]

Table 1

Descriptive Statistics

	Mean	Maximum	Minimum	Std. Dev.
BVB-Share	7.22	11.00	4.65	1.51
CDAX	452.72	572.38	318.43	51.48
KICK	156.51	220.91	107.25	31.30
WTP	87.48	97.43	58.63	9.21

Source: own calculations.

the transfer rights to Evanilson over to AC Parma and then signed him up again on loan immediately afterwards. Experts thus valued the signing of Amoroso at approx. 25 million €. In the context of the transfer of Ewerthon Henrique de Souza from the Corinthians Paulista Sport Club, the BVB bought 50 % of the transfer rights for a price of 3.4 million US$. In addition the Borussia Dortmund GmbH & Co. KgaA retains to their advantage a unilateral option to acquire the remaining 50 % of the transfer rights until 15 July 2003.

[16] All share indices fell over the observation period., e.g. EURO STOXX 50 (27.5 %), DAX (24.8 %), MDAX (8.8 %), Nemax 50 (81.0 %).

Figure 1 depicts the course of the various time series. In order to gain an initial impression of the relation between the share price and the BVB's sporting performance, the course of the weighted relative league table position (*WTP*) was also included.

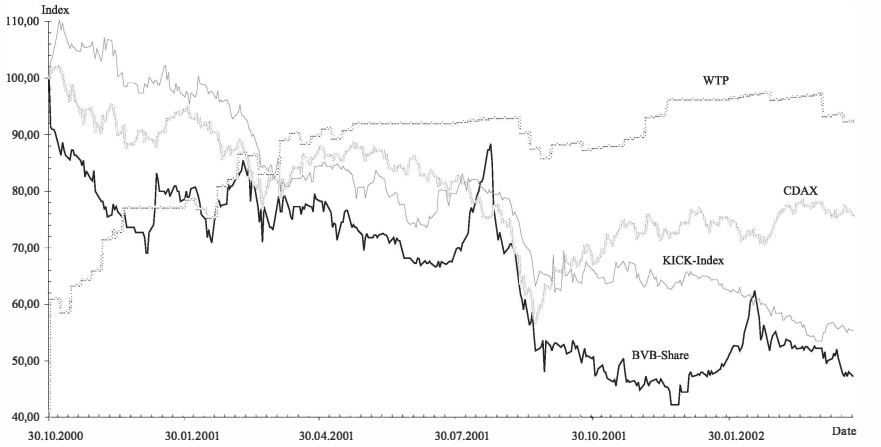

Figure 1: Development of the BVB share price, the *CDAX*, the *KICK*-Index and the weighted relative league table position *WTP*

5. Empirical examination of the capital market efficiency hypothesis

5.1 Test for weak market efficiency

Weak market efficiency is usually examined with the aid of a test for the autocorrelation of the first differences of the natural logarithms of the market price PD_t (on this and the following see Fama, 1965, 45 ff. and 144 ff.):

$$PD_t = \ln P_t - \ln P_{t-1} \; . \tag{5}$$

The connection between current share price (P) difference and past changes in share price

$$E(PD_t|PD_{t-\tau}) = \alpha_\tau + \beta_\tau PD_{t-\tau} \; ; \tag{6}$$

can be tested with the aid of the regression equation:

$$PD_t = \alpha_\tau + \beta_\tau PD_{t-\tau} + \varepsilon_t \; . \tag{7}$$

The coefficient β_τ can be regarded as an autoregression coefficient or an autocorrelation coefficient for lag τ. According to Fama (1976, 145), weak market efficiency means that the autocorrelation of the share price differences has to be approximately zero for all lags τ. And on the assumption that the true autocorrelation is zero, the sample autocorrelation is approximately normally distributed with the following approximate mean and standard deviation:

$$E\left[r(PD_t, PD_{t-\tau})\right] = -\frac{1}{N-\tau}$$

$$\sigma\left[r(PD_t, PD_{t-\tau})\right] = \sqrt{\frac{1}{N-\tau}}$$

Table 2

Autocorrelation coefficients (β_τ)

lag (τ)	Daily basis	Weekly basis
1	–0.092	0.120
2	–0.023	0.122
3	0.045	–0.066
4	0.016	–0.047
5	0.012	–0.193
6	–0.004	0.060
7	–0.088	–0.095
8	0.092	0.056
9	–0.035	–0.053
10	0.067	–0.067
N	385	76

Notes: * Deviations in the autocorrelation coefficient of more than two standard deviations from the approximate mean value.

Source: Authors' own calculations.

The autocorrelation coefficient for both samples and the individual lags (τ) in the logarithmed differences in the BVB share price are given in *Table 2*. None of the autocorrelation coefficients deviate significantly from the above-mentioned approximate mean value, meaning that the assumption of weak market efficiency cannot be rejected.

5.2 Test for medium-level market efficiency

In order to test for medium-level information efficiency it is necessary to define the term information, particularly with regard to the difference between public and non-public information. As described above, for the study of the BVB shares, the general stock market environment in the form of the *CDAX* and Kick-Index was used as an explanatory variable, as were Borussia Dortmund's relative weighted league table position and "news" in the form of signings of new players and contract renewals. Since the hypothesis of market efficiency in its medium-level form states that share prices immediately reflect the publicly available and relevant information, an appropriate empirical test of this thesis is to examine the adjustment speed of the share price to new information.

5.2.1 Test for cointegration

For the purpose of examining the stationarity of the time series used (BVB share price, *CDAX, KICK,* weighted relative table positions)[17], a Unit Root Test was carried out in the form of an Augmented Dickey-Fuller Test (ADF).

Table 3

Unit Root Tests (ADF-Test)

	Daily basis		Weekly basis	
K	–2.166	(0)	–2.148	(0)
Δ *K*	–21.597**	(0)	–8.737**	(0)
CDAX	–2.068	(0)	–2.080	(0)
Δ *CDAX*	19.420**	(0)	–8.375**	(0)
KICK	–0.788	(2)	–1.641	(1)
Δ *KICK*	16.340**	(1)	–7.384**	(0)
WTP	2.849	(0)	–2.668	(0)
Δ *WTP*	–19.214**	(0)	–8.599**	(0)

Notes: ** $p < 0.05$; lags in brackets.

Source: Authors' own calculations.

The ADF test was carried out with p lags and a constant. No trends are taken into consideration in the test equation. The determination of the significance of the ADF test is based on MacKinnon's critical values (1991). The corresponding lag lengths (p) were chosen in such a way that the Ljung-Box

[17] Since the variables *SEASON, TRANSFER* and *CONTRACT* are dummy variables, it is not necessary to test these time series for a unit root.

Q-statistics do not demonstrate any significant autocorrelation within the residues (Enders, 1995, 227). All time series (*P, CDAX, KICK* and *WTP*) possess a unit root in both samples and hence are non-stationary. Since the first differences are stationary, the time series are I(1).

The test with regard to cointegration between the non-stationary variables was carried out with the aid of the two-step Engle-Granger method, since in the case in question there can only be one meaningful cointegration vector, which has also been established a priori (Hansen, 1988, 352).

The results of the tests of the stationarity of the estimated residues $\hat{e}_t$ of the OLS regressions,

$$\ln K_t = \alpha + \beta \ln CDAX_t + \gamma \ln KICK_t + \delta \ln WTP_t + \omega\, SEASON + \mu\, TRANSFER + \eta\, CONTRACT + e_t$$

are documented in *Table 4*.

Table 4

Results of the cointegration regression

Variable	Daily basis	Weekly basis
Constant	–9.121	–9.532
$CDAX_t$	0.445	0.428
$KICK_t$	1.067	1.098
WTP_t	0.654	0.734
SEASON	0.085	0.089
TRANSFER	–0.009	–0.001
CONTRACT	–0.027	–0.037
N	386	77
Mean	1.953	1.954

Notes: explained variable: P_t.
Source: Authors' own calculations.

To test whether the sequence of the estimated residues $\hat{e}_t$ from the cointegration regression is stationary, ADF tests were once again carried out with the lag length (p) and without any trends (results in *Table 5*). For the critical values as well as for the determination of the corresponding lag lengths (p) the procedure mentioned above was used. Given that the sequence tested consists of the residues of a regression, it is not necessary to take into consideration an intercept term in the context of the unit root tests (Enders, 1995, 374).

Table 5

Degree of integration of the estimated residues (ADF test)

Variable	Daily basis		Weekly basis	
$\hat{e}_t$	–3.353**	(1)	–2.969**	(0)

Notes: lags in brackets.

Source: Authors' own calculations.

The result shows that the estimated residues $\hat{e}_t$ are stationary for both samples. In combination with the above insight that the observed time series *CDAX, KICK, WTP* and *P* (share price) are I(1), this results in a cointegration relation of degree (1.1) for both samples. Thus the long-term relation of equilibrium assumed in (3) is valid. The existence of cointegration means that the coefficients estimated therein are "super-consistent", i.e. that these estimated coefficients move faster towards their true value than by using regressions with stationary variables (Phillips / Durlauf, 1986; Engle / Granger, 1987; Stock, 1987). However the t-statistics are not approximately normally distributed and thus cannot be interpreted (Hansen, 1988, 351; Hassler, 2000, 26). Likewise the R^2 cannot be consulted for the evaluation of the quality of the estimation (Frenkel / Funke / Koske, 2003, 736). Hence they are not reported in *Table 4*.

We do not provide a more detailed interpretation of the results of the cointegration regression (*Table 4*), since they permit no statements to be made on the adjustment speed of the BVB share price. Hence these results are of little importance for the question as to whether the medium-level market efficiency hypothesis can be rejected.

5.2.2 Error correction model

According to Granger's representation theorem, every cointegration relation can also be written as an error correction model (ECM) (Koop, 2000, 159). The ECM used here has the following form:

$$\begin{aligned}(8)\quad \Delta \ln P_t = {} & \varphi + \lambda \hat{e}_{t-1} + \beta_1 \Delta \ln P_{t-1} + \beta_2 \Delta \ln CDAX_t + \beta_3 \Delta \ln CDAX_{t-1} + \\ & \beta_4 \Delta \ln KICK_t + \beta_5 \Delta \ln KICK_{t-1} + \beta_6 \Delta \ln WTP_t + \beta_7 \Delta \ln WTP_{t-1} + \\ & \beta_8 \Delta SEASON + \beta_9 \Delta TRANSFER + \beta_{10} \Delta CONTRACT + \varepsilon_t\end{aligned}$$

The specification of the equations of the ECM for both samples, in particular the selection of the lags, was undertaken with the aid of the "general to specific" method, by successively eliminating the non-significant lags. The final result was that – with the exception of the lagged endogenous factors – no lag possesses any significance (results in *Table 6*).

The ECM is designated in such a way because it contains a so-called error correction term $\hat{e}_{t-1}$. This error correction term is merely the lagged disturbance term of the cointegration regression (5) whose equation can be transformed as follows:

$$(3') \qquad \hat{e}_{t-1} = \ln P_{t-1} - (\alpha + \beta \ln CDAX_{t-1} + \gamma \ln KICK_{t-1} + \delta \ln WTP_{t-1} + \omega SEASON + \mu TRANSFER + \eta CONTRACT)$$

This expression of the error correction term corresponds to the representation of the abnormal performance introduced in Chapter 3.2. If $\hat{e}_{t-1}$ takes a value not equal to zero, then a deviation from the long-run equilibrium exists and thus an abnormal performance. According to the theoretical considerations of the capital market efficiency hypothesis (Chapter 3.1) the adjustment to such an error must take place directly, so that it does not have to be rejected in its medium-level form. Therefore the regression coefficient (λ) of the error correction term $(\hat{e}_{t-1})$ from the error correction model (8) is of importance, because it shows – under the assumption of the validity of the long-term cointegration relation – how quickly the share price adjusts to deviations from the long-run equilibrium. The results of the ECM (5) are as follows in *Table 6* on next page.

It can be seen that in both tested samples, a change in the weighted relative league table position and the indicators for the stock exchange environment (with the exception of the *CDAX* in the analysis on a weekly basis) show a significantly positive influence – to an error level of at least 10 % – on the change in the price of the BVB shares, whilst the news of new player signings and contract renewals have no significant influence in the short run. As mentioned above, the regression coefficient of the error correction term $(\hat{e}_{t-1}$ has some meaning, because it shows the speed of adjustment. This coefficient is negative and significantly different from zero in both samples. This fact is a necessary stability condition, which ensures that the equilibrium errors are corrected. Otherwise $(\lambda > 0)$ the equilibrium errors would be magnified (Koop, 2000, 166). In the sample taken on a weekly basis, the coefficient has a value of –0.17. This means that the stock market price of the BVB shares adjusted to a deviation from the long-term equilibrium of (only) 17 % in the first period. For the sample taken on a daily basis this value was (only) – 0.054, i.e. the BVB share price has very slow speed of adjustment. Both values are also significantly different from minus one. From the previous considerations a value of 1 close to minus one – that means direct adjustment – can be required for the existence of the efficient capital market hypothesis in his medium-level form. In other words, the BVB share price fails to fulfill the conditions for medium-level capital market efficiency.

Table 6

Results of the error correction model

Variable	Daily basis	Weekly basis
Constant	–0.002 (–1.545)	–0.006 (–1.065)
$\hat{e}_{t-1}$	–0.054 (–3.535)***	–0.170 (–2.687)***
ΔP_{t-1}	–0.082 (–1.691)*	–
$\Delta CDAX_t$	0.173 (1.856)*	0.128 (0.660)
$\Delta KICK_t$	0.166 (2.073)**	0.593 (2.419)**
ΔWTP_t	0.422 (3.560)***	0.486 (2.594)**
$\Delta SEASON$	0.016 (1.543)	0.039 (2.163)**
$\Delta TRANSFER$	0.005 (–0.629)	–0.012 (–0.751)
$\Delta CONTRACT$	0.005 (0.772)	0.014 (1.105)
N	384	76
Mean	–0.002	–0.009
R^2	0.010	0.311
adj. R^2	0.082	0.240
DW-Test	2.052	1.890
F-Statistics	5.295***	4.392***

Notes: t-values in brackets; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.
Source: Authors' own calculations.

6. Conclusions and further research prospects

The motivation behind this contribution was to test whether and to what degree of intensity and speed of adjustment a connection exists between sporting success and the capital market valuation of the share price of the Borussia Dortmund GmbH & Co. KgaA. The weak form of capital market efficiency as formulated by Fama (1970) was not rejected. In contrast, the hypothesis of medium-level market efficiency should be rejected. Nor is this conclusion mitigated by the objection that the above mentioned diversification strategy pursued by the management of the Borussia Dortmund GmbH & Co. KgaA was, or is, explicitly directed towards reducing the dependency of the share

price on sporting success. The corresponding achievement of these goals would change the parameters of the long-term relation (5) (particularly in the direction of zero for the *WTP* coefficients). It was not possible within the context of this study to examine whether such a change in the long-term relation was taking place. Medium-level capital market efficiency requires, however, that the adjustment to the currently valid long-term relation should take place completely and without delay. There is, however, no trace of such a complete and immediate adjustment in this case.

Similar argumentation applies with regard to the objection that the lack of efficient adjustment is due to the investment motives of the shareholders. Hence it might be argued that the share packets are held in the hands of the parent club and the Deutsche Bank and thus are unavailable, in terms of their reactions, for the immediate creation of adjustment reactions to the long-term equilibrium. It could also be added that the owners of the widespread shareholdings consist largely of fans of the club, who have (also) bought and retain the shares for motives other than profit. However, this kind of investment policies, which are (almost) independent of sporting success, would primarily change the coefficients of the long-term relation (5) (in the direction of reduced values for all coefficients), yet would not prevent immediate adjustments. In borderline cases, in which all the shareholders always behave independently of the examined influencing determinants (with "unshakeable loyalty"), all the determinants would equal zero. In this case the share price would be constant – and the "adjustment reaction" would always be "complete".

In addition it is hardly possible for the relatively low volume of trade and the resulting tight market to contribute to an explanation of the inefficiencies observed; tight markets regularly lead to especially pronounced share price spikes that can exceed the long-term relations. This makes it difficult to arrive at a final explanation of the medium-level capital market efficiency. In view both of the relatively short time during which the Borussia Dortmund GmbH & Co. KgaA shares have been listed and of the fact that the BVB shares are the only German football shares on the stock exchange, a future repetition of the tests on a broader data basis and incorporating (further) learning effects of participating actors due to preceding inefficiencies would seem a fruitful prospect.

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