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Does the stock market value the inclusion in a sustainability stock index? An event study analysis for German firms

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Does the Stock Market Value the Inclusion in a Sustainability Stock Index?

An Event Study Analysis for German Firms

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Abstract

This paper empirically analyzes the effect of the inclusion of German corporations in the Dow Jones STOXX Sustainability Index (DJSI STOXX) and the Dow Jones Sustainability World Index (DJSI World) on stock performance. In order to receive robust estimation results, we apply an event study approach that is based on both a modern asset pricing model, namely the three-factor model according to Fama and French (1993), and additionally on a GARCH model. Our empirical analysis implies that stock markets may penalize the inclusion of a firm in sustainability stock indexes. This result is mainly driven by the negative effect of the inclusion in the DJSI World. While we do not find significant average cumulative abnormal returns for the inclusion in the DJSI STOXX, the inclusion in the DJSI World leads to strong negative impacts. This suggests that the inclusion in a more visible sustainability stock index has larger negative impacts.

Keywords:

Sustainability stock indexes, Corporate financial performance, Event study, Three-factor model, GARCH model

JEL classification:

Q56, M14, G14, G12, C22

1. Introduction

The question whether voluntary activities of a firm to protect the natural environment or to comply with social and ethical norms benefit its financial performance and conversely whether a poor sustainability (i.e. environmental or social) performance can have damaging financial consequences has been of vital interest for corporate management for a long time. Knowledge about the relationship between corporate sustainability performance and financial performance is also important for public policy. If corporate environmental or social activities are rewarded, while bad sustainability performance is penalized, it can be argued that the public support of information-based mechanisms is promising. This means that the main goal of public policy would be to ensure publication and spreading of information about corporate sustainability performance. This approach can be thought to be more cost-efficient than traditional (e.g., command and control) regulation. Finally, an understanding of the aforementioned relationship also matters substantially for investors. The question is whether socially responsible investing (SRI), also called ethical or sustainable investing (e.g., Renneboog et al., 2008), which refers to the practice of choosing stocks on the basis of environmental, social, and ethical screens, is rewarded or penalized by the stock market. The high relevance of this question is witnessed by the increase of SRI investments worldwide by over 300% between 1995 and 2007 and the fact that in the US already one tenth of all assets under management is invested in SRI funds (e.g., Social Investment Forum, 2007).

Against this background, some portfolio analyses compare the risk-adjusted stock returns of socially responsible and conventional mutual funds (e.g., Bauer et al., 2005, 2007). Since the financial performance of existing funds is influenced by fund management decisions that cannot be separated from the SRI impact, other portfolio analyses focus on specific corporate sustainability performance assessments, such as those by Innovest (e.g., Derwall et al., 2005) or KLD Research & Analytics (e.g., Kempf and Osthoff, 2007). Some of these assessments

are the basis for widely considered sustainability stock indexes, such as the Domini 400 Social Index, which is constructed with the ratings from KLD. Another strand of economic SRI studies directly examines the financial performance of sustainability stock indexes (e.g., Sauer, 1997, Bauer et al., 2005, Schröder, 2007), which are the basis for several socially responsible funds. However, a strong drawback of portfolio analyses is that only the relationship between corporate sustainability and financial performance can be examined, whereas the causal effect of environmental or social activities cannot be identified.

Such an analysis is in principle possible with common micro-econometric approaches based on cross-sectional or panel data, which regress corporate financial performance on specific indicators for corporate sustainability performance (besides several control variables). While a few studies (e.g., Filbeck and Gorman, 2004, Ziegler et al., 2007a) exclusively consider stock returns as an indicator for corporate financial performance, most other studies apply accounting data based indicators and thus examine the impact of corporate environmental or social activities on, for example, Tobin's Q, return on assets, return on sales, or return on equity (e.g., Hart and Ahuja, 1996, Waddock and Graves, 1997, Russo and Fouts, 1997, Dowell et al., 2000, Konar and Cohen, 2001, King and Lenox, 2001, 2002, Elsayed and Paton, 2005, Telle, 2006, Guenster et al., 2011). While many of these analyses only use one-dimensional and rather narrow indicators for corporate sustainability performance, such as emissions of pollutants, some studies consider more general indicators that refer to the environmental dimension or even incorporate both corporate environmental and social activities. Finally, a few studies examine the impact of the inclusion in a sustainability stock index, namely the Domini 400 Social Index, on corporate financial performance, measured by accounting data based indicators (e.g., McWilliams and Siegel, 2000, Becchetti et al., 2008).

Although micro-econometric approaches seem to be more appropriate to examine the effect of corporate sustainability performance on financial performance than portfolio analyses, the

identification of the causality of this relationship in such studies can also be problematic since it is possible that corporate financial performance has an impact on environmental or social activities. If such a reverse effect exists, the corresponding parameter estimates could be biased. This problem is evident in micro-econometric analyses with cross-sectional data. But even in modern panel data models including unobserved heterogeneity, dynamic effects, and instrumental variable approaches (e.g., according to Arellano and Bond, 1991), the reliability of the estimations is ambiguous since appropriate instrument variables are often not available. This shortcoming of common micro-econometric approaches is a significant starting point for a third methodological approach, namely event studies. Event studies generally examine the mean stock returns for corporations experiencing a specific event (i.e. new information) and therefore aim to measure the effect of this event on the value of a corporation (e.g., MacKinlay, 1997, McWilliams and Siegel, 1997, Kothari and Warner, 2006).

Event studies have been developed and particularly applied in financial economics and accounting to examine, for example, the effect of mergers and acquisitions, earnings announcements, or issues of new debt or equity. However, event studies are also increasingly used to analyze the reactions of mean stock prices due to new information about corporate sustainability performance. Most of former event studies in this field refer to relatively specific corporate environmentally, socially, or ethically relevant information (e.g., Hamilton, 1995, Klassen and McLaughlin, 1996, Konar and Cohen, 1997, Posnikoff, 1997, McWilliams and Siegel, 1997, Khanna et al., 1998, Teoh et al., 1999, Dasgupta et al., 2001, Gupta and Goldar, 2005, Cañón-de-Francia and Garcés-Ayerbe, 2009, Capelle-Blancard and Laguna, 2010, Fisher-Vanden and Thorburn, 2011). The corresponding events can have the character of negative news, such as information about environmental accidents or toxic emissions, as well as positive news, such as information about firms winning environmental awards, membership in voluntary environmental programs, or withdrawal from South Africa during the apartheid regime (as a reaction to human rights abuses).

Another rather small group of event studies recently analyzes the impact of the inclusion in a sustainability stock index on stock performance. For example, Curran and Moran (2007) examine British firms with respect to their inclusion in the specific FTSE4Good UK 50 Index, i.e. an index that is based on corporate sustainability performance assessments by the FTSE Group, which is jointly owned by the Financial Times and the London Stock Exchange. Furthermore, Doh et al. (2010) analyze US firms with respect to the inclusion in the specific Calvert Social Index, i.e. an index created by Calvert Investments, an investment management firm which is headquartered in Bethesda, Maryland, and which is one of the largest SRI firms in the US. Finally, Cheung (2011) examines US firms with respect to their specific inclusion in the Dow Jones Sustainability World Index (DJSI World), i.e. an index that is based on corporate sustainability performance assessments by the SAM (Sustainable Asset Management) Group together with Dow Jones Indexes.

The crucial assumption for the reliability of the results of event studies is that capital markets are sufficiently efficient to react to events. If this condition for the application of event studies is given, the essential feature of this approach is that the causality of the relationship between corporate sustainability performance and stock performance is clear (e.g., Heal, 2005). As a consequence, if the stock prices (as in many of the aforementioned studies) decrease subsequent to negative news or increase subsequent to positive news and if possible confounding effects in the analyzed time period are excluded, it can be reliably concluded that this is due to the corresponding release of environmentally, socially, or ethically relevant information. Therefore, it can also be concluded in these cases that there is a negative or positive causal effect of corporate sustainability performance on stock and thus financial performance.

As a consequence, our paper adopts this event study approach. Specifically, we consider the impact of the inclusion of German corporations in two sustainability stock indexes, namely the Dow Jones STOXX Sustainability Index (DJSI STOXX) and the DJSI World, which are

based on corporate sustainability performance assessments by the SAM Group together with Dow Jones Indexes, as aforementioned, as well as in cooperation with STOXX Limited. The contribution of our event study is three-fold. First of all, our analysis is one of few studies for European and particularly continental European firms since by far the most studies refer to Anglo-Saxon firms. By specifically focussing on German firms, our event study refers to the country with the third largest European stock market in terms of market capitalization and the largest national economy in Europe. Second, and perhaps most important, we compare the effects of the inclusion in two different sustainability stock indexes with different visibility and importance on the stock markets. This allows the test for the possibility that the inclusion in a more recognized sustainability stock index has different – particularly stronger (positive or negative) – effects on the stock performance of firms on the same stock market. Third, we use an advanced event study methodology by basing our analysis not only on a simple asset pricing model (such as the market model), but also on the three-factor model according to Fama and French (1993). In this respect, we furthermore take into account GARCH effects (e.g., Engle, 2001), i.e. our results are reliable even if a varying conditional variance in the daily stock returns analysed occurs, which is frequently the case on the stock market.

The structure of the paper is as follows: On the basis of theoretical considerations, section 2 develops the hypotheses for our empirical analysis. Section 3 presents our event study approach and the data used. Section 4 discusses the empirical results and section 5 concludes.

2. Theoretical Background and Hypotheses

This paper empirically analyzes the impact of the inclusion in a sustainability stock index on corporate financial performance. Such sustainability stock indexes are commonly considered an appropriate indicator for corporate environmental and social activities, corporate sustainability performance, or corporate social responsibility (CSR) (e.g., McWilliams and Siegel,

2001, Heal, 2005). Against this background, our empirical analysis of the relationship between corporate sustainability performance and financial performance tests two different competing theoretical perspectives, namely the traditional view which suggests a negative relation and the revisionist view which suggests a positive relation (e.g., Porter, 1991, Wagner et al., 2001).

One argument for the revisionist view and thus for a positive effect of corporate sustainability performance on financial performance is based on neoclassical micro-economics. It suggests that governments do not fully resolve all problems with external effects and that competitive markets are not efficient (e.g., Heal, 2005). Therefore, corporate environmental and social activities can substitute missing markets (and thus missing regulations) if external costs arise from them and can reduce conflicts between firms and stakeholder groups, such as the government, the general public, non-governmental organizations, competitors, employees, or clients. As a consequence, it can be argued that the reduction of these conflicts increases corporate profits or financial performance (at least in the long term) and thus stock returns.

This stakeholder argument is strengthened in the strategic management literature (e.g., Waddock and Graves, 1997, Barnett and Salomon, 2006, Curran and Moran, 2007). Stakeholder theory suggests that management has to satisfy several groups who have an interest or “stake” in a firm and can influence its outcome (e.g., McWilliams et al., 2006). It can therefore be financially beneficial to engage in environmental and social activities because otherwise these stakeholders could withdraw the support for the firm. For example, the avoidance of child labor in the full value-added chain of the products can reduce risks due to aggressive campaigns of non-governmental organizations. These arguments can be embedded in the resource-based view of the firm (e.g., Barney, 1991), which suggests that competitive advantages evolve from internal capabilities that are valuable, rare, and difficult to imitate or substitute (e.g., Russo and Fouts, 1997, Klassen and Whybark, 1999, King and Lenox, 2001,

McWilliams et al., 2006). In this respect, stakeholder management can be considered an important organizational capability or resource. New technologies that are installed due to proactive corporate environmental activities are a further example for a tangible or physical resource if these technologies cannot be easily imitated by competitors.

The previous arguments exclusively refer to corporate environmental and social activities, which indeed produce costs, but are also an important organizational resource and reduce conflicts with stakeholder groups, which could lead to net benefits in the long term. While negative news, for example, with respect to child labor or environmental pollution can relatively easily be observed and evaluated, it is much more difficult to identify proactive environmental or social activities. One example for a signal to stakeholders that a firm carries out such activities is the certification of environmental management systems according to ISO 14001 (e.g., Cañón-de-Francia and Garcés-Ayerbe, 2009). Another signal for high corporate sustainability performance associated with such activities is the inclusion in a sustainability stock index. Reputation gains through this positive signal can also attract new customers who are sensitive to sustainability issues, which could lead to higher sales and increased profitability. Furthermore, firms with a good reputation can increase its employee retention rate and additionally attract highly skilled and thus more productive employees. Regarding the embedding in the resource-based view of the firm, a good reputation is a further example for an intangible resource that is valuable, rare, and difficult to imitate or substitute.

In summary, this leads to the following hypothesis that represents the aforementioned revisionist view:

Hypothesis 1a: *The inclusion in a sustainability stock index has a positive effect on stock performance.*

It should be noted that a crucial assumption for the argumentation leading to our first hypothesis is that the inclusion in a sustainability stock index, such as the DJSI STOXX or the

DJSI World, is a reliable signal for a higher intensity of environmental and social activities. In this respect, however, Koellner et al. (2007) show that the differences between socially responsible and conventional funds, which are both managed on the basis of the MSCI World Index, indeed are present in terms of environmental impacts, but relatively small compared with possible expectations of investors. Ziegler and Schröder (2010) analyze the determinants of the inclusion in the DJSI STOXX and the DJSI World and show that factors not related to corporate environmental or social activities matter significantly for the inclusion in these sustainability stock indexes. As a consequence, the reliability of the inclusion in these two stock indexes as a real indicator for higher corporate sustainability performance can be put into question (e.g., Fowler and Hope, 2007), so that strong reputation gains also remain doubtful.

Furthermore, activities aimed at increasing corporate sustainability performance can also be considered non-productive (e.g., Shadbegian and Gray, 2005) and thus only serve societal goals (e.g., environmental protection). From the beginning of the debate on the “business case of CSR”, it has been argued that CSR is expensive and demands significant portions of corporate financial resources, although benefits of CSR can be reaped only in the distant future if at all. Based on this, already Friedman (1970) argues that there is no role for CSR. More specifically, Cañón-de-Francia and Garcés-Ayerbe (2009) argue with respect to the proactivity of corporate environmental activities, that ISO 14001 certification could be interpreted as a purely symbolic action driven by institutional and isomorphic pressures (e.g., DiMaggio and Powell, 1983). In other words, corporate activities for this certification need not necessarily be voluntarily conducted. This argument also applies to the inclusion in sustainability stock indexes. In this case, corresponding environmental and social activities may lead to additional costs, which are not directly productive, so that weaker positive or even negative impacts on financial success are possible. This argumentation is in line with the traditional view in neo-classical micro-economics. According to this, the operating costs of corporate environmental (e.g., Telle, 2006) or social activities outweigh their financial benefits, so that the underlying

principle of shareholder wealth maximization is violated. As a consequence, corporate sustainability performance can lead to reduced profits, decreased firm values, or competitive disadvantages, supporting the aforementioned argument of Friedman (1970) that CSR should not be pursued.

This neoclassical notion is supported by corporate governance theory (e.g., Shleifer and Vishny, 1997, Tirole, 2006). According to a rather narrow definition, corporate governance comprises all measures, such as optimal incentive or control structures, which assure that investors get an adequate return for their investments. Only if corporate governance structures are properly designed, management will focus on profit maximization. According to this, it can, for example, be argued that the consideration of stakeholder goals as a motivation for corporate environmental or social activities and ultimately the inclusion in a sustainability stock index enlarges the latitude of management which could be misused for only maximizing the utility of managers, so that investors in purely profit-maximizing firms with a lower intensity of such measures can expect a higher financial performance.

In summary, this leads to the following competing hypothesis that represents the aforementioned traditionalist view:

Hypothesis 1b: *The inclusion in a sustainability stock index has a negative effect on stock performance.*

With respect to the previous discussion about the inclusion in a sustainability stock index as a positive signal for corporate sustainability performance or conversely a negative signal for a pure symbolic action, it should be noted that in both cases this signal has to be evident. In other words, a signal has to be widely visible for all actors and intermediaries on the stock market in order to have an impact on stock prices. In this respect, it can be argued that the inclusion in the DJSI World is generally more recognized than the inclusion in the DJSI STOXX. The DJSI World was first published in 1999 and is certainly the most important sus-

tainability stock index in the DJSI family. All other indexes from this family, such as the DJSI North America, the DJSI Asia Pacific, and particularly also the DJSI STOXX, were launched later. This latter European sustainability stock index was first published in 2001 and has in the meantime been substituted by the DJSI Europe, which was launched in 2010. This suggests that the DJSI World was more recognized than the DJSI STOXX, which implies that the signalling effect should be weaker for the latter sustainability stock index. As a consequence, the positive signal for corporate sustainability performance or the negative signal for a pure symbolic action is likely weaker for the DJSI STOXX than for the DJSI World, so that the positive or negative impact of the inclusion in the DJSI STOXX on corporate financial performance should be weaker than the corresponding positive or negative impact of the inclusion in the DJSI World.

This leads to the following two hypotheses which are based on the two competing hypothesis 1a and 1b and whose validity is conditional on the acceptance of the former ones, i.e. hypothesis 2a (2b) can only apply when hypothesis 1a (1b) holds:

Hypothesis 2a: *The positive effect of the inclusion in a sustainability stock index on stock performance is stronger for the DJSI World than for the DJSI STOXX.*

Hypothesis 2b: *The negative effect of the inclusion in a sustainability stock index on stock performance is stronger for the DJSI World than for the DJSI STOXX.*

3. Methodological Approach and Data

3.1. Event Study Approach

Event studies try to examine the stock return behavior for corporations which experience a specific event and therefore aim to measure the effect on the value of a corporation (e.g., MacKinley, 1997, Kothari and Warner, 2006). The main features in the application of event studies have not been changed since their development by Ball and Brown (1968) and Fama

et al. (1969). One crucial assumption in this respect is that capital markets are sufficiently efficient to react on events (i.e. new information) regarding expected future profits of affected corporations. Event studies are mostly rested upon the analysis of so-called “normal” and “abnormal” returns, which are estimated on the basis of asset pricing models. The main approaches are the market model (Sharpe, 1963, Fama, 1968) and the one-factor model based on the CAPM (Sharpe, 1964, Lintner, 1965) and the market model. The market model for a corporation or stock i in day t ($i=1, \dots, N$; $t=1, \dots, T$) is:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$$

The combination of the market model and the CAPM leads to the following one-factor model:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \varepsilon_{it}$$

In these models r_{it} and r_{mt} are the returns for corporation i and the market portfolio at the end of period t (i.e. between $t-1$ and t), r_{ft} is the risk-free interest rate at the beginning of period t , and ε_{it} is the disturbance term with expectation $E(\varepsilon_{it}) = 0$ and variance $\text{var}(\varepsilon_{it}) = \sigma_\varepsilon^2$. Finally, α_i and β_i besides σ_ε^2 are the unknown parameters.

However, many studies show that the three-factor model of Fama and French (1993), which includes the excess returns $r_{mt} - r_{ft}$ of the market portfolio, but also two additional factors to explain the excess returns $r_{it} - r_{ft}$, has more explanatory power than the one-factor model, for example, Fama and French (1993, 1996) for the US, Berkowitz and Qiu (2001) for the Canadian, Hussain et al. (2002) for the British, and Ziegler et al. (2007b) for the German stock market. The structure of this three-factor model for a corporation or stock i in day t is as follows ($i=1, \dots, N$; $t=1, \dots, T$):

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1} (r_{mt} - r_{ft}) + \beta_{i2} SMB_t + \beta_{i3} HML_t + \varepsilon_{it}$$

In this model SMB_t is the difference between the returns for a portfolio comprising stocks of “small” corporations and a portfolio comprising stocks of “big” corporations. HML_t is the

difference between the returns for a portfolio comprising stocks of corporations with a “high” book-to-market equity and a portfolio comprising stocks of corporations with a “low” book-to-market equity, respectively, in day t (for details see Fama and French, 1993). Whereas ε_{it} is the disturbance term with $E(\varepsilon_{it}) = 0$, the parameters $\text{var}(\varepsilon_{it}) = \sigma_\varepsilon^2$, α_i , β_{i1} , β_{i2} , and β_{i3} are unknown and have to be estimated.

In event studies the unknown normal (excess) returns $E(r_{it}-r_{ft})$ are defined as the expected (excess) returns without conditioning on the event. The so-called abnormal returns for a corporation i in day t are defined as the difference between the actual and the normal (excess) returns:

$$ar_{it} = (r_{it} - r_{ft}) - E(r_{it} - r_{ft})$$

The unknown parameters in $E(r_{it}-r_{ft})$ can be estimated by OLS on the basis of the three-factor model for all days t in the time interval $[T_0, \dots, T_1]$, i.e. in the “estimation window”. Based on this, the normal and abnormal returns are estimated for each corporation i and for separate days t in the time interval $[T_2, \dots, T_3]$, i.e. in the “event window”. The estimated abnormal returns for a corporation i in day t on the basis of the more reliable three-factor model are:

$$\text{est}(ar_{it}) = (r_{it} - r_{ft}) - \text{est}(\alpha_i) - \text{est}(\beta_{i1}) (r_{mt} - r_{ft}) - \text{est}(\beta_{i2}) SMB_t - \text{est}(\beta_{i3}) HML_t$$

If the estimation window is sufficiently large, the $\text{est}(ar_{it})$ are approximately normally distributed with expectation zero and $\text{var}[\text{est}(ar_{it})] = \sigma_\varepsilon^2$ under the null hypothesis H_0 that the event has no impact on the (excess) returns.

The estimated abnormal returns can be aggregated across corporations and over time. For an aggregation across affected corporations, the estimated average abnormal returns $\text{est}(aar_t)$ for a day t in the event window are the means of the estimated abnormal returns for the corporations $i=1, \dots, N$:

$$\text{est}(aar_t) = \frac{1}{N} \sum_{i=1}^N \text{est}(ar_{it})$$

For an aggregation over time, the estimated cumulative abnormal returns $est(car_i)$ for a corporation i are the sums of the considered estimated abnormal returns for all days t from T_a to T_b (with $T_2-1 < T_a < T_b < T_3+1$):

$$est(car_i) = \sum_{t=T_a}^{T_b} est(ar_{it})$$

For a combined aggregation over time and across affected corporations, the estimated average cumulative abnormal returns $est(acar)$ are the means of the estimated cumulative abnormal returns for the corporations $i=1, \dots, N$:

$$est(acar) = \frac{1}{N} \sum_{i=1}^N est(car_i)$$

If the estimated (cumulative) abnormal returns are independent across corporations and/or over time and if the estimation window is sufficiently large, the $est(aar_t)$, $est(car_i)$, and $est(acar)$ are approximately normally distributed with expectation zero as well as $var[est(aar_t)] = \sigma_\varepsilon^2/N$, $var[est(car_i)] = \sigma_\varepsilon^2(T_b-T_a+1)$, and $var[est(acar)] = [\sigma_\varepsilon^2(T_b-T_a+1)]/N$, respectively, under the null hypothesis H_0 that the event has no impact on the (excess) returns. As a consequence, the ratios between $est(aar_t)$, $est(car_i)$, and $est(acar)$ and their variances, respectively, are approximately standard normally distributed in this case.

Based on z-statistics that directly arise from the approximated normal distributions of $est(aar_t)$ and $est(acar)$ under H_0 , we can examine whether the inclusion in a sustainability stock index actually had an effect on stock returns. As discussed below, we consider several days prior and subsequent to the event day as it is common in many event studies. In this respect, we particularly apply the common z-test according to Campbell et al. (1997), which includes an appropriate estimation of $var[est(aar_t)]$ and $var[est(acar)]$, so that the ratios between $est(aar_t)$ or $est(acar)$ and their estimated variances are also approximately standard normally distributed under the null hypothesis H_0 that the event has no impact on the (excess) returns.

It should be noted that the assumption of estimated (cumulative) abnormal returns being independent across corporations could be violated due to event-time clustering since we analyze the effect of only some singular events. Therefore, the estimated variances of the estimated average abnormal returns $est(aar_t)$ and of the estimated average cumulative abnormal returns $est(acar)$ could be biased downward (e.g., Kothari and Warner, 2006). Furthermore, event-induced variance according to Boehmer et al. (1991) could be a problem for $est(aar_t)$. This means that the variance of an abnormal return increases when the absolute value of the abnormal return rises or that the variance of a return increases prior to the event due to uncertainty. As a consequence, the null hypothesis H_0 that the event has no impact on the (excess) returns can be rejected too often if this event-induced variance is not considered.

In order to test the robustness of our estimation results, the corrected z-statistic of Boehmer et al. (1991) can be used. Another possible approach is to examine GARCH models (e.g., Bollerslev, 1986), which consider a varying conditional variance and which are therefore very appealing approaches for the analysis of high-frequent time series. Due to their preferable properties to describe daily stock returns, they are extensively used in this field for a while. The main advantage of GARCH models is that they address the so-called volatility clustering, i.e. the tendency that current volatility of stock returns tends to be positively correlated with its past values. In this respect, the use of the specific GARCH(1,1) model is widespread since it sufficiently explains systematic variation of stock return volatility in most cases (e.g., Akgi-ray, 1989, Andersen and Bollerslev, 1998, Engle, 2001), although several modifications have been proposed in the meantime. While GARCH models are already widely applied for several event studies so far (e.g., Savickas, 2003, Babalan and Constantinou, 2006, Oberndorfer and Ulbricht, 2007), only very few event studies use this approach to analyze the impact of corporate environmental or social performance on stock returns (e.g., Becchetti et al., 2007).

Against this background, we specifically analyze an event study approach on the basis of the three-factor model as discussed above with an additional inclusion of a GARCH (1,1) model. This model approach allows the variance of ε_{it} (conditional on $\varepsilon_{i,t-1}, r_{m,t-1}, r_{f,t-1}, \dots$) to vary according to a GARCH (1,1) process by additionally assuming that the conditional disturbance terms are normally distributed. In this respect, three parameters of the conditional variance are estimated besides the parameters of the three-factor model in the estimation window as discussed above. On this basis the respective abnormal returns and thus the average abnormal returns, the cumulative abnormal returns, and the average cumulative abnormal returns can be estimated for several days or time intervals in the event window. Finally, the corresponding z-test statistic according to Campbell et al. (1997) can be constructed on the basis of the three-factor model event study approach including this specific GARCH model in order to examine whether the inclusion in sustainability stock index actually had an impact on stock returns.

3.2. Data

In our event study we analyze German corporations that were included in a sustainability stock index in the years between 1999 and 2002. As discussed above, we consider the DJSI STOXX and the DJSI World. Together with Dow Jones Indexes and STOXX Limited, the SAM Group, which is an independent and internationally active financial services institution with an exclusive focus on sustainability, has launched a family of sustainability stock indexes to track the financial performance of corporations that are sector leaders in terms of sustainability performance (including environmental, social, and also economic criteria, e.g., Fowler and Hope, 2007). The DJSI STOXX comprised the European leaders, i.e. the 20% most sustainable European corporations of each sector in the Dow Jones STOXX 600 Index (DJ STOXX 600 Index) were intended to be included in that sustainability stock index. The DJSI World comprises the world-wide leaders, i.e. the 10% most sustainable corporations of

each sector of the biggest 2500 corporations in the Dow Jones World Index (DJ World Index) are intended to be included in this sustainability stock index.

In a first step, 33 inclusions in the DJSI STOXX (for 33 German corporations) for the years 2001 and 2002 and 29 inclusions in the DJSI World between 1999 and 2002 (for 28 German corporations due to a double inclusion of one firm, namely Allianz, in 1999 and 2002 after its exclusion in 2001) have been identified. With respect to the DJSI STOXX, we can only examine these two years since this sustainability stock index was launched only in 2001, as aforementioned. Furthermore, we can only examine the years 1999, 2001, and 2002 in the case of the DJSI World since in 2000 no German firm was included in this sustainability stock index. However, we do not analyze all these events due to several confounding effects, i.e. important other events within or shortly before the event window. The main confounding effects in our sample refer to the double inclusion in or exclusion from one of the sustainability stock indexes. According to this, seven inclusions in the DJSI STOXX in 2001 are not considered since the same corporations have been included in the DJSI World in the same year and the corresponding announcement was one week before the announcement of the inclusion in the DJSI STOXX. Furthermore, two inclusions in the DJSI STOXX in 2001 and one inclusion in 2002 are not considered since the same corporations have been excluded from the DJSI World in the respective year and the corresponding announcements were one week before the announcements of the inclusion in the DJSI STOXX. As a consequence, only 23 inclusions in the DJSI STOXX (for 23 corporations) are examined in our event study. Moreover, we only examine 28 inclusions in the DJSI World (for 27 corporations) since the inclusion of one firm (namely Aixtron) in 2002 is not considered. The reason for this is that this corporation was excluded from the DJ World Index in this year.

It should be noted that for our event study two different dates in each year are of interest for the inclusion in a sustainability stock index, namely the new composition of the index as well

as its corresponding announcement. The announcement of the new composition of the DJSI World was in each year (i.e. 08.09.1999, 04.09.2001, 04.09.2002) between one and three weeks before its real new composition (i.e. 17.09.1999, 21.09.2001, 23.09.2002). The announcement of the new composition of the DJSI STOXX in the year 2002 (04.09.2002) was more than three weeks before its real new composition (30.09.2002). In contrast, the real new composition of the DJSI STOXX in the year 2001 (28.09.2001) was before its public announcement in this year (15.10.2001). As a consequence, we consider in each case two event dates. While the first event date for the analysis of the DJSI World refers to the announcement of the new composition of this sustainability stock index, the second event date refers to its real new composition, respectively. The first event dates for the analysis of the DJSI STOXX are the 28.09.2001 and 04.09.2002. The 28.09.2001 is maintained in our analysis for the second event date in this case since this day refers to the real new composition of the DJSI STOXX in 2001. The 30.09.2002 is additionally considered as second event date.

Our estimation window $[T_0, \dots, T_1]$ comprises 200 trading days and ends 11 days prior to the respective first event days. If we define the event day as $t=0$, then $T_0=-210$ and $T_1=-11$. This window has been used for the estimation of the unknown parameters α_i , β_{i1} , β_{i2} , and β_{i3} in the Fama-French three-factor model including or not including a GARCH (1,1) process in the conditional disturbance terms. Based on the corresponding parameter estimates $\text{est}(\alpha_i)$, $\text{est}(\beta_{i1})$, $\text{est}(\beta_{i2})$, and $\text{est}(\beta_{i3})$ for each event firm i , the corresponding abnormal returns could be estimated. Our event window comprises several days prior and subsequent to the event days, as it is common in corresponding event studies. This approach is justified since a leakage of information to investors before the information was fully revealed to the public (at the event day) is possible. We specifically consider five days prior and five days subsequent to the event days, so that our event window $[T_2, \dots, T_3]$ with $T_2=-5$ and $T_3=5$ comprises overall eleven days. In this event window all individual abnormal returns ar_{i0} at the event day have

been estimated. Furthermore, we have estimated individual cumulated abnormal returns car_i for the time intervals $[-1,1]$ (with $T_a=-1, T_b=1$), $[-5,5]$ (with $T_a=-5, T_b=5$), $[1,5]$ (with $T_a=1, T_b=5$), and $[-5,-1]$ (with $T_a=-5, T_b=-1$). Additionally, we have particularly estimated the average abnormal returns aar_0 at the event day and the average cumulative abnormal returns $acar$ for the four aforementioned time intervals.

Our financial data stem from a carefully controlled unique database for German stock corporations (Stehle and Hartmond, 1991, Schulz and Stehle, 2002). The data contain the daily (discrete) stock returns r_{it} and r_{mt} (in %) for the event firms and for the German market portfolio, which comprises all stocks traded on the Frankfurt stock exchange. To calculate the two risk factors SMB_t and HML_t for the estimation of the Fama-French three-factor model, the data also contain the market and book values of all corporations whose stocks are traded on the Frankfurt stock exchange, except banks and insurances as well as stock corporations with negative book values (for details see Ziegler et al., 2007b). The risk-free interest rates r_{ft} (in %) are based on the one-month Frankfurt Interbank Offered Rate (FIBOR) and the one-month Euro Interbank Offered Rate (EURIBOR).

4. Results

Table 1 reports the estimation results for overall 51 inclusions in the DJSI STOXX or the DJSI World with respect to 35 corporations. In contrast, Table 2 only refers to the 23 inclusions in the DJSI STOXX and Table 3 only refers to the 28 inclusions in the DJSI World. The second and third columns, respectively, report the percentages of negative (and significantly negative) estimated abnormal returns $est(ar_{i0})$ for the event day as well as the percentages of negative (and significantly negative) estimated cumulated abnormal returns $est(car_i)$ for several time intervals. While the second column refers to the estimation results on the basis of only the three-factor model event study approach without the inclusion of the GARCH model,

the estimation results in the third column are based on the three-factor model and the GARCH model. The fourth and fifth columns report the estimated average abnormal returns $est(aar_0)$ across all events for the event day as well as the estimated average cumulated abnormal returns $est(acar)$ across all events for several time periods, respectively. While the fourth column again refers to the estimation results on the basis of only the three-factor model, the estimation results in the fifth column are based on the three-factor model and the GARCH model. Besides the common z-statistics according to Campbell et al. (1997) that are reported in the fourth and fifth columns, the fourth column additionally reports the corrected z-statistics according to Boehmer et al. (1991).

4.1. Joint analysis of the DJSI STOXX and the DJSI World

In the first step, we consider the inclusion in the DJSI STOXX or the DJSI World jointly. With respect to the first event dates, the upper part of Table 1 reports in the fourth and fifth columns that neither the average abnormal returns aar_0 at the event day nor the average cumulative abnormal returns $acar$ for the time interval $[-1,1]$ shortly around the event day are significantly different from zero. This result holds true on the basis of all three z-statistics, i.e. on the basis of both common z-statistics in the three-factor model with or without the additional inclusion of the GARCH model, as well as on the basis of the corrected z-statistic when the GARCH model is not additionally included in the three-factor model. In line with these estimation results, the percentages of negative $est(ar_{i0})$ and of negative $est(car_i)$ for the time interval $[-1,1]$ across the 51 inclusions in the sustainability stock indexes are close to 50% and in fact are not significantly different from 50% on the basis of a common sign test. Furthermore, the corresponding percentages of significantly negative ar_{i0} and car_i are very low.

In contrast, the $acar$ are significantly negative for the time interval $[-5,5]$ (with estimated values in the amount of -2.07%) on the basis of both the three-factor model with and without the

GARCH model, at least when the common z-statistics are applied. Only the use of the corrected z-statistics when the GARCH model is not additionally included in the three-factor model leads to an insignificant average cumulative abnormal return. By examining the first and second sub-period of the time interval $[-5,5]$, it can be seen that the time interval $[1,5]$ is the driver for these estimation results since in this case the acar are strongly significantly negative on the basis of all three z-statistics (at the 1% significance level, respectively). Similarly, the hypotheses that the percentages of negative $est(car_i)$ on the basis of both the three-factor model with and without the GARCH model for this time interval and the time interval $[-5,5]$ are 50% are rejected with the corresponding sign tests (at the 5% significance level, respectively). In contrast, the acar for the time interval $[-5,-1]$ are insignificant on the basis of any event study approach and any z-statistic. As a consequence, it can be concluded that the inclusion of German firms in the sustainability stock indexes DJSI World or DJSI STOXX rather had a negative impact on their stock returns. Against this background, hypothesis 1a can be rejected and hypothesis 1b can be confirmed.

According to these estimation results, there is obviously no leakage of information to investors before the information was fully revealed to the public (at the event day). In contrast, it seems that the information about the inclusion need a few days before the stock market reacts. This is in line with the estimation results in the lower part of Table 1 with respect to the second event dates for the inclusion in the DJSI STOXX or the DJSI World. In this case, the acar for the time interval $[1,5]$, similar to the acar for the time interval $[-1,1]$ and the aar_0 at the event day, are not robustly significant. In contrast, the acar for the time interval $[-5,-1]$ are significantly negative (at the 1% significance level) and as a consequence of this, the acar for the entire time interval $[-5,5]$ are significantly negative (at the 5% significance level), at least on the basis of the two uncorrected z-statistics, respectively. These negative impacts prior to the second event dates can thus be a result of the penetration of the information from the first event dates.

4.2. Separate analysis of the DJSI STOXX and the DJSI World

In the next step, we separately consider the inclusion in the DJSI STOXX and in the DJSI World in order to test hypothesis 2b that the inclusion in the DJSI World leads to stronger negative effects than the inclusion in the DJSI STOXX. The examination of the competing hypothesis 2a has already become irrelevant in our case since the joint analysis of the DJSI STOXX and the DJSI World in the previous section has identified negative effects of the inclusion in any one of the two sustainability stock indexes on stock returns. The main finding in Table 2, which reports the estimation results for the inclusion in the DJSI STOXX, is that neither the average abnormal returns aar_0 at the event day nor the average cumulative abnormal returns $acar$ for any time interval are significantly different from zero. According to the upper part of the table, this result holds true for the first event dates on the basis of all three z-statistics without exception. With respect to the second event dates, the lower part of the table reports one single exception, namely for the time interval $[-1,1]$. In this case the $acar$ is significantly negative (at the 5% significance level) if the common z-statistic on the basis of the three-factor model without the inclusion of the GARCH model is applied. However, the use of the common z-statistic on the basis of the three-factor model with the additional inclusion of the GARCH model only leads to a significantly negative $acar$ at the 10% significance level and the use of the corrected z-statistic when the GARCH model is not additionally included in the three-factor model even leads to an insignificant $acar$. According to this, the negative $est(acar)$ are not very robust. Furthermore, it would be ambiguous why only the second event dates, but not the first event dates should lead to average cumulative abnormal returns.

In contrast, the estimation results for the inclusion in the DJSI World are more conclusive. The upper part of Table 3 reports very robust significantly negative $acar$ (with estimated values in the amount of -4.31% and -4.36%) for the entire time interval $[-5,5]$ (at the 1% significance level). This finding holds true on the basis of all three z-statistics. In the same way, the

corresponding sign tests reject the hypotheses that the percentages of negative $est(car_t)$ for this time interval on the basis of both the three-factor model with and without the GARCH model are 50% (at the 1% significance level, respectively). Furthermore, it is obvious that the time interval [1,5] is the main driver for these estimation results. While the $est(acar)$ are strongly negative (in the amount of -2.67% and -2.63%) and the $acar$ are robustly significantly different from zero on the basis of all three z-statistics (at the 1% significance level, respectively) for this time interval, the negative $est(acar)$ have a smaller extent for the time interval [-5,-1]. Furthermore, only the use of the corrected z-statistic when the GARCH model is not additionally included in the three-factor model leads to a significantly negative $acar$ in this latter time interval. In addition, neither the average abnormal returns aar_0 at the event day nor the average cumulative abnormal returns $acar$ for the time interval [-1,1] are significantly different from zero on the basis of any event study approach and any z-statistic. Finally, with respect to the second event dates, the lower part of the table reports strong and very robust significantly negative $acar$ for the entire time interval [-5,5] and for the time interval [-5,-1] with all three z-statistics (at least at the 5% significance level, respectively). In contrast, the aar_0 at the event day as well as the $acar$ for the time intervals [-1,1] and [1,5] are not significantly different from zero on the basis of any event study approach and any z-statistic.

The estimation results in Table 2 and Table 3 imply that the significantly negative impacts on stock returns according to Table 1 are obviously mainly generated by the significantly negative effects of the inclusion in the DJSI World since the inclusion in the DJSI STOXX does not lead to robustly significant average cumulative abnormal returns for any time interval. According to this, the inclusion in a more recognized sustainability stock index, namely the DJSI World, leads to stronger negative impacts on stock returns than the inclusion in a less visible sustainability stock index, namely the DJSI STOXX. As a consequence, hypothesis 2b can be confirmed by our event study.

5. Conclusions

This paper empirically analyzes the effect of the inclusion of German corporations in sustainability stock indexes on stock performance. In this respect, we examine the DJSI STOXX, which claims to comprise the European leaders in terms of sustainability performance, and the DJSI World, which claims to comprise the respective world-wide leaders. In order to receive robust estimation results, our event study approach is based on both a modern asset pricing model, namely the three-factor model of Fama and French (1993), and additionally on a GARCH model. Our empirical analysis implies negative average cumulative abnormal returns, for example, in the amount of almost 2% for the five days after the first event dates. This result is obviously mainly driven by the effect of the inclusion in the DJSI World. While the average cumulative abnormal returns are insignificant if a firm is included in the DJSI STOXX, the inclusion in the DJSI World leads to strong negative impacts. For example, our empirical analysis implies in this case an average decrease of the stock returns in the amount of more than 4% for the five days after the first event dates.

Our estimation results point to two conclusions. First, the German stock market obviously penalizes the inclusion of a firm in a sustainability stock index. Assuming that the inclusion in a sustainability stock index is an appropriate indicator for CSR, our results therefore suggest that a higher corporate environmental or social performance and thus possible associated reputation gains or cost savings are not financially rewarded. However, it should be noted that the assessment and selection process for the composition of sustainability stock indexes is not yet standardized. With respect to the selection process, Ziegler and Schröder (2010) show that, for example, relatively high numbers of firms in the DJ STOXX 600 Index and the DJ World Index are never assessed at all, so that these corporations cannot be included in the DJSI STOXX or DJSI World, irrespective of their environmental or social activities. This lowers the quality of the inclusion in these sustainability stock indexes as reliable indicator for

sustainability performance (see also Fowler and Hope, 2007). Against this background, our estimation results are in line with the notion of Cañón-de-Francia and Garcés-Ayerbe (2009) for the case of the adoption of environmental management systems, namely that the inclusion in a sustainability stock index can be negatively assessed by investors as a purely symbolic action. According to this argumentation, the inclusion in a sustainability stock index is only a reaction to institutional pressures, which have required corporate activities and which have therefore led to additional unproductive costs. Therefore, our results do not support voluntary corporate activities aiming at the inclusion in a sustainability stock index. From a public policy perspective, our results furthermore question the application of information-based mechanisms in order to correct for market failures due to negative (environmental or social) external effects. The publication and spreading of such “bad news” about the inclusion in a sustainability stock index can rather lead to a further reduction of corresponding voluntary corporate activities. Second, the German stock market penalizes the inclusion in the DJSI World to a larger extent than the inclusion in the DJSI STOXX. In fact, the inclusion in the DJSI STOXX has (in line with the results of Doh et al., 2010, for the inclusion of US firms in the Calvert Social Index) no robust impact on stock returns at all. Therefore, our estimation results are in line with the notion that the inclusion in a more visible sustainability stock index has larger impacts.

With respect to the latter finding, it seems plausible that the world-wide DJSI World has a higher recognition on the stock markets than the DJSI STOXX. However, it would be interesting in the future to analyze the impact of the inclusion in several further more or less recognized sustainability stock indexes for the same group of firms, such as German corporations analyzed here. Examples are alternative Dow Jones Sustainability Indexes, such as the DJSI World 80 and the DJSI Eurozone, or other specific sustainability stock indexes with an environmental focus, such as the Natur-Aktien-Index (NAI). Another direction for further research would be the additional analysis of the exclusion from such sustainability stock indexes (such

as in Doh et al., 2010, with respect to the Calvert Social Index). In fact, we have additionally considered the exclusion of German corporations from the DJSI STOXX or DJSI World between 1999 and 2002 (the estimation results are available upon request from the authors). This analysis implies some negative average cumulative abnormal returns. However, these estimation results should be treated with caution since the small number of analyzed events (only four exclusions from the DJSI STOXX and three exclusions from the DJSI World) could distort robust conclusions. In other words, it is likely that the estimation results are influenced by single firm specific characteristics.

Finally, it would be interesting in the future to expand the population within a comparative international analysis, for example, with European, American, and Asian firms. However, the prerequisite for such event studies is the availability of corresponding financial data, particularly with respect to risk factors. While such risk factors, for example, according to Fama and French (1993) or Carhart (1997) are accessible for the US stock market, they are not available for most other world-wide stock markets so far. Therefore, making risk factors available for other world regions would be an additional valuable contribution to enable future research.

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Tables

Table 1: Estimated abnormal returns $est(ar_{it})$, estimated cumulative abnormal returns $est(car_i)$, estimated average abnormal returns $est(aar_t)$, and estimated average cumulative abnormal returns $est(acar)$ for the inclusion in the DJSI STOXX or the DJSI World, basis: three-factor model event study approach, number of events (firms): 51 (35)

Event day or time interval	Percentage of negative $est(ar_{i0})$ or $est(car_i)$ (percentage of ar_{it} or car_i that differ from zero at the 5% significance level)	Percentage of negative $est(ar_{i0})$ or $est(car_i)$ with inclusion of GARCH model (percentage of ar_{it} or car_i that differ from zero at the 5% significance level))	$est(aar_0)$ or $est(acar)$ (z-statistic) [corrected z-statistic]	$est(aar_0)$ or $est(acar)$ with inclusion of GARCH model (z-statistic)
First event dates				
Event day	47.06% (7.84%)	50.98% (7.84%)	-0.29% (-0.94) [0.01]	-0.34% (-1.12)
[-1,1]	54.90% (3.92%)	54.90% (3.92%)	-0.85% (-1.60) [-0.88]	-0.83% (-1.55)
[-5,5]	66.67% (7.84%)	64.71% (9.80%)	-2.07% (-1.98)** [-1.23]	-2.07% (-1.96)**
[1,5]	66.67% (3.92%)	68.63% (5.88%)	-1.88% (-2.72)*** [-2.80]***	-1.86% (-2.70)***
[-5,-1]	54.90% (1.96%)	56.86% (3.92%)	0.09% (0.13) [0.44]	0.13% (0.19)
Second event dates				
Event day	37.25% (9.80%)	37.25% (9.80%)	0.23% (0.73) [1.10]	0.16% (0.52)
[-1,1]	52.94% (9.80%)	54.90% (11.76%)	-0.87% (-1.62) [-0.58]	-0.88% (-1.66)*
[-5,5]	56.86% (13.73%)	54.90% (13.73%)	-2.26% (-2.15)** [-1.00]	-2.28% (-2.15)**
[1,5]	56.86% (5.88%)	56.86% (5.88%)	-0.40% (-0.58) [-0.52]	-0.38% (-0.55)
[-5,-1]	58.82% (17.65%)	58.82% (15.69%)	-2.09% (-3.00)*** [-1.22]	-2.06% (-2.87)***

Note: * (**, ***) means that the null hypothesis that the average abnormal returns aar_t or the average cumulative abnormal returns $acar$ are zero can be rejected at the 10% (5%, 1%) significance level (according to the corresponding two-tailed z-tests)

Table 2: Estimated abnormal returns $est(ar_{it})$, estimated cumulative abnormal returns $est(car_i)$, estimated average abnormal returns $est(aar_t)$, and estimated average cumulative abnormal returns $est(acar)$ for the inclusion in DJSI STOXX, basis: three-factor model event study approach, number of events (firms): 23 (23)

Event day or time interval	Percentage of negative $est(ar_{i0})$ or $est(car_i)$ (percentage of ar_{it} or car_i that differ from zero at the 5% significance level)	Percentage of negative $est(ar_{i0})$ or $est(car_i)$ with inclusion of GARCH model (percentage of ar_{it} or car_i that differ from zero at the 5% significance level))	$est(aar_0)$ or $est(acar)$ (z-statistic) [corrected z-statistic]	$est(aar_0)$ or $est(acar)$ with inclusion of GARCH model (z-statistic)
First event dates				
Event day	30.43% (8.70%)	34.78% (8.70%)	-0.18% (-0.37) [0.92]	-0.27% (-0.56)
[-1,1]	47.83% (4.35%)	47.83% (4.35%)	-0.64% (-0.74) [0.26]	-0.55% (-0.63)
[-5,5]	47.83% (4.35%)	47.83% (4.35%)	0.65% (0.38) [1.08]	0.72% (0.41)
[1,5]	69.57% (0.00%)	69.57% (4.35%)	-0.92% (-0.83) [-0.90]	-0.93% (-0.84)
[-5,-1]	43.48% (4.35%)	39.13% (8.70%)	1.76% (1.56) [1.44]	1.92% (1.59)
Second event dates				
Event day	30.43% (13.04%)	30.43% (13.04%)	-0.27% (-0.55) [0.72]	-0.34% (-0.71)
[-1,1]	56.52% (13.04%)	56.52% (13.04%)	-1.71% (-1.99)** [-0.75]	-1.65% (-1.93)*
[-5,5]	43.48% (8.70%)	43.48% (8.70%)	-0.17% (-0.10) [0.58]	-0.09% (-0.05)
[1,5]	60.87% (8.70%)	60.87% (8.70%)	-1.15% (-1.03) [-0.87]	-1.10% (-1.00)
[-5,-1]	43.48% (8.70%)	43.48% (8.70%)	1.25% (1.10) [1.10]	1.35% (1.13)

Note: * (**, ***) means that the null hypothesis that the average abnormal returns aar_t or the average cumulative abnormal returns $acar$ are zero can be rejected at the 10% (5%, 1%) significance level (according to the corresponding two-tailed z-tests)

Table 3: Estimated abnormal returns $est(ar_{it})$, estimated cumulative abnormal returns $est(car_i)$, estimated average abnormal returns $est(aar_t)$, and estimated average cumulative abnormal returns $est(acar)$ for the inclusion in the DJSI World, basis: three-factor model event study approach, number of events (firms): 28 (27)

Event day or time interval	Percentage of negative $est(ar_{i0})$ or $est(car_i)$ (percentage of ar_{it} or car_i that differ from zero at the 5% significance level)	Percentage of negative $est(ar_{i0})$ or $est(car_i)$ with inclusion of GARCH model (percentage of ar_{it} or car_i that differ from zero at the 5% significance level))	$est(aar_0)$ or $est(acar)$ (z-statistic) [corrected z-statistic]	$est(aar_0)$ or $est(acar)$ with inclusion of GARCH model (z-statistic)
First event dates				
Event day	60.71% (7.14%)	64.29% (7.14%)	-0.37% (-0.99) [-1.37]	-0.39% (-1.03)
[-1,1]	60.71% (3.57%)	60.71% (3.57%)	-1.02% (-1.56) [-1.55]	-1.06% (-1.61)
[-5,5]	82.14% (10.71%)	78.57% (14.29%)	-4.31% (-3.34) ^{***} [-3.97] ^{***}	-4.36% (-3.41) ^{***}
[1,5]	64.29% (7.14%)	67.86% (7.14%)	-2.67% (-3.09) ^{***} [-2.87] ^{***}	-2.63% (-3.04) ^{***}
[-5,-1]	64.29% (0.00%)	71.43% (0.00%)	-1.27% (-1.49) [-2.36] ^{**}	-1.33% (-1.60)
Second event dates				
Event day	42.86% (7.14%)	42.86% (7.14%)	0.64% (1.63) [0.84]	0.57% (1.41)
[-1,1]	50.00% (7.14%)	53.57% (10.71%)	-0.18% (-0.26) [-0.14]	-0.25% (-0.38)
[-5,5]	67.86% (17.86%)	64.29% (17.86%)	-3.98% (-3.07) ^{***} [-2.14] ^{**}	-4.08% (-3.16) ^{***}
[1,5]	53.57% (3.57%)	53.57% (3.57%)	0.21% (0.24) [0.00]	0.21% (0.24)
[-5,-1]	71.43% (25.00%)	71.43% (21.43%)	-4.83% (-5.58) ^{***} [-2.56] ^{**}	-4.86% (-5.70) ^{***}

Note: * (**, ***) means that the null hypothesis that the average abnormal returns aar_t or the average cumulative abnormal returns $acar$ are zero can be rejected at the 10% (5%, 1%) significance level (according to the corresponding two-tailed z-tests)