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Non-technical Summary

This paper examines the determinants of the inclusion of European companies in the Dow Jones Sustainability World Index and the Dow Jones STOXX Sustainability Index. These stock indexes intend to comprise the 10% most sustainable corporations of the biggest 2500 corporations in the Dow Jones World Index and the 20% most sustainable corporations in the Dow Jones STOXX 600 Index. In doing so, our paper contributes to the micro-econometric literature analyzing the determinants and economic effects of sustainability performance in three respects: First, it examines a broad measure of corporate sustainability behaviour. This is in contrast to other studies which only apply narrow measures of environmental performance such as toxic releases. Second, the paper examines the effect of internal assessment processes regarding corporate sustainability performance by an independent financial service institution. Finally, it analyzes the influence of unobserved heterogeneity in the framework of panel data models.

Our analysis shows that the probability for an inclusion in the sustainability stock indexes strongly decreases if a company does not respond to the written survey of the assessing institution. Furthermore, time invariant random effects and an autoregressive structure in the stochastic components are important factors. Whereas firm size has a strong positive effect and the ratio between sales and total assets a negative effect on the inclusion in the sustainability stock indexes, a significant influence of past economic performance cannot be confirmed robustly.

According to these estimation results, the participation in the written survey obviously matters for the inclusion of corporations in the sustainability stock indexes. Therefore, we conclude that not only corporate sustainability performance itself, but also specific elements of the internal assessment process regarding sustainability performance matter for the inclusion of a corporation in a sustainability stock index. Another conclusion is that due to the strong state

dependence (many of the examined corporations are either included or not included in the sustainability stock indexes during the entire observation periods), biased and inconsistent estimations are likely if only cross-sectional data are used.

What Determines the Inclusion in a Sustainability Stock Index?
A Panel Data Analysis for European Companies

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What Determines the Inclusion in a Sustainability Stock Index?

A Panel Data Analysis for European Companies

Abstract

This paper examines the determinants of the inclusion of European companies in the Dow Jones Sustainability World Index and the Dow Jones STOXX Sustainability Index. In doing so, the paper contributes to the micro-econometric literature analyzing the determinants and economic effects of sustainability performance in three respects: First, it examines a broad measure of corporate sustainability behavior and thus does not only apply narrow measures of environmental performance such as toxic releases which is common in other studies. Second, the paper examines the effect of internal assessment processes regarding corporate sustainability performance by an independent financial service institution. Finally, it analyzes the influence of unobserved heterogeneity in the framework of panel data models. The analysis shows that the probability for an inclusion in the sustainability indexes strongly decreases if a company does not respond to the written survey of the assessing institution. Furthermore, time invariant random effects and an autoregressive structure in the stochastic components are important factors. In contrast, a significant influence of past economic performance cannot be confirmed robustly.

Keywords: Corporate sustainability performance, Sustainability stock indexes, Economic performance, Panel data, Probit models, Simulated maximum likelihood estimation.

JEL classification: Q01, Q56, G30, C23.

1. Introduction

The environmental and social behavior of stock corporations has attracted increasing interest in the last few years. This interest stems, for example, from investors in specific funds which consider environmental and/or social (or ethical) criteria and thus are specialized in so called socially responsible investments (SRI). In the discussion on SRI, an integrated perspective of environmental and social performance of companies is understood as corporate sustainability performance. The interest in corporate sustainability performance also stems from corporations (i.e. managers and shareholders) themselves since environmental and social performance are important factors for the public image and thus also for public and investor relations. In this respect, it is particularly important to know the determinants and economic effects of corporate sustainability performance. Concerning the economic effects, it is likely that the acceptance and diffusion of SRI depend on its economic success. In other words, it can be assumed that a good economic performance is important for attracting SRI. Furthermore, also policy should be interested in knowledge about economic effects of corporate sustainability performance, for example with respect to the design of regulations such as public disclosure programs pertaining to the environmental performance of companies. However, an appropriate design of regulations obviously also requires information about the determinants of corporate sustainability performance regarding, for example, the influence of the economic performance of companies.

Therefore, we examine this issue for European Dow Jones STOXX 600 Index (DJI STOXX 600) companies in our paper. Also with respect to investors, we measure corporate sustainability performance by the inclusion in two sustainability stock indexes: The Dow Jones Sustainability World Index (DJSI World) and the Dow Jones STOXX Sustainability Index (DJSI STOXX). According to this, corporations that are included in these stock indexes are marked as particularly sustainable, whereas corporations that are not included are regarded as less

sustainable. These stock indexes intend to comprise the 10% most sustainable corporations of the biggest 2500 corporations in the Dow Jones World Index (DJI World) and the 20% most sustainable corporations in the DJI STOXX 600. In contrast to previous micro-econometric studies analyzing the determinants and economic effects of corporate sustainability performance (concerning the determinants, see amongst others Doonan et al. 2005, concerning the economic effects, see amongst others Filbeck and Gorman, 2004), we consider a broad measure of corporate sustainability behavior. We do not examine narrow measures of environmental performance as, for example, toxic releases (see e.g. King and Lenox, 2001) or environmental organizational measures (see e.g. Khanna and Anton, 2002) which address only one component of corporate sustainability performance. Corporate sustainability performance is instead a relatively complex composition of the environmental and social behavior of companies. Based on surveys with detailed questionnaires, specialized independent financial service institutions assess the corporate sustainability performance covering these different aspects.

However, as corporate sustainability performance is not yet standardized, there exist different measures with a certain amount of subjectivity. Being aware of the subjective or normative elements of such assessments, the second contribution of our paper is the analysis of these internal assessment processes. This seems to be particularly interesting for investors since they certainly would like to know whether also internal assessment processes regarding corporate sustainability performance (and not only environmental and social criteria) play an important role for the inclusion of corporations in sustainability stock indexes. Finally, this paper applies panel data models that include lagged explanatory variables and particularly unobserved heterogeneity. The main reason for this choice is that spurious correlations can occur due to unobserved firm characteristics and that the direction of causality of the relationship between corporate sustainability and economic performance is not clear. Waddock and Graves (1997) already point to this causality problem and therefore examine both the effect of

corporate sustainability on economic performance and the reverse effect. However, most econometric studies at the firm level which analyze the determinants or economic effects of corporate sustainability performance (including Waddock and Graves, 1997) use cross-sectional data and therefore cannot address these endogeneity problems.

Our analysis shows that the probability for an inclusion in the sustainability indexes strongly decreases if a company does not respond to the written survey of the assessing institution. Furthermore, time invariant random effects and an autoregressive structure in the stochastic components are important factors. While firm size has a strong positive effect and the ratio between sales and total assets a negative effect on the inclusion in the sustainability stock indexes, a significant influence of economic performance in the past cannot be confirmed robustly. We conclude that not only corporate sustainability performance itself, but also specific elements of the internal assessment process regarding sustainability performance matters for the inclusion of a corporation in a sustainability stock index. Another conclusion is that due to the strong state dependence (many of the examined corporations are either included or not included in the sustainability stock indexes during the entire observation periods), biased and inconsistent estimations are likely in other similar studies if only cross-sectional data are used.

The structure of the paper is as follows: The second section reviews the corresponding micro-econometric literature. The third section explains the methodological approach including panel probit models. The fourth section describes the explanatory variables and the data and provides some descriptive statistics. The fifth section discusses the results of the panel probit analysis. The final section concludes.

2. Literature Background

The determinants and economic effects of corporate sustainability performance have been examined for a long time in the framework of econometric approaches at the firm level. One strand of this research is event studies. Such event studies consider short-term reactions of stock prices due to particular published information on the sustainability behavior of a corporation (see e.g. Hamilton, 1995, Klassen and McLaughlin, 1996, Konar and Cohen, 1997, Khanna et al., 1998, Dasgupta et al., 2001, 2004, Gupta and Goldar, 2005). These (mainly environmentally relevant) events can have the character of negative news such as information about toxic emissions according to the Toxic Release Inventory (TRI) in the U.S. as well as positive news such as information about companies winning environmental awards. Indeed, the main weakness of previous event studies (besides the rather narrow measure of corporate sustainability performance) is their short-term character. Thus, short-term over-reactions of stock markets are possible that may be compensated over time.

Therefore, another strand of research goes beyond this short-term consideration of the economic effects of corporate sustainability performance. Such micro-econometric studies can, for example, be found in Hart and Ahuja (1996), Waddock and Graves (1997), Konar and Cohen (2001), King and Lenox (2001), Thomas (2001), Wagner et al. (2002), Rennings et al. (2003), or Filbeck and Gorman (2004). Most of this research with cross-sectional or panel data (in the same way as event studies) finds a positive influence of sustainability performance on economic performance. One explanation for these positive effects is that a good corporate sustainability performance is an indicator for good management (see e.g. Waddock and Graves, 1997). Furthermore, the future benefits of environmentally or socially responsible actions can exceed their costs regarding impending penalties or even lawsuits, for example. Another explanation is that a better corporate sustainability performance improves relationships with key stakeholder groups. For example, good employee relationships can improve

morale or satisfaction and thus productivity of companies. Furthermore, the environmental properties of products and the government or community relationships could also become increasing competition factors.

However, as already noted by Waddock and Graves (1997), the direction of causality of the relationship between corporate sustainability and economic performance is not clear. It could also be argued that companies with a better economic performance have less difficulties to pay attention to stakeholders and to obey moral standards or can invest in new capital which inevitably (even when not intended) leads to, for example, lower emissions and thus to a better sustainability performance (see e.g. Telle et al., 2004). This is the reason why Waddock and Graves (1997) also analyze the effects of economic performance on corporate sustainability performance. According to their analysis, corporate sustainability performance is actually positively influenced particularly by return on assets, but also by return on sales or return on equity. Other investigations of the determinants of corporate sustainability performance (i.e. environmental performance) can, for example, be found in Arora and Cason (1995, 1996), DeCanio and Watkins (1998), Dasgupta et al. (2000), Nakamura et al. (2001), Khanna and Anton (2002), Foulon et al. (2002), Anton et al. (2004), Doonan et al. (2005), or Shimshack and Ward (2005). It should be noted that only some of these studies consider economic performance as an explanatory variable. Furthermore, economic performance is mostly not focused as a main determinant even in these studies.

As aforementioned, our paper also examines the determinants of corporate sustainability performance. However, we apply a broad measure since corporate sustainability performance obviously cannot be represented by one-dimensional indicators due to the multidimensionality of this construct. Indeed, most studies cited above still do this. For example, event studies only consider specific (environmentally relevant) events. But also micro-econometric studies based on cross-sectional or panel data frequently apply rather narrow indicators which often

comprise only the environmental dimension of corporate sustainability performance. For example, Hart and Ahuja (1996), Konar and Cohen (2001), or King and Lenox (2001) only consider the emissions according to the TRI to analyze the economic effects of corporate sustainability performance. Concerning the determinants of corporate sustainability performance (i.e. environmental performance), Arora and Cason (1995, 1996), DeCanio and Watkins (1998), Nakamura et al. (2001), and Khanna and Anton (2002) investigate environmental organizational measures such as the participation in voluntary public programs encouraging proactive environmental management, while Anton et al. (2004) additionally consider emissions according to the TRI. Dasgupta et al. (2000) and Shimshack and Ward (2005) examine self-assessed compliance with environmental regulation (Foulon et al., 2002, examine compliance rates in addition to emissions). Such measures are relevant but also very narrow indicators, even for corporate environmental performance. In contrast, Doonan et al. (2005) use (in the framework of structural equation models) with respect to corporate environmental performance a number of different variables including, for example, organizational measures and compliance rates with regulation.

3. Methodological Approach

However, Doonan et al. (2005) do not analyze the social dimension of corporate sustainability performance, either. In contrast, Waddock and Graves (1997) and Rennings et al. (2003) apply broad measures of corporate sustainability performance that include both an environmental and a social dimension. Both studies use measures that are based on assessments by independent financial service institutions. In this paper, we adopt this approach by analyzing the corporate sustainability performance assessments from SAM (Sustainable Asset Management) Group for European DJI STOXX 600 companies. SAM is an independent and internationally active financial services institution with an exclusive focus on sustainability and was

among the first companies to specialize in sustainability investments. As a pioneer in this field, SAM has built up a large pool of specialist knowledge and experience. However, we do not analyze their raw assessments since assessment data for all relevant European corporations (i.e. the corporations in the DJI STOXX 600) are not available. If we only examine the group of companies which has been assessed by SAM (this group comprises mainly those companies that have responded to the written survey), self-selection problems can be expected.

Therefore, we use the inclusion in the DJSI World and in the DJSI STOXX as indicators for corporate sustainability performance. Together with Dow Jones Indexes and STOXX Limited, SAM 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). All these sustainability stock indexes are based on corporate sustainability performance assessments from SAM. The DJSI World comprises the world-wide leaders. In other words, the 10% most sustainable corporations of each sector of the biggest 2500 corporations in the DJI World are intended to be included in the DJSI World. The DJSI STOXX comprises the European leaders. In other words, the 20% most sustainable European corporations of each sector in the DJI STOXX 600 are intended to be included in the DJSI STOXX. The examination of the sustainability stock indexes instead of the raw assessments also allows insights into the internal assessment and final selection process of financial service institutions. The underlying hypothesis is that the inclusion of a corporation in a sustainability stock index is not only determined by environmental and social criteria, but also by the internal assessment process regarding corporate sustainability performance.

Finally, it should be emphasized that we analyze panel data for the time period from 1999 to 2004 (for the DJSI World) and from 2001 to 2004 (for the DJSI STOXX). In doing so, we try to circumvent problems with cross-sectional data regarding the direction of causality of the

relationship between corporate sustainability and economic performance. As discussed above, a good economic performance can improve corporate sustainability performance, but a good corporate sustainability performance can also lead to better economic performance. Furthermore, spurious correlations could also occur due to unobserved firm characteristics. For example, a good management can positively influence both corporate sustainability and economic performance. Thus, micro-econometric analyses with cross-sectional data which do not address these endogeneity problems can lead to biased and inconsistent estimations, even if lagged explanatory variables are used. Therefore, we apply panel data models that include unobserved heterogeneity besides lagged explanatory variables. This unobserved heterogeneity refers to time invariant firm-specific random effects and to an autoregressive structure in the stochastic components. An example for time invariant factors is a business strategy that does not vary over time and an example for factors that decrease over time is a singular decision about employee wages. An application of panel data models can, for example, be found in King and Lenox (2001). However, their study only examines the effects of corporate environmental performance on economic performance.

Since we examine the determinants of the inclusion of European DJI STOXX 600 corporations in the DJSI World and the DJSI STOXX, the dependent variable is binary. Therefore, we construct an unobservable latent variable ($i = 1,\ldots,N;\ t = 1,\ldots,T$)

$$U_{it} = \beta' x_{it} + \varepsilon_{it}$$

and assume that a corporation i is included in one of the sustainability stock indexes in year t if $U_{it} > 0$. Based on this, we define an observable indicator variable:

$$SSI_{it} = \begin{cases} 1 & \text{if } U_{it} > 0 \\ 0 & \text{otherwise} \end{cases}$$

The vectors of the K known explanatory variables are $x_{it}=(x_{it1},\ldots,x_{itK})'$ and the corresponding unknown parameter vector is $\beta=(\beta_1,\ldots,\beta_K)'$. In the following, P($SSI_{it}$ = 1) denotes the prob-

ability for the inclusion in one of the sustainability stock indexes. Since we consider probit models, the unobservable stochastic components ε_{it} are normally distributed. Unobserved heterogeneity can be incorporated by decomposing these components (see e.g. Börsch-Supan, 1992, Hajivassiliou, 1994, Mühleisen and Zimmermann, 1994):

$$\varepsilon_{it} = \alpha_i + \nu_{it}$$

The α_i represent time invariant firm-specific random effects with $\alpha_i \sim N(0; \sigma_\alpha^2)$ ($i = 1,...,N$). An autoregressive structure can be incorporated by decomposing the stochastic component ν_{it} in

$$\nu_{it} = \rho \nu_{i,t-1} + \xi_{it}$$

with $\xi_{it} \sim N(0; 1)$ ($i = 1,...,N$; $t = 1,...,T$) and $|\rho| < 1$. In a panel probit model with time invariant random effects the parameter σ_α^2, and in a panel probit model with an autoregressive structure the parameter ρ have to be estimated besides the parameters in β. The maximum likelihood estimation of panel probit models with time invariant stochastic effects is feasible with standard software packages (such as STATA). In contrast, the estimation of models with an autoregressive structure is more complex due to the underlying multiple (i.e. T-dimensional) integrals in the probabilities $P(SSI_{it} = 1)$. Therefore, the application of simulation methods in the maximum likelihood estimation is necessary (see e.g. Ziegler and Eymann, 2001) and thus standard software packages cannot be applied. In this study, we apply a GAUSS program that uses the so called GHK (Geweke-Hajivassiliou-Keane) simulator (see Börsch-Supan and Hajivassiliou, 1993, Geweke et al., 1994, Keane, 1994) in the maximum likelihood method. As a rule, we always use 100 random draws in this simulator for our panel probit analysis.

4. Explanatory Variables, Data, and Descriptive Statistics

One main explanatory variable in x_{it} (for corporation i in year t) is economic performance. We consider return on assets (multiplied by ten) (*ROA*). Return on assets is defined as the ratio between operating income and total assets, where operating income is equal to the before-tax profit plus financial expenses. Thus, this indicator for economic performance measures the profitability of a company before tax and interest. Return on assets is also used in the studies of Arora and Cason (1995) and Waddock and Graves (1997). Alternatively, we also consider Tobin`s Q (*TobinsQ*) to analyze the robustness of the effect of economic performance. This variable is defined as the sum of market value and total debts divided by total assets. Furthermore, we incorporate two other financial variables as control variables as it is common in micro-econometric analyses of the determinants of environmental performance.

The first control variable is the ratio between sales and total assets (*Sales/Assets*) and is also considered in the studies of Khanna and Anton (2002) and Anton et al. (2004). Khanna and Anton (2002) argue that a low ratio between sales and total assets (i.e. a high ratio between capital and output) of corporations is an indicator for a stronger dependence on capital markets as well as on idle capacity and poorer financial health. As a consequence, these corporations are more likely to be concerned about negative investor and market reactions and therefore increase environmental organizational measures. The second control variable is the ratio between total debts and total assets (*Debts/Assets*). This variable is, for example, incorporated in the studies of Arora and Cason (1995) and Nakamura et al. (2001). Waddock and Graves (1997) also use this ratio as an indicator for the risk tolerance of the management. Nakamura et al. (2001) argue that companies with low debts can have more flexibility to finance activities for environmental organizational measures. Finally, we include firm size, namely sales (*Sales*) or alternatively the market value (*MVE*), as a further control variable. In this respect, the natural logarithm of sales or the market value is used to analyze a non-linear effect. Na-

kamura et al. (2001) argue that firm size is an indicator for the capacity of a company to perform activities since the improvement in corporate sustainability performance leads to fixed costs that are less significant for larger companies. It should be noted that all these explanatory variables are used in the panel probit models with a one year lag.

This paper also examines effects of internal assessment processes regarding corporate sustainability performance. The assessment process of SAM has two dimensions: The first dimension is based on the responses to the annual written surveys. The second dimension contains further internal assessments that are performed for some of the non-responding companies. Corporations that are not assessed in these two dimensions in a specific year are neither included in the DJSI World nor included in the DJSI STOXX in this year. We incorporate a dummy variable (*Answer*) which addresses this assessment process. It takes the value one if a company participates in the written survey. Finally, we also incorporate dummy variables for some countries to control for regional or political effects. It is, for example, possible that different regulations in the countries can lead to different levels of corporate sustainability performance. We analyze companies from altogether 16 countries, namely from *Austria*, *Belgium*, *Denmark*, *Finland*, *France*, *Germany*, *Greece*, *Ireland*, *Italy*, the *Netherlands*, *Norway*, *Portugal*, *Spain*, *Sweden*, *Switzerland*, and the *United Kingdom*. The corresponding dummy variables take the value one if a company has its headquarters in this country. It should be noted that we do not include sector dummies since our measure of corporate sustainability performance is based on a so-called best of class approach. In other words, the sustainability stock indexes already comprise the most sustainable corporations of each sector.

The data for the internal assessment process are directly from SAM, the financial data from Bloomberg. We analyze the inclusion in the DJSI World for $T = 6$ years from 1999 to 2004 and the inclusion in the DJSI STOXX for $T = 4$ years from 2001 to 2004 since the DJSI STOXX was launched only in 2001. Our population are the European corporations that were

continuously included in the DJI STOXX 600 between 1999 and 2004. In other words, we consider a balanced panel. As a consequence, we can examine altogether N = 253 corporations in the DJI STOXX 600 and thus $N \cdot T$ = 1518 or $N \cdot T$ = 1012 observations for which we have all relevant financial data over the entire observation period. 674 out of these 1518 observations (= 44.40%, see also Table 1) are assessed according to the written survey (i.e. *Answer* = 1). 651 observations (= 42.89%) are not assessed at all (i.e. they have neither responded to the survey nor have been internally assessed by SAM).

Most of the examined 253 companies are from the United Kingdom, France, and Germany. The corresponding numbers are displayed in Table 1. This table also reports for each country the shares of corporations that are included in the DJSI World (for $N \cdot T$ = 1518) and the DJSI STOXX (for $N \cdot T$ = 1012) as well as the shares of companies that participate in the written survey (for $N \cdot T$ = 1518). According to this, the participation rates strongly differ over the countries between 0% (for Austria, Greece, and Portugal) and 78.33% for Switzerland. These participation rates are obviously strongly positively correlated with the shares for the inclusion in the sustainability stock indexes. For example, corporations from Austria, Greece, and Portugal are, according to the 0% survey participation rates, not at all included in the DJSI World or the DJSI STOXX over the entire observation period. It should be noted that the dummy variables for countries with a rather low or even no inclusion in the sustainability stock indexes are not incorporated in the panel probit analysis. The average survey participation rates over all 253 corporations and over all six examined years amounts to 44.40%. The corresponding average shares of corporations that are included in the DJSI World and the DJSI STOXX are 34.12% and 42.39%. These shares are rather high if one bears in mind the intended composition of these sustainability stock indexes and are clearly a consequence of the consideration of a balanced panel.

Table 2 reports how the shares of corporations that are included in the DJSI World and in the DJSI STOXX as well as how the shares of companies that participate in the written survey develop over time. According to this, the survey participation rates strongly increase from 31.23% in 1999 to 55.34% in 2004 which might be due to an increasing publicity of the sustainability stock indexes. While the shares of companies that are included in the DJSI STOXX are rather stable between 2001 and 2004, the corresponding shares for the DJSI World strongly increase over time, particularly from 28.46% in 2001 to 42.69% in 2002. Subsequently, the shares remain on this level in 2003 and 2004. The strong increase between 2001 and 2002 is due to an increase in the number of corporations that have been considered for the inclusion in the DJSI World. In other words, in the years before 2002 the DJSI World intends to comprise the 10% most sustainable corporations of each sector on the basis of only the biggest 2000 instead of now 2500 world-wide corporations in the DJI World. As a consequence, the number of European corporations that are included in the DJSI World also increases in 2002.

5. Results of the Panel Probit Analysis

While Table 3 and Table 4 report the estimation results in panel probit models regarding the determinants of the inclusion in the DJSI World, Table 5 reports the corresponding estimation results for the DJSI STOXX. The estimated panel probit models according to Table 3 do not include the variable *Answer* which addresses the participation in the written survey. The four estimated model versions differ with respect to the inclusion or exclusion of the two types of unobserved heterogeneity (i.e. time invariant random effects and an autoregressive structure in the stochastic components). The estimated panel probit models according to Table 4 and Table 5 include *Answer* and both types of unobserved firm characteristics. The four estimated

model versions in each case differ with respect to the inclusion or exclusion of the two economic performance variables *ROA* or *TobinsQ* and the two firm size variables *Sales* or *MVE*.

According to Table 3, unobserved heterogeneity is obviously an important factor. Based on the values of the loglikelihood function, the appropriate likelihood ratio tests imply that the assumption of the independent panel probit model can be rejected at all commonly used levels of significance in support of the random effects probit model or the autocorrelation probit model as well as in support of the combined random effects and autocorrelation probit model. Likewise, the assumption of the random effects probit model or the assumption of the autocorrelation probit model can be rejected in support of the most flexible panel probit model. According to this, the distinction between these two types of unobserved heterogeneity is important. In other words, the effect of the time invariant random effects or of an autoregressive structure in the stochastic components is obviously over-estimated if only one of both types of unobserved heterogeneity is included alone in the panel probit model, since the estimated parameters σ_α and ρ decrease in the combined random effects and autocorrelation probit model.

Despite this importance of unobserved firm heterogeneity, the estimation results for the explanatory variables are very robust over all four examined model versions. Table 3 shows that the parameter estimates of return on assets are positive (in accordance with Arora and Cason, 1995, and Waddock and Graves, 1997), but that *ROA* has no influence at the 10% level of significance. This is in accordance with some estimation results of Arora and Cason (1995), but Waddock and Graves (1997) find that return on assets has a significantly positive effect as discussed above. In contrast, the natural logarithm of sales has a positive effect and the ratio between sales and total assets a negative effect on the probability for the inclusion in the DJSI World at the 1% level of significance. This conforms to the estimation results of Nakamura et al. (2001) for firm size as well as to the estimation results of Khanna and Anton (2002) and Anton et al. (2004) with respect to the ratio between sales and total assets. The parameter es-

timates of *Debts/Assets* are positive, but this variable has no influence at the 10% level of significance. This is in accordance with the estimation results of Arora and Cason (1995) and some estimation results of Waddock and Graves (1997), but contradicts the estimation results of Nakamura et al. (2001) who find a significantly negative effect.

According to Table 4, the estimation results for both types of unobserved heterogeneity, the insignificant effect of economic performance, and the positive significant effect of firm size remain extremely robust if the internal assessment variable *Answer* is included in the different panel probit models. In other words, the inclusion of *Answer* has no effect on these estimations (it only leads to the insignificance of the influence of some country dummies). It should be noted that the estimation results for economic performance do not depend on the inclusion of either *ROA* or *TobinsQ* and the estimation results for firm size do not depend on the inclusion of either *Sales* or *MVE*. Only the negative influence of *Sales/Assets* becomes insignificant if firm size is measured by the natural logarithm of the market value instead of the natural logarithm of sales. Thus, the negative effect of the ratio between sales and total assets is obviously covered by the inclusion of *MVE* as measure for firm size. However, the main estimation result according to Table 4 refers to the internal assessment variable *Answer* itself: The participation in the written survey has a strong positive effect on the probability for the inclusion in the DJSI World at the 1% level of significance (and even a clearly smaller level of significance). It should be noted that the corresponding parameter estimates are extremely stable over all four estimated model versions.

The estimation results regarding the determinants of the inclusion in the DJSI STOXX are qualitatively very similar to those for the DJSI World, although only the four years from 2001 to 2004 are analyzed here. Table 5 shows the strong significantly positive influence of the participation in the written survey, the insignificant influence of return on assets, the significantly positive influence of firm size, and the importance of both types of unobserved hetero-

geneity (the estimation results in the independent panel probit model and in the panel probit models with only one type of unobserved heterogeneity are not displayed in this paper, but are available on request). The only qualitative difference to the estimation results in Table 4 is the positive effect of Tobin`s Q at the 5% level of significance. However, this estimation result only holds if firm size is measured by the natural logarithm of sales. In contrast, the influence of Tobin`s Q becomes again insignificant if firm size is measured by the natural logarithm of the market value.

6. Conclusions

This paper examines for European DJI STOXX 600 companies the determinants of sustainability performance. This corporate sustainability performance is broadly measured by the inclusion in the DJSI World and the DJSI STOXX and therefore considers an integrated perspective of environmental and social performance. The panel probit analysis from 1999 to 2004 (for the DJSI World) and from 2001 to 2004 (for the DJSI STOXX) shows that the probability for an inclusion in these sustainability indexes strongly decreases if a corporation does not respond to the written survey of SAM, the assessing institution. Furthermore, unobserved heterogeneity, measured by time invariant random effects and an autoregressive structure in the stochastic components, is an important factor. While firm size has a strong positive effect and the ratio between sales and total assets a negative effect on the inclusion in the sustainability stock indexes, a significant influence of economic performance in the past cannot be confirmed robustly.

According to our estimation results, the participation in the written survey obviously matters for the inclusion of corporations in the DJSI World or DJSI STOXX. Therefore, we conclude that not only corporate sustainability performance itself, but also specific elements of the internal assessment process regarding sustainability performance matter for the inclusion of a

corporation in a sustainability stock index. In this respect, one could reply that the positive effect of the participation in the written survey is nothing else than a result of a self-selection. It is actually likely that corporations which respond to the written survey are often those corporations with a rather good sustainability performance. As a consequence, the effect of this internal assessment variable would be over-estimated in our panel probit analysis. However, our estimation results provide nevertheless first evidence for the (necessarily) subjective and normative elements in the assessment of corporate sustainability performance. In this respect, it should also be borne in mind that over 42% of the observations in our sample between 1999 and 2004 (and about one third, i.e. 83 out of the examined 253 corporations during the entire observation period) are not assessed at all (i.e. they have neither responded to the written survey nor have been internally assessed) such that the appropriate corporations cannot be included in the sustainability stock indexes in the corresponding years due to the assessment process.

Elements beyond corporate sustainability performance are not only relevant in the internal assessment process, but also in the final selection process regarding the sustainability stock indexes. Although the DJSI World intends to comprise the 10% most sustainable corporations of each sector of the biggest 2500 corporations in the DJI World and the DJSI STOXX intends to comprise the 20% most sustainable European corporations of each sector in the DJI STOXX 600, other criteria and particularly the market capitalization play an important role in the final selection process. Concerning the DJSI World, the market capitalization coverage for each Dow Jones super-sector (i.e. an aggregation of one or more sectors) should amount to 20% of the Dow Jones Global Index (DJGI) market capitalization for that super-sector. Concerning the DJSI STOXX, the market capitalization coverage for each super-sector should amount to 45% of the DJI STOXX 600 market capitalization for that super-sector. As a consequence, over 300 DJI World companies are (since 2002) included in the DJSI World and over 150 DJI STOXX 600 companies are included in the DJSI STOXX such that the intended

numbers of corporations that are included in these sustainability stock indexes are clearly exceeded. These selection requirements have to be noted in the analysis of the strong positive effect of firm size in our panel probit analysis. In other words, it seems that this estimation result cannot only be explained by the less significant fixed costs in larger companies for activities to improve corporate sustainability performance.

As a consequence of the importance of internal factors which are determined by the assessment and selection process, it could be possible that an otherwise (positive) effect of economic performance is covered. In this case, the insignificant influence of return on assets in all and the insignificant influence of Tobin`s Q in most of our estimations can be explained. In contrast, our estimation results show the importance of unobserved heterogeneity. However, this result is not very surprising when the extremely strong state dependence for the inclusion in the sustainability stock indexes is considered. It should be noted that 157 (= 62.06%) out of the examined 253 corporations either are included or not included in the DJSI World during the entire time period from 1999 to 2004 and even 188 (= 74.31%) either are included or not in the DJSI STOXX during the entire time period from 2001 to 2004. If we accept the inclusion in these sustainability stock indexes as an indicator for corporate sustainability performance, biased and inconsistent estimates are possible if the determinants of sustainability performance are investigated with cross-sectional data, even if the inclusion of time invariant random effects and an autoregressive structure in the stochastic components does not affect our estimation results for the explanatory variables in the panel probit models.

Indeed, it is also possible that our rather complex consideration of unobserved heterogeneity in panel probit models is still not complex enough to represent the strong state dependence. One direction for further research is therefore the application of dynamic panel probit models (i.e. the inclusion of lagged dependent variables) to analyze the determinants of the inclusion in sustainability stock indexes. Such complex approaches (including their difficult estimation)

are, for example, discussed and applied in Lee (1997) or Zhang and Lee (2004). Furthermore, it would be interesting to apply alternative estimation methods to the simulated maximum likelihood method such as the Generalized Method of Moments (GMM) in panel probit models (for different approaches see e.g. Baltagi, 2005, ch. 11). Other directions for further research which do not pertain to our panel probit models used here, but rather to the testing of the robustness of our estimation results are, for example, the analysis of an unbalanced panel or of other lag structures for the explanatory variables. Finally, it would be certainly interesting to examine alternative populations (i.e. corporations outside Europe), alternative sustainability stock indexes, and the economic effects of the inclusion in sustainability stock indexes.

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Table 1: Shares of corporations that are included in the DJSI World, are included in the DJSI STOXX, and participate in the written survey, separately for each examined country

	DJSI World inclusion	**DJSI STOXX inclusion**	**Survey participation (Answer = 1)**	**Number of corporations**
Austria	0%	0%	0%	2
Belgium	16.67%	13.89%	35.19%	9
Denmark	37.50%	43.75%	41.67%	4
Finland	54.17%	75.00%	66.67%	4
France	18,25%	30.95%	32.54%	42
Germany	58.05%	66.38%	74.71%	29
Greece	0%	0%	0%	5
Ireland	19.44%	16.67%	33.33%	6
Italy	8.33%	5.36%	19.05%	14
Netherlands	44.44%	58.33%	56.94%	12
Norway	50.00%	43.75%	50.00%	4
Portugal	0%	0%	0%	6
Spain	19.05%	26.79%	36.90%	14
Sweden	52.08%	51.56%	63.54%	16
Switzerland	50.00%	52.50%	78.33%	10
United Kingdom	40.79%	54.28%	43.20%	76
Average	34.12%	42.39%	44.40%	--

Table 2: Shares of corporations that are included in the DJSI World, are included in the DJSI STOXX, and participate in the written survey, separately for each examined year

	DJSI World inclusion	**DJSI STOXX inclusion**	**Survey participation (Answer = 1)**
1999	24.51%	--	31.23%
2000	24.11%	--	33.60%
2001	28.46%	39.53%	43.48%
2002	42.69%	44.27%	49.41%
2003	42.69%	44.27%	53.36%
2004	42.29%	41.50%	55.34%
Average	34.12%	42.39%	44.40%

Table 3: Parameter estimates in panel probit models, determinants of the inclusion in the DJSI World, N = 253, T = 6 (1999 to 2004)

Explanatory variables	**Independent panel probit model**	**Random effects**	**Autocorrelation**	**Random effects and autocorrelation**
Constant	-7.27***	-16.70***	-8.09***	-13.81***
ROA	0.23	0.21	0.19	0.22
Sales	0.62***	1.42***	0.68***	1.17***
Sales/Assets	-0.56***	-1.19***	-0.60***	-0.98***
Debts/Assets	0.00	0.55	0.05	0.28
Belgium	0.34	0.96	0.49	0.83
Denmark	0.77	1.47	0.93	1.42
Finland	1.91**	4.45***	2.19**	3.78***
France	0.38	1.61	0.62	1.30
Germany	1.82***	4.14***	2.10***	3.52***
Ireland	1.15*	2.89**	1.43**	2.48**
Italy	-0.36	-0.33	-0.30	-0.29
Netherlands	1.18*	2.72*	1.42**	2.33*
Spain	0.68	2.05	0.90	1.70
Sweden	0.90	2.00	1.05	1.73
Switzerland	1.39**	3.32**	1.65**	2.83**
United Kingdom	2.04***	4.91***	2.37***	4.12***
σ_α	--	2.49	--	1.98
ρ	--	--	0.90	0.69
Loglikelihood function value	-780.91	-601.72	-604.40	-562.47

Note:
** (**, ***) means that the appropriate explanatory variable has an effect at the 10% (5%, 1%) level of significance*

Table 4: Parameter estimates in panel probit models, determinants of the inclusion in the DJSI World, N = 253, T = 6 (1999 to 2004)

Explanatory variables	**Random effects and autocorrelation**	**Random effects and autocorrelation**	**Random effects and autocorrelation**	**Random effects and autocorrelation**
Constant	-7.11***	-7.00***	-7.10***	-7.61***
Answer	3.03***	3.05***	3.07***	3.03***
ROA	0.18	--	-0.20	--
TobinsQ	--	0.05	--	-0.12
Sales	0.49***	0.48***	--	--
MVE	--	--	0.47***	0.51***
Sales/Assets	-0.45**	-0.40**	0.01	0.00
Debts/Assets	0.12	0.12	0.37	0.35
Belgium	-0.99	-1.02	-0.96	-0.87
Denmark	0.07	0.10	0.08	0.03
Finland	0.59	0.56	0.55	0.71
France	-0.51	-0.53	-0.49	-0.33
Germany	0.51	0.46	0.63	0.81
Ireland	-0.09	-0.12	-0.30	-0.12
Italy	-1.26	-1.27	-1.29	-1.16
Netherlands	0.07	0.05	-0.00	0.10
Spain	-0.85	-0.83	-0.93*	-0.70
Sweden	-0.08	-0.08	-0.11	0.02
Switzerland	-0.13	-0.17	-0.44	-0.31
United Kingdom	1.27***	1.26***	1.13**	1.29**
σ_α	0.92	0.90	0.80	0.82
ρ	0.67	0.67	0.67	0.67
Loglikelihood function value	-441.76	-441.87	-442.34	-441.27

Note:
** (**, ***) means that the appropriate explanatory variable has an effect at the 10% (5%, 1%) level of significance*

Table 5: Parameter estimates in panel probit models, determinants of the inclusion in the DJSI STOXX, N = 253, T = 4 (2001 to 2004)

Explanatory variables	**Random effects and autocorrelation**	**Random effects and autocorrelation**	**Random effects and autocorrelation**	**Random effects and autocorrelation**
Constant	-7.35***	-7.87***	-9.20***	-9.20***
Answer	3.16***	3.18***	3.17***	3.18***
ROA	0.19	--	-0.14	--
TobinsQ	--	0.23**	--	-0.02
Sales	0.40***	0.45***	--	--
MVE	--	--	0.59***	0.58***
Sales/Assets	-0.62***	-0.67***	-0.16	-0.22
Debts/Assets	0.31	0.42	0.72	0.72
Belgium	0.36	0.31	0.37	0.39
Denmark	1.18	1.02	0.86	0.86
Finland	3.22***	3.10***	3.04**	3.01**
France	1.03	0.96	0.94	0.96
Germany	2.21***	2.16***	2.26***	2.29***
Ireland	-0.10	-0.10	-0.24	-0.23
Italy	-0.96	-1.02	-1.22	-1.23
Netherlands	2.03**	1.99**	1.84**	1.83**
Spain	0.74	0.73	0.59	0.58
Sweden	0.73	0.56	0.30	0.31
Switzerland	1.04	0.89	0.56	0.56
United Kingdom	2.96***	2.96***	2.96***	2.95***
σ_α	1.27	1.29	1.29	1.29
ρ	0.63	0.62	0.62	0.62
Loglikelihood function value	-312.51	-310.81	-307.85	-308.00

Note:
** (**, ***) means that the appropriate explanatory variable has an effect at the 10% (5%, 1%) level of significance*