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

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Abstract

This paper examines the determinants of the inclusion of companies in the Dow Jones STOXX Sustainability Index. In doing so, the paper contributes to the literature regarding the relationship between corporate sustainability and economic performance in three aspects: First of all, it considers a broad measure of corporate sustainability performance and thus does not use narrow approaches such as toxic releases. Since it analyzes the assessment of corporate sustainability performance by an independent institution, the paper also examines specific effects that depend on the internal assessment process. Finally, the paper examines the influence of unobserved firm characteristics in the framework of panel data models for the time period from 1999 to 2003. The preliminary panel probit analysis with European companies in the Dow Jones STOXXSM 600 Index shows that unobserved heterogeneity, measured by time invariant random effects and an autoregressive structure in the stochastic components, is an important factor. Furthermore, the probability to be part of the Dow Jones STOXX Sustainability Index strongly decreases if a company does not respond to the written survey. Economic performance in the past surprisingly has no significant influence or even a weakly negative influence on the inclusion in this sustainability stock index. We conclude that the internal assessment process matters for the view on corporate sustainability performance. Another conclusion is that due to the strong state dependence (289 out of the examined 323 companies either are included or not in the Dow Jones STOXX Sustainability Index during the entire observation period), biased and inconsistent estimations are likely if the determinants of corporate sustainability performance are investigated with cross-sectional data.

Keywords: Corporate sustainability, socially responsible investing, financial performance, panel data, probit models

JEL classification: Q01, G30, C23.

1. Introduction

The environmental and social performance of stock corporations has attracted increasing interest in the last few years. This interest stems particularly from specific investment funds. These funds increasingly consider environmental and/or social (or ethical) criteria and thus are specialized in so called socially responsible investments (SRI). In the discussion about 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 companies themselves since environmental and social performance are important factors for public image and thus also for public and investor relations. For investors, shareholders, or managers, it is particularly important to know the relationship between environmental or social performance and economic success (or, in other words, economic performance) of companies. However, this relationship is also relevant for policy, for example, regarding disclosure regulations for SRI. While SRI regulation can increase the transparency of corporate sustainability performance, it is likely that the acceptance and diffusion of SRI (and thus the acceptance and diffusion of SRI regulation) depend on the economic success of SRI. Although economic success can also be supported by regulation (e.g. by tax exceptions or reductions for SRI investments), it can be assumed that nevertheless a high economic performance is important for attracting investors.

Recent econometric studies (e.g. Hart and Ahuja, 1996, Konar and Cohen 2001, King and Lenox, 2001, Thomas, 2001, Wagner et al., 2002, Rennings et al., 2003) analyze the effects of corporate sustainability performance (measured e.g. by toxic releases) on the economic performance of companies. Other studies (e.g. Arora and Cason, 1995, DeCanio and Watkins, 1998, Khanna and Damon, 1999, Nakamura et al., 2001) investigate the opposite direction, in other words, the determinants of corporate sustainability performance (i.e. they consider the determinants of environmental performance), although the influence of economic performance is not focussed in these studies. In this paper, we examine the latter issue. We identify the corporate sustainability performance by analyzing the Dow Jones STOXX Sustainability Index (DJSI STOXX). In other words, companies that are included in this stock index are marked as particularly sustainable, whereas companies that are not part of this stock index are not sustainable. This stock index intends to comprise the 20% most sustainable European companies of each sector in the Dow Jones STOXXSM 600 Index (DJI STOXXSM 600).

In doing so, this paper contributes to the literature regarding the relationship between corporate sustainability and economic performance in three aspects: First of all, it considers a broad

measure of corporate sustainability performance and thus does not examine narrow approaches of environmental performance (e.g. toxic releases or environmental organizational measures) being only one component of corporate sustainability performance. Corporate sustainability performance is a relatively complex measure of the environmental and social (or ethical) behavior of companies. Based on surveys with detailed questionnaires, specialized independent institutions assess the corporate sustainability performance covering these different aspects. But as corporate sustainability performance is not yet standardized, there exist different measures with a certain amount of subjectivity. Being aware about the normative or subjective elements of such assessments, the paper secondly also examines specific effects that depend on the internal assessment process. Finally, this paper applies panel data models that include lagged explanatory variables and particularly unobserved heterogeneity in the stochastic components. The main reason for this is that the direction of causality of the relationship between corporate sustainability and economic performance is not clear and that furthermore spurious correlations can also occur due to unobserved firm characteristics. Waddock and Graves (1997) already point to this causality problem and therefore examine both the effect of corporate sustainability on economic performance and the opposite effect. However, all studies cited above (an exception is the study of King and Lenox, 2001) including Waddock and Graves (1997) perform econometric analyses with cross-sectional data that do not address these endogeneity problems.

The structure of the paper is as follows: The second section reviews the literature on the relationship between corporate sustainability and economic performance. The third section explains the methodological approach including panel probit models. The fourth section describes the dependent and explanatory variables, the used data, and shows some descriptive statistics. The final section discusses first preliminary results of the panel probit analysis.

2. Literature Background

The relationship between corporate sustainability and economic (or financial) performance has been examined for a long time in the framework of econometric approaches. One strand of research on this issue is event studies. Such event studies consider short-term reactions of stock prices due to particular published information on the sustainability performance of a company (see e.g. Muoghalu et al., 1990, Hamilton, 1995, Klassen and McLaughlin, 1996, Konar and Cohen, 1997, Blacconiere and Northcut, 1997, Khanna et al., 1998, Lanoie et al., 1998, Dasgupta et al., 2001). These (mainly environmentally relevant) events can have the

character of negative news such as information about hazardous accidents or emission data according to the Toxic Release Inventory (TRI) as well as positive news such as information about companies winning environmental awards or investments in environmental protection. Indeed, the main weakness of previous event studies is their short-term character. Thus, short-term over-reactions of stock markets are possible that may be compensated over time.

Therefore, the investigation of the relationship between corporate sustainability and economic performance needs long-term consideration. Such econometric studies on the effect of corporate sustainability on economic performance 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), or Rennings et al. (2003). Most of these long-term considerations with cross-sectional or panel data as well as event studies find a positive influence of a higher sustainability performance of companies on their economic performance. One explanation for these positive effects is that a high 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 future costs, for example, regarding impending penalties or even lawsuits. 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 or finally economic performance of companies. Furthermore, the environmental properties of products and the government and community relationships are obviously increasingly becoming 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 a higher economic performance provides the opportunity for companies to invest in sustainability performance. This is the reason why Waddock and Graves (1997) also analyze the effects of economic performance on corporate sustainability performance. According to their econometric analysis, corporate sustainability performance is in fact positively influenced particularly by return on assets, but also by return on sales or return on equity. Other investigations examining the effect of economic performance on corporate sustainability performance (i.e. considering environmental performance) can, for example, be found in Arora and Cason (1995), DeCanio and Watkins (1998), Khanna and Damon (1999), or Nakamura et al. (2001), although the influence of economic performance is not focussed in these studies.

Our paper focuses on the analysis of the determinants of corporate sustainability performance. In this respect, we use a broad measure of corporate sustainability performance. It appears to be clear that corporate sustainability performance cannot be represented by one-dimensional indicators due to the multidimensionality of this construct. However, most studies cited above examining the relationship between corporate sustainability and economic performance still do this. For example, event studies (caused by the used methodology) only consider specific (environmentally relevant) events. But also econometric analyses with a long-term consideration frequently apply rather narrow measures that 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) exclusively consider the emissions data in the Toxic Release Inventory (TRI) to measure the environmental performance of companies. Arora and Cason (1995), DeCanio and Watkins (1998), and Nakamura et al. (2001) examine the determinants of environmental organizational measures such as the participation in public voluntary programs encouraging proactive environmental management (e.g. 33/50, initiated by the U.S. Environmental Protection Agency). Such measures can be regarded as relevant but also very narrow indicators for corporate sustainability performance.

3. Methodological Approach

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 institutions. In this paper, we adopt this approach by analyzing the corporate sustainability performance assessments from SAM (Sustainable Asset Management) Group, an independent and internationally active financial services institution with an exclusive focus on sustainability. SAM 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, instead of analyzing these raw assessments, we use the inclusion in the DJSI STOXX as a measure for corporate sustainability performance. Together with the publisher of the best known world-wide stock indicator Dow Jones Indexes and the leading European stock index provider STOXX Limited, SAM has launched a family of sustainability stock indexes to track the financial performance of companies that are sector leaders in terms of sustainability performance (concerning environmental, social, and economic criteria). All these stock indexes are based on corporate sustainability performance assessments from SAM. The DJSI STOXX

comprises the European leaders. The 20% most sustainable European companies of each sector in the DJI STOXXSM 600 are part of the DJSI STOXX.

The reason for the investigation of the inclusion of companies in the DJSI STOXX is that assessment data for all DJI STOXXSM 600 companies are not available. If we only examine the group of companies that has been assessed by SAM (this group comprises mainly those companies that have responded to the written survey), self-selection problems can be expected. Furthermore, the examination of companies in the DJSI STOXX is interesting itself because it allows insights into the internal assessment process of an institution. In other words, since such assessments of corporate sustainability performance are analyzed, this paper examines specific effects that depend on the internal assessment process. The underlying hypothesis is that the inclusion in a sustainability stock index is not only determined by environmental and social (or ethical) criteria, but also by the assessment process itself and thus by the views of institutions regarding corporate sustainability performance.

Finally, it should be emphasized that we analyze panel data for the time period from 1999 to 2003. 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 structural reverse causality can exist since a higher economic performance can improve corporate sustainability performance, but a higher corporate sustainability performance can also lead to higher 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. Therefore, econometric analyses with cross-sectional data that do not address these endogeneity problems can lead to biased and inconsistent estimations, even when lagged explanatory variables are used (as e.g. in Arora and Cason, 1995, Waddock and Graves, 1997, DeCanio and Watkins, 1998, Khanna and Damon, 1999, Nakamura et al., 2001). Therefore, we apply panel data models that include lagged explanatory variables and particularly unobserved heterogeneity. 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 regarding employee wages. An application of panel data models can, for example, be found in King and Lenox (2001). However, this study only examines the effects of corporate sustainability on economic performance.

Since the determinants of the inclusion of companies in the DJSI STOXX are examined, the dependent variable (e.g. in contrast to the analysis of King and Lenox, 2001) is binary. According to the DJSI STOXX philosophy, a DJI STOXXSM 600 company is included in this sustainability stock index if it belongs to the 20% most sustainable companies of each sector. 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 company i is included in the DJSI STOXX in time period t if $U_{it} > 0$. Based on this, we define an observable indicator variable:

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

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, $P(DJSI_{it} = 1)$ denotes the probability that a DJI STOXXSM 600 company is included in the DJSI STOXX. Since we are considering 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 $\alpha_i \sim N(0;\ \sigma_\alpha^2)$ ($i=1,\ldots,N$). An autoregressive structure can furthermore incorporated by decomposing the stochastic component ν_{it} in

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

with $\xi_{it} \sim N(0;\ 1)$ ($i=1,\ldots,N;\ t=1,\ldots,T$) 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 possible 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 $P(DJSI_{it} = 1)$. Therefore, the application of simulation methods in the framework of 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 framework of the maximum likelihood method. In this respect, we always use 100 random draws in the GHK simulator.

4. Variables, Data, and Descriptive Statistics

One main explanatory variable in x_{it}, is economic performance. We consider return on assets (**ROA**). This variable 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). Furthermore, we incorporate two financial variables as control variables as it is common in econometric analyses on the determinants of environmental performance (that is an important component of the corporate sustainability performance assessments of the DJI STOXXSM 600 companies). The first variable is the ratio between sales and total assets (***Sales/Assets***) that is also considered in the studies of Khanna and Damon (1999) as well as Henriques and Sadorsky (1996), Khanna and Anton (2002), and Anton et al. (2004). Khanna and Anton (2002) argue that companies with a low ratio are more likely to be concerned about negative investor and market reactions if the corporate sustainability performance is low. The second variable is the ratio between 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 lower debts can have more flexibility to finance activities for environmental organizational measures. Finally, we include company size, namely the number of employees (***Employees***), as a further control variable. Nakamura et al. (2001) argue that size is an indicator for the capacity of a company to perform some activities since the improvement in corporate sustainability performance leads to fixed costs that are less significant for larger companies. Note that all these explanatory variables are incorporated in the panel probit models with a one year lag. Furthermore, these variables have been standardized such that the mean over all companies is zero and the variance is one. This is due to some estimation problems in complex panel probit models that are a consequence of the dimension of the variables.

Since we analyze the determinants of the inclusion of companies in the DJSI STOXX that are based on corporate sustainability performance assessments by an institution, this paper also examines specific effects that depend on the internal assessment process. The assessment process of SAM has two dimensions: The first dimension is based on the responses to annual performed written surveys that comprise all DJI STOXXSM 600 companies. The second dimension contains further internal assessments that are performed for some of the non-respondents. Companies that are not assessed in these two dimensions are not included in the DJSI STOXX. We incorporate a dummy variable (***Answer***) that addresses this assessment process. It takes the value one if a DJI STOXXSM 600 company participates in the 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 and thus to different inclusions in the DJSI STOXX. Note that we do not include sector dummies since the examined measure of corporate sustainability performance is based on a best of class principle since the DJSI STOXX comprises the 20% most sustainable companies of each sector in the DJI STOXXSM 600.

The data concerning the internal assessment stem directly from SAM. The financial data stem from Bloomberg. We analyze the inclusion of companies in the DJSI STOXX for $T = 5$ time periods from 1999 to 2003. We examine altogether $N = 323$ companies in the DJI STOXXSM 600 or $N \cdot T = 1615$ observations for which we have all relevant financial data over the entire observation period. Thus, we consider a balanced panel. 430 out of these 1615 observations comprise an assessment based on the participation to the survey (i.e. ***Answer*** = 1), 909 observations comprise no assessment. The data set contains companies from 15 countries (namely from ***Austria***, ***Belgium***, ***Denmark***, ***Finland***, ***France***, ***Germany***, ***Ireland***, ***Italy***, ***Netherlands***, ***Norway***, ***Portugal***, ***Spain***, ***Sweden***, ***Switzerland***, and ***UK***). The corresponding dummy variables take the value one if a company has its headquarter in this county. Most of the examined 323 companies are from UK (104), France (41), and Germany (33). Some countries are not at all included in the DJSI STOXX over the observation period. This result even holds true for rather big countries. For example, none of the 26 examined Italian companies appears in the DJSI STOXX. Note that the dummy variables for those countries with a rather low or even no variation regarding the inclusion in the DJSI STOXX are not incorporated in the panel probit analysis.

Table 1 reports correlation coefficients between some variables. Against the expectation based on previous studies regarding the relationship between corporate sustainability and eco-

nomic performance, a weak negative correlation between return on assets and the inclusion in the DJSI STOXX exists. In contrast, the positive relationship between ***Employees*** and ***DJSI*** and particularly between ***Answer*** and ***DJSI*** has been expected. Remarkable are the strong positive relationships between ***Sales/Assets*** and ***ROA*** as well as between ***Employees*** and ***Answer***. It appears therefore that the ratio between sales and total assets is also an indicator for economic performance (such that the correlation coefficients between ***Sales/Assets*** and ***DJSI*** or ***ROA*** and ***DJSI*** are similar) and that the costs for responding to the survey are significantly higher for smaller companies. Finally, note that the response rates are highest in Germany and Switzerland obviously due to the headquarter of SAM.

5. Preliminary Results of the Panel Probit Analysis

In a first step, we analyze the estimation results in probit models without unobserved heterogeneity. Model 1 includes economic performance, the two financial variables, company size, and some country dummies as variables to explain the inclusion in the DJSI STOXX. Model 2 additionally includes the dummy variable ***Answer***. The main estimation results according to Table 2 are:

- Economic performance, measured by the return on assets, has no significant effect.
- In contrast, the ratio between sales and total assets and (less significant) the ratio between debts and total assets rather have a negative influence. Furthermore, company size has a positive effect.
- The most important result is that the participation in the survey has a very strong positive influence on the inclusion in the DJSI STOXX.

However, these estimations neglect possible unobserved heterogeneity. If that does exist, the estimates in Table 2 are biased and inconsistent.

Table 3 reports the corresponding estimation results in panel probit models with unobserved heterogeneity. Model 3 only includes time invariant random effects, Model 4 only includes an autoregressive structure in the stochastic components, and Model 5 includes both time invariant random effects and an autoregressive structure. The main estimation results according to Table 3 are:

- Economic performance has a negative effect on the inclusion in the DJSI STOXX in Model 3 even if this effect is only weakly significant.

- The negative influences of the ratio between sales and total assets and the ratio between debts and total assets become insignificant as well as the positive influence of company size becomes less significant when unobserved heterogeneity is included.
- The positive effect of the participation in the survey remains strongly significant.
- The most important result is the strong influence of unobserved heterogeneity. The estimates for the corresponding parameters are extremely high and particularly for ρ on the boundary of the parameter space.
- Comparing both types of examined unobserved heterogeneity, it appears that time invariant random effects that do not decrease over time are dominant since the estimate for σ_α only decreases weakly in Model 5 compared with Model 3 while the decrease of the estimate for ρ is strong compared with Model 4. The extremely high estimate for ρ in Model 4 is obviously influenced by time invariant effects that are not covered by a suitable parameter in this model.

Based on these first estimation results, we conclude that unobserved heterogeneity matters for the inclusion of companies in the DJSI STOXX. In this respect, particularly time invariant firm-specific random effects are crucial. Note that the state dependence is extremely strong since 289 out of the examined 323 European companies either are included or not in the DJSI STOXX during the entire observation period from 1999 to 2003. If we accept the inclusion in this sustainability stock index as an indicator for corporate sustainability performance, biased and inconsistent estimations are likely if corporate sustainability performance is investigated with cross-sectional data.

Furthermore, we conclude that also the internal assessment process matters for the inclusion of companies in the DJSI STOXX. The participation to the survey has a strong positive effect. It is obviously assumed that the respondents to the survey are mostly the leaders with regard to corporate sustainability performance. In this respect, it should also be noted that more than 50% of the examined DJI STOXXSM 600 companies in our sample are not assessed such that they cannot be included in the DJSI STOXX according to the assessment process. Therefore, it appears that not only the corporate sustainability performance, but also the view on corporate sustainability performance is important for the inclusion in a sustainability stock index.

However, it should be noted that the estimation results in the panel probit models should be treated with caution since the estimates and (even to a higher extent) the z-statistics are extremely unstable over different model specifications. This instability is likely caused by the

very strong state dependence. In a revised version of this paper, we will address this problem. Furthermore, we will extend our data set such that we can also examine unbalanced panels since the investigation of balanced panels is restrictive. Finally, we will also consider other indicators for economic performance such as Tobins Q.

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Literature

Anton, W.R.Q., G. Deltas, and M. Khanna (2004), Incentives for Environmental Self-Regulation and Implications for Environmental Performance, Journal of Environmental Economics and Management, forthcoming.

Arora, S. and T.N. Cason (1995), An Experiment in Voluntary Environmental Regulation: Participation in EPA's 33/50 Program, Journal of Environmental Economics and Management 28, 271-286.

Blacconiere, W.G. and W.D. Northcut (1997), Environmental Information and Market Reactions to Environmental Legislation, Journal of Accounting, Auditing and Finance 12 (2), 149-178.

Börsch-Supan, A. (1992), Der Wohnungskonsum älterer Mitbürger: Wie lange selbständig? Wie oft in Mehrpersonenhaushalten?, in: Hujer et al. (eds.), Herausforderungen an den Wohlfahrtsstaat im strukturellen Wandel, Frankfurt/New York, 143-172.

Börsch-Supan, A. and V.A. Hajivassiliou (1993), Smooth Unbiased Multivariate Probability Simulators for Maximum Likelihood Estimation of Limited Dependent Variable Models, Journal of Econometrics 58, 347-368.

DeCanio, S.J. and W.E. Watkins (1998), Investments in Energy Efficiency: Do the Characteristics of Firms Matter?, The Review of Economics and Statistics 80, 95-107.

Geweke, J., M. Keane and D. Runkle (1994), Alternative Computational Approaches to Inference in the Multinomial Model, The Review of Economics and Statistics 76, 609-632.

Hamilton, J.T. (1995), Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data, Journal of Environmental Economics and Management 28, 98-113.

Hart, S.L. and G. Ahuja (1996), Does it Pay to be Green? An Empirical Examination of the Relationship Between Emission Reduction and Firm Performance, Business Strategy and the Environment 5, 30-37.

Hajivassiliou, V.A. (1994), A Simulation Estimation Analysis of the External Debt Crisis of Developing Countries, Journal of Applied Econometrics 9, 109-131.

Henriques, I. and P. Sardorsky (1996), The Determinants of an Environmentally Responsive Firm: An Empirical Approach, Journal of Environmental Economics and Management 30, 391-395.

Keane, M. (1994), A Computationally Practical Simulation Estimator for Panel Data, Econometrica 62 (1), 95-116.

Khanna, M., W. Rose, H. Quimio, and D. Bojilova (1998), Toxics Release Information: A Policy Tool for Environmental Protection, Journal of Environmental Economics and Management} 36, 243-266.

King, A. and M. Lenox (2001), Does it Really Pay to be Green?, The Journal of Industrial Ecology 5 (1), 105-116.

Klassen, R.D. and C.P. McLaughlin (1996), The Impact of Environmental Management on Firm Performance, Management Science 42 (8), 1199-1214.

Konar, S. and M.A. Cohen (2001), Does the Market Value Environmental Performance, The Review of Economics and Statistics 83 (2), 281-289.

Konar, S. and M.A. Cohen (1997), Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions, Journal of Environmental Economics and Management 32, 109-124.

Khanna, M. and W.R.Q. Anton (2002), Corporate Environmental Management: Regulatory and Market-Based Incentives, Land Economics 78, 539-558.

Khanna, M. and L.A. Damon (1999), EPA's Voluntary 33/50 Program: Impact on Toxic Releases and Economic Performance of Firms, Journal of Environmental Economics and Management 37, 1-25.

Mühleisen, M. and K.F. Zimmermann (1994), New Patterns of Labour Mobility: A Panel Analysis of Job Changes and Unemployment, European Economic Review 38, 793-801.

Muoghalu, M.I., H.D. Robison, and J.L. Glascock (1990), Hazardous Waste Lawsuits, Stockholder Returns, and Deterrence, Southern Economic Journal 7 (2), 357-370.

Nakamura, M., T. Takahashi, and I. Vertinsky (2001), Why Japanese Firms Choose to Certify: A Study of Managerial Responses to Environmental Issues, Journal of Environmental Economics and Management 43, 23-52.

Rennings, K., M. Schröder, and A. Ziegler (2003), The Economic Performance of European Stock Corporations: Does Sustainability Matter?, Greener Management International 44, 33-43.

Thomas, A. (2001), Corporate Environmental Policy and Abnormal Stock Price Returns: An Empirical Investigation, Business Strategy and the Environment 10, 125-134.

Waddock, S.A. and S.B. Graves (1997), The Corporate Social Performance – Financial Performance Link, Strategic Management Journal 18 (4), 303-319.

Wagner, M., N. Van Phu, T. Azomahou, and W. Wehrmeyer (2002), The Relationship between the Environmental and Economic Performance of Firms: An Empirical Analysis of the European Paper Industry, Corporate Social Responsibility and Environmental Management 9, 133-146.

Ziegler, A. and A. Eymann (2001), Zur Simulated Maximum-Likelihood-Schätzung von Mehrperioden-Mehralternativen-Probitmodellen, Allgemeines Statistisches Archiv 85, 319-342.

Table 1: Correlation coefficients

	DJSI	***ROA***	***Sales/Assets***	***Debt/Assets***	***Employees***	***Answer***
DJSI	1	--	--	--	--	--
ROA	-0.053	1	--	--	--	--
Sales/Assets	-0.037	0.441	1	--	--	--
Debt/Assets	0.003	-0.045	-0.233	1	--	--
Employees	0.233	-0.126	0.132	0.026	1	--
Answer	0.450	-0.050	-0.056	0.035	0.289	1
Austria	-0.048	--	--	--	--	-0.048
Belgium	-0.083	--	--	--	--	0.021
Denmark	0.056	--	--	--	--	0.039
Finland	0.061	--	--	--	--	0.052
France	-0.042	--	--	--	--	-0.146
Germany	0.146	--	--	--	--	0.232
Ireland	-0.114	--	--	--	--	-0.051
Italy	-0.179	--	--	--	--	-0.101
Netherlands	0.024	--	--	--	--	-0.009
Norway	-0.008	--	--	--	--	0.151
Portugal	-0.071	--	--	--	--	-0.090
Spain	-0.067	--	--	--	--	-0.013
Sweden	-0.001	--	--	--	--	0.034
Switzerland	0.011	--	--	--	--	0.183
UK	0.117	--	--	--	--	-0.103

Table 2: Parameter estimates (z-statistics) in probit models without unobserved heterogeneity, N=323, T=5 (1999 to 2003)

Dependent variable: *DJSI*		
Explanatory variables	**Model 1**	**Model 2**
Constant	-1.04 (-14.49)	-1.70 (-17.18)
ROA	-0.01 (-0.30)	-0.04 (-0.89)
Sales/Assets	-0.15 (-2.87)	-0.09 (-1.77)
Debts/Assets	-0.05 (-1.33)	-0.07 (-1.78)
Employees	0.30 (6.69)	0.13 (2.92)
Answer	-- --	1.40 (15.85)
France	0.11 (0.80)	0.68 (4.66)
Germany	0.75 (5.85)	0.65 (4.69)
Netherlands	0.41 (2.80)	0.74 (4.74)
Sweden	0.46 (3.06)	0.55 (3.05)
UK	0.71 (7.74)	1.04 (9.63)
Value of the Log-likelihood function	-854.43	-721.34

Table 3: Parameter estimates (z-statistics) in panel probit models with unobserved heterogeneity, N=323, T=5 (1999 to 2003)

Dependent variable: *DJSI*			
Explanatory variables	**Model 3**	**Model 4**	**Model 5**
Constant	-11.15 (-5.27)	-2.54 (-9.11)	-9.59 (-4.95)
ROA	-0.72 (-1.83)	-0.09 (-0.88)	-0.54 (-1.64)
Sales/Assets	-0.16 (-0.34)	-0.13 (-0.87)	-0.16 (-0.42)
Debts/Assets	0.49 (1.31)	-0.05 (-0.49)	0.33 (1.07)
Employees	1.17 (1.89)	0.24 (1.68)	0.99 (1.74)
Answer	6.90 (3.81)	1.90 (8.47)	6.15 (3.15)
France	3.82 (1.83)	0.90 (2.05)	3.30 (1.76)
Germany	5.91 (2.41)	1.10 (2.51)	5.35 (1.88)
Netherlands	4.95 (1.87)	1.06 (2.12)	4.22 (1.80)
Sweden	4.01 (1.21)	0.84 (1.51)	3.64 (1.30)
UK	7.59 (4.02)	1.59 (4.96)	6.48 (3.78)
σ_α	7.62	--	6.44
ρ	--	1.00	0.66
Value of the Log-likelihood function	-342.60	-447.18	-337.12