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Summary

Empirical research on the characteristics of environmentally responsive companies has focussed almost exclusively on US and Japanese firms. For Europe, which is commonly considered as the greenest of the three major developed economic markets, similar research is lacking. This paper seeks to fill this gap by empirically investigating the business and financial characteristics, stakeholder pressure and public policies distinguishing companies that have implemented the European Eco-Management and Audit System (EMAS) and those that have not using a unique firm-level dataset of European publicly quoted companies. The contribution of this paper is twofold. First of all, the decision to implement EMAS has not been widely analysed. Secondly, we focus on European firms which allows us to assess if and to what extent European firms behave like their US or Japanese counterparts. We find that the EMAS participation decision is positively influenced by the solvency ratio, the share of non-current liabilities and the average labour cost. Also, two measures of company size are positively associated with EMAS participation: both the absolute company size as well as the relative size of a company compared to its sector average. The profit margin on the other hand exerts a negative influence according to our results. We further show that public policy can heavily influence the EMAS participation decision: companies whose headquarters is located in a member state that actively encourages EMAS have a higher probability of participation.

Keywords: EMAS, European Companies, Public Policy

JEL classification: L2

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1. INTRODUCTION

In response to increasing stakeholder pressure, companies are embracing the "corporate social responsibility" concept evermore tightly. Social, environmental and sustainability reports are being published at an accelerating pace. Participation in voluntary environmental approaches is a straightforward manner to show a corporation's involvement. Within the wide scope of voluntary approaches, public voluntary programmes have an attractive appeal. In such programmes participating firms agree to standards that have been developed by public bodies such as environmental agencies (OECD, 1999). Well-known examples include environmental management systems (EMS) like the worldwide ISO 14001 standard and the European Eco-Management and Audit Scheme (EMAS), programmes developed by the US Environmental Protection Agency (EPA) such as Energy Star, Green Lights, and 33/50 and numerous environmental or social product labels. The appealing character lies in the fact that the credibility of these programmes is guaranteed by the initiators' public function and the external validation of a company's compliance with the programme. As most programmes allow the use of a logo, they are attractive instruments for companies to signal their pro-active stance to various stakeholders. Furthermore, some programmes provide participants with regulatory relief, subsidies or information sharing initiatives.

Not surprisingly, some of these initiatives are booming. The number of ISO 14001 certified companies has risen from 14,106 in December 1999 to 111,162 in five years time (ISO, 2006). Participation in EMAS has tripled to 3,389 organisations between 1997 and 2006[1]. A growth of 127% of the

[1]http://ec.europa.eu/environment/emas/documents/articles_en.htm#statistic

number of fairtrade certified producers has been experienced between 2001 and 2005 (Fairtrade Labelling Organizations International, 2006).

The question that emerges, is what causes some firms to pursue a pro-active strategy by participating in these programs whereas other companies seem to prefer a defensive strategy? To answer this question this paper examines the characteristics of large publicly quoted European companies that have adopted EMAS. EMAS was implemented by the Council Regulation (EEC) No 1836/93 of June 1993 allowing voluntary participation by companies in the industrial sector in a community eco-management and audit scheme. The regulation was replaced by Regulation No 761/2001 of 19 March 2001 whereby participation was opened to all sectors of economic activity, which enables us to analyse company behaviour in all sectors of economic activity and to draw conclusions that are not restricted to only a subset sectors. The scheme provides companies with a means to manage their environmental impacts and to improve their overall environmental performance. Next to the general requirements of installing an ISO 14001-like EMS, EMAS places special attention to the following elements: legal compliance, improvement of environmental performance, external communication and employee involvement. EMAS is considered as the standard of environmental excellence and is more stringent and demanding than ISO 14001 (e.g. Kollman and Prakash, 2002; Watson and Emery, 2004). Consequently the number of EMAS registered companies is rather small compared to the number of ISO 14001 certified ones. In December 2005, ISO 14001 outnumbered EMAS by a factor 10 in the EU-15. As such it can be argued that the decision to participate in EMAS is taken more thoughtfully and hence EMAS provides us with a better indicator of environmentally conscious companies.

The literature on environmentally responsive firms is rather elaborate. A wide range of internal characteristics (e.g. capital intensity, size, profitability and financial structure) as well as external drivers (e.g. pressure

from regulators, consumers, investors and local community) have been examined. As a literature survey of Alberini and Segerson (2002) however points out, the evidence on many determinants is not conclusive. Our research distinguishes itself from previous research in two ways. First is the voluntary approach under study: EMAS. Related research focused on ISO 14001 (Nakamura et al., 2001; Hibiky et al., 2003; Potoski and Prakash 2005) or on the comprehensiveness of environmental management practices implemented (Dasgupta et al., 2000; Khanna and Anton, 2002; Anton et al., 2004; Cole et al., 2006). As EMAS is perceived as being more demanding than ISO 14001, it may present a better picture of environmental responsiveness. Next to explaining the adoption of an EMS, a number of studies have focussed on the participation decision towards several US EPA's voluntary programmes such as the 33/50 program (Arora and Cason, 1995 and 1996; Khanna and Damon, 1999; Videras and Alberini, 2000), Green Lights (DeCanio and Watkins, 1998; Videras and Alberini, 2000) and Waste Wi$e (Videras and Alberini, 2000). King and Lenox (2000) studied companies' participation decision in the Chemical Industry's Responsible Care Program. Finally, Henriques and Sadorsky (1996) examined the motivations explaining firms' formulation of an environmental plan.

Second, this is the first study on the characteristics of green companies that uses a European firm-level dataset. Previous research has focused principally on US companies (Arora and Cason, 1995 and 1996; DeCanio and Watkins, 1998; Khanna and Damon, 1999; King and Lenox, 2000; Videras and Alberini, 2000; Khanna and Anton, 2002; Anton et al., 2004; Potoski and Prakash, 2005). Studies on ISO 14001 are mainly based on a sample of Japanese companies (Nakamura et al., 2001; Hibiky et al., 2003; Potoski and Prakash, 2005; Cole et al., 2006). Henriques and Sadorsky (1996) took a sample of Canadian companies and Mexican companies were the subjects of the study of Dasgupta et al. (2000).

Within the wide range of potential determinants for environmentally responsive behaviour, this paper focuses on business and financial indicators, stakeholder pressure and public policy. The results indicate that a company's financial structure, profitability, size and average labour cost are significant drivers of EMAS registration. Besides the nature of its activities and the location of its headquarters influence the likelihood of participation.

The paper is structured in the following sections. Section two presents the data and the model. Consequently the hypotheses and variables are discussed in section three. Section four presents the estimation results and section five concludes.

2. DATA AND METHODOLOGICAL APPROACH

This paper merges two firm-level datasets that, as far as we are aware, have not previously been combined. The first consists of the list of EMAS registered organisations (received from the EMAS helpdesk on the 25th of October, 2005). The second, the Amadeus database (Bureau van Dijk Electronic Publishing, update 131, August 2005), provides company-level data. Amadeus (Analyse Major Databases from European Sources) is a comprehensive, pan-European database containing financial information on approximately 8 million private and public companies in 38 European Countries. Both databases were linked using a companies ISIN (International Securities Identification Number) number. The ISIN number is a code that uniquely identifies a specific security and is accepted as standard by virtually all countries.

Our sample uses data from companies listed in the Dow Jones STOXX 600 Monthly Selection list of November 2005[2]. This list registers the largest

[2] Available at *www.stoxx.com/info/reports/selection2005.html*

publicly quoted companies from the EU-15, Norway and Switzerland. In November 2005 there were 968 companies on this list of which 74 were marked as EMAS registered. From this list, we excluded a number of companies. First we eliminated holding companies (Nace Revision 1.1 codes 7414 and 7415) because we believe their idiosyncratic characteristics might distort the results. Secondly, due to data limitations, we did not include companies not covered in Amadeus (especially banks and insurance companies) or companies with missing values on some items. Thirdly we eliminated companies with less then 500 employees[3]. This resulted in a final sample of 436 observations of which 38 (8,7%) are EMAS participants[4]. The number of participants in the total sample (8,7%) is low, but in line with some previous research (e.g. Arora and Cason, 1996; King and Lenox, 2000; Potoski and Prakash, 2005). As table I in appendix shows, the results presented in this paper are not substantially different from the results when all companies for which all data is available are included.

The sample consists of a quite homogeneous set of large and publicly quoted companies. Due to their visibility it is quite plausible to assume that all of them face at least some public scrutiny, receive a lot of cover in the financial press and face financial analysts who track and evaluate their performance on a daily basis. Probably most of these companies have several environmental and/or social projects running, publish sustainability reports and have, to some extent, implemented environmental management practices. Presumably a rather high percentage is ISO 14001 certified. It should be noted that whereas ISO 14001 and EMAS are generally presented as substitutes, this should not be the case. Although there are no official numbers it is safe to assume that a number of companies have implemented

[3] This was done due to our doubts on the accuracy of these data. 53 companies were lost.
[4] The EMAS helpdesk lists all organisations at facility level. Our sample however consists of companies at group level. As such following Nakamura et al. (2001) and Hibiki et al. (2003), an organisation was marked as EMAS participant if at least one of its facilities was registered.

both standards. In June 1998, close to half of the companies that were EMAS-registered also held an ISO 14001 certificate, while another third intended to go for ISO 14001 certification (Hillary, 1998). Moreover, with the revision of the EMAS regulation of 2001, ISO 14001 is considered as fulfilling the management system element of EMAS. This was done with the explicit aim to induce ISO 14001 certified companies to take an additional effort to become EMAS. As such, our analysis might reveal the characteristics identifying those companies that have taken the extra step.

As EMAS is a voluntary scheme, companies' participation decision will follow from a comparison of the monetary and non-monetary costs and benefits. Assume that both discounted monetary and non-monetary costs (C) and benefits (B) are influenced by the business characteristics (b) of the firm, the financial characteristics (f) as well as stakeholder pressure and public policy (s), i.e. C = C(b,f,s) and B = B(b,f,s). One would expect that a firm would implement EMAS if B>C. However, a company's net benefit is not directly observed and one only observes the participation decision. As such we create the variable $D(EMAS)_i$ that takes the value 1 if the *i*-th company was EMAS registered on October 25, 2005 and we assume that for these companies the discounted benefits outweigh the discounted costs whereas the opposite holds for all other companies for whom the EMAS variable equals 0 . To examine which characteristics are important, we use a binary response model and estimate

$$P[EMAS = 1] = \Lambda(\beta x)$$

where Λ is either the cumulative logistic function (logit model) or normal distribution function (probit model), β is a vector of parameters to be estimated and x are the characteristics of the firm influencing the costs and benefits of EMAS and hence, the decision to implement it.

3. DETERMINANTS OF ENVIRONMENTALLY RESPONSIVE COMPANIES

In this section we outline our main hypotheses and define the related independent variables. The European scope of the sample limits the independent variables we were able to include and thus the hypotheses to be tested. Next to Amadeus, the availability of comparable company-level data in Europe is limited. As such, although it would be interesting to test hypotheses on export ratio, R&D, advertising intensity… data limitations imply this is beyond the scope of this paper. Next the almost non-existence of comparable firm-level environmental performance data in Europe hinders testing whether EMAS participants prove superior environmental performance. Furthermore the fact a number of countries are included in the sample limits the variables to be included due to comparability problems with data from national sources.

We found inspiration for the majority of our independent variables in the literature. In a perfect world one would take the data from year(s) preceding a company's registration to EMAS. However, this might also create a bias as the implementation time is likely to differ between companies and some variables might be influenced by business cycle fluctuations. Therefore, for most financial variables that were taken from a company's balance sheet or profit and loss statement, we used averages over a 7-year period.

Business characteristics

Companies with a high number of facilities will face more difficulties in coordinating and monitoring all individual plants. As such the number of subsidiaries might be a determinant of the need for standardisation of a company's environmental policy and operating procedures. An EMS serves

as an instrument to structure the inflow of information and to monitor the implementation of the corporation's policy. A higher number of subsidiaries also serves as a proxy for the visibility of the company. Finally, companies with a larger number of facilities have a greater likelihood of participation since a company was considered a participant if at least one of its facilities volunteered to join. The variable (SUBSIDIARIES) measures the number of subsidiaries in 2004. The number of subsidiaries was previously examined by Arora and Cason (1996) and Dasgupta et al. (2000).

It is commonly hypothesised that size of a company positively influences the participation decision. Possible explanations include the following. First larger companies are more visible and face greater scrutiny from various stakeholders (Henriques and Sadorsky, 1996; Videras and Alberini, 2000; Cole et al., 2006). However, since all the firms in this analysis are publicly quoted and face scrutiny in the financial press, this reason might not be as important in our analysis. Second the key role of management is to ensure coordination of all actions of the many individuals and subgroups in the organisation. Larger companies face higher coordination costs, as there are more people and activities to coordinate. As such the need for formal structures and procedures to ensure that all employees are focussing their efforts towards the goals set by the management rises (Henriques and Sadorky, 1996). An EMS might serve as an instrument to reduce these coordination costs. Third large companies presumably have more financial and intellectual resources and experience with management standards like ISO 9001 (Nakamura et al., 2001; Hibiki et al., 2003; Cole et al., 2006). Here, we measure company size in 2 different ways. First, we use the average number of employees in the period 1998-2004 (EMPLOYEES). Secondly, we also created an additional size-variable (RELATIVE SIZE) that grasps the relative size of a company compared to the sector average. To do this we divided the number of employees of a specific company by the average number of all employees in all companies in the same 4 digit

NACE category in the sample. As such this variable compares the size of the company to that of its sector-competitors.

Next we hypothesise that the higher the average labour costs of a company, the more likely it is to have implemented EMAS. Higher average labour costs might represent a higher educated workforce or might refer to rather unsafe working conditions (e.g. higher wages in the nuclear or chemical sector). If higher educated people have a higher environmental awareness, as well the educated workforce as the unsafe working conditions explanation imply higher incentives to exert pressure on top management for safe working conditions and pollution abatement efforts. Moreover a highly skilled workforce will make it easier to implement a complex management system as they are generally more trainable, adaptable, and less resistant to change. We took the average costs of employees and averaged it over the years 1998-2004 to remove business cycle fluctuations. We will denote this variable with "LABOUR COST".

A measure for capital intensity was included under the premise that capital-intensive companies have more complex production technologies; require more energy and raw materials input and hence have higher emission levels (Cole et al., 2006). This induces the need for mechanisms to control these complex and highly polluting processes and in turn provides greater opportunities and scope for the introduction of clean technologies. The variable (CAPITAL INTENSITY) is measured by the ratio fixed assets per employee. Again the average over the years 1998-2004 is taken.

Finally, industry sector dummies are included to take into account industry-specific characteristics (e.g. Henriques and Sadorsky, 1996; Videras and Alberini, 2000; Hibiki et al., 2003). As such industry-wide differences with respect to, for instance, pollution intensity, regulatory burden and public concern are controlled for. Also, it controls for the differences with respect to the possibility to implement EMAS. As already noted, some firms were only able to implement it after the revision in 2001.

A company's activity was grouped based on the NACE classification Revision 1.1 and grouped into five industry dummies (SECTOR) shown in table 1. In our empirical test, the mining and quarrying, manufacturing and construction sector (sector A) is the omitted dummy.

Table 1 Sector dummies

Dummy	NACE	Description	Number of companies	EMAS
Sector A	C	▪ Mining and quarrying	16	2
	D	▪ Manufacturing	160	21
	F	▪ Construction	32	0
Sector B	E	▪ Electricity, gas and water supply	25	10
Sector C	G	▪ Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	51	0
	H	▪ Hotels and restaurants	13	1
	I	▪ Transport, storage and communication	50	1
Sector D	J	▪ Financial intermediation	15	0
	K	▪ Real estate, renting and business activities	56	2
Sector E	O	▪ Other community, social and personal service activities	18	1

Note: For the other NACE classes there were no companies in the sample

Financial characteristics

Implementing an EMS can be considered as a voluntary investment in an intangible asset, which is more likely to occur in companies with a sound financial structure (Videras and Alberini, 2000). It should be noted that the primal objective of an EMS is not to increase short-term profits. In fact, the opposite might be the case. The costs are immediate but the benefits are uncertain and might only materialise in the long run.

First we include the profit margin as a measure for a company's profitability. More profitable companies are supposed to have easy access to the funds, by retained profits or capital markets (Nakamura et al., 2001). The variable (PROFITABILITY) is measured by the average profit margin, defined as profit before taxation on turnover, over the period 1998-2004.

Second we include the solvency ratio (SOLVENCY) and expect a positive sign. The solvency ratio is calculated as shareholders funds on total assets and we use averages over 1998-2004.

Stakeholders and public policy

Within the wide range of stakeholders, shareholders and creditors may be important groups requesting the company to adopt a certified EMS. Both may require an EMS as a guarantee of good management in general and environmental risk minimization in particular to safeguard their invested funds. We hypothesize that the higher the number of shareholders the more pressure they will exert. Small shareholders have less influence on and knowledge about the company's operations and strategy compared to major shareholders. As a result they have more interest in external verification of good management to minimize the risk of future environmental liability. The variable (SHAREHOLDERS) reports the number of shareholders in 2004. A shareholder is reported if he holds at least 1% of the shares.

The pressure that emanates from creditors is measured by the average of the ratio of the non-current liabilities on total assets over the period 1998-2004 (NON-CURRENT LIABILITIES). The higher their share in the way the company is financed, the higher their associated risks. The variable only reflects the interests of long-term creditors, as we believe short-term creditors do not have an incentive to push the company's policy towards long-term objectives.

Finally, we include the country in which the company's headquarters is located. EMAS participation rates differ significantly form country to country. The national government's policy is supposed to play pivotal role in this regard by e.g. facilitating access to information, granting support funds, shaping attractive public procurement guidelines (e.g. Perkins and Neumayer, 2004; Delmas, 2002; Kollman and Prakash, 2002). The variable

is created as dummy variable (COUNRTY) that takes the value 1 if a company's headquarters is located in Member State that actively encourages EMAS registration. The classification is based on the number of incentives (regulatory flexibility, public procurement, support funding and technical assistance/information support measures) for registered organisations provided by each country as reported by the European Commission (2004). For companies in Germany (17 measures), Italy (15), Spain (13) and Austria (12) the variable takes the value 1. All other countries in the sample have eight or less incentive measures and are considered as less supportive.

Table 2 provides some descriptive statistics on the variables.

Table 2 Descriptive statistics (means and standard deviations)

Variable	unit	Total sample	EMAS companies	Non-EMAS companies
Business characteristics				
Subsidiaries	Number	72.99	156.05	65.06
		(121.1)	(265.30)	(93.68)
Employees	Number *1000	25.49	63.66	21.84
		(52.12)	(102.68)	(42.91)
Relative size	Ratio	1.085	1.914	1.006
		(1.06)	(1.46)	(0.98)
Labour cost	Thousand euro	44.68	51.51	44.03
		(20.67)	(13.41)	(21.13)
Capital intensity	Million euro	0.47	0.54	0.46
		(1,57)	(0.71)	(1.63)
Financial characteristics				
Profitability	Percentage	8.89	8.83	8.90
		(10.29)	(8.19)	(10.48)
Solvency	Percentage	38.63	39.12	38.58
		(17.72)	(11.77)	(18.20)
Stakeholders and public policy				
Shareholders	Number	15.70	19.42	15.35
		(18.94)	(22.09)	(18.60)
Non-current liabilities	Percentage	27.68	34.54	27.03
		(16.14)	(12.08)	(16.34)
Country	Dummy	0.24	0.53	0.21
		(0.43)	(0.51)	(0.41)
Sector dummies				
Sector A	Dummy	0.48	0.61	0.46
		(0.50)	(0.50)	(0.50)
Sector B	Dummy	0.05	0.26	0.03
		(0.23)	(0.45)	(0.19)
Sector C	Dummy	0.26	0.05	0.28
		(0.44)	(0.23)	(0.45)
Sector D	Dummy	0.16	0.05	0.17
		(0.37)	(0.23)	(0.37)
Sector E	Dummy	0.04	0.03	0.04
		(0.20)	(0.26)	(0.20)

4. RESULTS

The first column of table 3 presents the parameter estimates for the logit model. The corresponding probability values are presented between

parentheses. As a robustness check, the last column shows the probit results. The results of both estimations are in line. In the following we concentrate on the logit model. The goodness of fit measure count R^2, defined as the percentage correctly classified observations with the estimated equation is 92.89%. Due to the low number of EMAS registered companies in the sample, this is however only slightly above the percentage estimated with a constant probability measured by dividing the number of non-certified companies by the total sample number (91.28%). The McFadden R^2 value is 0.33 and as the likelihood ratio statistic equals 85,54, the null hypothesis that all coefficients are zero is rejected at the 1% significance level. However it should be noted that in binary regressand models the goodness of fit is of secondary importance. The sign of the coefficients and their significance is what matters (Gujarati, 2003).

The second column shows (for the logit model) the change in odds ratio due to an increase in the independent variable by one unit. For instance, the coefficient for the variable employees equals 0.009. The corresponding odds ratio ($e^{0.009}$) is 1.009. Then we may say that when the independent variable increases one unit, the odds that the dependent equals 1 increase by a factor of 1.009, when other variables are controlled for. The closer the odds ratio is to 1, the less influence the independent variable exerts on the dependent variable. Equally one can say that when the variable employees increase by one unit (1000 employees) the odds of being EMAS registered increases by 0.9%. The third column shows the percent increase in the probability of being certified for a one-unit increase in the independent variable, controlling for the other variables in the model.

Table 3 Logit estimation results for EMAS certification

Variable	Logit estimation	Percent increase in odds	Percent increase in probability	Probit estimation
Business characteristics				
Subsidiaries	0.0002	0.02	0.002	0.0003
	(0.9048)			(0.6994)
Employees	0.0090**	0.90	0.072	0.0041*
	(0.0253)			(0.0581)
Relative size	0.5047***	65.65	4.940	0.2575***
	(0.0019)			(0.0034)
Labour cost	0.0270***	2.73	0.217	0.0122**
	(0.0098)			(0.0226)
Capital intensity	0.0491	5.04	0.399	0.0159
	(0.8139)			(0.8717)
Financial characteristics				
Profitability	-0.0400*	-3.92	-0.312	-0.0180
	(0.0787)			(0.1142)
Solvency	0.0576***	5.93	0.470	0.0258**
	(0.0068)			(0.0011)
Stakeholders and public policy				
Shareholders	0.0058	0.58	0.046	0.0032
	(0.4702)			(0.4673)
Non-current liabilities	0.0458**	4.69	0.372	0.0200*
	(0.0317)			(0.0528)
Country	0.7619*	114.23	8.266	0.4673**
	(0.0821)			(0.0430)
Sector dummies				
Sector B	1.6582***	424.97	24.672	0.9490***
	(0.0048)			(0.0036)
Sector C	-2.6182***	-92.71	-8.024	-1.0677***
	(0.0071)			(0.0075)
Sector D	-2.6320***	-92.81	-8.033	-1.0557**
	(0.0090)			(0.0165)
Sector E	-0.5340	-41.38	-3.415	-0.2957
	(0.6257)			(0.5841)
Constant	-7.9945***			-3.9540***
	(0.0000)			(0.0000)
N	436			436
Log-likelihood	-86.2457			-87.5513
Rest. log-likelihood	-129.0158			-129.0158
LR statistic (14)	85.540***			82.929***
Prob. (LR statistic)	(0.0000)			(0.0000)
% correctly classified	92.89%			92.66
McFadden R^2	0.3315			0.3214

* , ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level respectively

Note. Probability values are shown in parentheses. LR statistic is a chi-square test for all slope coefficients jointly equal to zero.

Next we turn to the significance of the variables. The number of shareholders, the number of facilities, the capital intensity[5] and one sector dummy are not significant. The insignificance of the number of facilities corresponds with Arora and Cason (1996) but contradicts with Dasgupta et al. (2000) who found that being a multi-plant company was the most influential variable. Whereas the theoretical arguments for the capital intensity variable were appealing, our unexpected result is also found by Cole et al. (2006). In their paper, for some measures of a company's environmental awareness it even turned out significantly negative. Note however that three sector dummy variables are significant. These dummies may partly capture differences in capital intensiveness among companies. Compared to the mining and quarrying, manufacturing and construction sector (sector A), companies involved in electricity, gas or water supply (sector B) are more frequently registered. Companies in the services sectors C (trade, hotels, restaurants, logistics and communication) and D (financial intermediation, real estate and business activities) participate significantly less frequent in EMAS. Notwithstanding this finding was expected as on average manufacturing companies face higher environmental risks, it should be taken in account that is was only in April 2001 when the renewed EMAS scheme was implemented that companies in the service sector were allowed to participate. Finally, other community, social and personal service activities (sector E) have no significantly different participation rates compared to the mining, quarrying, manufacturing and construction sector.

The size of a company, measured by the number of employees, is significant at the 5% level. Controlling for the absolute number of employees, the relative size of a company compared to its sector average turns out positive and significant at 1%[6]. These results confirm the

[5] Taking total assets per employee yields similar results.

[6] When the absolute and relative size of a company are measured based on turnover, the corresponding coefficients are positive and significant at the 1% respectively 5% level.

expectation that larger companies are more likely to have implemented EMAS even when controlling for the number of facilities. From the odds ratio's, it follows that relative size has the most important influence on the probability of EMAS implementation. Hence, within a given sector and controlling for absolute size, we find that especially larger firms implement EMAS.

Labour cost's influence on the probability of EMAS implementation is positive and highly significant. This implies that companies with highly skilled workforce of with unsafe working conditions have a higher probability of having implemented EMAS. This corresponds to some extent with Dasgupta et al.'s (2000) finding that companies in which a higher proportion of employees followed postsecondary education have significantly more comprehensive EMS.

When looking at the financial variables, it turns out that the profitability measure is significant at the 10% level, but has a negative coefficient. In the probit model, this variable is also negative but no longer significant. Using alternative measures of profitability such as the return on shareholder funds or the return on total assets did not alter this result: these alternative variables turned out negative but insignificant.[7] Again this is in contrast with our a priori expectations, but consistent with the diverging results of related research. On the one hand, Cole et al. (2006) found a negative influence whereas Hibiki et al. (2003) found it to be positive. In the results of De Canio and Watkins (1998), Arora and Cason (1995) and Nakamura et al. (2001) profits do not seem to have a significant influence on a company's environmental responsiveness. This leads to conclude that profit levels do not seem to exert a decisive (positive) impact on this issue. A possible explanation for the negative coefficient may be that the need to

However in this case the labour cost variable and the country dummy variable lose their significance.

[7] These results are available upon request from the authors.

differentiate from competitors is higher in more competitive markets where profit margins are generally rather moderate.

The coefficient of the solvency ratio is positive and significant. Furthermore, the higher the share of non-current liabilities the higher the probability a company is EMAS registered. Both confirm that a solid financial structure on the long term is favourable for implementing EMAS. [8] The positive sign of non-current liabilities may also point to the pressure exerted from long-term creditors for the company to demonstrate that it minimises its (environmental) risks. While the number of shareholders was positive but not significant, the non-current liabilities are. This seems to suggest that pressure from external stakeholders is especially relevant for those who provide long-term debt. With respect to debt variables, the results reported in the literature are mixed. The debt ratio turns out negative and significant in Nakamura et al. (2001) and Cole et al. (2006) but insignificant in Arora and Cason (1995), DeCanio and Watkins (1998) and Hibiki et al. (2003). These diverging results may partly be explained by a difference in the way debt is measured. Is debt exclusively measured by current or non-current liabilities or as the aggregate of both? Our analysis turns out debt diminishes the likelihood of participation in EMAS but that especially the current liabilities exert a strong negative influence whereas the non-current liabilities on the other hand invoke a positive pressure[9].

[8] When the percentage of current liabilities takes the place of the non-current liabilities, the coefficient is negative and significant which supports this claim. However, the solvency ratio is no longer significant.

[9] When we take the debt ratio, defined as the current and non-current liabilities on total assets, the coefficient is negative and significant at 5%. This points out that debt as such has a negative influence, but when controlled for the solvency ratio, the impact of current liabilities is negative whereas non-current liabilities is not. If we include only current liabilities, the coefficient is negative and significant, if we only include non-current liabilities; the coefficient is positive but not significant even at the 10% level. Notice that the aggregate of the variables solvency, non-current and current liabilities by definition equals one.

Finally, a stimulating government policy, as reflected by the country dummy variable, provokes a positive and significant influence. Companies whose headquarters is located in Germany, Italy, Spain or Austria seem to get higher incentives to register.

5.CONCLUSIONS

Responding proactively to growing environmental pressure is becoming a widespread trend among companies. It goes without saying that the level of commitment however is uneven ranging from environmental leaders to defensive companies. Empirical research on the characteristics of environmentally responsive companies has focussed almost exclusively on US and Japanese firms. For Europe, which is commonly considered as the greenest of the three major developed economic markets, similar research is lacking. This paper seeks to contribute by empirically investigating the business and financial characteristics, stakeholder pressure and public policies distinguishing companies that have implemented EMAS. A logistic regression analysis was carried out on a sample of 436 European companies listed on the Dow Jones Stoxx 600 selection list. Our results indicate that the solvency ratio, the share of non-current liabilities, the average labour cost and the company size positively influence the participation decision. Next to the absolute company size, the relative size of a company compared to its sector average increases the likelihood of participation. The profitability on the other hand exerts a negative influence. Also, the location of a company's headquarters and the industrial sector determine the likelihood of EMAS participation.

Overall, our conclusions are in line with related findings from research carried out in the US and Japan. Although evidence is still limited, this might point to a rather moderate influence of the institutional context when

it comes to distinguishing the characteristics of environmentally leading companies. The literature on the geographical diffusion of EMS on the other hand points to the decisive role of institutional-related aspects to explain the diverging adoption rates between countries. Linking these two findings might be a challenging task for future research.

Another issue that calls for further exploration is the question whether the adoption of voluntary initiatives makes companies outperform others on environmental abatement. Clear signals of added value above business-as-usual assessments are required to justify that many voluntary initiatives provide benefits for participants in the form of decreased regulatory pressure, subsidies or positive publicity. Increasing the amount of and reliability of environmental information is crucial to enhance transparency and enable public monitoring efforts. The Toxic Release Inventory in the US is a forerunner in this regard en has enabled this kind of research. For now, the findings do not permit an incontestable answer. Unfortunately, comparable firm level environmental performance data is lacking in Europe. A database on firm level CO_2-emissions created in the wake of the recent emission-trading directive on greenhouse gas emissions might provide us with a promising indicator in this regard.

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APPENDIX

Table 4 Sensivity analysis

Variable	Full sample without holdings (logit)	Full sample with holding companies (logit)
Business characteristics		
Subsidiaries	0.0004	0.0009
	(0.8089)	(0.5124)
Employees	0.0079**	0.0057*
	(0.0432)	(0.0756)
Relative size	0.5479***	0.277**
	(0.0007)	(0.0227)
Labour cost	0.0230**	0.0141*
	(0.0350)	(0.0725)
Capital intensity	-0.1560	-0.3202
	(0.5304)	(0.1365)
Financial characteristics		
Profitability	-0.0163	-0.0127
	(0.3370)	(0.3513)
Solvency	0.0515**	0.0477**
	(0.0161)	(0.0020)
Stakeholders and public policy		
Shareholders	0.0054	0.0024
	(0.4997)	(0.7670)
Non-current liabilities	0.0467**	0.0555***
	(0.0273)	(0.0005)
Country	0.7594*	0.4786
	(0.0810)	(0.1648)
Sector dummies		
Sector B	1.7022***	1.6543***
	(0.0043)	(0.0020)
Sector C	-2.3785**	-2.151***
	(0.0121)	(0.0096)
Sector D	-2.6861***	-0.3201
	(0.0086)	(0.3847)
Sector E	-0.4058	-0.4654
	(0.7085)	(0.6649)
Constant	-7.8039	-6.9213***
	(0.0000)	(0.0000)
N		
Log-likelihood	474	628
Restricted log-likelihood	-88.3601	-145.5351
LR statistic (14)	-132.3320	-186.4544
Probability (LR statistic)	87.944	81.839***
% correctly classified	(0.0000)	(0.0000)
McFadden R^2	93.04	91.40
	0.3323	0.2195

* , ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level respectively

Note. Probability values are shown in parentheses. LR statistic is a chi-square test for all slope coefficients jointly equal to zero.

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