

Firm-Level Determinants of Participation in EMAS – A Study of German Publicly Listed Companies

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Overview

- (1) Motivation
- (2) Adoption of EMAS by German Firms
- (3) Data
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- (5) Hazard Model
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(1) Motivation

- ▶ Proliferation of voluntary approaches to environmental policy in OECD countries
- ▶ Requires better understanding of why firms participate
 - ▶ Maxwell et al. 2000; Alberini and Segerson 2002; see also Shimshack and Kitzmueller 2012
- ▶ Evidence from cross-country studies informative
 - ▶ Perkins and Neumayer 2004; Cormier et al. 2005; Bracke et al. 2008
- ▶ Better yet: Studies at firm level – but limited evidence
 - ▶ USA (e.g. DeCanio and Watkins 1998, Arora and Cason 1995)
 - ▶ Japan (Nakamura et al. 2001; Nishitani 2008)
- ▶ At this stage, empirical evidence base not yet exhausted

(2) Adoption of EMAS by German Firms

- ▶ Attractive part of evidence base: EMAS adoption in Germany
 - ▶ EMAS (Eco-Management and Audit Scheme): Standardized public voluntary environmental management system
 - ▶ high propensity among German firms to adopt EMAS when compared to other EU countries (Morgenstern and Pizer 2007; Kollman and Prakash 2002),
- ▶ Research question

Which firm-specific factors induce German publicly listed companies to voluntarily adopt EMAS?

- ▶ Two interesting dimensions of EMAS adoption decision
 - ▶ Likelihood of participating in EMAS
 - ▶ Timing of the EMAS participation decision

(3) Data

- ▶ **Sample sizes**
 - ▶ Probit: N=233
 - ▶ Hazard: N=135 firms, time scope of 16 years (1995 to 2010)
- ▶ **Assumptions**
- ▶ **Data sources**
 - ▶ Thomson Datastream's Global Database, Bureau van Dijk's AMADEUS, European Commission's EMAS Register
- ▶ **Hypotheses based on observable firm characteristics**
 - ▶ Business characteristics: firm size and firm age
 - ▶ Financial characteristics: profit margin, earnings per share, quick ratio
 - ▶ Stakeholder pressures: debt ratio, extent of foreign holdings, export ratio
 - ▶ Control variables: industry effects

(4) Probit Model

- ▶ Likelihood of participating in EMAS
 - ▶ Binary response variable $D(\text{EMAS})$
- ▶ Theoretical model
 - ▶ Facility participates, if benefits exceed costs:

$$D(\text{EMAS})_i = \begin{cases} 1 & \text{if } \pi_i(b, f, s) > 0 \\ 0 & \text{if } \pi_i(b, f, s) \leq 0 \end{cases}$$

with

$$\pi(b, f, s) = B(b, f, s) - C(b, f, s)$$

$$\Pr[D(\text{EMAS}) = 1 | b, f, s] = \Pr[\varepsilon_i > -\beta' x_i] = \Phi[\beta' x_i]$$

,

(4) Probit Model

► Explanatory variables

Variable	Unit	Description
D(EMAS)	Dummy variable	Dependent variable, taking on the value 1 if the firm or one of its facilities has received EMAS certification as of 2010
LOGSIZE	Number	$\text{LOG}[(\text{Full-time} + \text{part-time employees} - \text{seasonal} - \text{emergency employees}) / 1,000]$
AGE	Number in years	Base year minus year of incorporation
MARGIN	Ratio	$(\text{Operating income} / \text{net revenue}) * 100$
EPS	Ratio	Profit / weighted average number of common shares
QUICK	Ratio	$(\text{Cash} + \text{cash equivalents} + \text{net receivables}) / \text{current liabilities}$
DEBT	Ratio	$(\text{Long term debt} / \text{total capital}) * 100$
FOREIGNH	Ratio	$(\text{Foreign holdings} / \text{total holdings}) * 100$
EXPORT	Ratio	$(\text{Exports} / \text{sales revenue}) * 100$

(4) Probit Model: Estimates

Variable	(1)	(2)	(3)
LOGSIZE	0.1678*** (0.001)	0.1694*** (0.000)	0.1907*** (0.000)
AGE	0.0042* (0.091)	0.0027 (0.237)	0.0024 (0.146)
MARGIN	0.0065 (0.750)	0.0107 (0.740)	0.0059 (0.859)
EPS	0.1031*** (0.006)	0.1190*** (0.009)	0.1753*** (0.005)
QUICK	-0.3385*** (0.000)	-0.3595*** (0.002)	-0.4519*** (0.000)
DEBT	0.0088 (0.171)	0.0086 (0.310)	0.0100 (0.199)
FOREIGNH	-0.0213*** (0.000)	-0.0226*** (0.001)	-0.0338*** (0.000)
EXPORT	0.0054 (0.171)	0.0060 (0.172)	0.0008 (0.897)
Industry Dummies	NO	NO	YES
Constant	-3.2600***	-3.1211***	-2.6308***
N	233	162	162
Log likelihood	-47.5098	-43.4499	-40.4011
Pseudo-R ²	0.3267	0.3046	0.3534

Notes:

*, ** and *** indicate significance levels of 10%, 5% and 1%, respectively.

Clustered Standard Errors on industry level.

Dependent Variable is the likelihood of EMAS certification.

The original sample of 233 observations is compressed to 162 observations in specification (2) and (3), since five industries are dropped because they predict failure perfectly.

(5) Hazard Model

- ▶ Timing of EMAS participation decision
 - ▶ First-mover advantages vs. benefit of learning experience of early movers
- ▶ Theoretical model
 - ▶ Survival analysis using Cox' proportional hazards model:

$$h(t|x_j) = h_0(t) \exp(x_j \beta_x)$$

with

$h_0(t)$ being the unknown non-negative base hazard function,

x_j representing a vector of multiple regressors for subject j, and

β_x denoting the coefficients to be estimated from the data.

- ▶ Hypotheses in analogy to probit model
 - ▶ Positive association in probit model → positive correlation in hazard model, which is shorter time to certification

(5) Hazard Model: Estimates

Variable	(1)		(2)	
	Coefficient	Hazard Ratio	Coefficient	Hazard Ratio
LOGSIZE	0.4269***	1.5325***	0.4830***	1.6209***
	(0.000)	(0.000)	(0.000)	(0.000)
AGE	0.0055***	1.0055***	0.0063***	1.0063***
	(0.002)	(0.002)	(0.000)	(0.000)
MARGIN	0.0043	1.0043	0.0351	1.0357
	(0.920)	(0.920)	(0.528)	(0.528)
EPS	-0.0016	0.9984	-0.0013	0.9987
	(0.804)	(0.804)	(0.815)	(0.815)
QUICK	-0.0852	-0.9184	-0.1397	-0.8696
	(0.602)	(0.602)	(0.476)	(0.476)
DEBT	-0.0014	0.9986	0.0031	1.0031
	(0.918)	(0.918)	(0.793)	(0.793)
FOREIGNH	-37.4667***	0.000***	-0.7863***	0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)
EXPORT	-0.0024	0.9976	-0.0025	0.9975
	(0.740)	(0.740)	(0.759)	(0.759)
Industry Dummies	NO		YES	
Wald Chi²	1370.03		9423.45	
Log likelihood	-86.3791		-80.9642	
NFirms	135		135	
NObs	1952		1952	

Notes:

*, ** and *** indicate significance levels of 10%, 5% and 1%, respectively.

Clustered Standard Errors on industry level.


Dependent Variable is the time to EMAS certification.

(6) Robustness

- ▶ Controlling for network/adoption effects
 - ▶ no significant result; main results confirmed
- ▶ Using relative values of variables (normalized on industry level)
 - ▶ main results confirmed

(7) Conclusion

- ▶ Major findings
 - ▶ Positive impact of (logged) firm size on EMAS certification in both models
 - ▶ Negative impact of foreign ownership in both models
 - ▶ Positive impact of age in the hazard model
 - ▶ Financial measures only significant in the Probit model
- ▶ Further research
 - ▶ Additional variables such as ownership structure
 - ▶ Declining participation numbers of German firms in EMAS



Thank you for your attention



Appendix

Probit Analysis

► Hypotheses

H ₁	The probability of deciding for EMAS certification is positively correlated with the firm size.
H ₂	The probability of deciding for EMAS certification shows negative association with firm age.
H ₃	The probability of deciding for EMAS certification is positively related to profitability as measured by the operative profit margin.
H ₄	The probability of deciding for EMAS certification is positively related to profitability as measured by earnings per share.
H ₅	The probability of deciding for EMAS certification shows is positively correlated with the quick ratio.
H ₆	The probability of deciding for EMAS certification is positively associated with the debt ratio.
H ₇	The probability of deciding for EMAS certification is positively correlated with the share of foreign holdings.
H ₈	The probability of deciding for EMAS certification is positively influenced by the export ratio.

Probit Analysis

► Industry Classification

Dummy	ICB code	ICB industry	Number of companies	Thereof EMAS- registered (abs.)	Thereof EMAS- registered (in %)
1	0500	Oil & gas	20	0	-
2	1000	Basic materials	16	5	31%
3	2000	Industrials	71	9	13%
4	3000	Consumer goods	50	4	8%
5	4000	Health care	22	0	-
6	5000	Consumer services	27	2	7%
7	6000	Telecommunications	3	0	-
8	7000	Utilities	8	1	13%
9	8000	Financials	4	0	-
10	9000	Technology	22	0	-
Total			233	21	9%

► Descriptive
Statistics:
Probit Sample
with N=233

Variable	Mean	Standard deviation	Minimum	Maximum
Dependent variable				
D(EMAS)	0.0901	0.2870	0.0000	1.0000
Explanatory variables				
SIZE	15.7775	56.0640	0.0010	451.5150
AGE	37.0558	44.2412	2.0000	170.0000
MARGIN	4.44223	10.1034	(69.6900)	57.6800
EPS	1.8812	4.2132	0.0000	37.3900
QUICK	2.3345	13.7639	0.1300	210.4100
DEBT	23.6576	21.5649	0.0000	100.0000
FOREIGNH	9.8026	21.4762	0.0000	95.0000
EXPORT	42.7864	30.8353	0.0000	99.4000
Industry dummies				
Oil & gas	0.0858	-	0.0000	1.0000
Basic materials	0.0687	-	0.0000	1.0000
Industrials	0.2876	-	0.0000	1.0000
Consumer goods	0.2017	-	0.0000	1.0000
Health care	0.0944	-	0.0000	1.0000
Consumer services	0.1030	-	0.0000	1.0000
Telecommunications	0.0129	-	0.0000	1.0000
Utilities	0.0343	-	0.0000	1.0000
Financials	0.0172	-	0.0000	1.0000
Technology	0.0944	-	0.0000	1.0000

► Descriptive
Statistics:
Hazard Sample
with N=135

Variable	Mean	Standard deviation	Minimum	Maximum
Dependent variable				
Time_to_EMAS	4.3750	1.8394	0.0000	14.0000
Explanatory variables				
SIZE	23.3217	62.4002	0.0010	536.3500
AGE	88.2482	74.3961	15.0000	702.0000
MARGIN	3.0184	8.1313	(83.4200)	62.5600
EPS	7.3074	80.1238	0.0000	3,183.7000
QUICK	1.3309	2.6290	0.0000	82.6900
DEBT	25.1960	21.4657	0.0000	100.000
FOREIGNH	4.4773	16.0830	0.0000	98.0000
EXPORT	36.9816	29.8188	0.0000	98.8300
Industry dummies				
Oil & gas	0.0000	-	0.0000	0.0000
Basic materials	0.0889	-	0.0000	1.0000
Industrials	0.3259	-	0.0000	1.0000
Consumer goods	0.3407	-	0.0000	1.0000
Health care	0.0667	-	0.0000	1.0000
Consumer services	0.0815	-	0.0000	1.0000
Telecommunications	0.0074	-	0.0000	1.0000
Utilities	0.0296	-	0.0000	1.0000
Financials	0.0148	-	0.0000	1.0000
Technology	0.0444	-	0.0000	1.0000