The characteristics of chemical firms registering for ISO 14001 or Responsible Care

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E C O N O M I C S B U L L E T I N

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Abstract

We use survey data to investigate the determinants of chemical firms' registration for the ISO 14001 standard or the Responsible Care program. We show that most determinants are different for the two systems analyzed: while firm size, previous experience with similar standards, information disclosure requirements and customers' location are major determinants of ISO 14001 standard registration, regulatory pressure, past environmental problems, and future risks are the main drivers of Responsible Care registration.

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1. Introduction

Due to several environmental catastrophes (*e.g.,* Seveso [1976]; Three Mile Islands [1979]; Bhopal [1986]; Chernobyl [1986]) and the perceived risks associated with its activities, the chemical sector has been exposed to an increasing pressure to improve the management of its environmental impacts. In response to these pressures, the Canadian Chemical Producers' Association (CCPA) designed the Responsible Care program in 1985 to cope with environmental issues and restore public confidence in chemical sector. This program has been diffused to several countries. This unilateral voluntary initiative encourages firms to adopt beyond-compliance policies and commit themselves to continually enhance their health, safety and environmental performances. Moreover, firms commit themselves to more openness in communication about their activities and their achievements. By acting in a responsible way, the chemical sector expects to earn public trust and maintain its 'social license' to continue its operations in a safe and profitable way and with due care for the interests of future generations. While there is a common basis, the Responsible Care program is adapted to domestic conditions by different national chemical industry associations. The program has gained credibility by threatening non-adopting firms that they would be excluded from the chemical association. Moreover, the self-monitoring procedure has evolved in a number of countries towards third party verification (Prakash, 1999).

More recently, another system, the ISO 14001 standard was adopted by several thousand chemical firms worldwide with a similar objective. Contrary to the Responsible Care program that was designed *by* and *for* the chemical industry, the ISO 14001 standard, launched in 1996 and revised in 2004 by the International Organization of Standardization (Geneva), is a generic standard that can be adopted by all kinds of organizations, regardless of their activity or location. This standard does not replace technical requirements embodied in statutes or regulations nor does it prescribe standards of performance for organizations. Instead, it requires that an organization implements a set of practices and procedures which, when implemented together, result in an environmental management system (EMS). The EMS provides the framework for ensuring that risks, liabilities and impacts are properly identified, minimized and managed (Darnall et al., 2000). It is based on the principle of a 'continual improvement', *i.e.,* the Deming's 'Plan-Do-Check-Act' cycle. The diffusion rate of ISO 14001 worldwide, as estimated by the number of certificates delivered, is impressive with more than 100 000 certificates delivered at the end of 2006[1]. Among benefits expected from this certification are cost savings from the improved resource use, better workforce management, and enhanced relations with stakeholders (*e.g.*, customers, public authorities, neighbors) (Holt, 1998).

The Responsible Care program and the ISO 14001 standard are both voluntary approaches, which share the goal of implementing environmental management systems. Nonetheless, these approaches also differ on several issues (Table 1).

[Insert Tables 1 here]

While there is a growing literature on EMSs (*e.g.*, Henriques et Sadorsky, 1996; Prakash, 1999; Nakamura et al., 2001; Anton et al., 2004), the empirical evidence regarding the determinants of ISO 14001 or Responsible Care registration in the chemical sector is relatively scarce. The aim of this article is to fill this gap by identifying the factors that drive chemical companies to adopt either RC or ISO 14001, in a comparative approach. Moreover,

[1] ISO website: www.iso.ch

compared to other empirical studies performed on other sectors, we investigate the effects of new variables such as previous environmental accidents and information disclosure requirements.

The remainder of the paper is as follows. In the next section, we provide a theoretical rationale for EMS certification and formulate hypotheses. The third section presents the data and the methods used. Section four discusses the results. Section five is devoted to conclusive remarks.

2. Related literature and hypotheses

From an economic viewpoint, the firm's decision to certify an EMS can be explored in the context of a discrete choice model, where the rational manager chooses the alternative (either Responsible Care or ISO 14001 or no EMS at all) that maximizes the net expected benefits. Most empirical studies devoted to EMS adoption are mainly multi-sectoral analyses and use a binary-choice model to explain a discrete voluntary decision by a vector of variables corresponding to the expected determinants. Based on a literature review, we formulate several hypotheses regarding the determinants of EMS certification by chemical firms.

Main activities of the firm

Environmental regulations differ among chemical subsectors due to their different types and levels of pollution. On the one hand, firms in more regulated and monitored subsectors are more likely to integrate environmental management into their overall management system and to seek a certified EMS to benefit from regulatory relief. Indeed, the costs incurred in the case of non-compliance are likely to be higher. On the other hand, firms belonging to the most polluting subsectors may face more difficulties in attempting to implement a comprehensive EMS than a less polluting subsector (Grolleau *et al.*, 2007). In line with these authors, we contend that EMSs are about more than 'pollution' in the ordinary sense and encompass a wide range of aspects relating to sustainable production, workers' health and safety and ethical issues. As our paper concentrates on chemical firms, we formulate the following hypothesis:

H1: The probability of registering for a certified EMS increases for firms belonging to chemical subsectors which are more polluting and more risky, ceteris paribus. Because Responsible Care has been directly conceived by and for the chemical sector and is more likely to fit sector specificities, we assume that the subsector effect is likely to play a more important role in registering for Responsible Care.

Company size

Arora and Cason (1995) argue that the company size has a positive effect on voluntarism. Given that EMS implementation and certification require significant amounts of financial, managerial and qualified human resources, larger firms are more likely to adopt an EMS. Economies of scale and 'learning by doing' may also give an advantage to larger firms. In addition, larger firms are more visible and more subject to various pressures that may encourage them to adopt a formal EMS. Most empirical studies (Nakamura et al., 2001; King and Lenox, 2001; Welch et al., 2002) found that the probability of adopting an EMS increases with the firm size. Consequently, we hypothesize:

H2: The probability of registering for a formal EMS increases with the firm size, ceteris paribus. Because the adoption cost of Responsible Care is frequently considered as lower

than that of ISO 14001, we contend that the size effect is stronger for ISO 14001 than for Responsible Care (Prakash, 1999).

Previous experience with similar mechanisms

In a 'new institutional economics' perspective, norms may have an impact on the cost of EMS certification (Grolleau *et al.*, 2007). In a context where there is a lot of information, resources and skills on how to implement a similar or related process standard, such as ISO 9000, there will probably also be information and skills available on how to implement an EMS (King and Lenox, 2001; Delmas, 2003). Firms that have previous experience with similar standards are expected to incur lower additional costs (*e.g.*, through the overlap of documentation requirements) because of learning by doing and scale economies. Moreover, integrated systems allowing joint implementation and certification of two or more standards also reduce the marginal cost of a certified EMS (Bansal and Hunter, 2003; Nakamura *et al*., 2001). Consequently, prior certification with standards having a similar architecture is likely to reduce the overall cost of EMS certification. Empirical studies corroborate this contention. We therefore hypothesise:

H3: The probability of registering for a certified EMS increases with firm experience with other process standards, ceteris paribus.

Disclosure requirement

Several countries have introduced in their regulatory arsenal a mandatory disclosure of information related to environmental performances of companies, such as the Toxic Release Inventory (TRI) (Antweiler and Harrison, 2003). In France, the regulatory act so-called '*Nouvelles Régulations Economiques'* (New Economic Regulations) requires that companies listed on the stock market provide an environmental report each year. According to Tietenberg (1998), the conceptual economic foundation for disclosure policies is the Coase Theorem, which asserts that socially optimal risk sharing can be obtained if all stakeholders can negotiate at a very low cost. Removing or at least attenuating information asymmetries, which constitute an impediment to private bargaining may enable to reach a Pareto-optimal outcome. Thanks to publicly available information on the environmental performances of the companies, various stakeholders may give an advantage to companies with good environmental performances. This mandatory requirement and the impact it can have, especially on the valuation of the firms in the stock market may push firms to adopt a formal EMS in order to demonstrate to their stakeholders their credible commitment to environmental management (Jiang and Bansal, 2003; Hibiki et al., 2003). Consequently, we formulate the following hypothesis:

H4: The mandatory disclosure requirements increase the probability that a firm registers for an EMS, ceteris paribus. Because, the ISO 14001 standard is considered to be more stringent and credible than Responsible Care, we contend that the disclosure requirements would have a stronger impact for registration to the former.

Customers' location

Firms' environmental performance is frequently unobservable, especially to customers located in areas which are institutionally, geographically and culturally different. In a signaling or screening rationale, firms that have distant customers are more likely to prove their environmental commitment (Arrow, 1963; Spence, 1973) through institutional devices like ISO 14001 and Responsible Care. The ISO 14001 certification may prove the ability of the supplier to satisfy environmental expectations of customers and make public unobservable

attributes, especially in contexts when customers may be vulnerable to reputation externalities (Boiral, 2006). King and Lenox (2001) showed that the distance to customers had a significant positive impact on firms' decisions to adopt a certified ISO 14001 standard. Moreover, anecdotal evidence shows that some EMSs are *de facto* passports to make business with foreign companies (Terlaak and King 2006). Several empirical studies, such as Corbett and Kirsch (1999) and Bansal and Hunter (2003), confirmed the significant role played by exports in firms' decisions to register for a certified EMS. Indeed, export markets in eco-sensitive countries like Germany and Austria may have a strong impact (relative to less eco-insensitive countries) on the decision to adopt EMS certification (Potoski and Prakash, 2004; Chang and Kristiansen, 2006). Thus, distinguishing between export destinations seems to be an important issue in EMS certification. Related to these arguments, we formulate the following hypotheses:

H5a: The probability of registering for a certified EMS increases with the distance to customers, ceteris paribus.

H5b: The probability of registering for a certified EMS increases as customers are located in foreign countries, ceteris paribus. Because of its international and generic aspect, and third party verification, we contend that export considerations are likely to have a higher impact on ISO 14001 certification compared to Responsible Care.

H5c: The probability of registering for a certified EMS increases as the customer's hosting country is sensitive to environmental issues, ceteris paribus.

Regulatory and external pressure

Firms may commit in voluntary initiatives to reduce or transfer direct and indirect regulatory pressure (Maxwell and Decker 1998). Welch *et al.* (2002) argue that firms experiencing stronger regulatory pressure are more likely to adopt an environmental management system. Moreover, "through their commitment to improve the natural environment and their threat of issuing more stringent regulations [or improving the enforcement of existing regulation], governments can send a clear signal to firms that environmental concerns will be taken seriously in the future" (Delmas, 2003, p. 12). According to Yiridoe and Marett (2004, p. 58), "the primary objective of the ISO 14001 EMS standard is to enhance and continuously improve compliance with environmental laws and regulations, and the environmental stewardship policies of organisations". Several empirical studies have proved that regulatory pressure is a significant determinant of EMSs certifications (Grolleau *et al.*, 2007 and references therein).

H6: The probability of registering for a certified EMS increases with the firm's exposure to regulatory pressure, ceteris paribus. Given the higher external pressure, we contend that firms that have experienced environmental accidents or problems and/or face higher environmental risks are more likely to register for a certified EMS.

3. Data and model specification

In January 2005, survey questionnaires[2] were sent to the exhaustive list of French chemical firms or production units (N=720) as published annually in '*Info Chimie Magazine*'[3]. The latter contains all the chemical firms, their addresses, the names of the CEO, the names of the environmental managers and some firms' key characteristics. Out of 720 firms surveyed, 86

[2] The questionnaire borrows several elements from surveys used in prior studies.
[3] Info Chimie Magazine, 2004, n°457, Juillet/Août, Spécial usines chimiques.

responded with usable data (with a response rate of 12 %), which can be considered as good given the sensitiveness of environmental issues in the chemical sector.

The dependent variables, denoted *ISO14* and *RC*, are binary variables equal to 1 if the firm is registered for the ISO 14001 standard and Responsible Care, respectively. The number of registered firms is 40 for ISO 14001 and 41 for Responsible Care. The proportion of certified firms in the sample (about 50%) is considerably higher than the proportion of certified firms in the whole firm population. Certified firms are over-represented in the sample of respondents, since certified firms were more willing to answer the questionnaire (26% of the companies inside the chemical industry in France are ISO 14001 standards certified, COI, 2006[4]).

To test hypotheses H1 to H6 we used ten dummy explanatory variables as follows. To test H1 (main activities of the firm), we asked the surveyed firms to indicate what their main activities are. Four subsectors commonly used in the French nomenclature[5] are considered: basic chemistry including both inorganic and organic chemistry, fine chemistry, speciality chemistry and pharmaceuticals. Among 86 firms who responded to our survey 47 are from basic chemistry industry, 24 from fine chemistry industry, 27 are from speciality chemistry industry, 7 are from pharmaceuticals, and 5 are from the category 'others'. Certain companies can participate in several subsectors. Due to a small number of responses, we can not compute for each subsector-specific discrepancy in the behaviour of chemical firms regarding certification. Thus, we investigate whether belonging to those subsectors generally considered as more polluting, *i.e.*, inorganic and organic chemistry (*BASIC*), increases the probability of EMS certification. The other subsectors constitute the reference group. For H2 (size of production unit), we use the variable *SIZE* equal to 1 if the firm has more than 100 employees in its production unit. To operationalise H3 (experience with other standards) we use ISO 9000 certification as a proxy (*ISO9*). To test H4 (disclosure requirements) we use the variable *STOCK* equal to 1 if the company is on the stock market. Indeed, as mentioned above, firms operating on stock markets are subject to the 'New Economic Regulations' act and thus are asked to provide a publicly available environmental report. To test H5a (distance to customers), we create the variable *DISTANCE* that takes the value of 1 if the distance to main customers is more than 250 km. The effect of exports on the registration for a certified EMS (H5b) is measured by the variable *EXPORT* that takes the value of 1 when the company makes more than 10% of its turnover in foreign countries. To test H5c (region of export), we use the variable *REGION* that is equal to 1 if the main region of exports is North Europe, North America or Japan. To test H6 (regulatory and external pressure), three variables are used: *SEVESO*, *ENVPROB* and *RISKS*. *SEVESO* is equal to 1 if the company is classified SEVESO I or SEVESO II or both. SEVESO I (1982) and SEVESO II (1996) are European directives intended for industrial companies where dangerous substances are present in quantities exceeding the thresholds in the directives. We contend that firms which are subject to these directives are more likely to register for a certified EMS. *ENVPROB* is equal to 1 if the firm declared that it has experienced an environmental problem in the last ten years. Finally, the variable *RISKS* is equal to 1 if the firm anticipates high future environmental risks. Firms were asked to weight the importance of environmental risks on a ten-point scale from 1 to 10, where 10 indicates that the environmental risks are very high. The variables used in estimation and general sample statistics are indicated in table 2. No problem of multicolinearity has been detected.

[4] Changement Organisationnel et Informatisation (COI), 2006, www.enquetecoi.net.
[5] See the website of the Chemical Industry Union (UIC) : http://www.uic.fr/us/indus01.htm

[Insert Table 2 here]

For each EMS, *i.e.*, ISO 14001 standard and Responsible Care, we use a linear model for the underlying latent variable driving certification:

$$Y_i^* = \alpha + \sum_{i=1}^{10} \beta_i X_i + \mu_i, \quad i = 1, 2, ..., N. \qquad (1)$$

where X_i represents the vector of variables for ISO 14001 and Responsible Care certification (*BASIC, SIZE, ISO9, STOCK, DISTANCE, EXPORT, REGION, SEVESO, ENVPROB, RISKS*); $\beta_1 - \beta_{10}$ are slope coefficients to be estimated, and α and μ are the intercept and the disturbance term, respectively. The interpretation of the latent variable in this kind of model is typically that of an overall net gain (or profit) originating from certification (that is, the perceived difference between profit under certification and profit without certification). Of course, profit here has to be taken in a very broad sense. When this latent variable is positive, certification gains outweigh losses due to certification. The model of firms' certification choice is stated as a discrete-choice model, with the dummy variables indicating certification, *ISO14* and *RC*, as the dependent variables Y_i :

$$\begin{aligned} Y_i &= 1 \quad if \quad Y_i^* > 0, \\ Y_i &= 0 \quad otherwise. \end{aligned} \qquad (2)$$

We specified logistic distributions for μ and maximized the log-likelihood of the logit models (Greene, 2003) to estimate models' parameters up to a positive constant[6].

4. Results and discussion

Logit estimation results are presented in Table 3. The main result from our estimation is that determinants for EMS certification differ among the two systems. While ISO 14001 registration is driven by the company size, the previous experience with process standards, the disclosure requirements and customers' location, registration for Responsible Care is mainly driven by environmental factors, *i.e.*, environmental regulations, problems and risks.

[Insert Table 3 here]

The hypothesis that subsector characteristics could have a differential impact on the decision to be EMS-certified (H1) is not supported. This may be explained by the fact that in the chemical industry the 'reputational' spillover effects are relatively high making all the industry incriminated in the case of an environmental crisis (Rees, 1994). Nevertheless, additional studies with more usable data are required to better understand the possible effects of subsectors.

The second hypothesis which states that the probability of EMS registration increases with the company size *ceteris paribus* is supported for ISO 14001 standard only. Our findings are consistent with previous studies. For instance, investigating the drivers of EMS certification in the agrofood industry, Grolleau *et al.* (2007) show that the probability of certification increases with the firm size. According to these authors, 'EMS promoters might be able to

[6] Unfortunately, due to the low number of observations (86), we could not use a multinomial logit model.

increase certification by encouraging large certified firms to require that their (smaller) suppliers become certified'. Our result gives an additional empirical content to this argument.

The hypothesis that the experience with other standards increases the probability of EMS registration *ceteris paribus* (H3) is supported for ISO 14001 since the variable ISO9 is significant and positive. A possible explanation of this result could be due to different architectures of ISO 9000 and Responsible Care. Moreover, since the date of creation of ISO 9000 is close to the date of creation of Responsible Care, early EMS adopters may have not benefited from the ISO 9000 experience.

The hypothesis that information disclosure requirements increase the probability of EMS certification, *ceteris paribus* (H4) is supported for ISO 14001 certification. As mentioned above, stockholders would prefer adoption of ISO 14001 because of Responsible Care 'credibility lack'. In addition, firms that have adopted Responsible Care before the creation of the ISO 14001 standard and are satisfied with its environmental outcome could have less interest in registering for the former.

The results related to hypotheses H5a, H5b and H5c are quite interesting. The distance to customers (H5a) is almost significant for ISO 14001 standard, but the sign of the parameter is negative. This counterintuitive result could be explained by the fact that, in general, consumers of chemical products could pay more attention to their near surroundings than those areas that are far from them. Nevertheless, we can not give a clear-cut conclusion and more research is needed to confirm or not this possible explanation. The hypothesis that the probability of EMS registration increases with exportation *ceteris paribus* (H5b) is not supported. This result could be explained by the fact that the French legislation on pollution may benefit from a good image abroad, making EMS registration less useful for exports.

The hypothesis H6 stating that the probability of registering for a certified EMS increases with the firm's exposure to regulatory pressure, *ceteris paribus* is supported for Responsible Care registration. Regulatory pressure through SEVESO is a significant determinant for EMS certification. Nevertheless, the parameter associated with past environmental problems is negative. This negative sign could be explained by the fact that some firms have already a bad image due to environmental problems. Thus, although, Responsible Care was created after a series of environmental catastrophes, firms could estimate that registration with Responsible Care is unlikely to reconstruct a good public image. The variable *ENVPROB* is significant but has a negative sign. Evidence exists that it is less costly for organizations with better environmental performance to acquire environmental management systems and certify with ISO 14001. Thus, the negative sign could be explained by the fact that companies that faced environmental problems will avoid certification because it is too costly for them to meet EMS requirements (King and Lenox, 2001). Finally, our estimation shows a positive effect of future risks on Responsible Care registration.

5. Concluding remarks

We examined empirically the determinants of registration for ISO 14001 standard or Responsible Care program by the French chemical industries. Although the aims of these two environmental management systems are similar, the factors that influence their adoption are quite different. Indeed, our findings suggest that the firm size and signaling unobservable attributes to distant customers are significant determinants of the ISO 14001 certification, while environmental factors play a significant role in Responsible Care registration. Thus, a company can choose one of these two EMSs depending on its strategy and business aim. A

company that has a higher turnover in foreign countries would rather implement the ISO 14001 standard.

Because the firm size is likely to play a more important role for ISO 14001 certification as compared to Responsible Care, it seems more feasible for small firms to be Responsible Care registered. Given the different nature of determinants for the two systems, the *a priori* high costs of a double certification can be an obstacle for firms that search for the environmental outcome while signaling their environmental efforts. For instance, firms that are ISO 14001 certified seem more sensitive to information disclosure requirements. Thus, it may be necessary to increase the credibility of Responsible Care program among stakeholders to allow firms that are registered with it to signal their outcome without having to incur additional costs to be ISO 14001 certified. Thanks to our results, policymakers willing to promote a given EMS may adopt better tailored policies. A natural extension to our contribution is to examine the determinants of joint certification (*i.e.*, ISO 14001 and Responsible Care) by some firms which could add a valuable contribution to these issues.

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Table 1: Characterization of the Responsible Care program and ISO 14001 standard

Characteristics	Responsible Care	ISO 14001
Date of creation	1985	1996
Designer	CMA	ISO
Adopters	Firms of the chemical sector	Any firm worldwide
Verification	Variable with an evolution to third party assessment	Auto-assessment or third–party certification
Cost of implementation	+	++

Table 2: Definition of variables and sample statistics

Variable	Definition	Mean	Standard deviation
ISO14	1 if certified with ISO 14001 standard	0.4651	0.5017
RC	1 if registered for Responsible Care program	0.4767	0.5024
BASIC (H1)	1 if main activity is basic chemistry	0.4884	0.5028
SIZE (H2)	1 if more than 100 employees in production unity	0.3488	0.4794
ISO9 (H3)	1 if certified with ISO 9000 standard	0.6163	0.4891
STOCK(H4)	1 if the firm is on the stock market	0.2209	0.4173
DISTANCE (H5a)	1 if distance to customers > 250 km	0.7209	0.4512
EXPORT(H5b)	1 if turnover abroad >10% of total sale	0.6395	0.4830
REGION(H5c)	1 if region of export North Europe, North America or Japan	0.3837	0.4891
SEVESO (H6)	1 if firm SEVESO I or SEVESO II or both	0.3837	0.4891
ENVPROB (H6)	1 if environmental problems in last 10 years	0.1628	0.3713
RISKS (H6)	if the importance of risk generates by firm's activity is higher than 5 on the scale from 1 to 10 (very low to very high)	0.3953	0.4918

Number of observations: 86.

Table 3: Determinants of ISO 14001/Responsible Care registration

Variables	ISO 14001		Responsible Care		Marginal Effect	
	Estimate	p-value	Estimate	p-value	ISO14001	RS
INTERCEPT	-2.25	0.00	-1.60	0.02	-	-
BASIC	0.85	0.14	0.89	0.11	0.21	0.22*
SIZE	2.28	0.00	0.07	0.90	0.51***	0.02
ISO9	1.13	0.10	0.97	0.12	0.27*	0.23*
STOCK	2.35	0.00	0.81	0.20	0.50***	0.20
DISTANCE	-1.15	0.12	-1.11	0.10	-0.28*	-0.27*
EXPORT	-0.73	0.35	0.95	0.19	-0.18	0.23
REGION	1.52	0.05	-0.58	0.38	0.36**	-0.14
SEVESO	0.98	0.16	1.09	0.08	0.24	0.26*
ENVPROB	0.99	0.23	-1.73	0.04	0.24	-0.36***
RISKS	-0.23	0.72	1.27	0.04	-0.06	0.31**
Max Rescaled R2	0.46		0.41			
-2 log L	82.35		87.63			
-2 log L (Intercept only)	118.80		119.03			
Likelihood ratio	36.44		31.40			
Percent concordant	84.2		82.1			
Number of observations	86		86			
Number of certified firms	40		41			

(*), (**) and (***) stand for parameter significance at the 10, 5 and 1 percent level respectively. Marginal effects are computed at the sample mean.