What Drives Agro-food Firms to Seek ISO 14001 Certification?[1]

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Abstract: Despite the large diffusion of environmental management systems (EMSs) worldwide, the number of economic studies devoted to the determinants of their certification is still limited, especially at a sector level. To fill this gap, we examine empirically what factors contribute to voluntary certification with the ISO 14001 standard by agro-food industries. A discrete-choice model of EMS certification is applied to a sample of 1000 French agro-food firms in order to know what they hope to achieve with ISO 14001 certification. The findings suggest that management-related factors drive certification more strongly than economic incentives and provide a new perspective on how the arguments *à la* Porter may influence the certification decision.

Key-words: Agro-food industries, EMS, ISO 14001 certification, Voluntary instruments.

JEL classification: L15; L59; Q59.

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1. Introduction

In wealthy post-industrial societies, firms need both a legal right and a 'social license' to operate (Gereffi et al., 2001; Grolleau et al., 2004). In response to these 'new' social constraints required by various stakeholders (e.g., activists, unions and consumers), firms have recently developed a myriad of voluntary instruments to support their commitment (Khanna, 2001). A growing but still limited literature has investigated theoretically and empirically the determinants of the adoption of voluntary instruments (Arora and Cason, 1995; Henriques and Sadorsky, 1996; Khanna and Damon, 1999; King and Lenox, 2000; Videras and Alberini, 2000), especially the ISO 14001 adoption (Harter and Homison, 1999; Nakamura et al., 2001; King and Lenox, 2001b; Welch et al. 2002; Bansal and Hunter, 2003; Darnall, 2003; Vastag, 2004). The traditional economic rationale contends that firms adopt voluntary instruments if they expect that the benefits of voluntarism will outweigh the costs (Segerson and Miceli, 1998; Welch et al., 2002).

Adoption of a formal environmental management system (EMS) is one form of these voluntary environmental actions. An EMS prescribes how an organization will meet its environmental objectives. The ISO 14001 standard is the most widespread EMS intended to motivate any organization, regardless of size or type, to be clean and green. The ISO 14001 standard prescribes how a company can develop an environmental policy, identify environmental aspects and impacts of its activities, products and services, define the significance of these impacts; rank them, identify legal and other requirements governing the organization's operation, establish objectives and targets, implement programs to meet those standards, establish an auditing system and procedures for management review, and implement corrective action, if needed, based on audit findings. The competitor scheme in Europe is the EMAS. The EU EMAS and international ISO 14001 share the same objective: to provide good environmental management systems. They may be considered to some extent as substitutable EMS. More formally, EMAS is a management tool for companies and other organizations to evaluate, report, and improve their environmental performance. The EU scheme has been available for voluntary participation by companies since 1995 (Council Regulation (EEC) No 1836/93 of 29 June 1993). It is often considered as being more stringent than ISO 14001. Nevertheless, technical distinctions between both schemes are beyond the scope of this contribution.

Despite the broad diffusion of such EMSs worldwide (66 070 ISO 14001 certifications by the end of 2003[1]), there are still few economic studies devoted to the determinants of ISO 14001 certification, especially at the sectoral level. These studies are generally multisectorial and use Logit or Probit regressions to explain a discrete voluntary decision by a vector of variables corresponding to the

expected determinants. The results of these studies are inconclusive and it is still difficult to derive general conclusions about the motivations of firms to certify (Table 1).

[Insert Table 1 around here]

Our paper seeks to understand what factors contribute to voluntary certification with the ISO 14001 standard by the French agro-food industry. The French food industry is leader in the European market and ranks second in the world, behind the U.S. market. It is also the largest industrial sector in France with sales valued at €136 billion. In France, there are more than 4200 agro-food companies, most of them are small and medium sized businesses. Despite a great number of small companies, the aggregated impact on the environment is huge small and well-reflected by important anti-pollution investments, ranked just behind the energy and chemical sectors (Vittek, 2000[2]). By the end of April 2002, only 62 agro-food companies were having at least a facility certified according to ISO 14001 standard (less than 1.5%) (APAVE, 2002[3]). Investigating the certification patterns of a self regulating device in the agrofood industry such as ISO 14001 is important for several reasons. First, the agrofood sector taken collectively has a strong impact on the environment and faces various stakeholders' pressures to manage environmental issues. Second, food businesses are influenced by public perceptions associating environmental quality and food safety. Reputation, which is a major asset in agrofood industries, is very sensitive to environmental concerns. Reputation is sometimes collectively held and agrofood firms are to some extent hostages to each other, creating peer pressures and customer demands for formal environmental management systems. Environmental issues frequently transcend the attributes of food products and extend to the processes by which the agrofood products are produced, processed and consumed (Batie, 2000; Chang and Kristiansen, 2004). Third, certification with a formal EMS in the agrofood industry is encouraged by public authorities as a credible means to ensure regulatory compliance and substantiate environmental claims (Chang and Kristiansen, 2004).

The originality of the paper is at least twofold. First, as far as we know, our survey is the only one to focus exclusively on the incentives of ISO 14001 certification in agro-food companies. Indeed, cross variations of ISO 14001 certification among sectors adds relevance to the current study. Such an empirical investigation enables us to understand if determinants at the sector level are similar to those identified at a multi-sectors level. This understanding may help ISO 14001 promoters increase the target of their policies rather than adopting a 'one-size-fits-all' policy. Moreover, we focus on certification rather than simple adoption. Indeed, certification is different from adoption *sensu stricto*. While certification does reflect the adoption of specified practices assessed by a third party, uncertified firms may still adopt a lot of practices. Although it is not easy to separate out the two concepts, this distinction becomes essential for some arguments, *e.g.*, the signaling rationale. Second, our

contribution is the first attempt to investigate the respective role played by several non mutually exclusive competitiveness drivers on ISO 14001 certification which are cutting costs by improving process, meeting customers' demands and managing human resources. This investigation may add empirical content at the micro-level to the so-called Porter hypothesis. Extending the so-called Porter hypothesis predicts that well crafted voluntary approaches such ISO 14001 may increase both environmental performance and economic efficiency. Our result emphasizes the importance of human resources management as a potential driver of ISO 14001 certification.

Our paper is organized as follows. In section 2, we review the economic theory devoted to firms' incentives for certifying environmental management systems notably the ISO 14001 standard. We develop a theoretically based model to predict voluntary certification of an EMS by agro-food firms. In section 3, we present the data and methods. We consider a logit analysis taking the discrete ''certify / not-certify'' variable as the dependant one. Section 4 provides our estimation results, discusses them and draws several policy implications. Section 5 concludes.

2. Related literature and conceptual framework

Traditionally, a profit maximizing firm will seek ISO 14001 certification when net benefits are positive. ISO 14001 aims by its nature to improve environmental performance without harming the firm competitiveness. Such a rationale clearly follows the arguments suggested by Porter. Based on a review of the literature, let us consider theoretical rationales that predict which factors determine the propensity of an entity to be ISO 14001 or EMAS certified[4] and confront these predictions with the available empirical studies[5] (Table 1).

Firm size

Certifying an EMS includes significant sunk costs and additional variable costs[6]. The fixed cost gives an advantage to big firms that can spread it over a greater number of produced units. Firms that have similar plants may incur lower costs due to scale economics and learning (King and Lenox, 2001b). Moreover, benefits resulting from certifying an EMS such as regulatory relief or improved public image are more likely and with a greater magnitude for bigger firms. Indeed, large firms are frequently more visible and more regulated and monitored than small ones. Last but not least, big firms are expected to have more financial and human resources to achieve an environmental commitment than small ones. The empirical tests have largely corroborated this reasoning. As far as we know, Harter and Homison (1999) is the only study where firm size is not significant. According to these authors, this could be due to the presence of other environmental management systems in large firms, which is likely to reduce, at least in a short period, their intention to certify according to ISO 14001. So, we

assume that the firm size influences positively its propensity to certify with ISO 14001 and formulate the following hypothesis:

H1: *The larger a firm, the more likely it will be ISO 14001 certified.*

Previous experience with similar standards

In a new institutional economics perspective, norms may have an impact on the cost of certifying according to the ISO 14001 standard. In a context where there is a lot of information, resources and skills on how to implement a similar or related process standard, e.g., ISO 9000 or HACCP, it is most likely that there will also be information and skills available on how to implement an ISO 14001 EMS (King and Lenox, 2001b; Delmas, 2003). Firms that have previous experience with similar standards are expected to incur lower costs (e.g., through the overlap of documentation requirements) because of learning by doing and scale economies. Moreover, integrated systems allowing a joint implementation and certification of two or more standards also reduce the cost of ISO 14001 EMS certification alone (Bansal and Hunter, 2003; Nakamura et al., 2001). Consequently, the prior certification with standards sharing a similar architecture with the ISO 14001 EMS is likely to reduce the overall cost of certifying it. All the empirical studies described in table 2 corroborate this contention. We therefore hypothesize:

H2: *Firms that have experience with process standards are more likely to be ISO 14001 certified.*

Foreign customers

The environmental aspects of the production process frequently have credence properties, i.e. unobservable attributes even after purchase. Because of information asymmetry, eco-sensitive buyers may fear an adverse selection outcome (Akerlof, 1970). In a signaling perspective, ISO 14001 certification may provide information on the general capability of a supplier to meet the environmental expectations of the customer (Spence, 1973). Information asymmetry about environmental attributes is generally more crucial when agents evolve in different institutional environments, are geographically, culturally and linguistically distinguished (King and Lenox, 2001b) or when customers do not have adequate abilities to assess environmental commitments of suppliers. For example, sensitive customers may trust domestic firms because of the credible enforcement of domestic regulations and doubt about foreign suppliers (Wojan and Bailey, 2000). So, the certification with an internationally recognized standard may play a strong role in signaling unobservable attributes and generating trust (Gunby, 1998; Zucker, 1986). Thus, environmentally proactive firms should incur additional costs to avoid being pooled together with other firms with a low level of compliance with environmental regulations. Nakamura et al. (2001) argue that "since foreign customers may have less chance to monitor the performance of a company or have knowledge about its actions and intentions, they may demand more visible signs of commitment of environmental protection". For instance, ISO 14001 certification may

provide information on the general ability of a supplier to meet the customer's specific environment control requirements and make public unobservable characteristics. This prediction was consistent with empirical tests of Nakamura et al. (2001) and Bansal and Hunter (2003).

H3: *The more an organization's buyers are located in foreign countries, the greater its propensity to be ISO 14001 certified.*

Improving resource productivity

Porter and Van Der Linde (1995) have argued that properly crafted regulation may generate a broad array of efficiency gains and economic opportunities[7]. The argument can be easily extended to self regulatory devices such as ISO 14001. Let us distinguish at least three non-mutually exclusive ways by which ISO 14001 certification may increase firm profitability. First, Porter and Van Der Linde (1995a; 1995b) argue that pollution is a manifestation of economic waste and involves unnecessary and incomplete utilization of resources. The authors provide anecdotal evidence of companies that have increased their resource productivity by process improvement and input savings. Consequently, ISO 14001 adoption may help a firm to detect and eliminate inefficiencies in resource use. Nevertheless, one may argue that adoption is sufficient to reap these benefits and that completion until certification may be unnecessary. Despite this, we formulate the following hypothesis:

H4: *The more an organization seeks to improve its resource productivity, the greater its propensity to be ISO 14001 certified.*

Meeting customers' demands

Second, adopting an ecofriendly innovation may help a firm to serve a growing market of environmentally informed customers and command a price premium (Porter and Van Der Linde, 1995a, 1995b). Customer demands encompass demands from upstream customers like agrofood processors and retailers but also demands from end consumers (Chang and Kristiansen, 2004). Yiridoe and Marett (2004) provide anecdotal evidence that certain agrofood companies certified with the ISO 14001 EMS early to benefit from a first mover advantage. These companies exploited their certificate to differentiate themselves from competitors. Moreover, because a customer's reputation may be vulnerable to environmental information resulting from its downstream supplier (especially in the agrofood chain), the former frequently puts pressure on the latter to obtain credible proofs of its environmental commitment. Subsequently, the development of EMS initiatives may receive a considerable boost among first-line suppliers of major food manufacturers or retailers (Yiridoe and Marett, 2004). Hence, we propose the following hypothesis:

H5: *The more an organization receives customers' demands related to environmental considerations, the greater its propensity to be ISO 14001 certified.*

Improving human resources management

Third, firms may adopt environmental voluntary initiatives to improve human resources management by facilitating recruitment, increasing employees' morale and motivations, and therefore raising workforce productivity (Börkey et al., 1999; Darnall et al., 2000, see also Frank, 1997). Based on a detailed case study, Phanuel (2001) indicates how ISO 14001 adoption has increased managerial efficiency. De Backer (1999) provides anecdotal evidence that ISO 14001 has significant effects on the employees' morale and productivity much more than the ISO 9000 certification. In sum, the ISO 14001 certification may eliminate organizational failures, motivate employees and improve managerial efficiency (Paton, 2001; Avadikyan et al., 2001). In the line of Gabel and Sinclair-Desgagné (1998, 2000), adopting an ISO 14001 may provide the necessary meta-framework and pressure to develop new organizational structures and routines that allow to look for some kinds of profitable improvements. Such propositions are somewhat supported by the findings of Yiridoe et al. (2003), which states that ISO 14001 certification is mainly organization-motivated, rather than client-driven. Consequently, we hypothesize that:

H6: *The more a firm wants to improve its organizational and managerial effectiveness, the greater its propensity to be ISO 14001 certified.*

Environmental considerations

For the firm, the primary purpose of interactions with government authorities is to acquire and retain the right to operate, i.e., a permit. Additional purposes may be to limit damage to humans and the environment, avoid future liabilities, not incur reputational loss, and maintain goodwill (Delmas and Marcus, 2004). Moreover, "through their commitment to improve the natural environment and their threat of issuing more stringent regulations, governments can send a clear signal to firms that environmental concerns will be taken seriously in the future" (Delmas, 2003). 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 organizations". As a management system that goes beyond existing command and control regulations, "firms would then consider ISO 14001 as a tool to prepare their organization for potentially more stringent regulations" or to preempt them (Delmas, 2003; see also Welch et al., 2002). In sum, regulatory compliance is a major concern for agrofood firms. Because of the perceived relationship between safety and environment impacts, regulatory compliance has not only legal consequences but also reputational and economic ones. Certifying with an ISO 14001 EMS has the potential to reduce risks related to environmental compliance.

H7: *The more a firm is willing to enhance its regulatory compliance, the greater its propensity to be ISO 14001 certified.*

Relations with third parties

In addition to the legal right to operate, firms may need a *'social license to operate'*. Indeed agrofood firms may be sensitive to various stakeholders' pressures such as local communities, environmental unions and care about their overall reputation (Grolleau et al., 2004). ISO 14001 certification may constitute a means to respond to these demands and generate reputational gains. Empirical studies are mitigated on this type of incentives, perhaps because of differences in the studied sectors and institutional environment. There is also anecdotal evidence that ethical considerations of managers may reinforce their desire to adopt voluntary approaches (Nakamura et al., 2001; Welch et al., 2002). Bansal and Hunter (2003) suggest that managers may also express their environmental commitment through other means than ISO 14001 certification.

H8: *The more a firm wants to improve its relations with third parties, the greater its propensity to be ISO 14001 certified.*

Table 2 summarizes the previous hypotheses and their expected sign.

[Insert Table 2 around here]

3. Data and model specification

Sample

In December 2003, survey questionnaires[8] were sent to the top 1000 French agro-food firms (out of a total of more than 4200 agro-food firms in France) ranked by sales volume. The original set of firms was drawn from the 2002 list provided by the French Ministry of Agriculture, more precisely the Central Department of Statistics (Service central des enquêtes et études statistiques, SCEES, 2003). The questionnaire was addressed whenever possible, to the environmental (or product quality) manager in the firm, so as to minimize the number of missing observations or irrelevant answers. Out of the 1000 firms surveyed, 232 responded with useable data (23.2 %).

Dependent variable

The dependent variable, denoted *ISO14*, is a dummy variable equal to 1 if the firm is ISO 14001 or European Eco-Management and Audit System (EMAS) certified and 0 otherwise. Despite some differences between ISO 14001 and EMAS such as the relevant geographical area and the stringency

level, we contend that the certification drivers are the same for both standards. Moreover the number of EMAS certificates is very low. We model the decision to certify at the company level, similarly to Nakamura et al. (2001). The certified firm is defined as a company which has at least one certified facility[9].

Explanatory variables

As mentioned above, economic theory predictions about determinants for ISO 14001 certification may be classified into five types, i.e., firms' characteristics, economic advantages, managerial advantages, environmental advantages, and relations with third parties. Some of these determinants for certification are captured by the scores explained below, and others are captured by other variables in the sample. More precisely, to test hypothesis 1 (firm size), we use total sales (*BIGF*) as a proxy. To operationalize hypothesis 2 (experience with other process standards), we use ISO 9000 certification as a proxy (*CERI9*). Indeed, the architecture and basic requirements of ISO 9001 and ISO 14001 are similar. Because of data limitations that do not allow to have a continuous measure, the export orientation (H3) is measured by a dummy variable (*EXPORT*) taking the value of 1 when a firm exports more than 30% of its total sales, and 0 otherwise. Customers' demands (H5) are also measured by a dummy variable (*ENVDEM*) taking the value of 1 when a firm states high customers' demands and 0 otherwise. Hypotheses H4, H6, H7 and H8 are operationalized as described below. Firms were asked to weight from 1 to 5 the importance of cutting costs, enhancing human resources management, enhancing regulatory compliance and improving relations with third parties. The questions were scored on a five-point scale from 1 to 5, where 5 indicates a significantly positive effect and 1 no effect. These scored factors, categorized into four broad determinants types, are presented in table 3. In order to reduce the time needed to fill the questionnaire, questions were all in qualitative (not ordered) format. Answers are not mutually exclusive within a given category, so that several positive answers may be reported.

[Insert Table 3 here]

Based on these qualitative variables, we compute a category-specific measure of the firm position in the form of scores denoted *SC_COST* (for cost cutting), *SC_MAN* (for managerial considerations), *SC_ENV* (for environmental considerations) and *SC_THP* (for third party considerations). The computation of these scores is as follows:

First, for the firm $i\left(i=1,2,...,N\right)$ and the consideration category $j\left(j=A1,A2;B1,B2,B3;C1;D1,D2\right)$ in table 3, we calculate the score as follows:

$$Score\ (i,j) = \text{Answer of the firm } i \text{ – mean answer of all firms for } j\ .$$

Second, for each category of consideration, i.e., COST, MAN, ENV, and THP, we calculate an aggregated score, denoted SC_X $(X = COST, MAN, ENV, THP)$, by summing individual scores *Score (i, j)* over all items within a given category of motivation, for every firm. Hence, the final score measures the location of each firm compared to the sample average, as a non-weighted mean of the different components for each category:

$$SC\_X_i = \sum_{j \in X} \left[Score(i, j) - \frac{1}{N} \sum_{k=1}^{N} Score(k, j) \right]$$

As usual in discrete-choice models with a binary dependent variable, we first specify a linear stochastic model for the underlying economic variable driving certification (a latent, unobserved variable).

Consider the following continuous latent variable model:

$$\begin{aligned} Y_i^* &= a + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{3i} + b_4 X_{4i} + b_5 X_{5i} + e_i \\ &= a + X_i b + e_i, \quad i = 1,2,..., N, \end{aligned} \tag{1}$$

where X_{1i} represents a vector of variables for firms' characteristics *(BIGF, CERI9)*, X_{2i} economic considerations *(SC_COST, ENVDEM, EXPORT)*, X_{3i} managerial considerations *(SC_MAN)*, X_{4i} environmental considerations *(SC_ENV)*, and X_{5i} relations with third parties *(SC_THP)*; b_1 to b_5 represent vector of coefficients to be estimated, and a and e represent the intercept and the error 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, or else, the difference between profit under certification and profit under the *status quo*. Of course, profit here has to be taken in a very broad sense. When this latent variable is positive, either certification gain outweighs losses due to certification, or the profit differential is in favor of certification by the firm.

Thus, the model of certification for the firms can be stated as a discrete-choice model with the dummy variable indicating certification, *ISO14*, as the dependent variable Y_i:

$$\begin{cases} Y_i = 1 \quad if \quad Y_i^* > 0, \\ Y_i = 0 \quad otherwise. \end{cases} \tag{2}$$

Specifying a logistic distribution for e with cumulative density function denoted $\Lambda(.)$, we maximize the log-likelihood of the sample, associated with individual probabilities of certification:

$$\log L = \sum_{i=1}^{N} \{ Y_i \log[\Lambda(a + X_i b)] + (1 - Y_i) \log[1 - \Lambda(a + X_i b)] \}. \quad (3)$$

As is well known, structural parameters b are only identified up to scale, because the variance of the standard Logit model is (arbitrarily) set to $p^2/3$. Nevertheless, statistical inference can still be performed regarding parameter significance, and the sign of each coefficient is preserved. In particular, joint significance of parameters contained in any of the vectors b_1 to b_5 can be tested, in order to validate or not the impact of a given category determinants on certification.

4. Results and discussion

The main variables used in estimation and sample statistics are presented in table 4. No problem of multicolinearity was revealed when examining the tolerances. Table 5 reports correlation coefficients.

[Insert Tables 4 and 5 here]

In the following we present our findings, discuss them and draw several policy implications. Logit estimation results are presented in table 6. Most estimates are consistent with the expected signs and generally support the formulated hypotheses, except for some variables.

As mentioned above, firm-specific variables such as *BIGF* (firm size), *CERI9* (ISO 9000 certification) and EXPORT (exportations) are included, beside scores. The percentage of correct predictions is satisfactory, with more than 83.1 percent of firms adequately predicted as being ISO 14001 certified. To better interpret the magnitude of the impact of different explanatory variables on the probability of certification, we also report marginal effects (right-hand side of table 6).

We test for the joint significance of parameter estimates corresponding to the 5 different types of determinants for certification: firms' characteristics *(BIGF, CERI9)*, economic advantages (*SC_COST, ENVDEM, and EXPORT*), managerial factors *(SC_MAN)*, environmental advantages (*SC_ENV*), and relations with third parties *(SC_THP)*. Wald test statistics are reported in table 6. As can be seen from the latter, except "relations with third parties", the joint significance of parameters is established.

Concerning marginal effects, managerial considerations have the most important impact on the probability of certification, with a marginal probability of 0.2373, significant at the 1 percent level. The second marginal effect, associated with firm size *BIGF* and the third, associated with ISO 9000 certification, *CERI9*, are also positive and significantly different from 0. Interestingly, marginal effects for *SC_COST* (cost cutting) and *SC_ENV* (environmental considerations) are both significant, but of opposite signs. Hence, it appears that favorable environmental incentives are more or less offset by negative economic prospects from certification. When comparing marginal effects for environmental and managerial considerations, it can be noted that the latter has much higher value than the former, which indicates that, even though ISO 14001 is dedicated to environmental purposes, environmental concerns have less importance than considerations related to management of human resources.

[Insert table 6 here]

The hypothesis that bigger firms are more likely to be ISO 14001 certified (H1) is strongly supported. In addition to the factors discussed above, bigger firms participated more in the ISO 14001 design than smaller ones, allowing them to tailor the ISO 14001 standard to their situation (Krut and Gleckman, 1998). Some authors suggested that bigger firms may capture the design of standards in order to raise the costs of smaller rivals (Salop and Scheffman, 1983; Scheffman, 1992). Such a strategy may be implemented by introducing a fixed cost that disadvantage smaller firms. Moreover, if bigger firms are more likely to certify, EMS promoters may try to induce suppliers' certification in response to the demands of these previously certified big firms. For example, in 1999, many multinational firms such as Ford or General Motors announced that all their suppliers around the world must be certified ISO 14001 by 2003 (Bansal and Bogner, 2002). Similar initiatives but to a lesser extent can be found among major agrofood manufacturers (Yiridoe and Marett, 2004, Marbek Resources Consultant, 1999[10]).

The hypothesis that previously ISO 9001 certified firms are more likely to be ISO 14001 certified (H2) is also strongly supported. This result is consistent with previous studies (Table 1). So, certifying an environmental voluntary approach is not an isolated act. Such certification fits more or less the pre-existing framework (Rogers, 1995). Encouraging the certification of a voluntary approach that fits the pre-existing system of the considered organizations reduces the opportunity costs of potential adopters, including the reluctance and psychological considerations. ISO 14001 promoters may prefer modifying incrementally the pre-existing system, rather than directly imposing a radical change. If certification is characterized by bandwagon effects, they may first target firms for which opportunity costs are lower, such firms having already implemented similar standards. Interestingly, the correlation between ISO 9000 and ISO 14001 is low (Table 5). Presumably that shows that many ISO 9000-certified firms did not take the next step to ISO 14001 certification.

The hypothesis that the more an organization's buyers are located in foreign countries, the greater its propensity to be ISO 14001 certified (H3) is not supported. A plausible explanation is that our proxy does not distinguish importing countries and/or the nature of importations that may influence the use of ISO 14001 as a signaling or/and screening device. Importations to eco-sensitive countries such as Germany or Austria (in contrast with insensitive countries) may have a strong impact on the decision of being ISO 14001 certified (Potoski and Prakash, 2004). Moreover, if the exporting country is considered as environmentally friendly by most importing customers, environmental certification plays a weaker role in transaction achievement. In other words, this would mean that the formal and informal regulations in France are perceived as sufficient.

Let us now discuss the hypotheses directly related to the Porter propositions. The hypothesis that the more an organization wants to improve its resource productivity by cutting costs the greater its propensity to be ISO 14001 certified (H4) is significant, but the sign of the coefficient is not the expected one. Indeed, *SC_COST* is negatively correlated with the probability of being ISO 14001 certified. This counter-intuitive result would lead to rejection of H4, meaning that firms do not certify with ISO 14001 to reduce costs. At first glance, ISO 14001 *adoption* is sufficient to improve resource productivity. ISO 14001 *certification* appears as an unnecessary and costly process with regard to this purpose. It is also possible that the firm has already reached the 'environmental point' of decreasing returns, making a costly ISO 14001 certification useless for this purpose. In other words, if all win-win or 'free lunch' opportunities have already been exploited (Palmer et al., 1995), the environmental commitment is then related to other determinants.

The hypothesis that the more an organization receives customers' demands related to environmental considerations, the greater its propensity to be ISO 14001 certified (H5) is supported. Consequently, despite the possibility that ISO 14001 certification may not improve resource productivity it can increase the perceived marketability of products and can sometimes become a *de facto* condition for doing business. The customers' use of ISO 14001 certification as a screening device may generate certification among suppliers, regardless of the certification benefits in terms of productivity improvement. For example, reputed companies (e.g., agrofood retailers) may be vulnerable to the environmental practices of their suppliers leading them to require an ISO 14001 certificate to ensure the greenness of their supply chain.

The hypothesis that the more a firm wants to improve its organizational and managerial effectiveness, the greater its propensity to be ISO 14001 certified (H6) is strongly supported. Managerial considerations and impact on employees' productivity play a significant role in explaining the ISO 14001 certification decision. In some plausible circumstances, socially-oriented arguments may motivate the workforce more than selfish profit maximization arguments (Margolis, 1982). By

participating in such environmental approaches, employees may feel better about themselves being involved with a project aiming at generating public benefits rather than a project oriented towards private benefits (See the detailed case studies of Phanuel, 2001 and Berger-Douce, 2002). Besides adoption, a formal certificate may constitute for employees a tangible proof of the firm's commitment (rather than cosmetic commitment) to support a socially responsible project. So, the ISO 14001 process may be used or 'instrumentalized' in order to improve the overall workforce productivity. Consequently, arguments aimed at convincing firms to certify may emphasize workforce impacts rather than cost cutting. This intriguing point deserves further investigations to precisely identify the positive effects of ISO 14001 and the processes through which an ISO 14001 EMS generates such positive effects.

When confronting opposite results for *SC_COST*, *SC_MAN* and *ENVDEM*, we may contend that firms in the sample are already operating at their efficient scale level (in terms of input mix and technology choice, in particular). This means that any deviation from this economic equilibrium is not to be favored. On the other hand, ISO 14001 is both an instrument to meet consumers' demands and an organizational standard which is seen to have a positive impact on employees' incentives. Therefore, there are economic gains from certification in a broad sense; this is captured by variable *ENVDEM* and *SC_MAN* in terms of a better marketability of products and improved internal organization of the firm.

The hypothesis that the more a firm is willing to enhance its regulatory compliance, the greater its propensity to be ISO 14001 certified (H7) is also supported by our findings. Again, ISO 14001 certification may send public authorities a clear signal that the firm has implemented a credible system to improve and ultimately ensure its regulatory compliance. Anecdotal evidence attests to the improved relations between regulatory agencies and firms thanks to an ISO 14001 certificate. For example, certified firms frequently benefit from a reduced number of inspections. The reduced number of inspections may enable regulators to target their resources in bringing heavy polluters into compliance, ultimately with greater benefits to the environment. Consequently, regulatory threats such as better enforcement of existing regulations or additional regulations may constitute a driver to boost ISO 14001 certification among firms. Nevertheless, the effectiveness of this mechanism is conditioned by the credibility of the certification and accreditation procedures. Indeed, the certification process may give rise to adverse selection and hazard moral issues (Andrews, 2001).

The hypothesis that the more a firm wants to improve its relations with third parties, the greater its propensity to be ISO 14001 certified (H8) is not supported by our empirical investigations. It is plausible that relations with third parties do not play a significant role, notably because of particularities of the agrofood sector. Indeed, French agrofood firms benefit from a good public image. An ISO 14001 certificate is unlikely to improve significantly their image compared to other sectors

suffering from a bad image, e.g., the chemical sector. In other words, the more the sector is perceived as harmful to the environment the more an ISO 14001 certification may improve its negative image. *A contrario*, a sector that already benefits from a good image is less likely to improve its overall relations with people who just get confirmation of their prior perception (See Khanna et al., 1998 for a similar rationale on the TRI impact). Moreover, an ISO 14001 certification may be perceived as having a counter-productive effect on the overall firm image, e.g., by casting doubt on its environmental performances. Interestingly, agrofood firms in France have been reluctant to support the creation of an ecolabel for their products, arguing that such ecolabels will cast doubt on their environmental practices and deteriorate their public image (Boy, 1996).

To conclude, we check the robustness of our results by estimating variants of the main model. Results, presented in table 7, appear robust to these different specifications. In particular, parameter estimates follow the same pattern of significance and prediction performance does not vary heavily.

[Insert Table 7 around here]

5. Concluding remarks and directions for future research

We have presented empirical estimates of the impacts of various determinants on the ISO 14001 certification among agro-food firms in France. Our findings suggest that firm size, previous ISO 9000 certifications, customers' demands, human resources management and regulatory compliance play a significant role in being ISO 14001 certified. At the survey date, ISO 14001 certification was at a relatively early stage of acceptance in the agrofood sector in France. It is possible that, as agrofood firms gain more experience with this standard, their attitudes and positions toward ISO 14001 certification will change. Nevertheless, our results provide indications to policymakers in order to improve the targeting and efficiency of their incentive policies. Conceptually the certification decision is likely to be determined by two sets of factors, one set generic across different sectors and another one more specific to a given sector. Indeed, a "one-size-fits-all" policy may waste public resources by not taking into account sector specific drivers of ISO 14001 certification. It is also possible that the biggest firms regardless of their main sector decide whether to be ISO 14001 certified or not mainly on a generic set of factors and that the specific sector factors play more for smaller organization sizes. Although this point requires further investigation, our findings suggest that policies emphasizing the image benefits of an ISO 14001 certificate will impact differently according to the prior public image of the considered sector. Thus, our contribution also constitutes an appeal to additional empirical investigations and comparisons at the sectoral level.

The higher rate of certification for bigger firms may constitute an indication that policies aiming at improving the diffusion among small and medium firms have to provide financial or technical assistance to reduce the opportunity cost of these smaller potential certifiers. From an efficiency viewpoint, the relative gains of such policies must be balanced against their costs. If public authorities use ISO 14001 certificates as a filter to reduce their monitoring activities towards certified entities, this policy may inadvertently give a regulatory advantage to bigger firms and consequently disadvantage smaller entities that are less able to be ISO 14001 certified.

Our investigations have also shown the major role of managerial considerations in being ISO 14001 certified. Raising workforce productivity by adopting well-crafted voluntary programs may constitute an insightful argument in favor of the controversial Porter hypothesis. Our hope is that this study will encourage other researchers to conduct similar empirical studies in other countries to determine whether the obtained results are idiosyncratic to the French agrofood sector or not. Moreover, further analysis is also necessary to determine the certification path, the degree of comprehensiveness among firms that certify to take into account the "assimilation gap" and the subsequent environmental effectiveness of the ISO 14001 certificate. An interesting issue is to investigate empirically the way(s) by which the ISO 14001 certification leads to workforce productivity, by confronting statements and performances. Extending our setting and testing it empirically constitutes challenging issues for future research.

Footnotes

[1] ISO website : www.iso.ch

[2] Vittek, G., 2000, Les investissements pour protéger l'environnement, Entre réglementation, aides et démarche volontaire, Les 4 pages de statistiques industrielles, Ministère de l'Economie, des Finances et de l'Industrie,139, http://www.industrie.gouv.fr/biblioth/docu/4pages/pdf/4p130.pdf

[3] APAVE, 2002, Les démarches de certification dans les entreprises agro-alimentaires.

[4] In the following we do not distinguish between the two EMS, i.e., ISO 14001 and EMAS. In other words, the "ISO 14001" expression used below includes the both schemes, except explicit indication of the authors.

[5] Some recent studies have explored the comprehensiveness and environmental effectiveness of environmental management systems (Anton et al., 2004; Yiridoe and Marette, 2004). Despite their obvious interest, these studies are out of scope of our review.

[6] Rough estimates on the costs of getting an ISO 14001 certificate in the French agrofood sector is given in Apave (2003).

[7] The so-called Porter hypothesis has been challenged in several papers, generating a wide controversy among economists (Jaffe et al., 1995; Palmer et al. 1995).

[8] The questionnaire borrows several elements from surveys used in prior studies (Table 2). The questionnaire has been pre-tested among several agrofood experts and managers in charge of environmental issues in order to improve its readability.

[9] The authors would have preferred to implement their survey at the facility level. By getting the number of the adopting facilities in each firm, they could have applied a Poison regression or negative binominal regression to explore the determinants of the number of the adopting facilities. Nevertheless, needed data, such as location of facilities and identity of the manager in charge of environmental issues were not available at the survey time.

[10] Marbek Resources Consultant. 1999. "Customer/Supplier Environmental Intitiatives (Final report)." Available at : http://www.nccp.ca/html/tables/pdf/options/customer_supplier_environmental_initiatives.pdf

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Table 1: Reasons for adoption of voluntary instruments in the economic literature

Main explicative variables	**Main Studies**					
	Harter and Homison (1999) (Company data)	Nakamura et al. (2001) (Company data)	King and Lenox (2001a) (Facility data)	Welch et al. (2002) (Facility data)	Bansal and Hunter (2003) (Company data)	Darnall (2003) (Company data)
Firm size	ns (-)	s (+)	s (+)	s (+)	.	.
ISO 9000 or other TQM certifications	s (+)	s (+)	s (+)	.	.	s (+)
Exports	.	s (+)	.	.	s (+)	.
Energy efficiency	.	ns (-)	.	.	.	.
Competitiveness	.	.	.	ns (+)	.	.
Advertising	.	ns (+)	.	.	.	.
Public assistance	ns (-)	.	.	ns (-)	.	.
Social responsibility	.	s (+)	.	s (+)	ns (-)	.
Regulatory pressure	ns (-)	s (-)	ns (+)	s (+)	.	s (+)
Civil society pressure	.	s (+)	.	s (-)	.	.
Firm image	.	.	.	.	s (+)	.
Financial performance	.	ns (-)	.	.	.	s (+)
R & D expenditures	.	s (-)	s (+)	.	.	.
Private/public ownership	.	ns (+)	.	.	.	.
Foreign ownership	.	ns (+)	s (+)	.	.	.
Employees characteristics	.	s (-)	.	.	.	.
Implementation costs	ns(-)	.	.	.	.	.

s: significant; ns: non-significant.

Table 2: Hypotheses and their expected signs

Hypothesis	Expected sign
H1: The larger a firm, the more likely it will be ISO 14001 certified.	(+)
H2: Firms that have experience with process standards are more likely to be ISO 14001 certified.	(+)
H3: The more an organization's buyers are located in foreign countries, the greater its propensity to be ISO 14001 certified.	(+)
H4: The more an organization wants to improve its resource productivity, the greater its propensity to be ISO 14001 certified.	(+)
H5: The more an organization receives customers' demands related to environmental considerations, the greater its propensity to be ISO 14001 certified.	(+)
H6: The more a firm wants to improve its organizational and managerial effectiveness, the greater its propensity to be ISO 14001 certified.	(+)
H7: The more a firm is willing to enhance its regulatory compliance, the greater its propensity to be ISO 14001 certified.	(+)
H8: The more a firm wants to improve its relations with third parties, the greater its propensity to be ISO 14001 certified.	(+)

Table 3: Items used for scored questions

A- Cost cutting
A1- Decreasing production costs
A2- Decreasing assurance costs
B- Managerial considerations
B1- Motivating employees
B2- Improving internal organization
B3- Improving communication among employees
C- Environmental considerations
C1- Enhancing regulatory compliance and pre-emption
D- Considerations related to third parties
D1- Improving the firm environmental reputation
D2- Enhancing relations with neighbors

Table 4: Definition of variables and sample statistics

Variable	Definition	Non-missing observations	Mean	Std Dev
ISO14	Firm certified with ISO 14001 standard or EMAS	233	-	-
BIGF	More than 100 salaries	233	-	-
CERI9	Firm certified with ISO 9000 standard	233	-	-
EXPORT	Abroad sales > 30 % of total sales	233	-	-
ENVDEM	High customers' environmental demands	233	-	-
SC_COST	Cutting costs determinants	220	2.4945836	1.0310693
SC_MAN	Managerial determinants	215	3.3215109	0.8596895
SC_ENV	Environmental determinants	220	3.0000000	0.9008091
SC_THP	Relations with third parties	219	3.4981987	0.9707558

Table 5: Correlation coefficients

	Pearson correlation coefficients								
	BIGF	**CERI9**	**EXPORT**	**ENVDEM**	**SC_COST**	**SC_MAN**	**SC_ENV**	**SC_THP**	**ISO14**
BIGF	1.00000	-	-	-	-	-	-	-	-
CERI9	0.01682	1.00000	-	-	-	-	-	-	-
EXPORT	-0.00762	-0.07318	1.00000	-	-	-	-	-	-
ENVDEM	-0.06328	0.00865	-0.01074	1.00000	-	-	-	-	-
SC_COST	0.16712	-0.00270	0.00406	-0.02725	1.00000	-	-	-	-
SC_MAN	0.01731	0.03208	0.09408	-0.03888	-0.00494	1.00000	-	-	-
SC_ENV	0.10815	0.03157	-0.05448	0.03048	0.09913	0.32764	1.00000	-	-
SC_THP	-0.00345	-0.01599	0.06905	0.01487	0.21505	0.36926	0.24397	1.00000	-
ISO14	0.12822	0.19357	0.00288	0.10368	-0.16181	0.41082	0.24790	0.08544	1.00000

Table 6: Estimates of determinants behind ISO 14001 certification

Maximum Likelihood Estimates				
Parameter	Estimate	Std.Error	Marginal effect	Std. Error
Intercept	-6.7846 (***)	1.2713	-	-
BIGF	0.8253 (***)	0.4022	0.1309(**)	0.0596
CERI9	1.3505 (***)	0.4184	0.2091(***)	0.0566
EXPORT	0.1064	0.3658	0.0181	0.0624
ENVDEM	1.0349 (***)	0.5670	0.2114	0.1315
SC_COST	-0.6409 (***)	0.2081	-0.1090(***)	0.0340
SC_MAN	1.3946 (***)	0.2819	0.2373(***)	0.0458
SC_ENV	0.4188 (***)	0.2242	0.0712(*)	0.0378
SC_THP	-0.0982	0.2155	-0.0167	0.0366
-2 log L			191.017	
-2 log L (Intercept only)			261.819	
Likelihood ratio			70.8013 (DF=8)	
Percent concordant			83.1	
Number of observations			215	
Number of observations ISO 14001 certified			64	
Test (BIGF = CERI9 = 0)			13.49 (0.0012)	
Test (SC_COST = ENVDEM = EXPORT = 0)			12.22 (0.0067)	
Test (SCMAN = 0)			24.47 (0.0000)	
Test (SC_ENV = 0)			3.49 (0.0618)	
Test (SC_THP = 0)			0.21 (0.6488)	

Notes. (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively. Wald test statistics for joint parameter significance have p-values in parentheses. The marginal effect for a binary explanatory variable is computed as the difference of two probabilities associated with the discrete change between 0 and 1 for that variable. Wald test statistics for single and joint parameter significance are reported together with p-values (in parentheses).

Table 7: Logit estimates. Dependent variable: ISO14 (Models 1 to 6)

Variable	Model 1	Model 2 M1/ BIGF and CERI9	Model 3 M1/ ECO	Model 4 M1/ MAN	Model 5 M1/ ENV	Model 6 M1/ THP
Intercept	-6.7846 (***)	-5.1296 (***)	-7.1634 (***)	-3.9559 (***)	-5.9360 (***)	-6.9426 (***)
BIGF	.8253 (***)	-	0.6223 (**)	0.7693 (***)	0.9434 (***)	0.8442 (***)
CERI9	1.3505 (***)	-	1.1694 (***)	1.1255 (***)	1.2858 (***)	1.3553 (***)
EXPORT	.1064	-0.0790	-	0.1296	0.0371	0.1005
ENVDEM	1.0349 (***)	0.9518 (***)	-	0.7470 (**)	1.0951 (***)	1.0246 (***)
SC_COST	-.6409 (***)	-0.4817 (***)	-	-0.5879 (***)	-0.6272 (***)	-0.6578 (***)
SC_MAN	1.3946 (***)	1.3095 (***)	1.3295 (***)	-	1.4841 (***)	1.3544 (***)
SC_ENV	.4188 (***)	0.4323 (***)	0.4031 (***)	0.6885 (***)	-	0.4122 (***)
SC_THP	-.0982	-0.1583	-0.2231	0.2610	-0.0713	-
-2 log L	191.017	206.540	204.731	224.344	194.693	191.226
-2 log L (Intercept only)	261.819	261.819	261.819	263.921	261.819	261.819
Likelihood ratio	70.8013 (DF=8)	55.2786 (DF=6)	57.0880 (DF=5)	39.5774 (DF=7)	67.1257 (DF=7)	70.5932 (DF=7)
Percent concordant	83.1	79.7	80.3	75.2	82.3	82.8
Number of observations	215	215	215	218	215	215
Number of firms ISO 14001 certified	64	64	64	64	64	64