Business Strategy and the Environment
Bus. Strat. Env. **11**, 43–62 (2002)
DOI: 10.1002/bse.318

VOLUNTARY ADOPTION OF ISO 14001 IN JAPAN: MECHANISMS, STAGES AND EFFECTS

Eric W. Welch,[1]* Yasuhumi Mori[2] and Midori Aoyagi-Usui[2]

[1] University of Illinois at Chicago, USA
[2] National Institute for Environmental Studies, Japan

This paper seeks to understand what factors contribute to voluntary adoption of the ISO 14001 environmental management system by private sector facilities in Japan. A model based on regulatory, competitiveness, social responsibility and organization theory is applied to 1999 survey data. Analysis shows systematically different factors to be important indicators of voluntarism in different industries and for facilities at different stages of certification. First adopters and second adopters appear to be fundamentally different types of organizations driven by different internal and external factors. Although results do not indicate a clear causal linkage between ISO adoption and greening activity, evidence shows that at least two different stages of adoption have taken place in Japan and that ISO adoption is associated with environmental action. Copyright © 2002 John Wiley & Sons, Ltd and ERP Environment.

*Correspondence to: Eric W. Welch, Public Administration, Course of Urban Planning and Public Affairs, 412 South Peoria, Room 140 (MC 278), University of Illinois at Chicago, Chicago, IL 60607, USA.

Received 2 August 2000
Revised 24 April 2001
Accepted 24 May 2001

INTRODUCTION

Adoption of an environmental management system (EMS) is one form of voluntary environmental action available to private sector organizations. It is often expected that adoption of an EMS will lead to beyond compliance business activities, which means that firm level environmental policy and actions are more stringent than regulations. The motivations behind voluntary environmental action and the effects of voluntarism have been a subject of recent research interest. Nevertheless, general application of new theoretical approaches to voluntary activity in Japan is limited, as is the academic investigation of firm level adoption of EMSs in Japan.

It is widely believed that firms adopt voluntary initiatives because the benefits of voluntarism outweigh the costs (Segersen and Miceli, 1998; Welch *et al.*, 2000a). Potential costs to EMS adoption include specialized training, production process reorganization, alteration of decision making structures and processes, technological investment, and consulting fees and certification charges. Future expected benefits may include market based

profits or reduced regulatory costs. More specifically, EMS implementation may identify opportunities to reduce production costs or may result in greater sales to an increasingly aware green consumer base. Reduction of regulatory costs may result from pre-emption, weakening, delay or transfer of regulation and regulatory pressure. However, recent research has paid little attention to motivational differences among industries or differences in trends of voluntarism over time. Like any other policy, understanding of these differences is important to furthering knowledge about the effectiveness of EMSs and voluntary approaches to regulation and management in general.

This paper develops a theoretically based model to predict voluntary adoption by Japanese firms of one EMS: International Standards Organisation (ISO) 14001. The model is applied to survey data to understand differences in adoption behaviour among four industries – chemical, electronics, electric machinery and electric power – and to show generalizable differences between first stage adopters, second stage adopters and nonadopters. The paper compares the environmental behaviour of these different adopter groups across four types of environmental action to determine the extent to which greenness is associated with EMS adoption. The primary research questions addressed in this paper are the following.

a. What factors contribute to ISO 14001 adoption in Japan?
b. Are the factors of adoption different among different industries?
c. To what extent is it possible to differentiate first stage adopters, second stage adopters and nonadopters?

ISO 14001 IN JAPAN

ISO 14000 is a multipart environmental management standard that was first published by the International Standards Organisation (ISO) in 1996. Generally applicable to organizations of all sizes, sectors and compositions, it comprises two main types of standard: specification standards and guidance standards (Krut and Gleckman, 1998). Specification standards establish requirements for ISO 14000 certification, while guidance standards present background and direction on development and implementation of management and evaluation techniques. ISO 14001 is the only specification standard in the series, while guidance standards cover a variety of topics including environmental performance evaluation (ISO 14031), environmental auditing (ISO 14010), environmental labelling (ISO 14020–14025) and life-cycle assessment (ISO 14040–14043) (ISO, 2000; Harrington and Knight, 1999; Welch and Schreurs, in press).

The ISO 14001 standard is made up of five main elements: the environmental policy, the environmental plan, plan implementation, continuous monitoring and management review (Cascio, 1996; Harrington and Knight, 1999; Krut and Gleckman, 1998). All five are designed to work together in a continuous environmental improvement cycle. An organization's policy states its commitment to environmental management and establishes the base upon which it can develop environmental targets and objectives. The environmental management plan identifies activities, products and services under the organization's control that have environmental impacts and establishes relevant environmental targets and objectives. Implementation addresses the resources required and mechanisms by which the organization will carry out the plan. ISO 14001 requires organizations to use an audit to regularly monitor activities that have important environmental impacts and to establish corrective action procedures to rectify problems of noncompliance. Finally, ISO 14001 requires management to regularly review the system to ensure its efficacy and relevance. Once an organization has satisfied these requirements, it is eligible for certification

by an officially recognized ISO 14001 agency (designated at the national level). It is evident that the certification process is potentially complex and may entail high costs. As a result, the adoption decision is not taken lightly. Nevertheless, around the world ISO 14001 adoption levels continue to rise (Zharen, 1995; Lamprecht, 1997; Prakash, 1999).

In addition to the technical elements of ISO 14001, it is important to note a few other characteristics of the standard. First, because ISO 14001 is a process standard not a technical standard, the organization sets its own environmental targets and objectives. Second, overcompliance is not a prerequisite; existing regulatory standards form baseline levels for certification. Third, there are no sanctions for a lack of improvement or even for noncompliance with regulations. 'An organization can be registered if it is not 100% compliant as long as it has a system in place to identify and comply with relevant environmental regulations and it responds appropriately to incidents of noncompliance' (Harrington and Knight, 1999, p. 69). Fourth, ISO 14001 auditing requirements are relatively relaxed, allowing organizations to choose between internal auditing and auditing by an external consultant. Therefore, ISO 14001 generally provides organizations maximum flexibility to set their own technical standards and to develop mechanisms to evaluate and address them; characteristics that private sector organizations consider to be critical for efficient and effective environmental action.

Finally, because an international industry association developed it, ISO 14001 is typically governed by a national level industry or trade ministry, not by an environment ministry (Krut and Gleckman, 1998). In Japan, the Ministry of International Trade and Industry (MITI) does not directly administer the ISO 14001 programme, but rather designates the Japan Accreditation Board for Conformity Assistance (JAB), an independent agency, to administer it. JAB designates specific ISO 14001 consulting firms that assist and certify organizations in Japan. Although MITI has helped establish what may be a less costly institutional structure through which organizations can gain information, assistance and accreditation, adoption of ISO 14001 is completely voluntary. No sanctions are associated with nonadoption and no direct benefits or pressure for adoption are provided by MITI or JAB.

Adoption of ISO 14001 in Japan has far outstripped adoption rates in other countries (Prakash, 1999; Mori *et al*., submitted). In April 2000 the total number of ISO certified organizations in Japan was 3548, while the country with the next most certified organizations, Germany, had only 1950 certified competitors. Sweden and the United Kingdom were third and fourth with just over 1000 each and the US was fifth with 750 (Figure 1). The rate of adoption as well as the total number of certificates has also been increasing in Japan. The number of Japanese firms adopting ISO 14001 jumped significantly from below 300 in March 1997 to over 3000 in April 2000. In general Figure 2 approximates the well known adoption diffusion curve.

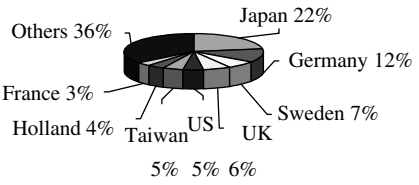

Figure 1. National Share of ISO 14001 Certifications, 2000

THEORY, HYPOTHESES AND MODEL

Mechanisms of voluntarism

Economic and political economic theory has identified three broad reasons for adoption of voluntary programmes: regulatory advantages, competitive market advantages and social responsibility. This paper also considers organizational factors to be important contributors to environmental voluntarism.

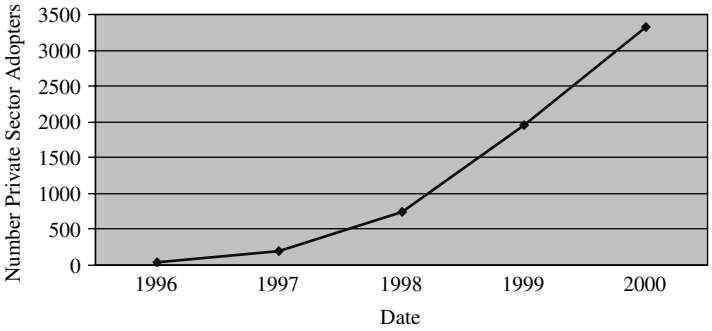

Figure 2. Adoption of ISO 14001 in Japan

Regulatory influence theory postulates that firms are willing to invest in voluntary environmental action because voluntarism provides the firm greater ability to influence or manipulate the regulatory system. Based on theoretical work in political economy on interest group pressure by Becker (1983), Peltzman (1976), and Stigler (1971), regulatory influence theory postulates that voluntarism effectively weakens the lobbying effectiveness of environmental and consumer groups (Maxwell *et al*., 1998). Effective political action by individuals to press for regulation incurs information and organizing costs. These costs act as a barrier between consumer benefits of voluntary abatement and the benefits of mandatory abatement (Lyon and Maxwell, 1999; Maxwell *et al*., 1998). In situations where information and organizing costs are high, voluntarism is unnecessary because pressure group threat is low. However, in situations where information and organizing costs are low, voluntarism is a viable means of reducing the lobbying threat, essentially driving a 'wedge' between individual regulatory pressure and the regulatory process (Lyon and Maxwell, 1999; Maxwell *et al*., 1998). Regulatory theory predicts that voluntary action results in a reduction of external regulatory, citizen and interest group pressure on the firm. Firms may volunteer as a strategy to pre-empt future regulations (Lyon and Maxwell, 1999; Maxwell *et al*., 1998), to slow or weaken future expected regulation (Lutz *et al*., 1998) or reduce or transfer direct regulatory pressure (Decker, 1998; Maxwell and Decker, 1998).

In the case of ISO 14001, firms experiencing stronger regulatory pressure are expected to be more likely to adopt the EMS. Firms experiencing stronger citizen and interest group pressure will also be more likely to adopt an EMS. A formal hypothesis for regulatory influence theory follows.

H1: Facilities experiencing higher regulatory, citizen and/or interest group pressure will be more likely to voluntarily adopt an EMS.

Firms may also voluntarily adopt an EMS for a variety of strategic economic reasons such as reduced compliance costs, increased investor appeal or satisfying market demand. For example, successful implementation of ISO 14001 may help a firm to simultaneously satisfy multiple regulatory requirements thereby reducing the costs of regulation to the firm (Fredericks and McCallum, 1995; ISO, 1998). Voluntary adoption of an EMS may also be undertaken to attract investors. Investors may favour green firms for ethical reasons (Baron, 1996), expected future profits from green product markets (Hamilton, 1995; Khanna and Damon, 1999; Khanna *et al*., 1998), or for some other perceived risk reduction or strategic advantage (Khanna and Damon, 1999; Williams *et al*., 1993). Others have indicated that voluntarism may signal a response to increasing consumer

demand for green products and green companies (Arora and Cason, 1996; Arora and Gangopadhyay, 1995; Williams *et al*., 1993). In addition, firms may realize economic benefits due to improvements in energy and resource efficiencies identified through the certification process (Buchholz, 1993; Groenenwegen *et al*., 1996; Cramer, 1998). In general, firms recognizing competitive market advantages to environmental action are expected to volunteer more.

H2: Facilities perceiving environmental actions to result in greater competitiveness will be more likely to voluntarily adopt an EMS.

Although economic theory predicts few private contributions to public goods and a dominance of free riding, empirical evidence on cooperation for the provision of public goods indicates otherwise. Experimental research has shown that cooperative behaviour (investment in public goods) is much higher than expected(Andreoni, 1995; Palfrey and Prisbrey, 1997). Termed 'kindness,' individual participants invest in public goods at much higher rates than is predicted by economic theory. Results show that 'on average about 75 percent of the subjects are cooperative, an about half of these are confused about incentives while about half understand free-riding but choose to cooperate out of some form of kindness' (Andreoni, 1995, p. 900). Expanded to the firm level, these findings indicate that some corporate investment in public goods may be due to kindness, where kindness may be better described as a sense of responsibility on the part of the firm for the reduction of pollution. Management research also finds that public and environmental concerns are significant motivators of environmental improvement (Baylis *et al*., 1998). One application of this literature is in the area of voluntarism. Voluntary adoption of an EMS may signal an intention to apply stronger environmental standards because the company considers itself publicly responsible. Accordingly, firms in industries producing goods that have a stronger public character, such as electric power, would volunteer more.

H3: Facilities producing goods with public characteristics will be more likely to voluntarily adopt an EMS for reasons of social responsibility than will facilities producing purely private goods.

The contribution of organizational factors to the adoption of voluntary programmes has received only limited acknowledgment in the voluntarism literature. That said, one of the most often identified organizational factors contributing to voluntarism is size (Welford, 1997; Gladwin, 1993; Shrivastava, 1995; Atkinson *et al*., 2000). The effect of size on voluntarism has been shown to have a strong positive correlation with voluntary action (Welch *et al*., 2000a; Arora and Cason, 1995). It is thought that larger organizations have a greater amount of slack resources and dedicated personnel that provide the capacity to volunteer. In addition, larger organizations are often thought to have the highest profile and to be the largest polluters. Therefore, voluntarism provides a more visible, public response and potentially carries a higher benefit that for smaller organizations. Larger size organizations are expected to volunteer more.

H4: Larger size facilities will be more likely to voluntarily adopt an EMS.

Representation of environmental concerns in top level decision making structures of the organization is another factor linked to voluntary behaviour. The literature has defined representation as top level commitment to greening activity by the leadership or access to decision making for environmental personnel (Prakash, 1999). Representation is expected

to be positively associated with the voluntary adoption of an EMS.

H5: A higher level of environmental representation in the decision making structure will lead to a higher probability of voluntarily adopting an EMS.

In addition, other structural characteristics of the organization are expected to contribute to voluntary adoption of an EMS (Cramer, 1998). Because ISO 14001 requires a significant amount of commitment, resources and information to apply for certification, organizations that are more familiar with written documentation and rules, and decision structures that are more centralized, may contribute to voluntarism. Formality and rule orientation of the organization represents a certain familiarity with written codes of conduct as behaviour guidance (Hall, 1991). Organizations that are more predisposed to formality and rules may be more able to put a certification process in place. In addition, formality may aid in the acquisition of information needed to conduct the certification process. Centralization of the decision making structure may also be important. Certification for ISO 14001 requires a significant effort for which broad organizational support is helpful. However, in situations where decision making power is spread throughout the organization, there may be a greater probability of localized resistance to certification. This scenario may be especially true if resource demands for certification are also unevenly distributed throughout the organization. These expectations are formalized in the following hypotheses.

H6: Higher formalization and rule orientation of the organization will lead to a higher probability of voluntarily adopting an EMS.

H7: Higher centralization of the organizational decision making structure will lead to a higher probability of voluntarily adopting an EMS.

In addition to the above indicators for voluntarism, adoption of ISO 14001 is expected to be less likely under conditions in which there is an accepted industry or national substitute. For example, adoption of ISO 14001 may be impeded in the chemical industry by preference of industry developed voluntary codes such as the Responsible Care programme.

Model

In summary, theory predicts that four major factors determine voluntarism: regulatory pressure, competitiveness, social responsibility and organization. A model of adoption incorporating the four main mechanisms for adoption can be expressed as

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (1)$$

where Y is a discrete 1/0, adopt/nonadopt decision, X_1 represents a vector of variables for regulatory pressure, X_2 market advantages, X_3 social responsibility and X_4 organizational factors; β_1 to β_4 represent coefficients for the vectors X_1 to X_4 and α and ε represent the intercept and the error for the equation respectively.

DATA AND METHODS

Survey

In March 1999, survey questionnaires were sent to 2918 Japanese facilities in four industries: chemical manufacturing, electronics, electric machinery and electric power. These industries were chosen because each represents a significantly different type of market and produces different types of output. In addition, chemical manufacturing, electronics and electric machinery all have relatively high numbers of ISO 14001 adopters. Fundamentally,

ISO 14001 is a site based programme that certifies establishments. Although it is possible that some companies require all of their manufacturing facilities to become ISO certified, this is not always the case. Therefore, questionnaires were sent to enterprise (facility) managers.

The research design included both ISO adopters and nonadopters. Questionnaires were sent to all ISO 14001 certified companies in the four industries. Contact information for these facilities was made available by the Environment Agency, sponsor of the project. A larger random sample of facilities was selected from the list of nonadopter facilities taken from the 1996 Japanese Census of Manufacturers. Of the 718 ISO certified facilities surveyed, 364 responded with useable data (50.7%). However, only 445 of the 2200 non-ISO facilities surveyed provided complete responses (20.2%). All responses were entered independently into two separate databases and subsequently cross-checked for errors. The current database contains 809 records. However, due to missing data for some of the variables and the fact that some facilities in the electric power industry requested their parent company to respond to the questionnaire, the data set used for this paper was reduced to 721.

Oversampling of ISO adopters, in and of itself, should not produce any problems of sample bias. However, there is a danger that the much lower response rate from nonadopters may represent some bias problems as those facilities least likely to reply are also potentially the most dissimilar to the adopter population. Analysis actually indicates that larger firms were more likely to respond to the survey and smaller firms less likely (the proportion of large firm responses was greater than their represented proportion in the population, according to the 1996 Census of Manufacturers). The resulting sample distribution – high percentage of large firms, low percentage of small firms – may indicate some sample bias, and therefore some bias in the results. On the other hand, comparison between adopters and nonadopters is probably more meaningful as the size distribution of adopters and nonadopters was similar. Interpretation of the results will further consider potential bias problems.

Independent measures

Regulation and external pressure were operationalized in four ways in the model: existence of local regulation, administrative guidance, citizen pressure and media attention. Existence of local regulation was measured using a combination of two questions on local ordinances and agreements. Facilities responding that air emissions or water emissions from the facility were regulated by local ordinances or agreements were coded one. Facilities not subject to local ordinances or agreements were coded zero. Those coded one are considered to face stricter regulatory environments as local regulations and environmental agreements are always stricter than national standard levels. Administrative guidance and citizen pressure were measured using similar types of question. Facilities responded that they received administrative guidance or citizen demands only rarely, sometimes or often. A higher level of administrative guidance and citizen demands indicate a perception of stronger external regulatory and citizen pressure. Media attention was represented by the degree to which media reports on the facility were positive (or negative). A higher media score indicates a more positive reaction from the media about the company's environmental policies. The specific questions used in the analysis are found in the Appendix.

The level of economic competitiveness associated with environmental action was operationalized using a combination of three questions. The questions queried the extent to which current development of environmental products will improve the company's competitive positioning the future; the extent to

which environmental countermeasures will help improve product quality and production efficiency; and the extent to which the facility believes greater overall competitiveness of their facility in the industry can be attained through greater attention to environmental countermeasures. The questions were scored on a five-point scale from four to zero, where four indicates a significantly positive effect of environmental action on economic competitiveness and zero indicates no effect. The Cronbach's alpha correlation coefficient for the three responses was 0.79. Please see the Appendix for the specific questions.

Social responsibility was operationalized using a measure of the importance for business to take a leadership position for a set of seven environmental activities. These activities included environmental information dissemination, environmental technology development, creation of environmentally friendly values and lifestyle, development of a green business market, bearing the costs of addressing global environmental problems, establishment of NPOs and training of volunteers, and creation of a social system based on environmental harmony. Facilities were asked to rank from one to four which sector (business, government, citizens or NPO) should take the leadership position, four being the most important sector. The summed level of business leadership ranking was used as the measure for social responsibility. Please see the Appendix for the specific questions.

Organization size was measured using a standardized combination of capital (in million yen) and full time equivalent employees. This combined variable was then logged as is usual practice when the distribution is skewed. Representation was measured as a one/zero interactive indicator of whether or not the facility has a person in charge of environmental issues multiplied by whether or not that person has access to high level decision making meetings. A score of one indicates that the company has environmental representation at the top level of decision making. Formalization was measured as an interactive variable in which the relative perceived amount of internal rules was multiplied by the extent to which the rules are formally written down. The combined score gives a measure of perceived formal rule boundedness of the organization, with a high score indicating a high level of rule boundedness. Respondents were asked to judge the facilities use of rules and their formalization relative to other organizations. Although not an optimal measure of rule boundedness, it provides some indication of rule orientation. Decentralization was measured using responses to a question about the level of employees in the organization who are able make decisions about organizational goals. Finally, a question on whether or not the facility follows environmental action standards set up by their industry was included. Please see the Appendix for the specific questions. Descriptive statistics for all independent variables are provided in Table 1.

Dependent and effectiveness measures

Facilities were coded according to the stage of adoption of ISO. Three categories were distinguished: certified ISO 14001 organizations, facilities in the process of obtaining certification and nonadopters. 'Certified adopters' indicated that their facility was already ISO certified at the time of the survey. Facilities that had either applied for certification or were preparing to apply for certification were coded as 'in process'. Facilities that were not considering certification, had not heard about ISO or were determining whether or not to become certified were coded 'nonadopters'. As seen in Table 1 about half the facilities were coded 'certified adopters' while only a small percentage of the facilities were coded 'in process'.

Because this paper also examines the association between ISO adoption and environmental action, responses regarding four types

Table 1. Descriptive statistics

	N	Mean	Standard deviation	Minimum	Maximum
ISO certified	721	0.48	0.50	0	1
ISO in process	721	0.06	0.23	0	1
Size	704*	12.13	5.03	2.20	23.69
Decentralization	721	4.00	1.79	1	6
Environmental presence	721	0.65	0.48	0	1
Rule boundedness	721	10.40	4.78	1	20
Local regulation	721	0.68	0.47	0	1
Administrative guidance	721	1.28	0.52	1	3
Citizen pressure	721	1.20	0.46	1	3
Media pressure	604*	1.59	2.14	1	5
Competitive advantage	721	9.32	2.09	1	12
Social responsibility	721	14.48	3.00	7.00	43.24
Industry guidelines	721	0.54	0.49	0	1

* Variation due to missing values.

of environmental activity were requested. The four activities include establishment of environmental targets, implementation of environmental management tools, environmental information disclosure and green purchasing action. In general, it was expected that certified adopters would score the highest in all four areas, followed by in process adopters and nonadopters. Environmental targets were measured as the perceived stringency of facility targets for a variety of pollutants and environmental considerations, relative to other facilities in the industry. Implementation of environmental management tools is measured as the summed level at which the facility has implemented seven types of environmental tool or policy. Environmental disclosure is measured as the summed level of dissemination of information for 13 types of environmental activity and pollutant. Green purchasing action is measured as the summed level of standardization of environmental purchasing criteria used by the facility. Please refer to the Appendix for all survey questions.

Methods

The final equation for the model is

$$Y = f(X_0, X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, \in_1) \quad (2)$$

where X_1 = local regulation, X_2 = administrative guidance, X_3 = citizen pressure, X_4 = media pressure, X_5 = competitive advantage, X_6 = social responsibility, X_7 = industry guidelines, X_8 = size, X_9 = decentralization, X_{10} = rule boundedness and X_{11} = decision making access. Y represents a 1/0, adopt/nonadopt variable for either ISO certified or ISO in process, depending on the regression run. Logit analysis was used to regress the discrete adopt/nonadopt dependent variable. Difference of means tests were run to determine whether mean levels of environmental activity of ISO certified, ISO in process and nonadopter facilities were significantly different.

FINDINGS

Two general types of regression analysis were conducted: comparison of model results among industries and comparison of model results among certified adopters, in process adopters and nonadopters. In the first case logit regression was conducted on all firms in

the sample, on all firms without electric power facilities, on chemical facilities only and on electric machinery facilities only. Sample sizes for electric power and electronics industries were too small for separate runs. However, it is possible to deduce some industry effects from the results provided.

Industry comparison

Results for all facilities (column one, Table 2) indicate that adopters are more likely to exist in environments that are more highly regulated as is expected by hypothesis one (H1). Also as expected, larger, more rule bound organizations, and organizations in which environmental representatives have access to top level decision making, are more likely to volunteer (H4–6). Contrary to expectations, more centralized organizations appear to be less likely to volunteer (H7). In addition, results indicate that administrative guidance and citizen pressure are not significant indicators of voluntarism, although positive media pressure (H1) and social responsibility are associated with adoption (H3).

Interestingly, when electric power companies are removed from the sample (column two, Table 2), the effect of social responsibility and decentralization disappear. Also, those firms experiencing less administrative guidance seem to be more likely to volunteer. These findings may indicate that facilities in the electric utility industry volunteer in part due to a higher level of social responsibility for environmental actions (in fact the mean values of social responsibility of the electric power industry are highest of the four industries). This finding accords with hypothesis three (H3) in which social responsibility is expected to be a more important factor for voluntarism in industries producing a greater proportion of public goods. Findings regarding decentralization show that decentralization is only important within the electric power industry. This is a relatively interesting finding because some writers consider the Japanese electric utility industry to be highly centralized on a regional basis (Lesbirel, 1998). Nevertheless, adoption of an EMS appears to be sensitive to variation in the centralization of the decision making structure.

Table 2. Logistic results, industry comparison

	ISO certified All facilities	ISO certified No electric power	ISO certified Chemical industry	ISO certified Electric machinery
Intercept	−5.72***	−4.37***	−16.20	−6.34***
Local regulation	0.54*	0.95***	13.26	1.42***
Administrative guidance	−0.15	−0.87***	−1.24**	−0.79***
Citizen pressure	−0.43	−0.36	−0.98**	0.43
Media pressure	0.33***	0.50***	0.24	0.77***
Social responsibility	0.14***	−0.02	−0.02	−0.03
Competitive advantage	0.05	0.02	0.10	0.05
Industry guidelines	−0.08	−0.28	−0.96*	0.45
Size	0.16***	0.29***	0.25***	0.30***
Decentralization	−0.12*	0.04	0.18	0.05
Decision making presence	0.67**	0.68**	−0.12	1.03**
Rule boundedness	0.10***	0.10***	0.12*	0.13**
Sample size	591†	546	148	327
Adopters (ISO firms)	314	310	57	216

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.
† Total sample size reduced due to missing values.

Results from analysis of chemical and electric machinery industry subsamples indicate that local regulatory environment is important in the electric machinery industry but not in the chemical industry. In general, national and local regulatory control of toxic chemicals is a relatively recent albeit significant effort in Japan.[1] As a result, local regulations may be less established in the chemical industry than in the electric machinery industry where emitted pollutants are more traditionally governed by local regulations. Administrative pressure is negatively associated with adoption in all but the electric utility industry, and citizen pressure is negatively associated with adoption in the chemical industry but not in the electric machinery industry. This may indicate either that adoption results in reduced pressure, or that first adopters are less likely to be under such pressure. The negative relationship between external pressure and adoption is further explored below.

Industry guidelines are negatively associated with ISO adoption in the chemical industry. This may indicate a substitution effect for environmental management systems. For example, adoption of alternative industry-sponsored environmental codes of conduct such as the Japan Chemical Industry Association's Responsible Care programme by a chemical facility may reduce the likelihood that it adopts an EMS. Also, surprisingly, competitiveness is not associated with adoption in any of the industries (H2). Finally, presence of an environmental leader in decision making meetings appears to be an important indicator of adoption for all industries except the chemical industry. Rule boundedness continues to be an important indicator for adoption in all industries, while decentralization is not. It is possible that the effect of interactions with other facilities or demands by parent companies is more important than internal decision making representation when chemical firms adopt ISO 14001, although this was not tested due to data limitations. Decentralization may either be poorly measured or not be an important indicator of adoption. If centralized organizations are just as likely as decentralized organizations to adopt ISO, this is further evidence of the flexible and accommodating nature of ISO 14001.

These findings indicate only limited support for the hypothesized linkages between regulatory, competitiveness, social responsibility and organizational elements and adoption of ISO. Two interpretations are possible. First, differentiation between adopters and nonadopters may not be fine enough a distinction to identify important factors associated with adoption. It may be, as regulatory theory predicts, that adopters experience a lower level of citizen, media and administrative pressure as a result of voluntarism. It is not possible in this study to show a change in the level of pressure over time due to the discrete nature of the dependent variable. A second explanation may be that initial adopters are large, complex organizations with good environmental records and good structures for implementing new environmental management systems. Adoption by these first runners has less to do with external pressure, business objectives and social responsibility than with existing internal structure, management and culture (only some of which are included in the model) of the facility prior to the advent of ISO 14001. Because clear conclusions are not possible, further analysis using the model was conducted to compare facilities at different stages of ISO 14001 adoption.

Comparison by stage of adoption

Table 3 shows results from four logit regression runs. The first column repeats column one in Table 2 – certified adoption for all facilities is regressed on the model. The second column compares ISO in-process adopters

[1] Regulated air toxicants: tetrachloroethylene, trichloroethylene and benzene. Regulated water toxicants: trichloroethylene, tetrachloroethylene, dicloromethane and benzene. Regulated solid waste toxicants: dioxins.

Table 3. Logistic results, comparison of adopters, in-process adopters and nonadopters

	ISO certified (all facilities)	ISO in process (all facilities)	ISO in process (with non-ISO only)	ISO in process (with ISO only)
Intercept	−5.72***	−7.99***	−13.01***	−5.33**
Local regulation	0.54*	1.32*	1.21	1.28
Administrative guidance	−0.15	0.72**	0.98**	1.22***
Citizen pressure	−0.43	−0.44	−1.06*	0.22
Media pressure	0.33***	−0.26**	−0.01**	−0.42***
Social responsibility	0.14***	0.07	0.25**	0.08
Competitive advantage	0.05	0.29**	0.41***	0.30**
Industry guidelines	−0.08	−0.81*	−0.86	−1.60
Size	0.16***	0.04	0.23***	−0.15**
Decentralization	−0.12*	−0.24*	−0.49***	−0.34**
Decision making presence	0.67**	1.10*	1.81**	0.52
Rule boundedness	0.10***	−0.01	0.07	−0.03
Sample size	591†	591	277	314
Adopters (ISO firms)	314	32	32	32

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.
† Total sample size reduced due to missing values.

with all facilities (certified adopters and nonadopters). The third column compares in-process adopters with nonadopters and the fourth compares in-process adopters with certified adopters.

Compared with ISO and non-ISO facilities, in-process adopters exist in more highly regulated environments, receive more administrative guidance, more negative citizen pressure and more negative media pressure. In-process adopters also consider competitiveness issues to be important reasons for environmental action. They are also more centralized and are more likely to have environmental representation in top-level decision making forums. There appears to be no association between rule boundedness and adoption, and size is also no longer an important distinguishing factor. Adoption of ISO appears to be associated with substantially different factors for certified firms compared with in-process firms.

When compared separately with certified adopter and nonadopter groups, in-process adopters are more likely to have received more administrative guidance and more negative media pressure. Interestingly in-process facilities report less citizen pressure than the non-ISO group. In-process adopters are also more likely to recognize competitive advantages for environmental action and are larger than nonadopters and smaller than certified adopters. The decision making structures are also less centralized in the in-process organizations than in the other two groups, and they are more likely to have environmental representation in decision making contexts than nonadopters but not more likely than certified adopters. Social responsibility is also important for ISO in-process adopters when compared with nonadopters, but this effect disappears when electric power companies are removed (the significance of statistics for all other relationships remain unchanged when electric power companies are removed).

These findings – especially those comparing in-process adopters to nonadopters – indicate greater support for the hypothesized linkages between regulation, competitiveness, social responsibility and organizational factors than was evident from the industry comparison.

Facilities under stronger administrative and media pressure are more likely to volunteer. Facilities producing public goods are more likely to consider environmental action to be a social responsibility of business. In-process volunteers are more likely to perceive competitive advantages to environmental action, and are likely to hold environmental decision making presence.

There are at least two general explanations for these findings. In the first scenario, high regulatory pressure is a contributor to certification; however, after certification regulatory pressure falls. In other words, voluntarism is a signal of investment that is recognized by the regulatory and other external communities (except citizens, who seem to have little or confused effect). Similarly, competitiveness is a primary factor determining initial decision to adopt, but after adoption competitiveness advantages are not realized and the perception that ISO leads to competitiveness advantages disappears. This paper is not able make a direct linkage between adoption and the reduction of subsequent regulatory pressure; therefore, a second explanation is equally or, perhaps more, likely.

According to the second explanation, early adopters (certified adopters) and later adopters (in-process adopters) represent two fundamentally different groups of organizations. Certified adopters are large, complex organizations with significant slack resources and a general commitment to environmental management (as evidenced by their positive media treatment and lack of government and citizen group pressure). They are more likely to adopt early because they have the resources and structures in place that allow easy, early adoption. The largest facilities are also more easily recognized either as polluters or as good examples and therefore receive greater benefits for being proactive volunteers. In-process adopters represent a second stage of adoption of ISO 14001. These companies are smaller, more decentralized and less rule bound. They are also under a greater degree of external pressure and are more likely to perceive that environmental action will lead to competitive advantage. These firms may represent a second tier of adopters brought along as a result of business linkages with first tier adopters and because of external pressure.

Although this paper cannot directly distinguish between these two competing explanations, the relatively short history of the ISO 14001 programme tends to support the second explanation for two reasons. First, most certified organizations in the sample adopted the ISO EMS less than two years prior to the survey, on average. It is unlikely that ISO 14001 adoption will result in a dramatic shift in external pressure within such a short span of time. Second, although the adoption of an EMS may affect organizational structure and processes, these changes are more than superficial and are likely to be revealed only after a significant amount of time. Moreover, the organizational differences of size and decentralization seem to support the conclusion that there are two tiers of adopters.

We do not discount the ultimate conclusion of regulatory theory – that voluntarism results in greater regulatory control. Rather, we believe that the data, method and results of this study better support the second explanation.

Adoption status and greening activity

Level of greening activity across the three different stages of adoption indicates significant differences among the three groups. Significance of the differences is shown in the group columns to the right of each type of greening activity (A and B represent statistically different means at the 0.05 level). ISO certified facilities show higher development and use of environmental targets, implementation of environmental tools, and green purchasing action than either the in-process group or the nonadopt group. There is no statistically significant difference between certified

Table 4. Greening activity and ISO status, descriptive statistics and difference of means

	Development and use of environmental targets	Group	Implementation of environmental tools	Group	Disclosure of environmental information	Group	Green purchasing action	Group
ISO 14001 certified	46.67 *9.27* ($n = 344$)	A	3.46 *0.71* ($n = 344$)	A	1.42 *0.34* ($n = 344$)	A	19.04 *5.96* ($n = 344$)	A
ISO application in process	40.11 *14.11* ($n = 40$)	B	2.93 *0.63* ($n = 40$)	B	1.35 *0.40* ($n = 40$)	A	15.09 *5.63* ($n = 40$)	B
ISO not certified & not in progress	30.20 *13.93* ($n = 337$)	C	2.28 *0.83* ($n = 337$)	C	0.82 *0.57* ($n = 337$)	B	12.85 *5.46* ($n = 337$)	C

and in-process levels of disclosure of environmental information – indicating either a fundamental limit to information disclosure or no effect of the ISO EMS on disclosure in Japan. Similarly, in-process facilities exhibit a statistically significant higher level of greening activity than nonadopters in all categories.

At one level, these differences may indicate that ISO 14001 adoption has some effect on the actual greening behaviour of the organization. In other words, facilities become greener as they move from nonadopters to in process and finally to certification. An alternative, more conservative explanation would state that adoption is initially a function of greenness, not the other way around. Firms are more likely to adopt or consider adoption of ISO if they are greener in the first place. In other words, ISO adoption is a symptom of greenness rather than a stimulant to greenness, and the greening effect of ISO implementation is a slow process. This second explanation may be more pessimistic, but also fits with the previous findings about two stages of adoption. A third explanation would hold that both occur simultaneously – greener firms self-select to adopt ISO 14001 and, as a result of certification (and the process of certification), they become even greener.

CONCLUSIONS

This paper asked three questions. What factors contribute to ISO 14001 adoption in Japan? Are the factors of adoption different among different industries? To what extent is it possible to differentiate first stage adopters, second stage adopters and nonadopters? To address these questions we used a national stratified national survey of ISO and non-ISO facilities. Results tend to indicate that facilities in Japan voluntarily adopt ISO 14001 in two tiers, in which different factors explain adoption for each tier. The early adopters (first tier) tend to be larger, greener and less driven by regulatory, competitive or media pressures. We tend to believe that these organizations are early adopters because they have the interest and resources with which to pursue new environmental initiatives. Presumably, these first adopters are also first adopters and innovators in other areas relevant to the environment. In the long run, therefore, early adopters may be better positioned for survival in an environment in which regulation, stakeholder action,

technical change and environmental risk are difficult to predict.

Subsequent adopters (second tier) of ISO 14001 tend to be smaller, less green and more pressured by regulatory, competitive and media forces. They probably have fewer resources with which to pursue environmental initiatives, necessitating a wait and see approach to picking and choosing the more promising or important initiatives. As diffusion research shows, this type of strategy tends to conserve resources in two ways. Follower organizations invest in fewer initiatives and thereby face less exposure to the risk of a poor return. By adopting the more established initiatives, follower organizations are able to bypass the high levels of uncertainty associated with first adopter status. In addition, second tier organizations are able to learn from the mistakes of first runners and take advantage of more standardized techniques for implementation of the innovation. In the case of ISO 14001, second runner organizations may be able to take advantage of more established consulting structures, implementation techniques, case studies of successes and failures, or broader institutional support (such as financial or technical assistance from government).

To some extent, however, the distinction between first and second tier adopters is artificial. This research has simply presented a snapshot view of the diffusion process, which is best represented as a continuous curve. Over time, organizations in Japan and around the world will continue to adopt ISO 14001, but the reasons for adoption will change. These findings have important implications for policy makers and public managers, who must develop a greater understanding that over time the characteristics of adopters of a truly voluntary programme or policy change. Where public sector support of voluntarism is desired, governments will need to develop a much more fine grain understanding of the strategies and limitations of different types of firms. Government may attain higher levels of certification when incentives for adoption are better tailored to specific groups or stages of the adoption process.

For example, early adopters of ISO 14001 may require a relatively mild persuasive approach with limited incentives, while second stage adopters may require established government assistance programmes or resources, stronger regulatory pressures or other more forceful actions. One example of support is the Tokyo Metropolitan government's initiative to cover half of the ISO registration costs up to a maximum of 1.3 million yen (about $10 000) (Standards Council of Canada, 1999). Alternatively, policy may seek to affect the network among firms and other organizations by providing incentives for corporate policies that require suppliers to adopt ISO 14001. While not discussed in this paper, the effect of interorganizational networks and the ability of governments and corporations to manage these is an important area for future work. For example, recent research shows that ISO 14001 certified firms are more likely than noncertified firms to place higher environmental demands on suppliers (Welch *et al*., 2000b). Also, Japanese multinationals commonly push their foreign affiliates seek ISO 14001 certification; Toyota Motor Corporation, which buys about 80% of its parts from outside companies, has been urging its suppliers to obtain ISO 14001 certification by 2003 (Welch and Schreurs, in press).

ISO 14001 clearly appears to have gained a strong foothold in Japan and is growing significantly. This paper has provides a detailed analysis for the process of ISO 14001 adoption to date; however, it is limited by it inability to examine the process over time and its lack of inclusion of important determining factors such as corporate pressure and supplier networks. Future work should address these factors. Japan has a long history of voluntary environmental action that is poorly understood and underreported in Western nations. It is hoped that this paper has helped to fill that gap.

APPENDIX. SURVEY QUESTIONS USED IN ANALYSIS

Regulation

Local regulation (combined variable)

1. Does your facility emits air pollution that is restricted by local ordinances formulated by municipal governments or agreements on pollution control? (1/0)
2. Does your facility discharge wastewater that is restricted by local ordinances formulated by municipal governments or agreements on pollution control? (1/0)

Administrative guidance

To what extent has your facility received administrative guidance regarding environmental problems? (rarely, sometimes, often)

Citizen complaints

To what extent has your facility received claims or requests from citizens or citizens' organizations? (rarely, sometimes, often)

Media attention

Overall, how would you characterize the reactions from mass media regarding the environmental policies and plans of your facility? (negative, somewhat negative, neutral, somewhat positive, positive)

Market

Combined variable (high, moderate, low, very low, none)

a. Over the next ten years or so, to what extent will the development of environmental products improve your facility's competitive position?
b. To what extent does your facility believe that taking countermeasures for environmental problems will help improve product quality and production efficiency?
c. Compared to other facilities in your industry, to what extent does your facility believe overall competitiveness can be improved by taking environmental countermeasures?

Social responsibility

Please indicate which sector (business, government, nonprofit sector, citizens/consumers) your facility believes should take the leadership in the area of environment? Rank one to *four* your top choices with one being the most important leader, two being the second most important leader, and three being the third most important leader.

a. Environmental information dissemination
b. Environmental technology development
c. Creation of environment-friendly values and lifestyle
d. Development of the green business market
e. Bear the costs of addressing global environmental problems
f. Training of volunteers and establishment of NPOs
g. Create a social system based on environmental harmony

Organizational factors

Size

Log of the standardized, combined measures.

1. Capital in million Yen
2. Number of full time equivalent employees

Representation

Whether or not there is a person charged with environmental issues multiplied by whether or not that individual is entitled to participate in top decision-making meetings (meetings of the board of directors or other equivalent meetings)

Written rules

Interactive combination of two responses.

1. Relative to other factories/companies in your industry, how many rules and regulations does your facility have? Range:

many fewer (1) – about the same (3) – many more (5)
2. To what extent are the 'rules' and 'regulations' expressed in a written form? Range: very little, some, many, most

Decentralization
In general, who makes decisions about setting goals that your organization will pursue? (top managers only (1), top level managers with formal input from middle level managers only (2), top level managers with some formal input from middle level managers and employees (3), consensus among top and middle level mangers only (4), consensus among top and middle level managers with formal input from employees (5), consensus among all employees (6))

Competing standards programme

When implementing environmental countermeasures, do you follow industry stipulated environmental action standards for the industry of which your facility (or parent company) is a member? (1/0)

Dependent variables

Please indicate your facility's status regarding ISO certification.

Coded ISO certified

a. Our facility is already ISO 14000 certified

Coded ISO in process

a. Our facility has applied for ISO 14000 certification
b. We are preparing to apply for ISO 14000 certification

Coded non-ISO

a. We are considering ISO 14000 certification
b. We have investigated ISO 14000 certification, but it is not relevant for us at this time
c. We have not considered ISO 14000 certification
d. We have not heard about ISO 14000

Measures of ISO effects

Environmental targets
For each of the following environmental topics for which your facility has targets, please indicate how high or low your facility's targets are relative to other facilities in your industry. (much lower, lower, comparable, higher, much higher)

a. Reductions of raw material use
b. Increase in use of recycled materials
c. Energy efficiency
d. Reduction of water use
e. Reduction of air toxicants
f. Reduction of air pollutants (SO_2, NOx, dust)
g. Reduction of CO2
h. Emission control of water pollutants
i. Substitution of environmentally damaging inputs
j. Reduction of solid waste
k. Increased collection of disposed goods
l. Disseminate company environmental data
m. Increase in lifetime of products
n. Other _____ (please name)

Implementation of environmental management tools
This question concerns some of the latest trends on the environment. Please check one of the statements below that best describes your facility's stance for each of the following key words: already introduced (4), planning to introduce (3), under study (2), have studied, no plan to introduce (1), heard of the term, not familiar with details (1), have not heard of the term (1)

a. LCA
b. Green procurement

c. Eco-labelling
d. Eco-efficiency
e. PRTR (Pollutant Release and Transfer Register)
f. EPR (extended producer responsibility)
g. Eco-audit

Environmental information disclosure
To what extent does your establishment disclose information on the following items? Information disclosure here means a condition in which information is available for perusal through brochures, reports and the Internet. (not disclosed at all (1), internally, to appropriate individuals only (2), internally disclosed to all employees (3), disclosed externally (4))

a. Environmental aspects and influence
b. Environmental objectives and targets
c. Reduction of energy consumption
d. Environmental records
e. Reductions of raw material use
f. Increase in use of recycled materials
g. Environmental management system
h. Reduction of CO_2
i. Reduction of solid waste
j. Reduction of air pollutants (SO_2 and/or NOx)
k. Reduction of toxic to air
l. Reduction of water pollutants (BOD, etc.)
m. Investment in environmental process technology audit results (internal)

Green purchasing action
What type of environmental criterion or purchasing list does your facility use for purchases of the following every-day business products? (required products listed and/or written criteria (5), recommended products listed and/or written criteria (4), no written product list or criteria exist, required consideration of environmental factors (3), no written product list or criteria exist recommended consideration of environmental factors (2), no written product list or criteria exist, no product list or criteria in place (1))

a. Copy paper
b. Office equipment (copiers, computers, etc)
c. Other office supplies
d. Building maintenance supplies
e. Toilet paper, cleaners, internal use products
f. Automobiles
g. Automobile maintenance supplies
h. Other _____ (please specify)

REFERENCES

Andreoni J. 1995. Cooperation in public-goods experiments: kindness or confusion? *American Economic Review* **85**: 891–904.

Arora S, Cason T. 1995. An experiment in voluntary environmental regulation: participation in EPA's 33/50 Program. *Journal of Environmental Economics and Management* **28**: 271–186.

Arora S, Cason T. 1996. Why do firms volunteer to exceed environmental regulations? Understanding participation in the EPA's 33/50 Program. *Land Economics* **72**: 413–432.

Arora S, Gangopadhyay S. 1995. Toward a theoretical model of emissions control. *Journal of Economic Behavior and Organization* **28**: 289–309.

Atkinson S, Schaefer A, Viney H. 2000. Organizational structure and effective environmental management. *Business Strategy and the Environment* **9**: 108–121.

Baron D. 1996. *Business and Its Environment*. Prentice Hall: Upper Saddle River, NJ.

Baylis R, Connell L, Flynn A. 1998. Sector variation and ecological modernization: towards an analysis at the level of the firm. *Business Strategy and the Environment* **7**: 150–161.

Becker G. 1983. A theory of competition among pressure groups for political influence. *Quarterly Journal of Economics* **98**: 371–400.

Buchholz R. 1993. *Principles of Environmental Management: The Greening of Business*. Prentice Hall: Englewood Cliffs, NJ.

Cascio J (ed.). 1996. *The ISO 14000 Handbook*. ASQ Quality: Milwaukee, WI.

Cramer J. 1998. Environmental management: from 'fit' to 'stretch'. *Business Strategy and the Environment* **7**: 162–172.

Decker CS. 1998. *Implications of Regulatory Responsiveness to Corporate Environmental Compliance Strategies*, Working Paper, Department of Business Economics and Public Policy, Kelley School of Business, Indiana University, Bloomington, IN.

Fredericks I, McCallum D. 1995. National Standards for Environmental Management Systems: ISO 14000.

Canadian Environmental Protection Magazine: Vancouver, B.C.

Gladwin T. 1993. The meaning of greening: a plea for organizational theory. In *Environmental Strategies for Industry*, Fischer K, Schot J (eds). Island: Washington, DC; 37–61.

Groenewegen P, Fischer K, Jenkins EG, Schot J. 1996. *The Greening of Industry Resource Guide and Bibliography*. Island: Washington, DC.

Hall RH. 1991. *Organizations: Structures, Processes, and Outcomes*. Prentice-Hall: Englewood Cliffs, NJ.

Hamilton JT. 1995. Pollution as news: Media and stock market reactions to the toxics release inventory data. *Journal of Environmental Economics and Management* **28**: 98–113.

Harrington HJ, Knight A. 1999. *ISO 14000 Implementation: Upgrading Your EMS Effectively*. McGraw-Hill: New York.

International Standards Organization (ISO). 2000. *ISO 14000 – Meet the Whole Family*. Geneva: ISO Central Secretariat. http://www.iso.ch/. Access date 11/1/01.

Japanese Industrial Standards Committee (JISC). 2000. *ISO 14001 Shinsa Tooryokuu Suii Jookyoo [Change in ISO 14001 Certification Registration]*. http://www.jisc.org/i14x.htm. Access date 11/1/01.

Khanna M, Damon LA. 1999. EPA's voluntary 33/50 Program: Impact on toxic releases and economic performance of firms. *Journal of Environmental Economics and Management* **37**: 1–25.

Khanna M, Quimio W, Bojilova D. 1998. Toxics release information: a policy tool for environmental protection. *Journal of Environmental Economics and Management* **36**: 243–266.

Krut R, Gleckman H. 1998. *ISO 14001: a Missed Opportunity for Sustainable Global Industrial Development*. Earthscan: London.

Lamprecht J. 1997. *ISO 14000 Issues and Implementation Guidelines for Responsible Environmental Management*.Amcom: New York; 43–88.

Lesbirel SH. 1998. *NIMBY Politics in Japan: Energy Siting and the Management of Environmental Conflict*. Cornell University Press: Ithaca, NY.

Lutz S, Lyon T, Maxwell J. 1998. *Strategic Quality Choice with Minimum Quality Standards*, Discussion Paper 1793. Centre for Economic Policy Research: London.

Lyon T, Maxwell J. 1999. *Voluntary Approaches to Environmental Regulation: a Survey*, Working Paper, Department of Business, Economics, and Public Policy, Kelley School of Business, Indiana University, Bloomington, IN.

Maxwell J, Decker C. 1998. *Voluntary Environmental Investment and Regulatory Flexibility*, Working Paper, Department of Business Economics and Public Policy, Kelley School of Business, Indiana University, Bloomington, IN.

Maxwell J, Lyon T, Hackett S. 1998. *Self-Regulation and Social Welfare: the Political Economy of Corporate Environmentalism*, Nota di Lavoro 55.98. Fondazione Eni Enrico Mattei: Milan.

Mori Y, Welch E, Aoyagi-Usui M. Submitted. Effects of ISO 14001 Certification on Reduction of Environmental Burdens of Companies. *Environmental Science* (Japanese Language).

Palfrey T, Prisbrey J. 1997. Anomalous behavior in public goods experiments: How much and why? *American Economic Review* **87**: 829–846.

Peltzman S. 1976. Toward a more general theory of regulation. *Journal of Law and Economics* **19**: 211–248.

Prakash A. 1999. A new-institutionalist perspective on ISO 14001 and Responsible Care. *Business Strategy and the Environment* **8**: 322–335.

Segersen K, Miceli T. 1998. Voluntary approaches to environmental protection: the role of legislative threats. *Journal of Environmental Economics and Management* **36**: 109–130.

Shrivastava P. 1995. Environmental technologies and competitive advantage. *Strategic Management Journal* **16**: 183–200.

Standards Council of Canada. 1999. ISO 14000 in Japan. *Consensus Magazine* **26**(5): 14–15.

Stigler G. 1971. The theory of economic regulation. *Bell Journal of Economics and Management Science* **2**: 3–21.

Welch E, Mazur A, Bretschneider S. 2000a. Voluntary behavior by electric utilities: levels of adoption and contribution of the climate challenge program to the reduction of carbon dioxide. *Journal of Policy Analysis and Management* **19**: 407–425.

Welch EW, Aoyagi-Usui M, Gotoh S. 2000b. *Greening Activity of Japanese Companies: An Application of Organization Theory*. Working Paper, Center for Technology and Information Policy, Syracuse University. No. 00-04.

Welch E, Schreurs M. In press. ISO 14000 and the Greening of Japanese Industry. In *Evaluating Alternative Policy Instruments for Environmental Protection*, Hatch MT (ed.).

Welford R. 1997. *Corporate Environmental Management 2: Culture and Organizations*. Earthscan: London.

Williams H, Medhurst J, Drew K. 1993. Corporate strategies for a sustainable future. Fischer K and Schot J (eds). *Environmental Strategies for Industry: International Perspectives on Research Needs and Policy Implications*. Island: Washington, DC; 117–146.

Zharen WM. 1995. *ISO 14000, Understanding the Environmental Standards*. Government Institutes: Rockville, MD; 39–49.

BIOGRAPHY

Eric W. Welch is an Assistant Professor at the Graduate School of Public Affairs, College of Urban Planning and Public Affairs, University of Illinois at Chicago, 412 South Peoria Street, Room 140, Chicago, IL 60607, USA. Tel.: 312-445-3639. Fax: 312-996-8804. Email address: ewwelch@uic.edu

Yasuhumi Mori and Midori Aoyagi-Usui are Senior Researchers at the Social and Environmental Systems Division, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-0053, Japan.