Journal of Environmental Economics and Management **42,** 23–52 (2001)
doi:10.1006/jeem.2000.1148, available online at http://www.idealibrary.com on IDEAL®

Why Japanese Firms Choose to Certify: A Study of Managerial Responses to Environmental Issues*

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Received April 29, 1999; revised December 16, 1999; published online October 24, 2000

This paper examines empirically the determinants that led large Japanese manufacturers to (1) incorporate environmental goals in their decisions, (2) obtain environmental certification (ISO 14001), and (3) become early adopters of environmental certification. We estimate two sets of models: (1) models based on a profit maximization assumption and (2) models which incorporate utility maximization arguments, recognizing that managers' values, attitudes, and beliefs may also influence firms' decisions. The empirical analysis suggests that while the costs and benefits of voluntary actions to enhance or protect the environment and the capacity to act are significant determinants of voluntary environmental commitment, so are the environmental values, beliefs, and attitudes of managers.

I. INTRODUCTION

It is well known that during the rapid economic growth of the 1950s and 1960s Japan's private and public sectors invested heavily without proper considerations for protecting the environment. Pollution levels increased and there was resulting irreversible damage to the natural environment. In addition serious health prob-

* Research in part has been supported by grants from the Sustainable Forest Management Network, a Network of Centres of Excellence (Canada), the Social Sciences and Humanities Research Council of Canada and the Hampton Fund of the University of British Columbia.

† Also with the Institute of Asian Research and the Faculty of Applied Science.

‡ Also with the Faculty of Commerce and Business Administration and the Institute of Asian Research.

0095-0696/00 $35.00

lems arose from the pollution, such as the Minamata disease (mercury poisoning) and severe asthma due to polluted air in the cities of Kawasaki and Yokkaichi. These pollution-caused health problems attracted increasing public attention in the late 1960s. In response to such environmental degradation and damage, and the resulting public outcry, the Japanese government introduced the Basic Law for Environmental Pollution Control (1967) and the Air Pollution Control Law (1968) both of which turned out to be ineffective in controlling environmental damage.

Significant improvement in the environment began only in the early 1970s when a series of amendments to these Pollution Control Laws and some additional laws including the Cost Allocation of Public Pollution Control Works and the Punishment of Environmental Pollution Crimes Relating to Human Health were enacted (see [20] for an empirical examination of the effects of these regulations).

Another significant factor, which contributed to the abatement of Japan's environmental damage, was the significant oil price increases due to the first and second oil shocks in the 1970s. Japanese government policy to promote global competitiveness of the Japanese industry in the midst of rising energy costs resulted in a massive effort, financial and otherwise, to encourage Japanese firms to shift their investment to less energy-consuming areas and to rapidly deploy energy-saving production equipment. Such energy-saving equipment was often found to be less polluting.

For example, the Japanese pulp industry was mainly responsible for most of the organic pollution of the Inland Sea, which was on the verge of an irrecoverable decline in 1970 [26]. The pulp industry was forced by law to reduce the amount of the waste discharged as effluent to one-fifth of the previous level within 2 years and to 1/20 within 7 years. Their response was to replace the sulfite pulp (SP) production process used up to then with a new kraft pulp (KP) process. The KP process is not only environmentally cleaner but also more energy-saving since it can utilize the organic wastes from pulping as an energy source.

Japanese industry's investment in pollution control and energy-saving devices increased from a small percentage of total investment in plant and equipment in the late 1960s to its peak of 20% in 1975, and then gradually declined to a small percentage in the mid 1980s, with an average of above 10% for the 1970s. The corresponding figures for the United States, the Netherlands, Germany, and Sweden in 1974 are considerably smaller at 3.4, 2.7, 2.3, and 1.2%, respectively [26]. This led to the general agreement that the Japanese industry was successful in at least partially "decoupling" environmental degradation and economic growth, proving that "environmental policies and economic growth policies can be not only compatible but indeed mutually supportive" ([28], pp. 95–96). In fact, in the 1970s through 1980s, Japan achieved the highest economic growth rate among the G7 countries while reducing SO_2 and NO_x emissions at the highest rate among the OECD members [28].

Discovering win–win solutions to environmental problems requires a proactive search for innovative solutions and significant investment in R & D [30]. Not surprisingly many firms consider such investment, if not mandated by regulation, to be highly risky and inconsistent with profit maximization.

The importance of the relationships between environmental performance and profit maximization objectives within a firm's management process cannot be

overstated.[1] We concur with Rugman and Verbeke [32] that the key question at the firm level is whether specific resource commitments expressly intended to achieve environmental performance may simultaneously improve industrial performance.

In responding to the energy crises during the 1970s and early 1980s Japanese firms were highly successful in turning energy/environmental challenges into opportunities for profit making.[2] Given their past success in responding to market-generated threats and opportunities, it is of considerable interest to analyze Japanese firms' organizational responses to contemporary environmental demands being imposed by Japanese as well as foreign governments, non-governmental and civil organizations, and citizens' groups. In addition to meeting some minimum standards of environmental protection, these new demands include increased commitment to constant improvement of environmental performance levels through such activities as environmental monitoring, formal reporting, and validation of environmental performance by independent agencies.

Some scholars suggest that contemporary Japanese firms may be merely reacting to the greening trend in some of their export markets while North American and European firms are following proactive green strategies. Roht-Arriaza [31], for example, suggests that Japanese firms' primary interest in obtaining ISO 14001 certification was to penetrate the European Union's (EU) trade barriers. Indeed, a 1992 survey of firms reports that no Japanese firm in the survey associates publication of environmental reports with enhancing a firm's competitive advantage, compared to 6 and 18% of North American and European firms, respectively [7].

There is, however, anecdotal evidence that some Japanese firms have placed environmental protection high in their priorities. For example, Sony set up their corporate Environmental Council in 1976, chaired by the C.E.O., and actively sought to improve its corporate environmental performance globally.

Sony obtained its first ISO14001 certification in May 1995 for one of its subsidiaries. The number of Sony plants and subsidiaries that have acquired ISO 14001 certification exceeded 30 by February 1997 and exceeded 90 by September 1998. A section chief in the Environment Department of Sony, which obtains about 70% of its sales revenues from outside Japan, believes that it has successfully institutionalized its investment process in the environment within its business planning system and hence that Sony's environmental activities are sustainable [34]. Many other Japanese firms are pursuing ISO 14001 certification. As of September

[1] Firm's environmental responsibility may be part of a firm's social responsibility but no generally acceptable definition of corporate social responsibility has emerged yet. For example, profit maximization and the resulting payment of corporate income taxes is an integral part of a firm's social responsibility [21, 39]. Horiuchi [14] discusses Japanese firms' organizational reactions to global warming.

[2] The major motives for Japanese innovations in this domain were the significant increases in Japan's energy cost due to the oil shocks in the 1970s, which changed the input factor price ratios faced by Japanese manufacturers in favor of the adoption of less-polluting energy-saving equipment. See also Hayami *et al*. [12] for a description of Japanese firm's more recent efforts to develop technologies for reducing the emissions of gases causing global warming.

1999, the number of ISO 14001-certified plants in Japan was 2,400, surpassing second-place Germany's 1400, third-place U.K.'s 1009, and the U.S.'s 490 [15].[3]

The objective of this study is to explain the significant variation that exists in environmental protection behaviors of Japanese manufacturing firms. In particular we focus on (i) the factors that led Japanese manufacturing firms to formally institutionalize their environmental protection commitments and those that led Japanese manufacturers to incorporate environmental goals in their decision processes; (ii) the characteristics of firms associated with achieving ISO 14001 certification; and (iii) the characteristics which explain early adoption of environmental certification. We postulate and test in this study two classes of models: (1) models which are based on profit maximization; and (2) models which are based on utility maximization. The latter recognize agency relationships and postulate that, in addition to profit maximization, attitudes and perceptions of executives may motivate action.

One characteristic that distinguishes Japanese firms from North American firms is the presence of various types of corporate groups (keiretsu) to which Japanese firms belong. There is some evidence that keiretsu group firms share business information and sometimes make joint investment and other business decisions. It is possible that such group behavior facilitates greening of Japanese firms. We investigate this hypothesis by including certain keiretsu-related variables in our econometric specifications.

Section II presents our models and data. In doing so we relate specifications of our models to earlier empirical models in the literature. Section III presents and discusses our estimation results. Section IV provides concluding remarks.

II. MODELS AND DATA

Models

Analysis of Japanese manufacturers' responses to contemporary environmental concerns is of considerable interest because it is often thought that, despite their rapid adoption of energy-saving equipment in the 1970s and the 1980s, their

[3] The ISO 14001 is an international, voluntary standard for environmental management systems, published by the International Organization for Standardization (ISO), an international standard-setting body [33]. In 1990, the ISO and the Business Council for Sustainable Development, composed of business leaders from around the world, had discussions about standardization related to environmental management. As a result of those discussions, in the next year, the ISO established a Strategic Advisory Group for the Environment (SAGE). Discussions in the SAGE resulted in the start-up in 1993 of an ISO Technical Committee (TC207), whose task is "standardization in the field of environmental management tools and systems." In 1996, the ISO accepted ISO 14001, "Environmental management systems—specification with guidance for use," as its formal international standard. This standard specifies the requirements of an environmental management system for organizations in any industry or field, such as manufacturing, service, nonprofit, and governmental organizations. Those requirements include five steps in an environmental management system: (1) environmental policy, (2) planning, (3) implementation and operation, (4) checking and operation, and (5) management review. Those steps must be recorded properly. An organization can self-declare that it is ISO 14001-compliant. But in our analysis, we deal only with ISO 14001 certifications certified by third parties. A caveat is in order. The ISO 14001 is a standard of environmental management systems not of environmental performance. Therefore, the ISO 14001 should not be interpreted as an indicator of "good" environmental performance, such as low pollutant emissions or energy efficiency.

current reactions to domestic and global environmental issues are less proactive than their North American and European counterparts. For example, when the European Union introduced its ISO certification standards in quality and then in environmental management, Japanese firms were originally reluctant in seeking these certifications.[4]

There are many studies which have analyzed the determinants of U.S. firms' decisions on environmental issues. DeCanio and Watkins [5], for example, estimate the determinants of over 9000 U.S. firms' decisions to participate in the Green Lights program, one of several voluntary pollution prevention programs initiated by the U.S. Environmental Protection Agency (EPA), and find that firm-specific variables such as firm size, earnings, and insider shareholding are significant determinants of U.S. firms' voluntary participation in these programs (see also [6] for similar findings with respect to the role of firm performance in the participation decision, using different methodologies).[5]

In two studies, one with some 300 and the second with 6000 U.S. firms, Arora and Cason [2, 3] investigate firms' participation decisions in 33/50, also an EPA voluntary program which encourages firms to voluntarily reduce releases and transfers of 17 toxic chemicals, and find that firm size and industry effects are particularly important determinants of firms' participation decisions. One important difference between the Green Lights and 33/50 programs is that each deals with different types of technology equipment. DeCanio and Watkins [5] note that firms' decisions to invest in energy-efficiency technologies covered by Green Lights are less firm- and industry-specific than technologies to reduce pollution associated with the toxic chemicals specified by 33/50.

In Canada, Henriques and Sardorsky [13] have studied the determinants of a firm's formulation of an environmental plan. Their empirical results showed that customer, shareholder, government regulatory, and community group pressures positively influenced the formulation of environmental plans. Negative influences included lobby group pressures and firms' sales to asset ratios. The perceived importance of environmental issues was also associated with increased probability of having a plan. Firms in the natural resources sector were more likely to have a plan than those in manufacturing and services sectors.

In our study we explore the determinants of organizational commitment to environmental protection objectives. We identify three levels of commitment. At the most basic level an organization can identify environmental objectives and institutionalize such objectives formally. Such formal commitment represents a firm's visible (but not necessarily implemented or implementable) resolve to cope with the environmental protection demands. A higher level of commitment sees environmental policy integrated into general corporate policy and practices receiving support from organizational members, especially from the top executives of the organization. The commitment can deepen further by the institution of a monitored process of continuous improvement of environmental protection validated by

[4] Companies and government agencies in the EU introduced requirements for ISO 9000 certification of quality on foreign exporters and the domestic firms [31]. Japanese firms originally reacted negatively to such a quality certification arguing that their products already have high quality standards. The EU requirements prevailed.

[5] Other voluntary programs include 33/50 and Energy Star programs. Firms joining these voluntary programs do not get any break in the degree of environmental regulations imposed by EPA but they are able to take advantage of EPA's technical expertise, among other benefits.

third-party certification. This stage involves an externally visible commitment to environmental objectives, the monitoring of performance, and the assessment of achievements. It requires allocation of resources and attainment of continuous improvement of environmental performance.

We have postulated nine models which explain organizational environmental efforts in terms of variables reflecting these three levels of commitment to environmental protection objectives (formal derivation and specification of each model are given in Appendix B).

We have postulated two classes of models to explain four dependent variables. One class of models is based on simple profit maximization and thus involves variables that affect the costs and benefits that accrue from the particular level of environmental commitment. The second class of models recognizes organizational agency relationships and thus incorporates variables that may affect the utility of managers and their behavior, in addition to variables reflecting profit maximization.

The first two models explain the degree of institutionalization of environmental policies (*FORMAL_POLICY*). Two other models explain the degree to which the formal policy is integrated into general corporate policies and receives support from its top management (*POLICY_INTEGRATION*). Three models explain the probability that the organization will choose to obtain a third-party environmental certification (specifically ISO 14001 certification). The last two models explain the propensity for early adoption by a firm of ISO 14001 certification.

In the profit maximization models postulated, the independent variables that explain environmental commitment include: firm size (*FIRM_SIZE*), profitability (*PROFITABILITY*), debt ratio (*DEBT_RATIO*), export ratio (*EXPORT_RATIO*), advertising expenditures (*ADVERTISING*), R & D expenditures (*R & D*), keiretsu membership (*KEIRETSU_DUMMY*), main bank ownership (*MAIN_BANK_OWNERSHIP*), foreign ownership (*FOREIGN_OWNERSHIP*), investment in plant (*INVESTMENT_IN_PLANT*), and average age of employees (*EMPLOYEE_AGE*). The utility maximization models include all the variables related to profit maximization as well as variables which reflect basic environmental values of managers (*EARTH_SPACESHIP*, *HARMONIOUS_COEXISTENCE*), the degree of pressures experienced by managers from civil society and government (*CIVIL_SOCIETY_PRESSURE*, *GOVERNMENT_PRESSURE*),[6] control beliefs (*CONTROLLABILITY*), perceived principles of environmental governance (*POLLUTER_PAY*, *ENERGY_EFFICIENCY*), and role definition (*RESPONSIBILITY*). The definition and derivation of these variables is described in detail in the next section.

Size (*FIRM_SIZE*) may determine the capacity of the organization to take action in the presence of economies of scale [23, 27]. Certification involves some significant fixed costs. These costs are less significant for larger organizations than for smaller ones. The impact of size upon the institutionalization of environmental objectives may involve two contradicting forces. On the one hand, larger organizations may find it more difficult to reach a consensus about values and actions while, on the other hand, the larger organization may already possess specialized

[6] Civil society's pressure affects firms' environmental behavior in various ways. For example, local communities can exert pressures on polluting firms to change their behavior without any help from the government [29].

skills that can facilitate formulation of environmental commitments and their integration into organizational policies and practices. The net direction of impact, however, is left as an empirical question in these models. Profitability (*PROFITABILITY*) and debt ratio (*DEBT_RATIO*) influence the costs of capital and financial flexibility. Profitable organizations are more likely to pursue environmental objectives. We also postulate that firms with lower short term debt have more flexibility to finance new programs; however, such a proposition is less certain since the debt ratio may reflect rational responses to tax laws or other variables that affect capital structure. We expect that the significance of the impact will increase with the increase in the level of commitment. The more export oriented the organization is (*EXPORT_RATIO*), the higher the benefits it may accrue from the more visible actions taken to protect the environment. 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. We expect companies with high export ratios to be more inclined to validate their environmental protection by obtaining a certification that is internationally recognized. Similarly, formal institutionalization of environmental policies may accrue more benefits to exporters than to domestically oriented firms, whose customers may have more direct ways of assessing the firms' environmental performance.

It is generally thought that the relative sizes of intangible assets, such as goodwill (*ADVERTISING*), knowledge capital (*R & D*), and other management capabilities that firms own have high correlations with firms' capacity and incentives to cope successfully with the contemporary environmental issues many manufacturers face [10, 32].

Firms with significant advertising expenditures are likely to have stronger contact with final consumers and other external stakeholders and hence are more likely to internalize environmental values held by the public. Firms with high R & D expenditures are more likely to be able to find technological solutions to their environmental problems. Such firms are also likely to be more innovative and less resistant to change.

One special characteristic of Japanese firms is the presence of various types of corporate groups (keiretsu) and other interfirm relationships, which do not exist in the U.S. (see, for example, [1, 24, 25]). Our models include two types of Japanese interfirm relationships. First we include dummies representing whether or not a sample firm belongs to the President's Club of one of the six major bank-based keiretsu groups (*KEIRETSU_DUMMY*). These banks are Mitsubishi (now Tokyo-Mitsubishi), Sakura (formerly Mitsui), Sumitomo, Fuji, Sanwa, and Daiichi-Kangyo Banks. It is possible that being a member of such a keiretsu group has systematic effects on firms' dealing with environmental issues. Another business group variable we use is the equity share owned by a sample firm's largest bank lender called "main bank" (*MAIN_BANK_OWNERSHIP*). While the member firms of each of the above six major bank-based keiretsu groups all have their keiretsu bank as their main bank, there are also many other firms which are not members of President's Clubs and yet have one of these six major banks as their main bank. We include the percentage of equity held by the main bank of each firm in our models to see the impact of such main bank–client firm relationships on environmental behavior.

If these keiretsu relations serve interfirm information exchange purposes as is often argued [1], then we do not know a priori the direction of keiretsu relations' contributions to the pursuit of environmental protection. On the positive side, keiretsu firms' environmental skills can be strengthened by mutual interfirm technology transfers. On the other hand, it is possible that keiretsu firms discuss and develop successfully legal means and know-how to cope with government and civil society pressures, thus relieving them of the need to increase their commitment to environmental protection. It is also possible to interpret Japanese keiretsu relations as representing a form of insider shareholding. If this is the case, it is possible that the impact of keiretsu relations on environmental responses is negative for Japanese firms, as was found by DeCanio and Watkins [5] for U.S. firms.

We have also included in the model a foreign ownership variable (*FOREIGN_OWNERSHIP*). Foreign owners may, on the one hand, be less willing to contribute to the social welfare of the country and thus less inclined to invest in environmental protection above the level required by regulation. On the other hand, it is possible that foreign owners must secure goodwill from regulatory authorities in host countries to prevent discrimination and do so by intensifying their environmental protection efforts.

INVESTMENT_IN_PLANTS represents opportunities for environmental improvement embodied in new machinery and equipment. Higher investment levels in plants may improve environmental performance and reduce external pressures for a deepening organizational commitment.

Lower average age in a company (*EMPLOYEE_AGE*) may reflect a higher learning capacity of organizational members, since younger employees are generally more trainable, adaptive, and less resistant to change. Consequently, companies with younger employees may accrue lower costs of implementing environmental policies or obtaining certification.

We also incorporated in the models which explain participation in ISO 14001 participation in ISO 9000 (*ISO9000*) series certification of quality management systems. Participation in ISO 9000 is likely to reduce the information search and learning costs involved in implementation of ISO 14001 because both systems are based on similar processes and ideas of system improvement and certification.

In deriving the utility maximization models we have postulated that in addition to pursuing profit maximization, managers of the firm are likely to undertake higher levels of environmental commitment (1) if they personally place high value on the environment and its protection (e.g., feeling that human interference with nature can produce disastrous consequences (*EARTH_SPACESHIP*) and that people must seek harmony with nature (*HARMONIOUS_COEXISTENCE*)); (2) if they are pressured by civil society or the government to do so in the form of criticisms, threats of loss of legitimacy, and other sanctions. (*CIVIL_SOCIETY_PRESSURE*, *GOVERNMENT_PRESSURE*); (3) if they feel that their firms are in control of the situation and can solve their environmental protection problems (*CONTROLLABILITY*); (4) if they accept the legitimacy of corporate environmental responsibilities (e.g., agreeing with the polluter pays principle and accepting that responsibility for environmental damage should be extended to those who use natural resources even if they do not directly damage the environment) (*POLLUTER_PAY*, *ENERGY_EFFICIENCY*); (5) if they accept their own and their firm's responsibly to protect the environment (*RESPONSIBILITY*).

Data

We have used several sources of published data for the financial, economic, and environmental variables. These include the Japanese Ministry of International Trade and Industry web site [22] and Japan Accreditation Body for Conformity Assessment's web site [17] for ISO 14001 and ISO 9000 series membership, respectively. Financial and economic firm-specific data were collected from various Japanese company data books [35, 36] and also from the Japan Development Bank financial database.

To obtain information about the formal institutionalization of environmental objectives as well as information about attitudes and perceptions of managers, we have conducted a survey using a structured questionnaire. One executive from each firm was asked to fill out the questionnaire. Specifically, the questionnaire was designed to obtain information about (1) environmental commitments at the firm level; (2) managers' attitudes toward the relationship between mankind and the natural environment; (3) institutional and social pressures; (4) managers' confidence in their personal and their firms' ability to manage environmental issues; (5) the principles used in management of firms' environmental affairs; and (6) managers' attitudes toward their personal and their firms' responsibilities for protecting the environment. The survey used a Likert-like five-point scale (from 1 = "strongly disagree" to 5 = "strongly agree").[7]

The questionnaires were sent in May, 1997 to 600 Japanese manufacturing firms which were randomly selected from all manufacturing firms listed in the First Section of the Tokyo Stock Exchange.[8] By the end of August, 1997 we got back usable responses from 193 firms (response rate = 32%). These responses were then matched to firm- and industry-specific information on financial, economic, and environmental characteristics. The definition and derivation of all variables are provided in the following section (Appendix A provides the descriptive statistics for these variables).

A. Financial, Economic and Environmental Variables

A-1. *Dependent variables*. We use two environment-related behavioral variables as dependent variables. The first identifies whether or not a particular firm has at least one of its plants certified for ISO 14001.[9] This binary variable, *ISO_DUMMY*, is used in our probit models. The second variable, *TIME_TO_ISO*, is the amount of (duration) time in months that had passed between the first Japanese certification of ISO14001 and the first certification for our sample firms. The duration time for the firms in our sample that have no ISO14001 certified plants is right-censored. We use this variable in our duration (survival time) analysis.

[7] Original items are found in Appendix C.

[8] This survey was conducted in cooperation with Professor Kanji Yoshioka and his research group at the Keio Economic Observatory of Keio University.

[9] Some of our sample firms received BS 7750 certifications, which were similar to ISO14001 certifications. BS 7750 certifications were subsequently converted to ISO 14001. All certifications of our sample firms, including those "converted" ones, were given for their "sites" inside Japan. Therefore, we can conclude that the certifications of our sample firms were not directly motivated by regulations in EU.

A-2. *Independent variables*. For each of our sample firms, the following firm-specific economic and other variables are calculated as mean values for fiscal years 1994, 1995, and 1996.

FIRM_SIZE is the number of employees the firm has. *PROFITABILITY* is calculated as the ratio between a firm's current before-tax profits and sales revenue.[10] *DEBT_RATIO* is calculated as the ratio between a firm's current debts and total assets. *EXPORT_RATIO* represents the percentage of export in total sales value. Relative size of customer goodwill is represented by a proxy, *ADVERTISING*, calculated by firms' advertising expenditures divided by firms' sales revenues.[11] Relative size of knowledge capital is represented by a proxy, *R & D*, calculated as firms' R & D expenditures divided by firms' sales revenues. To control for sectoral impact upon the firm's relative sizes of advertising and knowledge capital, industry dummies are used. (These dummies are defined in Appendix A.)

KEIRETSU_DUMMY indicates whether or not a firm belongs to the President's Club of one of the six major bank-based Keiretsu groups. *MAIN_BANK_OWNERSHIP* is calculated as the percentage of shares owned by a firm's main bank. *FOREIGN_OWNERSHIP* is calculated as the percentage of shares owned by foreign shareholders. *INVESTMENT_IN_PLANT* is derived as the ratio between a firm's annual investment in facility and total fixed assets. *EMPLOYEE_AGE* represents the mean age of a firm's employees.

Participation in ISO 9000 series certification (*ISO9000*) was included as a dummy variable of whether the firm obtained quality management system certification, ISO 9000 series certification.[12]

B. Variables Derived from Survey Responses

Since responses to survey questions are subjective and idiosyncratic, reflecting the respondent's interpretation of each question, we have used factor analysis to derive indicators representing attitudinal and perceptual variables in our models. Factor analysis simplifies a set of correlated variables by finding a smaller number of appropriate linear combinations of the variables so that those linear combinations would represent well the variations of the original variables [11, 18]. Combining responses to different questions reduces idiosyncratic errors and redundancy in

[10] It is known that accounting profits are not equal to economic profits [9]. In analyses not shown in this paper, we replaced the accounting profit rates with market returns, and found that the replacement does not change our results significantly.

[11] These variables (*R & D* and *ADVERTISING*) reflect many aspects of the firm and the industry sector other than the aspects of knowledge capital and goodwill. In fact, industry structure may influence both variables. Even though we tried to eliminate potential spurious relationships by including control variables such as industry dummies, we cannot completely deny the possibility of identifying such relationships.

[12] The diffusion of ISO 9000 series certification precedes the launch of ISO 14001. Therefore, we treated the variable representing ISO 9000 series certification as an exogenous variable. Indeed, exclusion of ISO9000 variable does not change our results significantly.

survey responses. Using factor analysis with Varimax rotation the following factors were derived.[13]

B-1. *Dependent variables*. The first group of rated items dealt with internal commitment of the firm to environmental objectives. Two factors were derived. *FORMAL_POLICY* measures the degree to which the firm has developed and formally institutionalized policies on the environment. *POLICY_INTEGRATION* measures the degree to which the firm has integrated its environmental policies into general corporate policies and practices and the degree that these policies receive top management support.

B-2. *Independent variables*. The second group of rated items focused on managers' perceptions of the relationship between the natural environment and mankind. Two factors were derived. *EARTH_SPACESHIP* measures the degree of vulnerability that the respondent attributes to our planet as a consequence of mankind impacts. *HARMONIOUS_COEXISTENCE* measures the degree of the respondent's belief that mankind must live with nature in a harmonious way.

The third group of rated items dealt with the pressures that government and nongovernmental organizations and groups are perceived to place upon firms to improve their environmental performance. Two factors were derived. *CIVIL_SOCIETY_PRESSURE* and *GOVERNMENT_PRESSURE*, which measure the pressures the firm faces from civil society (e.g., pressures from environmental groups, the mass media) and the pressures the firm faces from the government and the general public.

The fourth group of rated items explored the degree to which the firm is perceived by its managers as able to control its impact on the environment. One factor was derived—*CONTROLLABILITY*.

The fifth group of rated items explored perceptions of general principles that should govern environmental management in society. Two factors were derived. *POLLUTER_PAY* and *ENERGY_EFFICIENCY*, which measure acceptance of the principle of responsibility of polluters to pay the full cost of any environmental damages they caused and the acceptance of the principle of penalizing firms which use energy-inefficient equipment.

The sixth group of rated items focused on perceptions of the executives' of their personal responsibility and that of the firms to protect the environment. One scale was derived—*RESPONSIBILITY*.

Appendix C gives the results of the factor analysis.

III. EMPIRICAL RESULTS

Table I reports the results of the ordinary least squares regressions explaining formal institutionalization (*FORMAL_POLICY*) and environmental policy integration into general corporate policies and practices (*POLICY_INTEGRATION*).

[13] The factor scores obtained from the factor analysis are used in OLS and probit regressions and in survival analyses to follow. We extracted factors whose eigenvalues were larger than one. We used Varimax normalization as our axis rotation method when more than one factor was obtained. Missing values which resulted from no responses or responses corresponding to "Don't know" were replaced with the sample mean values. We interpret the obtained factors according to their factor loadings with respect to each question. The factor scores for all 193 firms were calculated using the factor loadings.

TABLE I

Japanese Manufacturers' Organizational Responses to Environmental Issues: Least Squares Regression Estimates[a]

	(1-1) Formal policy	(1-2) Formal policy	(1-3) Policy integration	(1-4) Policy integration
FIRM_SIZE	−0.0082	−0.0124	0.0105	0.0121
	−0.9078	−1.520	1.160	1.401
PROFITABILITY	−0.0226	−0.0166	−0.0021	−0.0010
	−0.9541	−0.7760	−0.0879	−0.0447
DEBT_RATIO	−0.0023	−0.0024	−0.0156**	−0.0172***
	−0.3572	−0.4085	−2.365	−2.760
EXPORT_RATIO	0.0021	−0.0016	0.0002	−0.0059
	0.3908	−0.3311	0.0427	−1.112
ADVERTISING	0.0241	0.0312**	−0.0131	−0.0054
	1.469	2.133	−0.7936	−0.3472
R & D	0.0865**	0.0675**	−0.0044	−0.0326
	2.481	2.091	−0.1248	−0.9507
MAIN_BANK_OWNERSHIP	0.0788*	0.0631	−0.0462	−0.0610
	1.714	1.527	−0.9982	−1.392
KEIRETSU_DUMMY	0.3224*	0.1922	0.2123	0.0290
	1.650	1.057	1.079	0.1504
EMPLOYEE_AGE	−0.0240	−0.0012	0.0159	0.0345
	−0.7641	−0.0439	0.5036	1.148
EARTH_SPACESHIP	—	−0.1828***	—	−0.0476
	—	−2.667	—	−0.6541
HARMONIOUS_COEXISTENCE	—	−0.2038***	—	0.1084
	—	−2.942	—	1.475
CIVIL_SOCIETY_PRESSURE	—	0.1592**	—	0.0707
	—	2.285	—	0.9562
GOVERNMENT_PRESSURE	—	0.1721**	—	−0.0274
	—	2.546	—	−0.3817
CONTROLLABILITY	—	0.3636***	—	0.2794***
	—	4.851	—	3.514
POLLUTER_PAY	—	0.0840	—	0.0240
	—	1.178	—	0.3168
ENERGY_EFFICIENCY	—	0.1168*	—	−0.0394
	—	1.688	—	−0.5372
RESPONSIBILITY	—	−0.0055	—	0.1643**
	—	−0.0736	—	2.076
Constant	0.6937	0.1652	−0.0733	−0.3852
	0.5467	0.1456	−0.0574	−0.3201
R-squared (Adj.R-sq.)	0.2158 (0.0930)	0.4148 (0.2889)	0.2050 (0.0805)	0.3413 (0.1996)
No. of observations	193	193	193	193

Note. Numbers under regression coefficients are *t*-statistics.

*, **, and *** denote, respectively, statistical significance at 10, 5, and 1% levels.

[a] Explanatory variables for the regression equations reported in this table include industry dummy variables, investment in plant and equipment, and foreign ownership. Investment in plant and equipment and foreign ownership are not statistically significant in all the equations.

The models based on profit maximization assumptions (Models (1-1) and (1-3)) explained about 9 and 8% of the variation in *FORMAL_POLICY* and *POLICY_INTEGRATION*, respectively.[14] The models based on utility maximization (Models (1-2) and (1-4)) explained about 29 and 20% of the variation of *FORMAL_POLICY* and *POLICY_INTEGRATION*, respectively. Table II reports the results of probit regressions in which the dependent variable is set to one if a firm has at least one plant which is ISO 14001-certified and zero otherwise.[15] Table III reports on their predictive powers. Both profit maximization based models and utility maximization based models provided accurate predictions for a majority of the cases in each cell with overall accuracy ranging from 85% for the profit maximization based models (Table III-1) and 88% for the utility maximization based models (Table III-2). Table IV provides the results of the Cox proportional hazard models. The dependent variable was the time elapsed (in months) between the first ISO 14001 certification in our sample firms and the certification of the particular firm. All models were significant.[16]

Profit Maximization Based Models

Three variables are significantly correlated with the degree to which Japanese manufacturing firms formally institutionalized their environmental objectives (Model (1-1) in Table I). As expected *R&D* was positively correlated to *FORMAL_POLICY* (Model (1-1) in Table I), confirming the expectation that firms which invest in knowledge assets are more likely to have the sophistication to articulate and formalize their environmental policies. The two business network variables (*MAIN_BANK_OWNERSHIP* and *KEIRETSU_DUMMY*) were also significantly positively related to formal institutionalization, reflecting perhaps the positive role that business groups in Japan play in communicating information concerning institutionalization of environmental objectives through formal policies. The coefficient for *ADVERTISING* was positive, but insignificant.

POLICY_INTEGRATION (Model (1-3) in Table I), which means the degree to which environmental commitments are actually attended to in firm decision making and are reflected in changes in practices, was negatively significantly related to

[14] To control for potential correlation between error terms of Formal Policy and Policy Integration models, we estimated them as a system (seemingly unrelated regression). This does not change our results significantly

[15] All models (2-1, 2-2, and 2-3) are significant at a 0.5% level. The likelihood ratio test rejects the hypothesis that the coefficients are zero in each model. Likelihood ratio tests also reject both the hypothesis that the coefficients of industry dummies are zero at a 5% level and the hypothesis that the coefficients of all eight organizational factors are zero at a 5% level. Table III shows three 2×2 tables of predictions by hits and misses for each of the three probit models used. A naive prediction rule which always predicts the probit dependent variable to be zero (since we have more zeros than ones) provides correct predictions 68.4% of the time. Our probit models (2-1), (2-2), and (2-3) provide more correct predictions, 85.0, 87.6, and 85.0%, respectively, than the naïve prediction rule.

[16] Models (4-1) and (4-2) are both significant at a 0.5% level. A likelihood ratio test rejects the hypothesis that the duration time analysis coefficients in each of these models are zero. A likelihood ratio test also rejects the hypothesis that the coefficients of all eight organizational factors are zero at a 5% level. Equations (4-1) and (4-2) include dummies for high polluting and low polluting industries instead of the individual industry dummies. The original 15 industries were classified into heavily, intermediate and low polluting industry groups based on each industry's pollution and energy intensities. Pollution and energy intensities for each industry were calculated as the ratios between the emissions for carbon dioxide, sulfur and SOx and energy consumption and value added.

TABLE II
Determinants of ISO 14001 Certification: Probit Regressions

	(2-1) ISO 14001 certification granted/with industry dummies	(2-1)′ Without ISO 9000 dummy	(2-2) ISO 14001 certification granted/with industry dummies	(2-2)′ Without ISO 9000 dummy	(2-3) ISO 14001 certification granted/without industry dummies	(2-3)′ Without ISO 9000 dummy
FIRM_SIZE	0.1939***	0.1976***	0.2387***	0.2318***	0.1993***	0.1847***
	3.7415	3.9377	3.4673	3.7224	3.8618	3.9409
PROFITABILITY	0.0276	0.0297	0.0679	0.0572	−0.0177	−0.0278
	0.5693	0.6425	1.1111	1.0495	−0.4980	−0.8069
DEBT_RATIO	−0.0226*	−0.0163	−0.0342**	−0.0244*	−0.0381***	−0.0298***
	−1.8041	−1.3750	−2.3980	−1.8791	−3.0718	−2.6118
EXPORT_RATIO	0.0065	0.0084	−0.0015	0.0009	0.0146*	0.0179**
	0.7177	0.9380	−0.1424	0.0930	1.8027	2.3630
ADVERTISING	0.0442	0.0449	0.0630*	0.0618*	0.0244	0.0201
	1.5290	1.5886	1.8316	1.9154	1.0080	0.8733
R & D	−0.0195	−0.0242	−0.1222	−0.0979	−0.1081*	−0.1071**
	−0.2712	−0.3523	−1.3434	−1.1572	−1.8957	−2.0221
MAIN_BANK_OWNERSHIP	0.0200	0.0333	0.0083	0.0046	0.0159	0.0233
	0.2320	0.4004	0.0825	0.0495	0.1892	0.2975
KEIRETSU_DUMMY	0.0702	0.1174	−0.1336	−0.0139	−0.2758	−0.0859
	0.1846	0.3171	−0.2739	−0.0309	−0.7693	−0.2549
FOREIGN_OWNERSHIP	−0.0104	−0.0033	0.0012	0.0112	0.0004	0.0058
	−0.5408	−0.1788	0.0516	0.5281	0.0247	0.4022
INVESTMENT_IN_PLANT	−0.0352	−0.0429	−0.0414	−0.0602*	−0.0091	−0.0142
	−1.1186	−1.4074	−1.1275	−1.7111	−0.3451	−0.5580
EMPLOYEE_AGE	−0.1271**	−0.1402**	−0.1260*	−0.1445**	−0.0972**	−0.1149**
	−2.1516	−2.4542	−1.8204	−2.2286	−1.9870	−2.4740

EARTH_SPACESHIP	—	—	−0.1500	−0.0775	−0.0788	−0.0547
			−0.8012	−0.4568	−0.4824	−0.3758
HARMONIOUS_COEXISTENCE	—	—	0.1709	0.1693	−0.0743	−0.0894
			0.8711	0.9130	−0.5388	−0.6941
CIVIL_SOCIETY_PRESSURE	—	—	0.2858	0.2896*	0.2467*	0.2532*
			1.5935	1.7170	1.7557	1.9377
GOVERNMENT_PRESSURE	—	—	−0.1761	−0.1621	−0.2796**	−0.1950
			−1.0006	−0.9944	−1.9928	−1.5385
CONTROLLABILITY	—	—	0.0437	0.0583	−0.0068	0.0100
			0.2218	0.3206	−0.0424	0.0678
POLLUTER_PAY	—	—	0.0962	0.0272	0.0342	0.0181
			0.5283	0.1597	0.2577	0.1420
ENERGY_EFFICIENCY	—	—	0.0310	0.0574	−0.0186	0.0034
			0.1727	0.3456	−0.1260	0.0251
RESPONSIBILITY	—	—	0.6749***	0.5790**	0.5940***	0.4854***
			2.7101	2.4991	2.9729	2.6866
ISO 9000	0.8043**	—	1.0623***	—	1.1050***	—
	2.4903		2.6844		3.5995	
Constant	4.1895*	4.7372**	4.4807**	5.3495**	3.3389	4.4681**
	1.7579	2.0685	1.5990	2.0561	1.6371	2.3531
Log-likelihood	−65.836	−69.182	−55.846	−60.037	−68.808	−76.123
	193	193	193	193	193	193

Note. Numbers under coefficients are *t*-statistics.
*, **, and *** denote, respectively, statistical significance at 10, 5, and 1% levels.

TABLE III
Probit Model Predictions: Hits and Misses

III-1 (Model 2-1)

	Actual		
Predicted	0	1	Total
0	123	20	143
1	9	41	50
Total	132	61	193

III-2 (Model 2-2)

	Actual		
Predicted	0	1	Total
0	123	15	138
1	9	46	55
Total	132	61	193

III-3 (Model 2-3)

	Actual		
Predicted	0	1	Total
0	124	21	145
1	8	40	48
Total	132	61	193

DEBT_RATIO. As expected firms with heavy short-term debt loads are less likely to place a priority on aspects that do not appear to affect directly their "bottom lines."

ISO 14001 certification (Model (2-1) in Table II) was, as expected, significantly positively correlated with *FIRM_SIZE* and negatively correlated with *DEBT_RATIO*. There are economies of scale in certification processes and thus larger organizations accrue relatively lower costs compared to their general outlays. *EMPLOYEE_AGE* and *ISO9000* certification, reflecting learning capacity and accumulated knowledge of certification processes, respectively, were also as expected significantly correlated with ISO 14001 certification.

The leaders in certification (Model (4-1) in Table IV) were exporters, not domestically oriented firms. This may reflect the fact that environmental values have been internalized earlier by customers and consumers in foreign markets (e.g., Europe) than by Japanese customers and consumers. Furthermore, the impact of these values is far more pronounced in European markets. While *EXPORT_RATIO* was significantly positively related to shorter time to certification, no significant association was found between time to certification and *ADVERTISING* (Note that a positive coefficient means a higher probability of certification and thus a shorter time to certification.) Lower relative costs of certification associated with *FIRM_SIZE*, *EMPLOYEE_AGE*, and *ISO9000* certification also explain earlier certification. *DEBT_RATIO* was significantly negatively associated with longer elapsed time to certification.

TABLE IV
Determinants of the Time to ISO Certification: Cox Proportional Hazard Models

	(4-1) Time to ISO certification	(4-1)′ Without ISO 9000 dummy	(4-2) Time to ISO certification	(4-2)′ Without ISO 9000 dummy
FIRM_SIZE	0.0916***	0.0990***	0.1049***	0.1146***
	5.5510	5.9452	5.7894	6.0939
PROFITABILITY	−0.0530	−0.0634	−0.0523	−0.0667
	−1.1695	−1.4154	−1.0729	−1.4007
DEBT_RATIO	−0.0221**	−0.0232**	−0.0344***	−0.0334***
	−2.0731	−2.0991	−2.9223	−2.8403
EXPORT_RATIO	0.0215***	0.0256***	0.0197**	0.0251***
	2.5881	3.2644	2.3553	3.2555
ADVERTISING	0.0188	0.0183	0.0370	0.0381
	0.7958	0.7197	1.4914	1.4457
R & D	−0.0062	−0.0472	−0.0041	−0.0634
	−0.0920	−0.7653	−0.0577	−0.9676
MAIN_BANK_OWNERSHIP	0.0376	0.0467	0.0399	0.0414
	0.3888	0.4882	0.3780	0.4012
KEIRETSU_DUMMY	0.1078	0.2093	0.0383	0.1120
	0.3266	0.6429	0.1039	0.3169
FOREIGN_OWNERSHIP	0.0042	0.0092	0.0032	0.0050
	0.2587	0.6142	0.2093	0.3432
INVESTMENT_IN_PLANT	−0.0150	−0.0150	−0.0049	−0.0085
	−0.4859	−0.4896	−0.1575	−0.2782
EMPLOYEE_AGE	−0.1466***	−0.1660***	−0.0964*	−0.1323**
	−2.6988	−3.1020	−1.6543	−2.3837
HEAVILY_POLLUTING_INDUSTRIES	0.4553	0.6496*	0.2327	0.4272
	1.1891	1.7338	0.5750	1.0472
LOW_POLLUTING_INDUSTRIES	0.4637	0.5827	0.2934	0.4386
	1.0602	1.3938	0.6282	0.9913
EARTH_SPACESHIP	—	—	−0.1645	−0.1759
			−0.8689	−0.9887
HARMONIOUS_COEXISTENCE	—	—	−0.1861	−0.1992
			−1.1988	−1.2862
CIVIL_SOCIETY_PRESSURE	—	—	0.1977	0.2146
			1.4390	1.5500
GOVERNMENT_PRESSURE	—	—	−0.1029	−0.0796
			−0.6600	−0.5213
CONTROLLABILITY	—	—	0.0902	0.1435
			0.4634	0.7577
POLLUTER_PAY	—	—	0.0428	−0.0032
			0.2939	−0.0213
ENERGY_EFFICIENT	—	—	0.0140	−0.0079
			0.0820	−0.0486
RESPONSIBILITY	—	—	0.6741***	0.6518***
			3.2480	3.1401
ISO 9000	1.2626***	—	1.3435***	—
	2.9652		3.0215	
Log-likelihood	−258.739	−264.293	−249.636	−255.397
No. of observations	193	193	193	193

Note. Numbers under coefficients are *t*-statistics.
*, **, and *** denote, respectively, statistical significance at 10, 5, and 1% levels.

Utility Maximization Based Models

In these models, in addition to independent variables representing costs and benefits of different facets of environmental commitment, variables which represent values, attitudes and perceptions of executives are introduced to explain the level of such commitments.[17]

Formal institutionalization of environmental commitment (Model (1-2)) was, as expected, significantly positively correlated to *ADVERTISING*, *R & D*, *CIVIL_SOCIETY_PRESSURE*, *GOVERNMENT_PRESSURE*, *CONTROLLABILITY* and *ENERGY_EFFICIENCY*. Unexpectedly, the attitudinal variables, *EARTH_SPACESHIP* and *HARMONIOUS_COEXISTENCE*, which reflect personal values and perceptions consistent with the "environmentalists' paradigm," had negative coefficients. This may suggest that, in organizations with executives deeply committed to the environment, formal recognition of environmental objectives is not seen as affirmation of environmental values, but instead may be seen as an unnecessary exercise in public relations. The coefficients of variables representing business network relationships were both positive (but insignificant).

The level of integration of environmental policies into general corporate policies and practices (Model (1-4)), as expected, was correlated significantly negatively with *DEBT_RATIO* and positively with *CONTROLLABILITY* and *RESPONSIBILITY*. Firms with executives who feel that the firm can control its impact on the environment and who feel that they have personal responsibility to ensure that their firms protect the environment are more likely to see the pursuit of environmental objectives as a regular part of their business.

As expected, the probability of ISO 14001 certification (Model (2-2)) is associated positively with *FIRM_SIZE*, *ADVERTISING*, and *ISO9000* certification and negatively with the *EMPLOYEE_AGE* and *DEBT_RATIO* when sectoral factors are controlled. Although our interpretation of the sign of firm size is that larger firms are more endowed with resources to seek ISO certifications and that they enjoy economies of scale in implementing certification, we cannot exclude the possibility that the positive sign of firm size merely reflects a larger number of plants in larger firms, compared to smaller firms. (We did not control the number of each firm's plants in our regressions since the data are not available.) The positive effect of advertising intensity on the probability of an ISO certification is consistent with the findings of Arora and Cason [3] that advertising affects positively the probability of participating in a voluntary 33/50 program. *EXPORT_RATIO* is not significant when industry dummies are included in Model (2-2) but when industry dummies are excluded, export ratio becomes positive and significant (Model (2-3)). This means that industry dummies absorb the positive impacts of exporting on ISO certification, implying that export-oriented industries as a whole are more oriented to ISO certification. This is consistent with the generally accepted observation that Japanese exporters were forced to seek ISO certifications to be able to remain in the EU market. This does not exclude, however, alternative interpretations for the positive role export ratio plays in ISO

[17] Since we have used executives' ratings in our models to represent perception of executives in their firms, we have estimated all models using as control variables the individual characteristics of the respondent (e.g., age, role in the organization). Using the control variables had no significant impact on the results. For simplicity we report the results without these control variables.

certification. For example, export-oriented industries such as electronics, auto, and machinery have more progressive and globally more competitive firms with proenvironment policies than industries in noncompetitive, locally based sectors such as the chemicals, paper, and pulp and energy sectors.[18]

Another important finding in our probit regressions is that firms' high debt ratios deter their effort to obtain ISO certification (Models (2-2) and (2-3)). Finally we note that the importance of firm-specific variables in our probit estimation is consistent with DeCanio and Watkins [5] who estimated logit models for firms' decisions whether to participate in EPA's voluntary Green Lights program.

One puzzling finding is that in both models (Models (2-2) and (2-3)) R & D variables have negative coefficients. On the surface this result tends to contradict the idea that modern innovative firms are more likely to be greener. Further examination of the data, however, revealed a significant positive (negative) relationship between R & D intensity and membership in the low (high) polluting industries.[19] Clean industries do not have the same pressures to demonstrate their greenness and justify their legitimacy as those considered to be in high polluting sectors.

Personal responsibility felt by executives to ensure that their organizations protected the environment (*RESPONSIBILITY*) was the most significant attitudinal variable explaining certification. Perceived pressures from civil society (*CIVIL_SOCIETY_PRESSURE*) also increase the probability of certification. In contrast, government pressure to improve environmental performance (*GOVERNMENT_PRESSURE*) was negatively related to certification, perhaps reflecting the fact that such pressure is higher on companies that need significant investment in environmental protection. The pressure to satisfy the government may divert efforts from voluntary actions including environmental certification.

FIRM_SIZE and *EXPORT_RATIO* are significantly positively associated with shorter time to ISO certification (Model (4-2)). Larger firms have more resources to implement the new environmental management systems required for ISO 14001 certification and thus can obtain certification earlier. The costs of maintaining such systems as a share of corporate budgets are also smaller for the larger firms, so they are less likely to deter certification. Exporting firms lead domestic firms in obtaining certification. The significant positive coefficient of *EXPORT_RATIO* reflects in part the benefits from certification that exporters have perceived in maintaining market access to Europe. They may also reflect earlier exposure to shifting public values in Europe and North America placing higher priority on protecting the environment. The average age of firm employees and firm's high debt ratios, on the other hand, are significantly negative reflecting the slower path of learning in older companies, a lower ability to innovate, and the lower priority placed on nonfinancial objectives that firms with higher short-term debt have. As expected, firms with executives who take personal responsibility to ensure that they protect the environment tend to lead in the certification process.

[18] This is despite the serious voluntary effort by Keidanren (Japanese Federation of Economic Organizations) to promote environmentally responsible behavior among Japanese manufacturing industries [19].

[19] The simple correlations between R & D intensity and the low polluting and heavily polluting industry dummies, respectively, are 0.60 ($p = 0.00$) and -0.17 ($p = 0.02$).

IV. CONCLUDING REMARKS

Firms' responses to environmental issues are an important ingredient of global environmental management. Significant empirical research has been done on the behavior of U.S. firms. Despite their importance in the global market, little empirical research exists analyzing Japanese manufacturers' responses to environmental issues. In this paper we have presented empirical estimates of the impacts of various determinants of the levels of commitment of Japanese manufacturing firms in various dimensions of their environmental protection behavior.

Our analysis suggests that while the costs and benefits of voluntary actions to enhance and protect the environment and the capacity to act are significant determinants of environmental commitments, so are the environmental values, beliefs, and attitudes of key managers. The comparison of profit maximization and utility maximization models estimated shows that recognizing organizational agency relationships by incorporating into the traditional models based on profit maximization, variables which affect the utility of managers, increases the explanatory powers of the models significantly.

The results provide also some new insights about the environmental behavior of Japanese firms. We find that firms' intangible assets variables (*ADVERTISING* and $R \& D$) which play an important role in U.S. firms' environmental management are found to be important in only some aspects of Japanese firms' environmental management processes. This may provide some partial empirical support to the argument that most Japanese manufacturers have not institutionalized environmental issue management to the same degree as their European and American counterparts despite what appears to be successful coping with the energy conservation issues in the 1970s and 1980s.

In the 1970s and 1980s the driving force was economic survival in face of energy supply insecurity, and the environmental benefits were byproducts. In the 1990s very lax public opinion and weak civil society relegated environmental issues to a low priority status. Thus Japanese firms, despite their technical capabilities, have little reason to invest managerial resources in articulating and implementing environmental policies. However, the pressures of market access especially to Europe have increased since 1996 and have led to a reversal in this situation for at least a segment of these firms.

Japanese certification rates of ISO 14001 are found to be significantly affected by firm size, the average age of firm employees, export ratio, and debt ratio. Japanese corporate group (keiretsu) related variables were found to be positive and significant only in firms' institutionalization of environmental objectives through formal policies. It is possible that keiretsu information exchanges encourage some keiretsu firms to react positively toward investing in the environment while encouraging others to avoid complying with environmental requirements.[20] If this is the case, what we observe may be positive and negative keiretsu effects canceling each other.

[20] It is well known that firms try to take advantage of the existing regulations including environmental regulations. For example, Vogel and Rugman [40] reviewed 10 cases of environmentally related trade disputes between the U.S. and Canada and found that, in 9 out of these 10 cases, environmental regulations were used to obtain shelter.

The findings of this paper have some implications for environmental policy makers in both the private and the public sectors. First, we have found some evidence, as in previous studies, that polluting industries are more receptive to voluntary environmental programs than less-polluting industries.[21] Policy makers need to formulate policies based on how such industry effects interact with the levels of firm efforts and firms' intangible assets. Second, we found advertising intensity to have only limited effects on firms' environmental responses. This may suggest that Japanese producers of consumer products experienced little market pressure to incorporate green strategies.

One of the main objectives of this paper is to identify the determinants of Japanese firms' managerial responses to environmental issues. How environmental firm performance is affected by adoption of alternative environmental management systems is an important subject for future research. Indeed, Boiral and Sala [4] raise a question about whether or not ISO 14001 can really be an effective tool to improve firms' environmental performance rather than just another "management gadget." Considering the amount of resources poured into ISO 14001 certifications in Japan as well as the rest of the world, this question is too important to be left unanswered. Data which would allow researchers to undertake such a study are still lacking in Japan. This situation may be changing with a bill recently passed through the Japanese parliament [37, 38, 42]. This bill would set up a system of pollutant release and transfer registries. Such a system with its associated databases would allow researchers to collect more accurate data on firms' responses and environmental performance.

APPENDIX A: DESCRIPTIVE STATISTICS

	Mean	Standard deviation	Minimum	Maximum	Sample
Dependent variables					
FORMAL_POLICY (factor score)	0.000	1.000	−3.427	2.035	193
POLICY_INTEGRATION (factor score)	0.000	1.000	−2.775	2.785	193
ISO_DUMMY	0.316	—	0.000	1.000	193
TIME_TO_ISO (in months)	34.891	8.249	0.000	39.000	193
Explanatory variables					
FIRM_SIZE (no. of workers in 1000s)	5.092	9.513	0.320	74.821	192
PROFITABILITY (%)	4.243	4.282	−4.382	27.629	192
DEBT_RATIO (%)	38.823	13.225	8.550	84.650	191
EXPORT_RATIO (%)	15.468	17.209	0.000	83.667	192
ADVERTISING (%)	3.027	4.903	0.000	37.018	189
R & D (%)	4.455	3.366	0.000	16.186	183
FOREIGN_OWNERSHIP (%)	8.806	9.517	0.300	62.200	192
INVESTMENT_IN_PLANT (%)	9.521	5.063	1.124	25.735	191
EMPLOYEE_AGE	38.816	2.757	31.000	47.000	192

[21] To determine if the level of pollution at the industry level influences individual firms' environmental responses, we repeated our calculations for Models (1-1), (1-2), (1-3), (1-4), (2-1), and (2-2) in Tables I and II using dummy variables for heavily polluting industries and low-polluting industries. (Results are not shown here to save space.) We found the coefficient for Heavily_Polluting_Industries dummy to be positive and statistically significant at a 13% level in five out of the six reestimated models.

	Mean	Standard deviation	Minimum	Maximum	Sample
Industry dummies					
Food	0.052	—	0.000	1.000	193
Textiles	0.015	—	0.000	1.000	193
Pulp & Paper	0.057	—	0.000	1.000	193
Chemicals	0.161	—	0.000	1.000	193
Pharmaceutical	0.078	—	0.000	1.000	193
Petroleum	0.031	—	0.000	1.000	193
Rubber	0.031	—	0.000	1.000	193
Glass	0.031	—	0.000	1.000	193
Steel	0.015	—	0.000	1.000	193
Nonferrous metals	0.036	—	0.000	1.000	193
Metals	0.026	—	0.000	1.000	193
General machinery	0.083	—	0.000	1.000	193
Electric machinery	0.207	—	0.000	1.000	193
Transportation machinery	0.072	—	0.000	1.000	193
Precision instruments	0.047	—	0.000	1.000	193
Heavily_Polluting_Industries	0.295	—	0.000	1.000	193
Low_Polluting_Industries	0.332	—	0.000	1.000	193
Intermediate_Polluting_Industries	0.373	—	0.000	1.000	193
Keiretsu variables					
MAIN_BANK_OWNERSHIP (%)	3.519	1.671	0.000	5.267	192
KEIRETSU_DUMMY	0.275	—	0.000	1.000	193
Attitudinal and perceptual variables (factor scores)					
EARTH_SPACESHIP	0.000	1.000	−5.993	1.953	193
HARMONIOUS_COEXISTENCE	0.000	1.000	−3.161	1.784	193
CIVIL_SOCIETY_PRESSURE	0.000	1.000	−2.930	2.878	193
GOVERNMENT_PRESSURE	0.000	1.000	−3.799	1.920	193
CONTROLLABILITY	0.000	1.000	−3.851	2.096	193
POLLUTER_PAY	0.000	1.000	−4.120	2.418	193
ENERGY_EFFICIENCY	0.000	1.000	−2.827	2.593	193
RESPONSIBILITY	0.000	1.000	−3.345	2.124	193
ISO 9000 (ISO 9000 series certification)	0.6425	—	0.000	1.000	193

APPENDIX B: MODELS

For the purposes of this paper we consider firms choosing among various organizational forms regarding their environmental responses given their investment and other management decisions in the past. We consider two types of decision models. In the first type we assume that environmental responses are determined by maximizing firm profits which are assumed to depend on the firm's environmental responses conditional on its past production decisions. In the second type we assume that a firm's environmental responses are determined by the firm's manager who maximizes her utility function which is a function of the firm's profits from operations as well as the cost of environmental response and the intrinsic value the manager receives from her firm's environmentally friendly behavior. This model is similar in spirit to the agency model of the firm (e.g. [8, 16, 41]) in which firms' managers may have management goals which may be different from those of their shareholders.

Derivation of Our OLS Model Specifications (1-1), (1-2), (1-3), (1-4)

We define the following:

π_i: firm i's profit given its environmental responses with conditional revenue and cost functions $r(FP_i, PI_i \mid X_i)$ and $c(FP_i, PI_i \mid X_i)$, respectively

U_i: the utility of firm i's manager with utility function $u(r, c, v)$

$v(FP_i, PI_i \mid Y_i)$: intrinsic value the manager of firm i derives from its environmental responses (FP_i and PI_i)

FP_i: firm i's formal policy index (decision variable)

PI_i: firm i's policy integration index (decision variable)

X_i: firm i's production characteristics including past managerial decisions (given)

Y_i: manager's attitudinal and perceptual variables (given)

(I) Firm i's profit maximization problem (Models (1-1) and (1-3)).

We assume here that firm i determines FP_i and PI_i by maximizing its profit π_i conditional on X_i with respect to FP_i and PI_i as follows:

$$\text{Max } \pi_i$$

$$\pi_i = r(FP_i, PI_i \mid X_i) - c(FP_i, PI_i \mid X_i)$$

Assuming that $\pi(FP, PI \mid X)$ is concave in FP and PI, we solve this maximization problem and obtain reduced form equations for FP_i and PI_i for some functions $h(X)$ and $k(X)$ as,

$$FP_i = h(X_i)$$

$$PI_i = k(X_i)$$

Or in regression form,

$$FP_i = h(X_i) + \eta_i \qquad \text{Model (1-1)}$$

$$PI_i = k(X_i) + \iota_i \qquad \text{Model (1-3)}$$

where η_i and ι_i are equation error terms.

In our estimation, we have used linearized versions of the above specifications.

(II) Managers' utility maximization problem at firm i (Models (1-2) and (1-4)).

We assume here that firm i's manager maximizes her utility function Ui conditional on X_i and Y_i with respect to FP_i and PI_i as follows:

$$\text{Max } U_i$$

$$U_i = u\left[r(FP_i, PI_i \mid X_i), c(FP_i, PI_i \mid X_i), v(FP_i, PI_i \mid Y_i)\right]$$

Assuming $u(r, c, v)$ is concave in its arguments, we solve this maximization problem and obtain reduced form expressions for FP_i and PI_i,

$$FP_i = f(X_i, Y_i)$$

$$PI_i = g(X_i, Y_i)$$

for some functions f and g, or in regression forms,

$$FP_i = f(X_i, Y_i) + \phi_i \qquad \text{Model (1-2)}$$

$$PI_i = g(X_i, Y_i) + \gamma_i \qquad \text{Model (1-4)}$$

where ϕ_i and γ_i are equation error terms.

In our estimation, we have used linearized versions of the functions $f(X, Y)$ and $g(X, Y)$. Our empirical estimates for Models (1-1), (1-2), (1-3), and (1-4) are given in Table I.

Derivation of Probit Models (2-1), (2-1′), (2-2), (2-2′), (2-3), *and* (2-3′)

Our probit Models (2-1) and (2-1′) are based on managers' profit maximization, while Models (2-2′), (2-2), (2-3′), and (2-3′) are based on firms' utility maximization. These are explained below in turn.

(III) Probit Models (2-1), (2-1').

The decision rule for these models is that firm i maximizes its profit with respect to its choice on ISO certification as follows.

$$\text{If } B(X_i) - I(X_i) + \eta_i > 0, \text{ then firm } i \text{ seeks certification}(ISO\_DUMMY = 1) \qquad \text{(IIIa)}$$

$$\text{If } B(X_i) - I(X_i) + \eta_i \le 0, \text{ then firm } i \text{ does not seek certification}(ISO\_DUMMY = 0) \qquad \text{(IIIb)}$$

where $B(X_i)$ is benefit due to ISO 14001 certification; $I(X_i)$ is investment firm i makes for ISO 14001 certification; and η_i is unobservable factors assumed to be standard normal ($N(0, 1)$).

In our estimation we use the following linearized function for the expression

$$B(X_i) - I(X_i) = (\beta_x)' X_i \qquad \text{(IIIc)}$$

where X_i is a column vector of firm i variables defined above and β_x is a column vector of coefficients for X_i. Using (IIIa) and (IIIc), we get

$$(ISO\_DUMMY = 1) \text{ if and only if } \eta_i > -(\beta_x)' X_i$$

and our probit models imply that

$$\begin{aligned} \text{Prob}(ISO\_DUMMYi = 1) &= Prob(\eta_i > -(\beta_X)' X_i) \\ &= \Phi[(\beta_x)' X_i] \end{aligned} \qquad \text{(IIId)}$$

where Φ [.] denotes the distribution function for a standard normal random variable.

(IV) Probit Models (2-2), (2-2′), (2-3), and (2-3′).

We describe the utility that firm i's manager derives from obtaining an ISO 14001 certification as follows:

Firm i's manager's utility of the net benefit derived from an ISO 14001 certification $= B(X_i) - I(X_i) + \text{voc}(Y_i) + \eta_i$ where $\text{voc}(Y_i)$ is intrinsic value firm i's manager derives from ISO 14001 certification, and η_i is unobservable factors assumed to be standard normal ($N(0, 1)$).

Then our utility maximization decision rule for firm i is based on firm i's manager's utility as follows.

$$\text{If } B(X_i) - I(X_i) + \text{voc}(Y_i) + \eta_i > 0,$$
$$\text{then firm } i \text{ seeks certification } (ISO\_DUMMY = 1). \quad \text{(IVa)}$$
$$\text{If } B(X_i) - I(X_i) + \text{voc}(Y_i) + \eta_i \leq 0,$$
$$\text{then firm } i \text{ does not seek certification } (ISO\_DUMMY = 0). \quad \text{(IVb)}$$

In our estimation we use the following linearized function for the expression

$$B(X_i) - I(X_i) + \text{voc}(Y_i) = (\beta_X)' X_i + (\beta_Y)' Y_i \quad \text{(IVc)}$$

where X_i and Y_i are column vectors of firm i variables defined above. β_x and β_Y are column vectors of coefficients for X_i and Y_i.

Using (IVa) and (IVc), we get

$$(ISO\_DUMMY = 1) \text{ if and only if } \eta_i > -(\beta_X)' X_i - (\beta_Y)' Y_i$$

and our probit models imply that

$$\text{Prob}(ISO\_DUMMY_i = 1) = \Phi\left[(\beta_X)' X_i + (\beta_Y)' Y_i\right]. \quad \text{(IVd)}$$

Our probit estimation results are presented in Table II.

Derivation of Duration Models (4-1), (4-1′), (4-2), *and* (4-2′)

In formulating our duration models we make the following standard assumption that firms make a decision on ISO certifications every time period. Since our measurement unit of time is a month, it is assumed here that firms make decisions on ISO certifications according to the decision rules discussed above (IIId and IVd). Our empirical specifications, however, are based on the Cox proportional hazard model which specifies our conditional probabilities as follows.

(V) Duration Models (4-1), (4-1′).

In these models firm i's profit maximization determines firm i's duration until its ISO certification. The conditional probability is given by

$$\begin{aligned}&\text{Prob}(ISO\_DUMMY_i = 1 \text{ in month } t \\ &\qquad \mid \text{firm } i \text{ has not been certified up to month } t-1) \\ &= h_0(t) \exp\left[(\beta_X)' X_i\right] \end{aligned} \quad \text{(Va)}$$

where $h_0(t)$ is the base hazard function.

(VI) Duration Models (4-2), (4-2′).

In these models firm i's manager's utility maximization determines firm i's duration until its ISO certification. The conditional probability is given by

$$\text{Prob}(\, ISO\_DUMMY_i = 1 \text{ in month } t \mid \text{firm } i \text{ has not been certified up to month } t-1) = h_0(t)\, \exp[(\beta_X)' X_i + (\beta_Y)' Y_i] \quad \text{(VIa)}$$

Our estimated duration models are presented in Table IV.

APPENDIX C: RESULTS OF FACTOR ANALYSIS

Group 1: *Firm's Environmental Commitments* (*Dependent Variables*)

Cumulative variance explained by the two factors = 60.3%

Statements	Factor 1 loadings	Factor 2 loadings
My firm has detailed written policies concerned with protecting the environment.	0.216	0.861
Environmental protection is an explicit component of my firm's strategic (long-term) plan.	0.434	0.715
Most people in my firm are very aware of the need to protect the environment and are well-informed about our environmental policy	0.418	0.682
The people in charge of environmental protection in my firm have sufficient authority	0.529	0.551
Many top managers in my firm are personally and actively involved in developing environmental protection policies and monitoring their implementation	0.598	0.467
My company has a written environmental policy that states goals for improving our environmental performances	0.229	0.858
Clear and strong signals have been sent from our top managers that better environmental management is a requirement in our firm, not a choice	0.413	0.754
The environmental protection department of my enterprise is headed by a senior executive	0.443	0.412
Environmental managers or those chiefly responsible for environmental management in my firm have adequate authority to get involved in and have a say in decision making on the investment plans of my enterprise	0.654	0.283
My firm has a long term plan to lower our pollution control costs in order to be more competitive in the market	0.504	0.322
Environmental concerns have been integrated into the decision-making of my organization's senior management	0.789	0.351
Environmental protection is an integral part of my company's culture	0.756	0.284
In my firm we are constantly looking for advances in technology to reduce our pollution levels	0.746	0.185
The people in charge of environmental protection in my firm have the authority to stop operations if they perceive a significant risk of environmental degradation	0.661	0.260
Ideas on pollution management are shared freely among lower, middle, and upper levels within my firm	0.706	0.332
There is no consensus in my firm about the desirable level for environmental protection	−0.301	−0.634
Explained variance	4.923	4.714
Proportion to total variance	0.308	0.295
Factor names	*POLICY_INTEGRATION*	*FORMAL_POLICY*

Group 2: *Personal Beliefs about the Relationship between the Natural Environment and Mankind* (*Independent Variables*)

Cumulative variance explained by the two factors = 57.1%

Statements	Factor 1 loadings	Factor 2 loadings
When humans interfere with nature it often produces disastrous consequences	−0.830	0.061
Mankind should live in harmony with nature rather than modify it for its own needs	−0.176	0.800
The earth is like a spaceship with only limited room and resources	−0.753	0.099
Humans have the right to modify the natural environment to suit their needs	0.089	−0.844
Advances in technology will eventually solve the problem of environmental degradation	0.421	−0.136
Explained variance	1.471	1.385
Proportion to total variance	0.294	0.277
Factor names	*EARTH_SPACESHIP*[a]	*HARMONIOUS_COEXISTENCE*

[a]Factor scores were multiplied by −1.

Group 3: *Institutional and Social Pressures* (*Independent Variables*)

Cumulative variance explained by the two factors = 51.0%

Statements	Factor 1 loadings	Factor 2 loadings
Government has set some pollution/production standards, so we have to make sure that we do not violate them	−0.074	0.706
Newspapers and TV have created a lot of concern about environmental issues, and this has put pressure on our company to improve our environmental performance	0.688	0.127
My company's labor union has influenced our environmental practices	0.736	−0.078
A pollution incident, if reported by the public media, could ruin our corporate image and market, so we must pay full attention to such issues before they become a public concern	0.070	0.710
My company is subject to a lot of governmental regulation regarding environmental matters	0.406	0.567
My company's environmental practices have been influenced by what other industrial organizations have done	0.712	0.116
Explained variance	1.697	1.360
Proportion to total variance	0.283	0.227
Factor names	*CIVIL_SOCIETY_PRESSURE*	*GOVERNMENT_PRESSURE*

Group 4: *Confidence in Their and Their Firm's Ability to Control Its Impact on the Environment* (*Independent Variables*)

Cumulative variance explained by the factor = 53.3%

Statements	Factor 1 loadings
My firm's contribution to environmental pollution is small and hardly makes a difference	0.494
I have insufficient knowledge to influence the environmental practices of my firm	0.758
I have insufficient authority to influence the environmental practices of my firm	0.846
My firm cannot act on its own to improve the environment because we have insufficient resources	0.803
My firm cannot act on its own to improve the environment because we must remain competitive	0.698
Explained variance	2.667
Proportion to total variance	0.533
Factor names	*CONTROLLABILITY*[b]

[b] Factor scores were multiplied by −1.

Group 5: *Accepted Environmental Governance Principles* (*Independent Variables*)

Cumulative variance explained by the two factors = 51.4%

Statements	Factor 1 loadings	Factor 2 loadings
Polluters should pay fully for the damage they cause, and be responsible for cleaning up their pollution	0.800	−0.014
Those who use natural resources should pay the full cost of using them even though the resources are public	0.674	0.208
An activity should only proceed if the risk to the environmenty from the activit can be fully evaluated and controlled	0.673	0.026
Those firms which use energy inefficiently are as responsible for the environmental damage as those firms which directly pollute their immediate environment	−0.089	0.793
Users of goods produced using energy intensive processes should pay for the environmental damage caused by their production	0.104	0.769
A certain amount of environmental damage is tolerated if there is to be economic growth	−0.287	−0.414
Explained variance	1.649	1.436
Proportion to total variance	0.275	0.239
Factor names	*POLLUTER_PAY*	*ENERGY_ EFFICIENCY*

Group 6: *Perceived Personal and Firms' Responsibilities for the Environment* (*Independent Variables*)

Cumulative variance explained by the factor = 35.1%

Statements	Factor 1 loadings
Complying with regulations and preventing environmental incidents are all that is required from a business enterprise like us	−0.293
It is the role of government, not the enterprise, to protect the environment	−0.477
It is the role of each individual, no matter what is his or her position, to see to it that the environment is protected	0.763
Government regulation is effective in protecting the environment	0.567
I feel it is my personal responsibility to ensure that my organization improves its environmental performance	0.732
Explained variance	1.754
Proportion to total variance	0.351
Factor names	*RESPONSIBILITY*

REFERENCES

1. M. Aoki, "Information, Incentives, and Bargaining in the Japanese Economy," Cambridge Univ. Press, New York (1988).
2. S. Arora and T. N. Cason, An experiment in voluntary environmental regulation: Participation in EPA's 33/50 program, *J. Environ. Econom. Management* **28**, 271–286 (1995).
3. S. Arora and T. N. Cason, Why do firms volunteer to exceed environmental regulations?: Understanding participation in EPA's 33/50 program, *Land Econom*. **72**, 413–432 (1996).
4. O. Boiral and J. Sala, Environmental management: Should industry adopt ISO 14001?, *Business Horizons* **41**(1), 57–64 (1998).
5. S. J. DeCanio and W. E. Watkins, Investment in energy efficiency: Do the characteristics of firms matter?, *Rev. Econom. Statist*. **80**, 95–107 (1998).
6. S. J. DeCanio, Energy efficiency and managerial performance: Improving profitability while reducing greenhouse gas emissions, *in* "Global Climate Change and Public Policy" (D. L. Feldman, Ed.), Nelson-Hall, Chicago (1994).
7. Deloitte Touche Tohmatsu International, International Institute for Sustainable Development and Sustainability, "Coming Clean: Corporate Environmental Reporting," Deloitte Touche Tohmatsu International, London (1993).
8. G. Donaldson, "Managing Corporate Wealth: The Operations of a Comprehensive Financial Goals System," Praeger, New York (1984).
9. F. M. Fisher, J. J. McGowan, and J. E. Greenwood, "Folded, Spindled, and Mutilated: Economic Analysis and U.S. v. IBM," The MIT Press, Cambridge, MA (1983).
10. P. Ghemawat, Sustainable advantage, *Harvard Bus. Rev*. **64**, 53–58 (1986).
11. H. Harman, "Modern Factor Analysis," second ed., revised, The University of Chicago Press, Chicago, IL (1967).
12. H. Hayami, M. Nakamura, M. Suga, and K. Yoshioka, Environmental management in Japan: Applications of input–output analysis to the emission of global warming gases, *Managerial and Decision Econom*. **18**, 195–208 (1997).
13. I. Henriques and P. Sadorsky, The determinants of an environmentally responsive firm: An empirical approach, *J. Environ. Econom. Management* **30**, 381–395 (1996).
14. K. Horiuchi, Global environmental problems and organizational change, (in Japanese), *Soshikikagaku* **30**, 27–35 (1996).

15. ISO World, "The number of ISO 14001/EMAS Registration of the World," available at ⟨http://www.ecology.or.jp/isoworld/english/analy14k.htm⟩ (1999).
16. M. C. Jensen and W. Meckling, Theory of the firm: Managerial behavior, agency costs and ownership structure, *J. Financial Econom.* **3**(4), 305–360, (1976).
17. Japan Accreditation Body for Conformity Assessment, *Web site*, October 1999, available at ⟨http://www.jab.or.jp/eng/htm/e-frame.htm⟩ (1999).
18. J. Johnston, "Econometric Methods," third ed., McGraw-Hill, New York (1984).
19. Keidanren (The Japanese Federation of Economic Organizations), "Keidanren Charter for Good Corporate Behavior," Keidanren, Tokyo (1996 and 1997).
20. M. Mani and D. Wheeler, In search of pollution havens? Dirty industry in the world economy, 1960 to 1995, *J. Environ. and Development* **7**, 215–247 (1998).
21. J. McGee, Commentary on "Corporate Strategies and Environmental Regulations: An Organizing Framework" by A. M. Rugman and A. Verbeke, *Strategic Management J.* **19**, 377–387 (1998).
22. Ministry of International Trade and Industry, *Web site*, (in Japanese), May 1998, available at ⟨http://www.miti.go.jp⟩ (1998).
23. H. Mintzberg, "The Structuring of Organizations," Prentice-Hall, Englewood Cliffs, NJ (1979).
24. R. Morck and M. Nakamura, Banks and corporate control in Japan, *J. Finance* **54**, 319–339 (1999).
25. M. Nakamura and I. Vertinsky, "Japanese Economic Policies and Growth," The University of Alberta Press, Edmonton, Alberta, Canada (1994).
26. H. Nishimura, The greening of Japanese industry, *in* "Business and Environment" (M. D. Rogers, Ed.), St. Martin's Press, New York (1995).
27. G. B. Northcraft and M. A. Neale, "Organizational Behavior: A Management Challenge," second ed., The Dryden Press, Fort Worth, TX (1994).
28. OECD, "OECD Environmental Performance Review: Japan," OECD, Paris (1994).
29. S. Pargal and D. Wheeler, Informal regulation of industrial pollution in developing countries: Evidence from Indonesia, *J. Polit. Econom.* **104**, 1314–1327 (1996).
30. M. E. Porter and C. van der Linde, Toward a new conception of the environment–competitiveness relationship, *J. Econom. Perspect.* **9**, 97–118 (1995).
31. N. Roht-Arriaza, Environmental management systems and environmental protection: Can ISO 14001 be useful within the context of APEC? *J. Environ. Dev.* **6**, 292–316 (1997).
32. A. M. Rugman and A. Verbeke, Corporate strategies and environmental regulations: An organizing framework, *Strategic Management J.* **19**, 363–375 (1998).
33. R. Starkey, Standardization of environmental management systems: ISO 14001, ISO 14004 and EMAS, *in* "Corporate Environmental Management 1: Systems and Strategies," second ed., (R. Welford, Ed.), Earthscan, London (1998).
34. H. Tada, Promotion of green management at Sony (in Japanese), *in* "Earth Environment Policies" (K. Horiuchi, Ed.), Yuhikaku, Tokyo (1998).
35. Toyo Keizai, "Kigyo Keiretsu Soran '98," (in Japanese), Toyo Keizai, Tokyo (1998).
36. Toyo Keizai, "Japan Company Handbook [First Section] 1994–1997," Toyo Keizai, Tokyo (1994–1997).
37. K. Tsunoda, The role of NGOs in PRTRs (in Japanese), *Environ. Information Sci.* **28**(2), 36–41 (1999).
38. K. Urano, Prospects and requirements for the PRTR system in Japan (in Japanese), *Environ. Information Sci.* **28**(2), 31–35 (1999).
39. A. Verbeke and C. Coeck, Environmental taxation: A green stick or a green carrot for corporate social performance?, *Managerial and Decision Econom.* **18**(6), 507–516 (1997).
40. D. Vogel and A. Rugman, Environmentally related trade disputes between the United States and Canada, *Amer. Rev. Canadian Stud.* **27**, 271–292, (1997).
41. O. E. Williamson, "Economic Organization: Firms, Markets and Policy Control," Wheatsheaf Books, Sussex, U.K. (1986).
42. Yomiuri Shimbun, "The Act on Pollutant Release and Transfer Registries Passed the Lower House" (in Japanese), *Yomiuri Shimbun* May 22, 1999, (2) International version No. 13.