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Corporate Environmental and Financial Performances and the Effects of Informational Instruments of Environmental Policy in Japan

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Corporate Environmental and Financial Performances and the Effects of Information-based Instruments of Environmental Policy in Japan*

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Summary

Focusing on 278 listed corporations in Japan, the present study tests the hypothesis that robust environmental conservation activities have a positive effect on their financial performance. It also examines the role played by the environmental policies introduced and strengthened by the government since the end of the 1990s.

By a statistical causality analysis using data from 1999 to 2003 we have shown that a positive effect of corporate environmental activities on financial performance was verified more clearly when information about the firms' responses to environmental policies were included with information about environmental management activities. Furthermore, an analysis of industrial groups revealed the following: firstly, in the machinery industry, the effect of environmental performance on financial performance was, on the whole, in a negative direction, i.e., higher environmental performance tends to lead to lower financial performance; secondly, although a positive relationship exists in the energy-intensive industry group for the period as a whole, a recent trend of tightening climate policies appears to turn this relationship into a negative one; and thirdly, in the miscellaneous industry group, a strong positive relationship exists and this tendency is growing stronger.

It is interesting that a structural change in the socio-economic system toward sustainability is underway in the industrial group which is closely related to people's daily lives with an obvious connection to health, safety and the environment.

Keywords: *virtuous circle of the environment and economy, information-based policy instruments, environmental reporting, corporate performance*

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1. Introduction

Empirical studies on the relationship between the social/environmental performance and the economic/financial performance of business corporations have a long history. Even fairly recent surveys report mixed results (see, e.g., Griffin and Mahon (1997), Roman *et al.* (1999), and Wagner (2001)). More recent studies, however, tend to provide increasing evidence of a positive association of the two aspects. The Environmental Capital Markets Committee which was established by the US Environmental Protection Agency to study the environment-finance connection, found from the existing body of research that a moderate positive correlation exists between the environmental and financial performance. It was concluded, however, that causation has yet to be determined (US EPA (2000)). Murphy (2002, p. 14) concludes:

> Research conducted over the last decade increasingly shows that there is a clear correlation between environmental performance and corporate profitability.
> .....
> Financial accounting measures, such as return on equity (ROE) and return on assets (ROA), have been shown to improve with improved environmental performance, while the inadequate disclosure of environmental liabilities has been found to have a compounding negative effect on the financial results of poor environmental performers.
> .....
> Considered collectively, this research provides a solid basis for concluding that there is, in fact, a profitable correlation between superior environmental stewardship and strong financial performance.

Orlitzky *et al.* (2003) performed a meta-analysis of fifty-two empirical studies on the topic, and they conclude that corporate social performance is positively correlated with corporate financial performance and that the relationship tends to be bi-directional and simultaneous.

A number of improvements that have been devised in the empirical research may explain the above tendency. First, theoretical underpinnings have been enhanced by resorting to the stakeholder theory of the firm and a related resource-based view (see, e.g., Preston and O'Bannon (1997) and Russo and Fouts (1997)). Second, methodological improvements have been made by shifting from a simple correlation to a multiple regression and related techniques that can control various relevant factors affecting corporate performance in question. Third, larger sample observations have become available.

The present authors have been working to answer the question of whether or not similar conclusions, particularly those related to the virtuous circle of the two, would apply to Japanese corporations (see Nakao *et al.* (2005) for an earlier attempt). In this paper we approach the problem of causality by applying a simplified version of the Hurlin-Venet extension of the Granger causality test (Hurlin and Venet (2001)). This enables us to use panel data of a fairly large size (five years' data on 278 Japanese listed

corporations in the manufacturing industry). We are also interested in analysing the effects of environmental policy measures by the Japanese government in promoting environmental information disclosure through the application of this methodology.

The Basic Environment Law, which replaced the former Basic Law for Environmental Pollution Control, was enacted in Japan in 1993 to deal with global environmental issues and new types of pollution problems. Since then a succession of laws and measures have come into force containing the ideas and instruments of new public environmental policies which differ from traditional ways of tackling industrial pollution. Some of these are outlined here. In connection with corporate activities, attention should be drawn to the enactment and amendment of a wide variety of recycling laws incorporating the concept of "extended producer responsibility," according to which the responsibility of the producer does not end with the manufacturing, distribution and utilisation stages of a product, but extends further to its end-of-life stages such as collection, reuse, recycling, scrapping, and final disposal. The Pollution Release and Transfer Register (PRTR) Law was also enacted as an information-based instrument to encourage various organisations to practice environmental conservation through disclosure and provision of environmental-impact information to consumers, investors, local residents and other stakeholders. The publication by the government of the Environmental Reporting Guidelines and the Environmental Accounting Guidelines and the formulation of the Scheme for the Promotion of Measures to Combat Global Warming, which aims to build a global-warming-free society, should also be noted.

Subject to these public policies, voluntary efforts over and above the basic compliance with laws and regulations have become prominent in the firms' environmental conservation activities. For example, a look at the number of firms which publish environmental reports and voluntarily disclose information on their environmental impacts as well as environmental conservation activities, reveals that this number is still on the increase, from 96 firms in 1996 to 743 firms in 2003 (The Ministry of the Environment (2004a, p.5)).[1] Furthermore, the firms' attitude toward environmental conservation has been changing, with a continual increase in the number of firms which perceive such activities not as a "cost" factor but as linked to the profit of the firm (The Ministry of the Environment (2002b, pp. 5-6), (2004a, pp. 8-10)).

Research carried out prior to the present study (Nakao *et al.* (2005)) found that,

[1] The number of firms shifting from "environmental reports" to "social and environmental reports" or "sustainability reports" has been increasing. However, according to the survey mentioned above, 93 per cent of respondents report on the "principles of environmental management" 78 per cent on the "concrete programs for environmental management," and only 44 per cent on "concrete social programs based on CSR principles."

according to a statistical analysis of corporate financial data obtained over five years from the 278 listed firms and these firms' environmental management scores[2], a firm's environmental performance has a positive impact on its financial performance and *vice versa*, with the tendency becoming more conspicuous recently. Moreover, in analyses based on environmental management scores for individual topics, such as, management system, pollution risk, resource-cycling, and global warming, a comparatively clear effect was confirmed in the case of environmental management indices and pollution risk indices. This suggests that such factors as corporate efforts to acquire ISO 14001 certification, an increase in the number of firms that publish environmental and sustainability reports, and other private voluntary initiatives such as the Responsible Care Initiative, as well as information-based instruments of environmental policies exemplified by the government's publication of the Environmental Reporting Guidelines and the Environmental Accounting Guidelines and the enforcement of the PRTR Law, have encouraged firms to disclose environmental information which in turn has had an influence on their financial performance. In order to clarify this point further, the present study investigates to what extent the firms' environmental reports (including environmental/social reports and sustainability reports) contain information concerning various environmental policy-related topics as mentioned above. We then associate the information with corresponding environmental management scores and statistically test the hypothesis that the responsiveness of firms to environmental policies affects their financial performance.

The previous study also obtained significant results through dummy variables created on the basis of information contained in the "*Environmental Reporting Plaza*,"[3] the Japanese Ministry of Economy, Trade and Industry's website. However, since the data in this website for years prior to 2002 were sporadic, there was a problem with the number of effective samples. The present study used the database compiled for the Study on Environmental Reports in the "Business and Environment Project" carried out from April 2001 to March 2004 by the Institute for Global Environmental Strategies, Kansai Research Centre. Since the data used in the present study concern both years and firms that are not included in this database, however, we went back to 1999 to check whether or not the firms had published an environmental report and for those that had, we collected data in the reports that are related to environmental policies of

[2] Nihon Keizai Shimbun and Nikkei Research *ed.* (2000)-(2004)

[3] "Environmental Report Plaza" is a website where you can access corporate environmental report data which are classified by industrial category and by environmental topic. For further information, refer to http://ecoreport.jemai.or.jp/.

our interest.[4]

Bearing in mind that the type of environmental impact varies considerably from industry to industry, we divided the industrial categories into larger industrial groups and conducted the same analysis in order to clarify the trend for each industrial group.[5]

2. Data for the Present Study

The present study used two alternative variables for the firms' financial performance: Tobin's q minus 1,[6] which expresses the market's assessment of a firm's intangible assets, and return on assets (ROA), a profit indicator obtained from financial statements. As environmental performance variables, we used the scores from the *Nikkei Environmental Management Score Report* published by Nihon Keizai Shimbun Inc. As variables indicating whether or not firms have carried out specific environmental conservation activities in order to conform to public environmental policies recently introduced, we constructed dummy variables showing whether the firms provided quantitative information for the specific topic closely related to the particular policy in question in their annual environmental reports[7]. The enforcement of the following environmental policies appears to be one of the underlying factors that encouraged specific responses by such firms.

In the first place, the Containers and Packaging Recycling Law (a law promoting

[4] We collected data by asking the firms by e-mail or phone whether they had published environmental reports or not.

[5] Since the number of firms in each industrial category differs in size from small to large, the present study aggregates the categories into three industry groups.

[6] Tobin's q is the market value of a firm's assets divided by the replacement value of the firm's tangible assets. For the present study, we collected necessary data from *Kaisha Shikiho* (*Japan Company Handbook: Quarterly*) and *NEEDS-CD ROM Nikkei Corporate Financial Data* and calculated Tobin's q minus 1 using (aggregate market value of listed stock + total debts) for the numerator and (current assets + investment and other loans + tangible fixed assets) for the denominator. Konar and Cohen (2001) and King and Lenox (2002) used Tobin's q (or q minus 1) as a financial performance index in their study of the environmental-financial performance relationship.

[7] At present, there are various types of reports including "sustainability reports" and "social and environmental reports" based on the concept of corporate social responsibility (CSR). We consider all periodic publications or reports which describe environmental impacts of companies' activities in a systematic manner as environmental reports. Currently issued environmental reports are in the form of brochures, printed matter or CDs or on websites. Regardless of the type of media, any report which explains and discloses data on the environmental impact of a firm's business activity and their environmentally-friendly efforts in a comprehensive manner is deemed an environmental report. We did not include in-house reports as samples for the present study.

separated collection and recycling of containers and packaging and re-merchandising) was enacted in 1995 and came into force in 1997 for glass and plastic (PET) bottles and in 2000 for paper and plastic containers and packaging. Another law related to recycling, the Home Appliance Recycling Law was established in 1998 and put into effect in 2001. June 2000 saw the enactment of the Basic Law for Establishing a Recycling-based Society, on the basis of which seven recycling laws were established or amended. The abovementioned two recycling laws were followed by the enactment and enforcement of various other recycling-related laws: the Food Recycling Law (enacted in 2000, effective from 2001), the Construction Material Recycling Act (enacted in 2000, effective from 2002), the Automobile Recycling Law (enacted in 2002, effective from 2005), the Law for the Promotion of Effective Utilisation of Resources (amended and enforced in 2001), and the Waste Disposal Law (amended in May 2002). Behind this tougher legislation lies a widening awareness of the need for a societal system of recycling since the amount of waste never decreases and the final disposal landfill sites are reaching their capacities.

Secondly, the Law for the Promotion of Chemical Substance Control(a law concerning the reporting, *inter alia*, of the release of specific chemical substances into the environment and the promotion of improvements to control them) was enacted in 1997. In April 2001, a system for reporting the substances which firms handle was established; a start on reporting was made in April 2002, and on information disclosure in April 2003. This law is also known as the PRTR Law (PRTR is an acronym for Pollutant Release and Transfer Register) and in the United States as TRI (Toxics Release Inventory). Providing a mechanism whereby businesses first investigate their release and transfer of toxic chemicals, then compile and publish the data, this new policy instrument for the control of chemical substances, which has long attracted international attention, has been introduced by countries around the world.

Thirdly, in connection with the Environmental Accounting Guidelines, the Guidelines for Reporting and Disclosing Environmental Conservation Costs (Interim Report) published in 1999 by the Ministry of the Environment, have been revised from time to time. These revisions include the Guidelines for the Introduction of Environmental Accounting Systems (2000), published in May 2000, the Environmental Accounting Guidelines (2002), published in March 2002, and the Environmental Accounting Guidelines (2005), published in February 2005. The last revision incorporates the developments of environmental accounting practices. Environmental accounting is a device for the voluntary disclosure of environmental conservation costs and the efficacy of conservation activities. In the Basic Law for Establishing a Closed-Cycle Society approved at a cabinet meeting in March 2003, a target was set for 50 per cent of listed firms and 30 per cent of unlisted firms (with 500 employees or

more) to put environmental accounting into practice by 2010. At present, according to a survey in 2003 by the Ministry of the Environment[8], 393 listed businesses and 268 unlisted businesses – a total of 661 firms – have already introduced environmental accounting (the Ministry of the Environment (2004a, p.108)).

Finally, in June 2002 Japan ratified the Kyoto Protocol adopted in December 1997 by the Third Conference of the Parties to the United Nations Framework Convention on Climate Change. It was on this basis that Japan enacted the Law for the Promotion of Measures to Combat Global Warming and formulated the Scheme for the Promotion of Measures to Combat Global Warming. Japanese firms' climate change initiatives had been greatly encouraged by such governmental efforts, while some revisions were made to the scheme following the 2001 Marrakesh Accords. Moreover, in March 2005, the cabinet approved a bill for the partial amendment to the Law for the Promotion of Measures to Combat Global Warming, according to which, every business that releases a certain volume of greenhouse gases will be obliged to report their emissions. The last step, however, goes beyond the period covered by the present study.

Dummy variables corresponding to the above four topics, namely recycling, PRTR, environmental accounting and global warming countermeasures, respectively, are constructed by giving each firm that disclosed the relevant information in its report a value 1, and similarly a value 0 to those which did not, for each year. Firms which did not publish an environmental report at all were also given a value 0. As for recycling, information-disclosing firms refer to those which gave quantitative information on materials recycled or reused, or those mentioned the recycling rate in relation to the amount of waste generated (or emissions released); as for the PRTR, those which gave quantitative information on the PRTR substances; as for environmental accounting, those which gave numerical data on environmental conservation costs; and as for global warming countermeasures, those which disclosed the volume of CO_2 emissions.[9]

In order to examine whether the dummy variables constructed in this way can represent additional information that improves a firm's financial performance, we used them by relating each dummy variable to the individual scores of the Nikkei environmental management indices in the following way: the recycling dummy variable to the "resource recycling index," the PRTR dummy variable to the "pollution risk index," the environmental accounting dummy variable to the "management system

[8] The survey presented in the Ministry of the Environment (2004a) covers a total of 6,354 firms (2,674 firms listed on the first and second sections of the Tokyo Stock Exchange, the Osaka Securities Exchange and the Nagoya Stock Exchange and 3,683 unlisted firms that employ 500 or more) where the number of valid responses was 1,234 from listed firms plus 1,561 from unlisted firms.

[9] For further information, refer to the Annex Table.

index," and the CO_2 dummy variable to the "global warming countermeasure index." The corresponding environmental management index and the dummy variable were then used to test whether these additional factors can improve the explanation of a firm's financial performance.

Basic financial performance and environmental performance data were the same as those used in the previous study (Nakao *et al.* (2005)), and consisted of five years' data (1999-2003) from 278 listed corporations[10] spread over nineteen industrial categories[11] in the manufacturing sector (excluding the energy and construction industries).[12] Figure 1 shows the time profiles of the information provided by these 278 firms on environmental accounting, PRTR substances, recycling and CO_2 emissions. The figure also shows, for reference, the change in the number of firms publishing environmental reports (the top line).

[10] Firms listed on the Tokyo Stock Exchange, the Osaka Securities Exchange, the Nagoya Stock Exchange, JASDAQ and other new markets.

[11] Food, textiles, pulp and paper, chemicals, pharmaceuticals, petroleum, rubber, ceramic, iron and steel, non-ferrous metals and metal products, machinery, electric appliances, shipbuilding, automobiles, automobile parts, other transportation machinery, precision machinery, miscellaneous manufacturing industries, printing, and other light industries.

[12] The aggregate market value of stock used to calculate Tobin's q minus 1 is obtained from the number of shares issued by a parent company since the consolidated number of outstanding shares has not been publicised. Therefore, for the present study, the other financial data were taken from non-consolidated financial statements for the sake of data consistency.

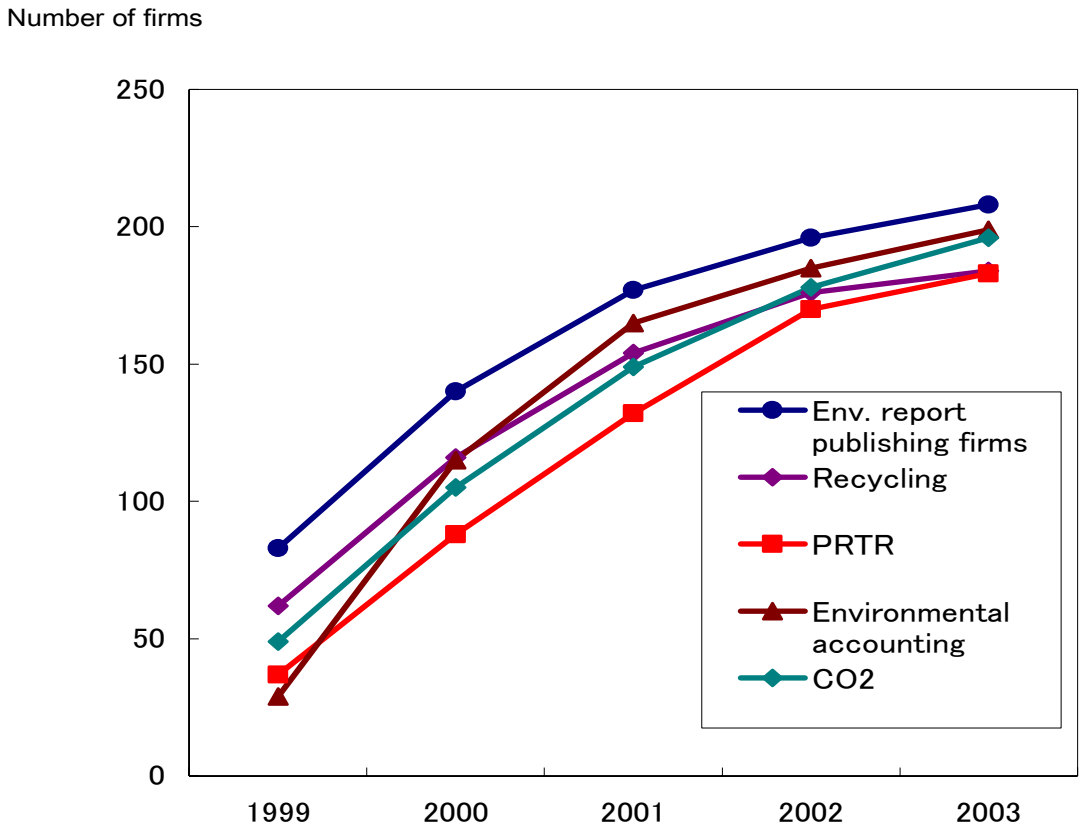

Figure 1 Number of firms whose reports include information on various topics.

3. Analytical Method

Hurlin and Venet (2001) extended the Granger Causality Test methodology developed for time series models to panel data. Using a simplified form of this method, the present study examines whether or not information relating to a firm's environmental performance, while having a positive effect on temporal fluctuations in its financial performance, can be deemed as a cause in a statistical sense, i.e., in the sense that such information significantly reduces the variance of explanatory errors of a time-series model.

Here, the model of financial performance alone is expressed as:

(1) $(\text{Financial performance index})_{i,t} = (\text{Constant term}) + a_1(\text{Financial performance index})_{i,t-1} + e_{i,t},$

where a_i represents the i-th estimated coefficient, $e_{i,t}$ the error term, and the subscript t represents the t-th period, and i the i-th firm.

Additional information concerning environmental performance is introduced into this model in the following three ways:

(2.1) $(\text{Financial performance index})_{i,t} = (\text{Constant term}) + a_1(\text{Financial performance index})_{i,t-1} + a_2(\text{Environmental performance index})_{i,t} + a_3(\text{Environmental performance index})_{i,t-1} + e_{i,t}$

(2.2) $(\text{Financial performance index})_{i,t} = (\text{Constant term}) + a_1(\text{Financial performance index})_{i,t-1} + a_2(\text{Environmental performance index} * \text{Policy dummy variable})_{i,t} + a_3(\text{Environmental performance index} * \text{Policy dummy variable})_{i,t-1} + e_{i,t}$

(2.3) $(\text{Financial performance index})_{i,t} = (\text{Constant term}) + a_1(\text{Financial performance index})_{i,t-1} + a_2(\text{Environmental performance index})_{i,t} + a_3(\text{Environmental performance index})_{i,t-1} + a_4(\text{Policy dummy variable})_{i,t} + a_5(\text{Policy dummy variable})_{i,t-1} + e_{i,t}$.

In Equation 2.1, environmental performance data are simply added; in Equation 2.2, the product of environmental performance index and the firm's dummy variable for environmental policy (called here "policy dummy variable") is added; while in Equation 2.3, the environmental performance index and the policy dummy variable are introduced separately. The problem concerns whether or not the addition of such information significantly reduces the explanatory errors of the estimated equation compared to the original model of Equation 1.

Let the residual sum of squares of the estimated Equation 1 be RSS1 and the residual sum of squares of the estimated Equations 2.1, 2.2, or 2.3 be RSS2. Then, the value of F-statistic for testing the null hypothesis that all coefficients for additional variables are zero is given by

(3) $F = [(RSS1 - RSS2)/q]/[RSS2/(NT - (q+2))$

where N denotes the number of firms, T the number of years, and q the number of variables added. The statistic F follows the F-distribution with the degree of freedom (q, NT – (q+2)). If this statistic is not significant, the null hypothesis that there is no causal relationship is accepted and environmental performance is deemed to have no causality relationship to financial performance.

4. Testing Statistical Causality

4.1. Analysis of All Firms

The samples used here are pooled cross-sectional data for four years, three years, and two years, respectively, with the latest set involving data for 2002 and 2003. For environmental performance data, we used the overall scores and four individual scores (management system scores, pollution risk scores, resource recycling scores, and global warming countermeasure scores) taken from the Nikkei Environmental Management Indices reports. For the financial performance data, we used Tobin's q minus 1 and ROA (return on assets).

The first objective of the present study is to test the hypothesis of whether the firms' response to recently implemented public environmental policies has a statistical causality effect upon the firms' financial performance. Table 1 summarises the results of our tests using Tobin's q minus 1 as an index of financial performance.

All samples in Table 1 cover 278 listed firms, and the method of statistical causality analysis as described above has been applied to test whether the additional information about environmental performance has any systematic effect on a firm's financial performance. In the table, Cases 1, 2 and 3 are the results corresponding to the models expressed by Equations 2.1, 2 .2 and 2.3 in the previous section, respectively, and test results are shown for each case in terms of F-value and P-value. The third column for each case designated "Effect" shows the direction and magnitude of the steady-state effect upon the dependent variable of the additional explanatory variable related to environmental performance/activities. That is, the sum of the product of estimated coefficient of the additional explanatory variable multiplied by the value of the variable is calculated, assuming that all explanatory variables are steady. Where the explanatory variable is an environmental performance index, the steady-state value is set to the sample mean of the variable, while where it is a policy dummy variable, simply the value 1 is used.

Comparing Cases 1 and 2, it is clear that the statistically significant results are more frequent in Case 2, where the product of environmental performance index and dummy variable is added, than in Case 1 where the environmental performance index is simply included. This means that the environmental performance information from firms that publish relevant activities in their environmental reports can explain financial performance of firms more satisfactorily than the environmental performance information alone. Furthermore, a comparison of Cases 2 and 3 shows a further increase in the number of significant results, indicating the respective contributions of environmental performance information and information disclosure by environmental reports. It is interesting that statistically significant results were obtained at the 1 per

cent level for all three samples concerning the cases of PRTR and CO_2 emissions.

With regard to the steady-state effects, all values are positive except for two values in Case 3. Therefore, the firms' activities concerning environmental accounting, the PRTR, and recycling may in general be considered as having a positive effect on financial performance. However, we will discuss more on the implications of negative effects later when we come to the analysis of disaggregated industries.

Finally, we noted that samples with three-year data generally yielded relatively fewer results that are statistically significant, with smaller steady-state effects. We looked into the residual errors of estimated equations and found that a considerable number of firms showed large variations in their Tobin's q minus 1 for reasons other than changes in environmental performance. For this reason, the error variances in the estimated equations were generally larger and this resulted in *relatively* smaller error variance reductions attributable to the addition of environmental performance information.

From the above results, it is clear that the number of significant results increases when the information on corporate environmental responses to relevant governmental policies is provided in addition to the corporate environmental performance scores. It has, therefore, been confirmed that by making efforts to respond to public environmental policies and publishing the results of their efforts, firms can enhance the positive effect on their financial performance.

Table 1 Causality analysis of Environmental Performance and Policy-related Disclosures on Financial Performance (all firms)

Environmental Activity	Sample	Case 1			Case 2			Case 3		
		F-value	P-value	Effects	F-value	P-value	Effects	F-value	P-value	Effects
Recycling	4 years	1.986	0.138	0.123	12.12	0.000**	0.059	13.01	0.000**	0.076
	3 years	0.674	0.510	0.027	1.825	0.162	0.025	2.712	0.067	0.005
	2 years	1.072	0.370	0.128	1.775	0.132	0.050	2.249	0.063	0.099
PRTR	4 years	5.969	0.003**	0.264	10.06	0.000**	0.048	12.12	0.000**	0.195
	3 years	2.796	0.062	0.115	5.042	0.007**	0.033	8.210	0.000**	0.052
	2 years	3.096	0.015*	0.224	3.337	0.010*	0.063	5.808	0.000**	0.138
Environmental accounting	4 years	3.408	0.033*	0.197	11.33	0.000**	0.060	11.49	0.000**	0.083
	3 years	0.870	0.419	0.100	2.480	0.084	0.031	2.530	0.080	0.039
	2 years	1.263	0.284	0.162	1.862	0.116	0.054	2.216	0.066	0.092
CO_2 emissions	4 years	1.531	0.217	0.264	11.75	0.000**	0.048	13.09	0.000**	0.074
	3 years	2.578	0.077	0.115	2.251	0.106	0.033	7.498	0.001**	-0.072
	2 years	1.720	0.144	0.224	1.722	0.144	0.063	4.484	0.001**	-0.018

** $p<0.01$, * $p<0.05$
Sample sizes are 1,112 for four years, 834 for three years, and 556 for two years.

Table 2　Causality Analysis of Financial Performance and Policy-related Disclosures on Environmental Performance　(all firms)

Environmental Activity	Sample	Case 1			Case 2			Case 3		
		F-value	P-value	Effects	F-value	P-value	Effects	F-value	P-value	Effects
Recycling	4 years	2.179	0.114	0.166	86.25	0.000**	2.972	15.77	0.000**	3.717
	3 years	3.098	0.046*	0.269	39.87	0.000**	0.216	13.23	0.000**	4.131
	2 years	5.685	0.004**	0.352	62.87	0.000**	0.242	16.32	0.000**	5.544
PRTR	4 years	9.434	0.000**	0.352	33.95	0.000**	0.414	16.40	0.000**	3.332
	3 years	6.131	0.002**	0.330	27.89	0.000**	0.370	10.92	0.000**	3.276
	2 years	7.693	0.001**	0.417	23.48	0.000**	0.386	9.153	0.000**	3.440
Environmental accounting	4 years	3.201	0.041*	0.162	56.88	0.000**	0.192	21.33	0.000**	3.053
	3 years	3.182	0.042*	0.189	53.73	0.000**	0.173	16.20	0.000**	3.605
	2 years	4.463	0.012*	0.291	39.01	0.000**	0.259	2.216	0.066	0.092
CO_2 emissions	4 years	4.563	0.011*	0.246	43.08	0.000**	0.293	12.84	0.000**	2.955
	3 years	2.954	0.053	0.209	34.30	0.000**	0.212	22.63	0.000**	3.043
	2 years	5.115	0.006**	0.165	39.48	0.000**	0.161	7.090	0.000**	3.435

** $p<0.01$, * $p<0.05$
Sample sizes are the same as in Table 1.

Table 2 presents the results of "reverse" causality analysis: that is, we tested the statistical causality relations running from financial performance to environmental performance. Preston and O'Bannon (1997) called this "Available Funds Hypothesis" as the availability of slack funds enables a firm to pursue costly environmental/social activities. They found the strongest evidence that financial performance either precedes or is contemporaneous with social performance, meaning that socio-financial performance correlations are best explained either by positive synergies or by available funding (Preston and O'Bannon (1997, p. 428)). As Table 2 shows, all cases examined but three are statistically significant. Our results also exhibit much stronger drive in this direction than in the reverse causality relation. Orlitzky *et al.* (2003) also found from their meta-analysis a virtuous circle between corporate social performance and financial performance; with stronger results, however, when corporate environmental measures were removed from social performance.

4.2. Analysis by Industrial Group

The above section provided a statistical causality analysis on the basis of samples including all firms. However, since the type and size of environmental impacts vary depending on industrial category, there will naturally be variations in the effects of public policies upon firms and the implications of the firms' responses to them upon their financial performance. In this section, we divide the firms into specific industrial groups according to the category to which they belong, and then perform the same causality test as above in order to clarify how the relationship between environmental performance and financial performance differs depending on the industrial group. Firms were divided into three groups on the basis of the statistical categories prepared by the Ministry of Economy, Trade and Industry as follows:

(1) Energy-intensive industry group: chemicals, ceramic, iron and steel, non-ferrous metal/metal products, pulp/paper,
(2) Machinery industry group: electric appliances, precision machinery, automobiles/ automobile parts, shipbuilding, and other transportation machinery, and
(3) Miscellaneous industry group: rubber, textiles, pharmaceuticals, light industries, food, printing, and other manufacturing industries.

The estimated results are listed in Table 3.

As expected, the analysis by industrial group suggests that the results differ considerably among the industrial groups. The table demonstrates that the influences of environmental performance information are particularly significant in Case 3, but also indicates that causality is not so clear in some industrial groups. It is also apparent that the particular environmental policy to which a firm's response has a significant effect differs from group to group and the effect of the response to some environmental

Table 3 Causality analysis of the effects of environmental policy (By industrial group)

		Sample	Case 1			Case 2			Case 3		
			F-value	P-value	Effects	F-value	P-value	Effects	F-value	P-value	Effects
Energy-intensive industry	Recycling	4 years	2.144	0.119	0.028	3.938	0.020*	0.051	6.736	0.001**	0.038
		3 years	3.489	0.032*	0.031	1.822	0.164	0.048	5.040	0.007**	0.033
		2 years	3.712	0.027*	0.002	1.963	0.144	0.064	5.377	0.006**	-0.002
	PRTR	4 years	1.151	0.318	0.184	5.144	0.006**	0.033	6.084	0.003**	0.112
		3 years	0.861	0.424	0.113	3.314	0.038*	0.038	4.979	0.008**	0.018
		2 years	1.421	0.245	0.009	2.737	0.068	0.077	7.594	0.001**	-0.168
	Environmental Accounting	4 years	2.292	0.103	0.106	3.394	0.035*	0.060	7.744	0.001**	0.039
		3 years	2.839	0.060	0.107	1.287	0.278	0.055	5.076	0.007**	0.024
		2 years	2.970	0.054	0.008	0.069	0.503	0.053	4.877	0.009**	-0.101
	CO_2 Emissions	4 years	1.898	0.152	-0.018	5.336	0.005**	0.057	8.816	0.001**	0.025
		3 years	6.880	0.001**	-0.112	2.274	0.105	0.053	10.92	0.000**	-0.092
		2 years	7.141	0.001**	-0.151	0.602	0.549	0.040	9.124	0.000**	-0.148
Machinery industry	Recycling	4 years	0.296	0.744	-0.055	4.975	0.007**	0.063	8.476	0.000**	-0.195
		3 years	0.899	0.408	-0.205	1.443	0.238	-0.009	2.494	0.084	-0.259
		2 years	0.250	0.779	-0.054	1.727	0.180	0.039	2.585	0.077	-0.150
	PRTR	4 years	0.811	0.445	0.155	3.924	0.020*	0.057	4.776	0.009**	0.031
		3 years	0.802	0.449	-0.068	1.622	0.199	0.005	3.504	0.031*	-0.102
		2 years	1.760	0.174	0.087	1.547	0.215	0.045	3.922	0.021*	0.004
	Environmental Accounting	4 years	1.241	0.290	0.183	5.901	0.003**	0.083	7.818	0.000**	-0.037
		3 years	0.593	0.553	-0.024	0.269	0.764	0.011	0.939	0.392	-0.079
		2 years	0.076	0.927	0.062	1.118	0.329	0.057	1.410	0.246	-0.045
	CO_2 Emissions	4 years	0.801	0.449	0.078	2.663	0.071	0.045	4.029	0.018*	-0.045
		3 years	1.164	0.313	-0.236	0.365	0.695	-0.009	2.625	0.074	-0.315
		2 years	0.482	0.618	-0.156	0.794	0.453	0.029	3.529	0.031*	-0.292
Miscellaneous industry	Recycling	4 years	2.138	0.120	0.219	3.537	0.030*	0.034	4.358	0.014*	0.201
		3 years	5.117	0.007**	0.330	5.850	0.003**	0.055	8.046	0.000**	0.313
		2 years	5.031	0.008	0.393	3.119	0.047*	0.051	6.599	0.002**	0.380
	PRTR	4 years	2.426	0.090	0.182	3.387	0.035*	0.030	4.586	0.011*	0.140
		3 years	4.285	0.015*	0.256	9.485	0.000**	0.057	10.73	0.000**	0.170
		2 years	5.577	0.005**	0.367	5.953	0.003**	0.066	8.165	0.000**	0.291
	Environmental Accounting	4 years	0.865	0.422	0.131	1.934	0.146	0.029	2.017	0.135	0.064
		3 years	2.856	0.060	0.237	6.217	0.002**	0.069	6.703	0.001**	0.101
		2 years	2.827	0.062	0.285	5.221	0.006**	0.084	5.918	0.003**	0.181
	CO_2 Emissions	4 years	3.211	0.042*	0.156	2.358	0.096	0.034	4.740	0.009**	0.098
		3 years	5.127	0.007**	0.259	8.316	0.000**	0.070	9.904	0.000**	0.138
		2 years	4.560	0.012*	0.332	7.058	0.001**	0.084	7.942	0.001**	0.181

** p<0.01, * p<0.05
Energy-intensive industry: 324 samples for four years, 243 for three years, and 162 for two years.
Machinery industry: 488 samples for four years, 366 for three years, and 244 for two years.
Miscellaneous industry: 300 samples for four years, 225 for three years, and 150 for two years.

policies is positive for some groups and negative for others. Some characteristic points emerging from our analysis can be summarised as follows.

Firstly, the industrial groups where causality was found significant are energy-intensive and miscellaneous industrial groups, while only a few statistically significant cases appeared in the machinery industry. This result may seem a little surprising, given that the machinery industries include manufacturers of household appliances and automobiles, many of which are supposed to have an excellent environmental record. It may be due to the fact that there is not such a close relationship as in the other two industrial groups between efforts to deal with environmental problems and high-priority innovations. This can be an interesting topic for further research.

Secondly, as expected, the steady-states effects of environmental performance on financial performance change the sign from positive to negative in the energy-intensive industry as requirements grow more stringent to step up energy conservation. It should be noted that the causality relationship was recognised at a significance level of 1 per cent or less in all Case 3 results in this industrial group with this change in the steady-state effects from positive to negative. Although environmental activities seem to have had an economically beneficial effect in samples over the past four years, the same is not true for more recent periods. Hard times lie ahead and are likely to continue for some time to come. It will take a concerted national effort in order to achieve Japan's target set under the Kyoto Protocol.

Thirdly, a contrasting trend is apparent in the miscellaneous industry group. Only with one exception, the environmental performance and response to environmental policies all have a positive effect and this tends to grow more marked as the amount of old data is reduced. More or less the same trend can be seen in all policy response cases, although to varying degrees. This is an extremely interesting indication that implies that it is in the industrial sector which is closely related to people's daily lives and has an obvious connection with health, safety and the environment, where a structural change in the socio-economic system is already underway that leads to a virtuous circle of the environment and the economy.[13] It hints at which concrete measures should be implemented, as a matter of priority, and, in which industrial sector to allow information-based instruments of environmental policy to display their effectiveness.

[13] A similar observation can be found in Wolf and Curcio (1994) and Wagner (2001). They point to the possibility that the closeness to the end consumer market, or more generally, the location of firms in the production chain is of importance because high name or brand recognition is affecting the more strongly intangible assets of these firms (Wagner (2001, p. 39)).

5. Concluding Remarks

From the results of the foregoing analysis, it becomes clear that, where the firms' environmental performance has a beneficial effect on their financial performance with the underlying promotion of public environmental policies, such a trend results from the following two types of dynamics: i) the promotion of environmental policies through direct regulations can encourage energy/resource savings through innovations in technology and management, thereby reducing the cost of environmental measures, in general and also stimulating improvements in value-added, and ii) information-based instruments of environmental policy encourage information disclosure by firms which leads to a favourable reception of the firm by other firms, clients and consumers, and raise the market value of its management as a whole.

When, at the preparatory stage of the present study, we carried out a test similar to the one above using ROA as an index of financial performance, the number of significant results fell drastically. This not only shows that Tobin's q minus 1 is a more suitable index of financial performance for the present issue, but also suggests that information-based instruments used in combination with direct regulatory measures of environmental policy are very useful because they heighten the incentives for the firms' efforts in the direction of a virtuous circle of the environment and economy and the decoupling of economic growth from environmental/resource degrading.

Thus, the information-based measures should play a proper role together with economic measures in the arsenal of public environmental policy in order to build a sustainable society.[14]

[14] Examining the relationship between firms' environmental and financial performance, the U. S. Environmental Protection Agency reached a very similar conclusion. (See: US EPA (2000)).

Annex Table

Criteria for assigning the value of policy dummy variables[15]

Dummy variable for environmental accounting ・ "1" when the report includes numerical data on environmental conservation cost ・ "0" when the report only discloses the amount of accumulated investment or capital investment as accounting data because such disclosure departs from the purpose of the Environmental Accounting Guidelines. ・ "0" when the report merely mentions a "plan to introduce."
Dummy variable for the PRTR ・ "1" when the report includes quantitative data on PRTR substances (354 substances defined as specified chemical substances of Class 1 by an ordinance to enforce the PRTR Law) ・ "1" when the report includes concrete quantitative data on a PRTR substance. ・ "1" when the report includes a total amount of data on PRTR substances. ・ "0" when the report merely mentions a "plan to introduce." ・ "0" when the report states that their company does not handle any PRTR substances.
Dummy variable for recycling ・ "1"when the report uses an expression like "recycling amount" in connection with waste emissions and includes quantitative recycling data, and "0" when the report only includes quantitative data on the amounts of effective utilisation, because it is considered to imply no reference to "recycling." ・ "1" when the report discloses emissions of waste, etc., and shows recycling rates. ・ "1" when the report includes quantitative data on the amounts of reuse, because "reuse" is considered to be synonymous with "recycling."
Dummy variable for CO_2 emissions ・ "1" when the report includes quantitative data on CO_2 emissions. ・ "0" when the report only includes reference to CO_2 emissions per unit quantity of production. ・ "0" when the report includes no reference to CO_2 emissions and only mentions energy consumption.

[15] These criteria are based on the Ministry of the Environment's reports (2003a) and (2002c) and Kokubu *et al.* (2004, pp.194-205).

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