

Environmentally Conscious Actions and Firm Value: A Case for DBJ's Environmental Rating Loan*

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Abstract

Firm's environmentally conscious actions are used to be regarded as a cost factor and treated as less important operations. However, the number of firms paying attention to voluntary environmental actions has been increasing recently along with the increase of environmental consciousness in society as a whole. The acquisition of ISO14001 certification and the publication of environmental reports are typical cases of such actions. One possibility to be considered as the background of these actions is that each firm has an intention to enhance the corporate image and valuation.

In this paper, we employed the cases of receiving the environmental rating loan provided by the Development Bank of Japan as a kind of voluntary environmental actions of firms, and analyzed empirically focusing on these firms.

The main findings are as follows. First, the estimation results suggest that getting the loan increases the firm's value or that the stock market evaluates environmentally conscious actions by the firm. Second, the results suggest that overseas business expansion, advertisement, shareholder composition, and creditworthiness are likely to affect the decision making of firm to get the loan. However, the results reported here should be taken with caution due to data availability and estimation problems.

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1 Introduction

As various types of global environmental issues get more acute, the international community devotes much effort to establish an intergovernmental coordination system to cope with the issues. Each nation has also promoted its domestic programs to protect the environment.

Some firms have incorporated environmental goals into their decision making processes while others appear to ignore environmental considerations or carry out the minimum required by legislation. Firms with environmental consciousness have conducted voluntary efforts in a variety of ways. It is commonly considered that the increasing awareness of environmental protection and social responsibility in society as a whole is behind the activities. For example, the reduction of plastic shopping bag use and the abatement of CO₂ emission are becoming a part of our ordinary life. Environmental management systems have become common to a considerable extent to achieve the purpose of emission reduction, and they are operated both systematically and functionally in many companies. The number of ISO14001 certificates issued, which is a typical form of the environmental management systems, is growing steadily. Most companies publish environmental reports to summarize their environmentally conscious actions.

Non-governmental organizations, local communities and market agents such as consumers and investors have been becoming to evaluate the environmentally conscious actions of firms. We are able to catch a glimpse of the aspects of it in such things as eco-funds and SRI funds.*¹

In response to this trend, firms begin to recognize that proper controls of environment risks are significant factors for the business management. In other words, they are aware that the management with environmental cost-consciousness will enhance their corporate image and then increase their value. When the environmental risks are expected to decrease and the future environmental liabilities such as environmental expenditures or environmentally-related litigation expense are estimated to cut down along with the environmentally conscious actions of a firm, the stock market will evaluate the growth of future profitability of the firm and then its value will

*¹ These days SRI does not mean Socially Responsible Investment but rather implies Sustainable and Responsible Investment in Europe and the United States in accordance with the changes of SRI's contents among the investors.

appreciate in accordance with stock market price. As a result, the firm can enjoy flexible financial strategies such as sufficient fund raising, and then create a virtuous cycle for the corporate management. In common parlance, the firm's sustainability will be strengthened. On the other hand, if a firm mishandles the environmental issues, it can be subjected to a difficulty in surviving.

Understanding the economic incentives for firms or the reasons why firms positively perform voluntary environmental actions is an interesting topic. Since firms are supposed to maximize the profit, such environmental actions are likely to be inconsistent with their objectives. The basic questions of this paper are firms' decision about voluntary environmental actions, and the performance of the stock market in the context of such actions, that is, whether the stock market valuate such firms. However, these points are not necessary clear.

This paper aims at analyzing the characteristics of the firms which received the environmental rating loan from the Development Bank of Japan (DBJ), based on the disclosed data. Getting DBJ's environmental rating loan is considered to be a kind of voluntary environmental actions for the firm. Another purpose is to examine whether getting DBJ's environmental rating loan increases the value of the firm.

The rest of this paper is organized as follows. Section 2 gives a brief overview of the literature on the relationship between environmentally conscious actions and firm valuation. Section 3 explains the outline of DBJ's environmental rating loan. Section 4 describes the data and methodology employed in our empirical analysis, and then reports the results. Section 5 provides concluding remarks.

2 Literature Review

The empirical studies with regard to environmentally conscious actions of firms are classified into three categories: the determinants of the actions, the effects of emission reduction by the actions and the market valuation of firms by the actions.

Nakamura et al. (2001) are a pioneering study to examine the relationship between ISO14001 certification and firm-level characteristics for Japanese firms. They carried out a questionnaire survey of random sampling Japanese firms listed in the first section of the Tokyo Stock Exchange in May 1997,

and discuss the incentive to environmental actions of 193 respondents. They show that the adoption of ISO14001 is influenced by firm size, the closeness between firm and consumers, and export ratio.

Cole et al. (2006) study the factors to introduce environmental management system by Japanese firms using the firm-level survey data of *Report on Study of Environmental Management* conducted by Nihon Keizai Shimbun in 1999. They apply a cross-sectional regression analysis to an overall sample of around 400 firms. They find that the globalization factor, for example foreign direct investment or export, is positively correlated with the introduction of environmental management, and that Japanese firms are increasingly aware of their environmental obligations for their multinational activities.

Using Japanese facility-level data from OECD, Arimura et al. (2008) estimate the effects of implementation of ISO14001 and publication of environmental reports on the facilities' environmental performance. They find that both ISO14001 and report publication help reduce three environmental impacts: natural resource use, solid waste generation, and wastewater effluent.

Frondel et al. (2008) investigate the relevant incentives for a facility's voluntary adoption of an environmental management system, and the triggers of an environmental innovation behavior, using the data set of German manufacturing industry from OECD survey.

As far as the author is aware, Konar and Cohen (2001) and Hibiki et al. (2003) are only a few studies investigating the relationship between environmental action and firm value. Konar and Cohen examine the effect of a firm's environmental performance on its Tobin's q and the value of intangible assets using the samples of 321 S&P500 firms in 1989.

Hibiki et al. examine the factors for a firm to acquire an ISO14001 certificate and the effect of the acquisition on the market value of the firm. They analyze the data set of 573 manufacturing firms listed in the first section of the Tokyo Stock Exchange on March 31, 2002, and suggest that the stock market gives firms the incentive to acquire ISO14001.

In the previous studies, most researchers employ the acquisition of ISO14001 as a type of voluntary environmental actions. In addition, they use only cross-sectional data or survey data.

The features of this paper comparing with the previous studies are that we employ the disclosed data of DBJ's environmental rating loan as a proxy

for a firm's voluntary environmental action, and that we construct the panel data set using firm's financial data instead of survey data to explain such an action of the firm. Conducting questionnaire survey is said to be costly and difficult to continue every year, and therefore we tend to apply cross-sectional estimation method. On the other hand, constructing panel data set using firm's financial data is relatively easy, and we enjoy a merit of overall accuracy enhancement of the analysis.

3 Outline of DBJ's Environmental Rating Loan

3.1 Overview of the Loan Program

The Development Bank of Japan (DBJ) was a policy-based financial institution. The government, however, decided to privatize DBJ under the reform plan of policy-based finance, and then transformed DBJ into stock company in October 2008. Before privatization, DBJ as a governmental financial institution used to conduct its business of making long-term loans and investments, according to the policies of the government.

DBJ launched its Loan Program for Promotion of Environmentally Conscious Management in fiscal 2004.*² This program utilizes environmental rating methods originally developed by DBJ. It also aims at the acceleration of environmentally conscious management of firms by linking the rating to the interest rate of the loan. Therefore, this program has another name of "environmental rating loan."

The process of environmental rating is as follows. First of all, DBJ measures the level of environmentally conscious management of a firm by scoring both the impacts the firm's business gives to the environment and the environmentally conscious actions in each department or total management of the firm. Then DBJ assigns a rating of four-step evaluations by the overall score.

In the meantime, there already exist investment trust funds such as eco-funds and SRI funds which induce firms to environmentally conscious management. These funds, however, have a limitation because they can invest in and support only listed companies. The environmental rating loan can complement this limitation, that is, this program can help not only listed

*² For the background and details of the program, see Uchiyama (2007) or Maeda (2006).

firms but also non-listed firms by means of loans. Through the program, DBJ assesses the environmental risks and environmental management system to select suitable firms for the loan, and supports these environmentally excellent firms by applying lower interest rate along with their rating. In other words, the program gives firms incentives through the institutional design that advanced firms in environment-friendliness can be financed at lower interest rate.

Firms which desire the loan, first of all, have to get the environmental screening in regard to the superiority of their environmentally conscious actions. We should note that the ordinary corporate screening as a process of loan consulting is done in parallel. As the result of the process, the loan is decided (Figure 1).

Recently firms have been exposed by growing environment risks such as the management of chemical materials, soil contamination and global warming. Adequateness of risk management can affect the existence of them. In order to reduce environmental liabilities in the future, lots of firms are just about to address voluntary environmental actions under proper environmental risk management. Firms apply for the environmental rating loan along with these various actions. We can say that such behavior of applying for the loan voluntarily and receiving an assessment about their environmental actions is regarded as a type of environmentally conscious action itself with self-motivation.

After getting the loan from DBJ, the firms have to be monitored in both ordinary credit risks and environmental achievements (Figure 1). The environmental rating and other assessments on loan consulting set up loan terms and conditions at the time. However, needless to say, the level of environmentally conscious management has to be kept at least during the period of lending. In case a serious accident or a malicious violation of law and ordinance related to the environment is discovered, the firms have a possibility to take a penalty of the raise of interest rate.

< Figure 1: Schematic Diagram of Loan Program for Promotion of Environmentally Conscious Management >

3.2 Impacts of the Loan Program

DBJ has received applications for the environmental rating loan from lots of firms to the present. After the necessary loan consultation, DBJ has provided the environment rating loans of approximately 180 billion yen in total from April 2004, the start of the program, to the end of September 2008.*³

As seen from the official name of the program, the expected goal of the program is to promote the environmentally conscious management of firms. However, beyond the original goal, some firms of receiving the loan are reporting the following outcomes.*⁴

First, the firms find that they can cut down their interest payment according to the degree of improvement of environmentally conscious management. Although there used to be some cases that environmental department in firm was regarded as a costly sector, there are examples of cases where such a situation is corrected these days.

Second, the firms enjoy IR (investors relations) effects of receiving DBJ's environmental rating by appealing to such media as newspapers or by publishing environmental report. Receiving a rating from a neutral organization such as DBJ is recognized to be effective on media strategies.

Third, the firms find that they are able to boost employee motivation. The acquisition of an environmental rating makes a good chance to inform not only environmental department but also general employees of the significance of environmentally conscious management.

Fourth, the firms are able to acquire the objective assessment concerning their environmentally conscious actions through the environmental screening process. The assessment by DBJ is fed back to the firm, and can help the firm to improve its environmentally conscious management.

Among them, the first and second points have deep relationship to the valuation of firm in particular. Although we are able to make out intuitively these reports by the firms, it is not certain that we reach quantitative un-

*³ Including corporate bond guarantees.

*⁴ DBJ also receives merits from this program. One of the typical merits is that DBJ can cut off its transaction costs as a result of firm's reducing the environmental risks. Another merit DBJ enjoys is that the program itself is regarded as one of DBJ's environmental actions and that it increases DBJ's reputation from the viewpoint of the CSR/SRI.

derstanding. One of the purposes of this paper is to examine these actual feelings the firms have.

4 Estimation of the Effect of the Environmental Rating Loan

4.1 Methodology

In this section, we discuss the market value of the firms to which DBJ lent the environmental rating loan, using firm-level data. The objective of this section is to reveal characteristics of the firms of choosing the loan, based on qualitative estimation models.

In what follows, we base on the analytical framework proposed by Hibiki et al. (2003), which carried out cross-sectional regression analysis, and we extend it to panel data analysis in order to improve precision of analysis.

We postulate the following model to estimate the relation between firm's value and the environmental rating loan.

$$q_{it} = x'_{1it}\beta_1 + \gamma D_{it} + e_{1it} \quad (1)$$

where we denote q_{it} as the value for firm i in year t , x_{1it} as a vector of firm i containing the explanatory variables such as the attributes of the firm, D_{it} as a dummy variable with $D_{it} = 1$ indicating that firm i receives the environmental rating loan or holds the loan balance in year t ,^{*5} and e_{1it} as an error term. We can say that the loan is effective to raise the firm's value when coefficient γ is significantly positive.

Here, we should note that q_{it} and D_{it} cause simultaneity bias. In general, there are two kinds of views about the causality of this case. These are described as follows. One is that firm's environmentally conscious actions conduce to its high market value. The other is that only firms with high market value can afford environmentally conscious actions. The simultaneity bias stated here reflects these views. Also, in relation to equation (1), when such a positive shock as technological change occurs to firm i , it may increase the firm's value q_{it} as well as the chance to get DBJ's environmental rating loan. In other words, this relation indicates that e_{1it} correlates D_{it} .

^{*5} This setting reflects the situation that firm is monitored continuously and required to perform environmentally conscious actions by DBJ as long as it holds the loan balance.

In order to cope with such a bias arising from the situation that only firms with strong confidence in environmentally conscious actions tend to choose the environmental rating loan, we set up the following two-step estimation procedure presented by Hibiki et al. (2003) and Hartman (1988).

On the first step, we adopt panel probit estimation method to predict firm's choice probability of the environmental rating loan. On the second step, we estimate equation (1) using the predicted probability.

We can understand that the first step implies the analysis of firm's decision making to get the loan. The firm is supposed to determine whether to obtain the loan based on the net benefit. In order to describe the decision of firm, we employ panel probit estimation method. Let us assume a latent variable B_{it}^* , which represents the i th firm's net benefit from the loan in year t . B_{it}^* is specified as

$$B_{it}^* = x'_{2it}\beta_2 + e_{2it} \quad (2)$$

where x_{2it} is a vector of exogenous variables for firm i in year t , including firm's attributes such as size and profitability, β_2 is a vector of coefficients, and e_{2it} is an error term.

We assume that firm gets the loan if B_{it}^* is positive. B_{it}^* is unobservable in practice and what we observe is the firm's choice decision. That is:

$$D_{it} = \begin{cases} 1 & \text{if } B_{it}^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

e_{2it} is written as follows.

$$e_{2it} = \mu_i + \epsilon_{it}$$

where μ_i denotes unobservable individual effects, and ϵ_{it} denotes the remainder stochastic disturbance. Or we assume as follows.

$$\begin{aligned} E(\mu_i) &= 0, & \text{Var}(\mu_i) &= \sigma_\mu^2, & \text{Cov}(\mu_i, \mu_j) &= 0 \quad (i \neq j) \\ E(\epsilon_{it}) &= 0, & \text{Var}(\epsilon_{it}) &= \sigma_\epsilon^2, & \text{Cov}(\epsilon_{it}, \epsilon_{js}) &= 0 \quad (i \neq j, t \neq s) \\ \text{Cov}(\mu_i, \epsilon_{it}) &= 0 \\ \text{Cov}(e_{1it}, e_{1js}) &= \begin{cases} \sigma_\mu^2 + \sigma_\epsilon^2 & (i = j, t = s) \\ \sigma_\mu^2 & (i = j, t \neq s) \\ 0 & (i \neq j) \end{cases} \end{aligned}$$

Under this specification, the probability of getting the environmental rating loan is given by

$$P(D_{it} = 1) = P(\epsilon_{it} > -x'_{2it}\beta_2 - \mu_i) = 1 - \Phi(-x'_{2it}\beta_2 - \mu_i) \quad (4)$$

where Φ denotes the cumulative normal function.

By estimating this equation, we can analyze the factors for firms to get the environmental rating loan. The result, however, reveals just only determinants of the loan choice, and does not reach the market valuation of firms.

Therefore, on the second step, we use the predicted probability \hat{P} from equation (4) as an explanatory variable, instead of the dummy variable in equation (1), to obtain the following estimating equation.

$$q_{it} = x'_{1it}\beta_1 + \tilde{\gamma}\hat{P}(D_{it} = 1) + \mu_i + \epsilon_{it} \quad (5)$$

4.2 Data Set

The samples are Japanese listed firms which received the environmental rating loan from DBJ and announced the fact to the public in the newspapers by the end of September, 2007. This is because we need to consider that the effects of the loan should be reflected in the latest settlement of accounts (in March, 2008). In addition, we exclude banking sector and the firms with incomplete data. As the result of this process, we obtain 35 sample firms.

We collected data from the corporate financial databank provided by DBJ and *Kaigai Shinshutsu Kigyō Soran* (Survey of Business Expansion Abroad) by Toyo Keizai Inc.

When analyzing the effect of the environmental rating loan on firm's value, comparing the differences between firms with the loan and those without the loan is not applicable. For instance, let us consider a case that only firms with relatively low market value receive the loan and that firms with relatively high market value are not interested in the loan. Then the average of value of firms without the loan is likely to be higher than that of firms with the loan. As a result, we may conclude that the loan has an effect of decreasing firm's value. For this reason, we attempt to compare the changes before and after the loan about the firms with the loan here.

In order to cope with this, we construct the panel data set with regard to only firms receiving the environmental rating loan, with the sample period of fiscal 2000 to 2007. Since the loan program started in fiscal 2004, we employ four years before and after as a sample period. Furthermore, we should note that there are some missing data in regard to several firms which dropped out of the stock market during the period or were not established in the

year 2000. Therefore, the data set here is unbalanced panel data with the number of observations of 274.

4.3 Variables

4.3.1 Dependent Variables

We employ a dummy variable as a regressand, representing the status of the loan, to estimate equation (4), which examines the factors and predicts the choice probability of the decision (D).^{*6} Namely, this takes value 1 when firm i holds the loan balance at the end of fiscal year t and value 0 otherwise.

For the estimation of equation (5), we calculate the ratio of the value of shares and the value of total assets, and use it as a dependent variable (Q). Although we should calculate and use Tobin's q for better analysis, we adopt a simpler method of using the variable above to capture a trend roughly. We calculate the value of shares by multiplying the number of stocks issued by the average of maximum and minimum stock price during a fiscal year.

4.3.2 Explanatory Variables for Eq.(4)

Previous studies pointed out that globalization and firm size are significant factors to explain firms' voluntary environmental actions. In this paper, we employ explanatory variables of factor endowment, firm specific controls and globalization with regard to equation (4), referring Nakamura et al. (2001) and Cole et al. (2006).

Factor Endowment

Capital Intensity (Capital-Labor Ratio) It will be easy for firms with higher capital-labor ratio to introduce the latest environmental technology. Some reports suggest that capital-labor ratio is negatively correlated with emissions of pollutants. We measure it (LCAP_PC) as tangible fixed assets per worker (in logarithm).^{*7} The expected sign is positive.

Human Capital Intensity Those firms where a large portion of the workforce is skilled are more likely to have technologically advanced environmental technologies or to be aggressive in environmentally conscious actions. We measure this index (LWAGE_PC) as total wages per worker (in logarithm).

^{*6} In parentheses are the variable name hereafter.

^{*7} For convenience, we calculate the logarithm of "(tangible fixed assets +1)/total worker" in consideration of the case that tangible fixed assets is zero.

The expected sign is positive.

Firm Specific Controls

Firm Size Larger firms with many facilities are more likely to have resources and infrastructure to enable them to perform environmentally conscious actions. On the other hand, in terms of environmental management, smaller firms are considered to have potential advantages over larger firms in fast decision making and in sophisticated environmental actions. Firm size (**LSCALE1**) is measured by total employment (in logarithm). The expected sign of the coefficient is therefore undetermined.

Profitability High profitability enables firms to have access to fund-raising and to develop flexible financial strategies. It may also lead them to eco-friendly investments and actions. The profitability of a firm (**ROA**) is measured as the return on assets. The expected sign is positive.

Average Age of Employees Younger employees are assumed to be generally more trainable, adaptable, and less resistant to change to environmentally conscious management (Cole et al., 2006). The expected sign of the average age of employees (**AGE**) is negative.

Marketing Intensity Along with the increasing public awareness of environmental issues encouraged by non-governmental organizations, firms intend to enhance their image and brand through environmentally conscious actions. Thus, we attempt to investigate the relationship between public exposure and environmental performance. We assume that the higher the marketing expenditure of a firm, the stronger the relationship between the firm and consumers, the media, and other external stakeholders. Firms with larger marketing expenditure are more likely to retain close contact with final consumers and the public, and to internalize the environmental values held by the public. Marketing intensity (**AD_SALES**) is measured as the share of advertising expenditures relative to sales. The expected sign is therefore positive.

R&D Intensity A certain percentage of R&D expenditures of firms are considered to contribute to the advance of environmental technologies in general. In addition, forward looking firms who engage in R&D is supposed to be more interested in avoiding future environmental risks and increasing their future profit. R&D intensity (**RD3_SALES**) is measured as the share of the sum of R&D expenditure in three consecutive years relative to current sales. Since these firms are more likely to get the environmental rating loan,

the expected sign is therefore positive.

Shareholder Composition Shareholders can give impacts on the decision making of a firm through governance. Here we present three kinds of share of stock, and estimate the effects.

The first one is the share of stock held by financial institutions (**ST_FIN**). It is hard to tell a priori whether the firm governed by financial institutions is positive in getting the loan from DBJ. Therefore the expected sign is undetermined.

The second one is the share of stock held by foreign stockholders (**ST_FOREIGN**). Since foreign investors are generally thought to be more conscious in the environment, they are likely to require efforts in environmentally conscious actions of the firm aggressively. The expected sign therefore is positive.

The third one is the share of stock held by the largest ten stockholders (**ST_MAJOR**). As for the firm governed by a few stockholders, it will practice environmentally conscious actions aggressively when stockholders are strongly eco-minded, whereas it will do few when they are not. The expected sign therefore is undetermined.

Interest Payment DBJ lends the environmental rating loan to firms at low interest rate determined by the environmental rating. The better rating a firm acquire, the lower interest rate the firm enjoy. Firms with the sensitivity in interest rate may promote environmentally conscious actions to get the loan and reduce the interest payment. We employ two variables to examine this.

One is debt-asset ratio (**DEBT**). It is envisaged that the smaller the debt of a firm, the more the expenses for environmentally conscious actions of the firm (Nakamura et al., 2001). In this case, the expected sign is negative. However, from the viewpoint of financing, a firm with larger amount of debt tends to seek lower cost money. Hence, the expected sign is undefined.

Another is interest rate spread (**SPREAD**), which is defined by subtracting average interest rate from the ratio of real interest payment and real interest-bearing liabilities of a firm. Here, average interest rate is given by the following equation.

$$\begin{aligned}
& \text{Average Contracted Rates on Short-term Loans} \\
& \quad \times \frac{\text{Short-term Loans} + \text{Notes Discounted}}{\text{Interest-bearing Liabilities}} \\
& + \text{Average Contracted Rates on Long-term Loans} \\
& \quad \times \frac{\text{long-term loans} + \text{Bonds}}{\text{Interest-bearing Liabilities}}
\end{aligned}$$

where interest-bearing liabilities is defined by the following.

$$\text{Short-term Loans} + \text{Long-term Loans} + \text{Bonds} + \text{Notes Discounted}$$

Average contracted rates on loans are obtained from *Bank of Japan Statistics*, by Research and Statistics Department, Bank of Japan.

Globalization Factors

Overseas business expansion of firm can affect on its environmentally conscious actions. Firms embarking on direct investment abroad should observe the environmental standards and rules required by host countries. They are also likely to introduce advanced environmental technologies from abroad. Moreover, multinational firms are always monitored by consumers and media all over the world. As to exporting firms, in particular with high export ratio, they also tend to introduce advanced technologies and to be monitored, since they are exposed in global competition. Environmentally conscious actions abroad performed by such firms are likely to be absorbed in home countries easily. Therefore the expected sign is positive. We employ two explanatory variables here.

Foreign Direct Investment One is foreign direct investment dummy variable (FDI_D). This takes value 1 when a firm establishes either overseas subsidiary or overseas branch.^{*8}

Export Another is export dummy variable (EX_D). Unfortunately, we cannot calculate export ratio of firms because of data availability.^{*9} Therefore, we adopt the following steps to generate necessary data. First of all, we obtain consolidated net sales abroad from the segment information in annual securities reports, and then calculate consolidated export ratio by dividing

^{*8} Data about overseas business expansion is obtained from *Kaigai Shinshutsu Kigyo Soran*(Survey of Business Expansion Abroad) by Toyo Keizai Inc.

^{*9} We cannot obtain the data of export sales, since it has not been disclosed after the revision of accounting system.

it by consolidated total net sales. Second, using the ratio, we generate export dummy variable, that takes value 1 when the calculated consolidated export ratio is above 10% in average over the period.

4.3.3 Explanatory Variables for Eq.(5)

In terms of the estimation of equation (5), the sign of the coefficient on the choice probability for the environmental rating loan predicted by equation (4) (P-D) is expected significantly positive. On estimating this, we employ firm size, profitability, interest payment, marketing intensity, and R&D intensity as control variables, referring Hibiki et al. (2003). These variables are the same as those used in equation (4) (AD_SALES , RD3_SALES , ROA , DEBT , SPREAD) except for firm size, which is defined by total sales of firm here (in logarithm) (LSCALE2).

Table 1 gives the descriptive statistics and brief explanations of the variables.

< Table 1: Descriptive Statistics >

4.4 Estimation Results

In order to choose an appropriate model, we define ρ as follows to test estimated models.

$$\rho \equiv \frac{\sigma_{\mu}^2}{\sigma_{\mu}^2 + \sigma_{\epsilon}^2} = \frac{\sigma_{\mu}^2}{\sigma_{\mu}^2 + 1}$$

We adopt panel probit model as a result of likelihood ratio test when $\rho = 0$ is significantly rejected. In contrast, we should select a normal probit model estimated on pooled data when $\rho = 0$ is not rejected.

The estimation results of the first step is shown in Table 2.

< Table 2: Panel Data Estimates (Panel Probit Model) >

The result of the test showed that the null hypotheses of $\rho = 0$ is rejected at the significant level of 5%. Consequently we select a result by panel data estimation rather than pooling estimation.

Case 1 is the estimation result in which all explanatory variables are included. Although Case 2 and Case 3 are slightly changed version of Case 1, the results are roughly the same. In what follows, we proceed to a discussion based on the result of Case 1.

Some characteristic points are found in foreign direct investment, mar-

keting intensity, the share of stock held by financial institutions, and the share of stock held by foreign stockholders.

Foreign direct investment dummy is significantly positive. This implies that firms expanding their business overseas are highly probable to get the environmental rating loan. This is because they seem to be always aware of strict environmental regulations in foreign countries. On the other hand, export dummy is insignificant.

Marketing intensity is also significantly positive. Firms with the hope to enhance their image or brand by frequent advertisement and the closeness to consumers, are highly probable to get the loan. Another explanation is that they think the acquisition of environmental rating itself rather than the loan is very effective in advertising strategies.

The share of stock held by financial institutions is significantly negative, while the share of stock held by foreign stockholders is positive. Firms with high share of stock held by financial institutions are likely to be governed by the banks strongly, and we may interpret that they are less positive in getting the loan from DBJ. Moreover, firms with high share of stock held by foreign investors are likely to be governed by the foreign firms, and we may say that they are not only interested in financing at low interest rate but also considerably aware of the environmental issues. On the other hand, the share of stock held by the largest ten stockholders is insignificant.

As for interest payment, interest rate spread is significant, while debt-asset ratio is not. Namely, we find that firms with low credit risks and interest rate spread are highly probable to get the environmental rating loan.

The sign of firm size is significantly negative. Although most of the results with regard to the acquisition of ISO14001 certification indicate that firms with larger size are highly probable to acquire, the estimation result here with regard to the environmental rating loan is the contrary. As for environmentally conscious actions, we may interpret that smaller firms rather than larger firms have impetus to promote such actions.

In contrast, capital intensity, human capital intensity and profitability are insignificant.

The sign of R&D intensity is significantly negative. This is difficult to explain. Considering 27 firms out of 35 sample firms belong to manufacturing industry, the estimation result here seems to be inconsistent with our feelings. One possibility to be considered is that unusual values are included in

the financial data of some firms which shifted to holding companies during the period.^{*10}

On the second step, we adopt random effect method to estimate equation (5), which examines the valuation of firms in the stock market.

The estimation result is shown in Table 3. Case 1 here is estimated using the predicted choice probability based on the result of Case 1 on the first step. This case also includes all the control variables.

< Table 3: Panel Data Estimates (Random Effect Model) >

The coefficient of predicted choice probability is significantly positive at 1% level as we expected. In other words, we can see that the higher probability of getting the loan firms have, the higher market value they enjoy.

5 Concluding Remarks

The main conclusions of this paper are as follows.

First, we conducted panel probit regression analysis using firm-level data, and showed that DBJ's environmental rating loan was likely to increase firm's market value measured by the ratio of the value of shares and total assets.

Second, we found that factors such as overseas business expansion, enhancement of corporate image, shareholder composition, and credit worthiness to raise funds at low interest rate, were likely to affect the firm's decision to get the environmental rating loan.

However, the results reported here should be taken with caution due to data availability and estimation problems. In particular, we should be careful that it is very hard to tell which effects the increase of firm's value, environmental actions or lower interest rate.

Many subjects remain for further research.

First, the number of samples is very small. It is desirable to collect more samples considering the analytical method of this paper, although it is difficult to increase the number of cases of the loan rapidly.

The second point is that we need to consider the features of each industry.

^{*10} We can safely say that the financial data of holding company is considerably different from that of non-holding company. However, we did not take this issue into consideration in this paper, because holding company is loosely defined term and because we could not identify such companies.

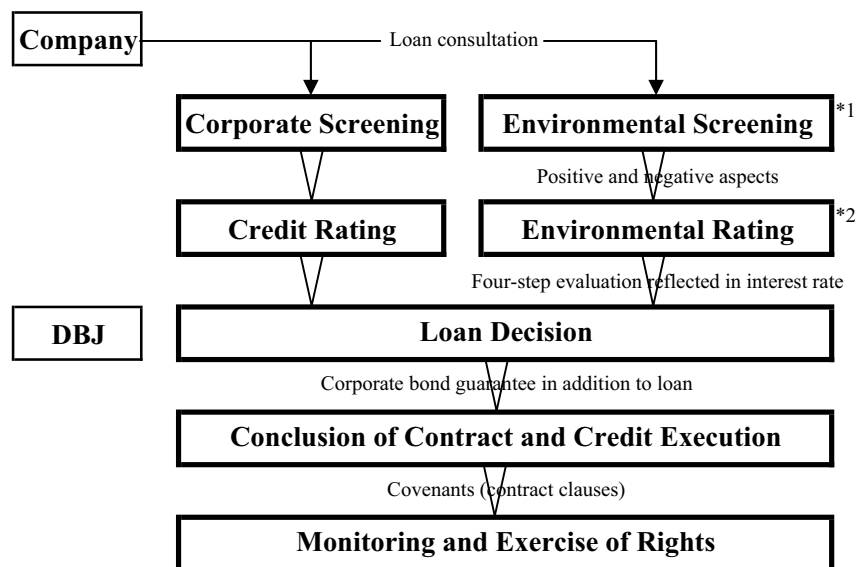
It seems natural that environmental measures and voluntary environmental actions differ by industry. In order to capture the differences, most researchers in the previous studies employed industry dummy variables in the model. However, we did not discuss the issue in this paper.

These subjects remain as our future work.

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- Notes: *1 Screening items are categorized as follows, with consideration of particular attributes of industry.
- (a) Overall management (corporate governance, etc)
 - (b) Business-related aspects (capital spending, etc.)
 - (c) Environmental performance aspects (global warming measures, etc)
- *2 Four-step evaluation:
- (a) Particularly advanced (b) Advanced
 - (c) Adequate (d) Inadequate

Source: *Annual Report 2005*, Development Bank of Japan.

Figure 1 Schematic Diagram of Loan Program for Promotion of Environmentally Conscious Management

Table 1 Descriptive Statistics

Variable	Average	Median	S.D.	Explanation
LCAP_PC	10.07	10.37	2.448	Tangible fixed assets per worker (in logarithm)
LWAGE_PC	9.075	9.010	0.4473	Total wages per worker (in logarithm)
LSCALE1	7.325	7.372	1.413	Total employment (in logarithm)
LSCALE2	18.85	18.66	1.440	Total sales (in logarithm)
ROA	0.03454	0.03060	0.02272	Return on assets
AGE	39.75	40.15	2.570	Average age of employees
AD_SALES	0.009520	0.001645	0.01551	Advertising expenditure / Total sales
RD3_SALES	0.05774	0.02220	0.07624	Sum of R&D expenditure in 3 consecutive years / Total sales
ST_FIN	36.51	36.53	11.49	Share of stock held by financial institutions (%)
ST_FOREIGN	10.92	6.485	11.17	Share of stock held by foreign stockholders (%)
ST_MAJOR	41.40	40.00	12.24	Share of stock held by the largest 10 stockholders (%)
DEBT	0.6242	0.6487	0.1452	Debt-asset ratio
SPREAD	-0.3197	-0.3567	0.4977	Interest rate spread (%)
FDI_D	0.6350	1.000	0.4823	FDI dummy
EX_D	0.5474	1.000	0.4987	Export dummy

Note: The number of observations is 274.

Table 2 Panel Data Estimates: Panel Probit Model

Sample Period: fiscal 2000–2007
Dependent Variable: D

Regressors	Case 1	Case 2	Case 3
LCAP_PC	0.05445 (0.57)	0.01157 (0.13)	0.08297 (0.89)
LWAGE_PC	-0.8232 (-1.63)	-0.5996 (-1.39)	-0.6181 (-1.34)
LSCALE1	-0.6222*** (-3.24)	-0.5126*** (-2.82)	-0.5852*** (-3.14)
ROA	7.187 (1.23)	4.520 (0.81)	4.956 (0.89)
AGE	0.05997 (1.01)	0.04284 (0.75)	0.05666 (0.94)
AD_SALES	23.58** (2.21)	17.27* (1.75)	22.71** (2.10)
RD3_SALES	-5.576* (-1.81)	-7.093** (-2.24)	-6.416** (-2.08)
ST_FIN	-0.06259*** (-3.30)	-0.05988*** (-2.75)	-0.06451*** (-3.53)
ST_FOREIGN	0.1079*** (4.70)	0.0962*** (3.54)	0.1066*** (5.03)
ST_MAJOR	-0.008784 (-0.64)	-0.005751 (-0.43)	-0.007674 (-0.56)
DEBT	1.536 (1.25)	0.3161 (0.29)	
SPREAD	-0.8521*** (-2.66)		-0.7257** (-2.44)
FDI_D	1.299*** (2.66)	1.024** (2.32)	1.304*** (2.64)
EX_D	-0.03496 (-0.08)	0.1090 (0.24)	0.03202 (0.07)
CONS	7.726 (1.41)	7.305 (1.50)	6.566 (1.22)
ρ (<i>p</i> -value)	0.3366** (0.05)	0.2858* (0.10)	0.3595** (0.03)
Log Likelihood	-129.4	-133.3	-130.1
No. of Obs.	274	274	274

Notes: 1. Figures in parentheses are *z* statistics for regression coefficients.
2. Estimated coefficients marked with ***, ** and * are significant at 1% , 5% and 10% level, respectively.

Table 3 Panel Data Estimates: Random Effect Model

Sample Period: fiscal 2000–2007

Dependent Variable: Q

Regressors	Case 1	Case 2	Case 3
P_D	0.2248*** (4.50)	0.2463*** (4.85)	0.3011*** (5.24)
LSCALE2	-3.494E-03 (-0.21)	-2.513E-03 (-0.15)	-0.04361** (-2.16)
AD_SALES	-3.066** (-2.47)	-3.391*** (-2.64)	-3.128*** (-3.00)
RD3_SALES	-0.2847 (-1.48)	-0.2756 (-1.42)	-0.1880 (-1.16)
ROA	4.365*** (4.90)	4.117*** (4.77)	5.431*** (5.71)
DEBT	-1.361*** (-7.16)	-1.382*** (-7.21)	
SPREAD	-0.02408 (-0.50)		-0.08882 (-1.45)
CONS	1.213*** (3.78)	1.219*** (3.77)	1.029*** (2.58)
R^2	0.26	0.26	0.26
No. of Obs.	274	274	274

- Notes: 1. Figures in parentheses are z statistics for regression coefficients.
2. Estimated coefficients marked with ***, ** and * are significant at 1% , 5% and 10% level, respectively.
3. Heteroskedasticity-robust standard errors are used for computing z -value.