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Abstract

The purpose of this study is to empirically analyze the influence of a firm's environmental initiatives on its economic performance, taking into account the role of environmental disclosures. This is because although the positive influence of environmental initiatives on economic performance generally results from plural paths, involving both an improvement in productivity and an increase in demand, it is expected that the environmental initiatives through an increase in demand will not directly but indirectly via disclosed information influence economic performance. Indeed, the discussions in the literature on social and environmental accounting support this possibility. The theoretical model derived from a Cobb–Douglas production function and an inverse demand function predicts that a firm's environmental initiatives enhance economic performance through an improvement in productivity and/or an increase in demand, and the environmental disclosures are substituted for environmental initiatives through an increase in demand for the empirical estimations. The empirical findings that used panel data on Japanese manufacturing firms from 2010 to 2012 support the view that although environmental initiatives enhance economic performance, even if only the effect of an improvement in productivity is considered, environmental initiatives enhance economic performance further if the effect of an increase in demand is also considered; thus environmental disclosures play an important role for the relationship.

Keywords

Environmental disclosures; Environmental initiatives; Economic performance; Improvement in productivity; Increase in demand; Fixed effects instrumental variables model

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1. Introduction

Environmental initiatives have become a key corporate priority in order to succeed in business for many firms, although it was conventionally believed that there was a trade-off between a firm's environmental initiatives and its economic performance (Porter and van der Linde, 1995). To confirm this, many empirical studies have analyzed this relationship and found, in fact, that there was a positive relationship between a firm's environmental initiatives (and environmental performance) and economic performance (economic performance generally means financial performance in this paper) as reviewed in the next section. The positive influence of environmental initiatives on economic performance generally results from plural paths, involving both an improvement in productivity and an increase in demand (Nishitani, 2011). Poor environmental initiatives are regarded as reflecting poor management practices and a lack of innovativeness in taking up the potential cost savings available by reducing environmental impacts (Hart and Ahuja, 1996; Russo and Fouts, 1997). For example, use of unnecessary inputs is decreased and production processes are optimized when focusing on the introduction of cleaner production processes that prevent the generation of environmental impacts in manufacturing through process-by-process innovation (Baas, 1995; Nishitani et al., 2011). Then, through environmental initiatives, firms can reduce both their environmental impact and production costs. However, better environmental initiatives provide positive information about environmentally friendly firms and their products to the public, and this enables firms to increase their market share and/or charge higher prices for their products where consumers have preferences for environmental protection (Khanna, 2001; Khanna et al., 1998). In Japan, for example, the number of firms and government administration offices that specify environmental initiatives as a condition for transactions with suppliers is increasing (Japanese Ministry of the Environment, 2014). However, except for Nishitani (2011) and related studies such as Nishitani et al. (2014, 2011), none of the empirical studies estimated these influences simultaneously, although some studies such as Khanna (2001) discussed the possibility, and some studies such as Darnall et al. (2007) and Heras-Saizarbitoria et al. (2011) estimated these influences independently. Thus, to analyze the influence of a firm's environmental initiatives on its economic performance more precisely, it is necessary to analyze and distinguish both the influence of the improvement in productivity and the influence of the increase in demand. The growing number of such studies that analyze the specific influence of environmental initiatives is necessary to provide new scientific knowledge not only for the academic field but also for business.

However, with respect to the positive influence occurring through an increase in demand, it is expected that the environmental initiatives will not directly influence the economic performance, but indirectly influence it through the environmental information disclosed by the firm. This is because consumers who cannot directly observe corporate environmental initiatives that are implemented inside the firm cannot evaluate them without any disclosed information. Indeed, Bullough and

Johnson (1995) suggested that environmental disclosures have the potential to be an important marketing tool to establish competitive advantage. Furthermore, as introduced in Section 3, the analysis of environmental disclosures in the literature on social and environmental accounting supports this possibility. Thus, the analysis should also consider the role of a firm's environmental disclosures. Although some previous studies have focused on secondary environmental information, such as the environmental ranking of a firm, disclosed by third parties, and analyzed the influence of this information on a firm's economic performance (e.g. Nakao et al., 2007; Nishitani et al., 2011), there is no study that focuses directly on the environmental information disclosed by the firm itself, acting as a tool to actualize the influence on economic performance of environmental initiatives through an increase in demand.

Therefore, the purpose of this study is to empirically analyze the influence of a firm's environmental initiatives on its economic performance, taking into account the role of environmental disclosures. To achieve this purpose, this study applies a simple theoretical economic model derived from a Cobb–Douglas production function and an inverse demand function to identify whether a firm's environmental initiatives enhance economic performance through an improvement in productivity and/or an increase in demand, as proposed by Nishitani (2011). Then, the environmental disclosures are substituted for environmental initiatives through an increase in demand. The model estimates these parameters using the fixed effects instrumental variables model for Japanese manufacturing firms for the period 2010–2012. Even Nishitani (2011) and related studies did not directly focus on the role of environmental disclosures for the influence of environmental initiatives through an increase in demand. Furthermore, previous studies in social and environmental accounting suggest that consumers are one of the important stakeholders for Japanese firms; this study additionally analyzes the influence of environmental initiatives through an increase in demand in B-to-C (business-to-consumers) firms and B-to-B (business-to-business) firms respectively, to confirm if the influence is different between final consumers and business consumers.

The main findings are as follows. First, a firm that implements environmental initiatives more proactively is more likely to enhance economic performance through an improvement in productivity even if the influence of the environmental initiatives through an increase in demand, namely the role of environmental disclosures, is not considered. Second, a firm that implements environmental initiatives more proactively is more likely to enhance economic performance through an improvement in productivity and an increase in demand if the influences of the environmental initiatives through both paths are simultaneously considered. Because the magnitude of the influence of environmental initiatives through an improvement in productivity is almost equivalent, either with or without considering the influence of the environmental initiatives through an increase in demand, estimation that focuses only on the influence of environmental initiatives through an improvement in productivity will underestimate the total influence of environmental initiatives. Third, although the

influence of environmental initiatives through an increase in demand is only observed for B-to-C firms, the influence is not statistically different to that for B-to-B firms.

This study is divided into the following sections. Section 2 reviews the literature on the relationship between environmental initiatives (and environmental performance) and economic performance. Section 3 introduces the discussions of corporate environmental disclosures in the literature on social and environmental accounting. Section 4 provides a theoretical economic model of the influence of a firm's environmental initiatives on its economic performance. Section 5 presents details of the data. Section 6 provides the estimation results. Section 7 presents the conclusion and implications.

2. Literature review on the relationship between environmental initiatives (and environmental performance) and economic performance

In this section, the literature on the relationship between environmental initiatives (and environmental performance) and economic performance are reviewed. Previous studies are classified into studies focusing on financial performance such as return on assets (ROA) and return on sales (ROS), and those focusing on stock market performance such as stock price and Tobin's q (Table 1). We review these former studies below for the purpose of this study, which focuses on financial performance (however, a summary of the latter studies is also shown in Table 1). Although they did not focus on the role of environmental disclosures for the relationship, it is valuable for this study to review them because their hypothesis that better (worse) environmental initiatives and performance increases (decreases) economic performance is consistent with ours at least in a broad sense.

In the second half of the 1990s, Hart and Ahuja (1996) analyzed 127 manufacturing firms in Standard and Poor's 500 from 1989 to 1992 by multiple regression analysis, and found that a reduction in total chemical substance emissions enhanced the ROA, ROS, and return on equities over 1–2 years. Russo and Fouts (1997) analyzed 243 firms assigned environmental ratings by the Franklin Research and Development Corporation (FRDC) from 1991 to 1992 by pooled data analysis, and found that environmental rating scores by FRDC enhanced ROA.

In the 2000s, Sarkis and Cordeiro (2001) analyzed 482 US firms in 1993 by ordinary least squares (OLS), and found that both pollution prevention and end-of-pipe approaches were negatively related to ROS. King and Lenox (2002) analyzed 614 US manufacturing firms from 1991 to 1996 by a fixed effects regression, and found that pollution prevention enhanced ROA. Zhu and Sarkis (2004) analyzed 186 Chinese manufacturing firms from 2002 to 2003 by moderated hierarchical regression, and found that green supply chain management practices had positive relationships with positive and negative economic performance indicators. Darnall et al. (2007) analyzed approximately 4200 manufacturing facilities in Canada, France, Germany, Hungary, Japan, Norway, and the US in 2003 by a bivariate probit model, and found that several environmental performance measures, including a

decrease in wastewater effluent, air pollution, and global pollutants such as greenhouse gases, enhanced financial performance such as profitability and sales volume.

In the 2010s, Heras-Saizarbitoria et al. (2011) analyzed 196 Spanish firms from 2000 to 2005 by a multivariate panel data analysis, and found that firms with ISO 14001 certification achieved superior ROA and sales volume. Iwata and Okada (2011) analyzed Japanese manufacturing firms from 2004 to 2008 by an industry-specific fixed effects model, and found that the reduction of greenhouse gas (GHG) emissions enhanced financial performance such as ROA, return on investment, and return on invested capital, but the reduction of waste emissions did not. Nishitani (2011) analyzed 871 Japanese manufacturing firms from 1996 to 2007 by a fixed effects instrumental variables model, and found that the implementation of an environmental management system enhanced a firm's value added through an increase in demand and improvement in productivity. Nishitani et al. (2011) analyzed 426 Japanese manufacturing firms from 2002 to 2008 by a random effects instrumental variable model, and found that a reduction of pollution emissions enhanced a firm's value added by increasing demand and improving productivity, although as the latter is conditional, a prevention approach to reducing emissions is preferred. Hatakeda et al. (2012) analyzed 1,089 Japanese manufacturing firms in 2007 by switching regression model, and found that although there was a positive relationship between a firm's GHG emissions and ROA, this relationship is mitigated if the firm had a positive stance on environmental management to reduce GHG emissions. Thoumy and Vachon (2012) analyzed 79 environmental projects that took place in Canadian manufacturing firms from 2001 to 2009 by OLS, and found that projects related to the main product or its underlying production process were financially more beneficial, whereas pollution prevention technologies and environmental project size were not. de Burgos-Jime´nez et al. (2013) analyzed 186 Welsh firms from 2003 to 2004 by multiple regression analysis, and found that environmental proactivity and environmental performance enhanced ROA and ROS, but environmental management did not. Nishitani et al. (2014) analyzed 423 Japanese manufacturing firms from 2007 to 2008 by a random effects instrumental variables model, and found that a firm's GHG emissions management enhanced its economic performance through an increase in demand and improvement in productivity. However, the latter effect is conditional. Although a firm's efforts to maintain lower GHG emissions improved productivity, efforts to reduce GHG emissions further did not always improve it, especially for energy-intensive firms. Qi et al. (2014) analyzed 39 Chinese industrial sectors from 1990 to 2010 by a dynamic generalized method of moments instrumental variable model, and found that SO_2 emissions per unit of industry value added enhanced industry-level ROA.

Thus, many studies found that environmental initiatives and performance would enhance economic performance. However, most of them did not distinguish between the influence of environmental initiatives through an improvement in productivity and an increase in demand, and even Nishitani (2011) and related studies did not directly focus on the role of environmental

disclosures for the relationship. Accordingly, it is expected that these studies underestimated the total influence of environmental initiatives on economic performance or did not suggest a causal relationship between them in the strict sense. To overcome this issue, this study will analyze the relationship between environmental initiatives and economic performance with consideration of the role of environmental disclosures.

(Table 1)

3. Discussions regarding corporate environmental disclosures

Understanding corporate environmental disclosures, which are sometimes analyzed as a part of social disclosures, has long been a major focus in the literature on social and environmental accounting. If the role of environmental disclosures has not been considered when analyzing the relationship between environmental initiatives and economic performance, it is valuable to supplement the discussions regarding this role by the studies on social and environmental accounting. Thus, we consider how corporate environmental disclosures have been analyzed in these studies in order to clarify the role of environmental disclosures for the relationship between environmental initiatives and economic performance.

Corporate environmental disclosures are defined as those disclosures that relate to the impact of firm activities on the physical or natural environment in which they operate (Wilmshurst and Frost, 2000). Hence, corporate environmental disclosures reduce the information asymmetry of the firm's environmental initiatives between insiders and outsiders (Cormier et al., 2011). According to Bullough and Johnson (1995) and Stanwick and Stanwick (2000), environmental disclosures are classified into the following three types: 1) a formal statement explaining the firm's corporate environmental policy; 2) a qualitative and quantitative description of the type of environmental initiatives implemented by the firm to show its environmental commitment; and 3) a combination of 1) and 2). The content of environmental disclosures is generally in accordance with the environmental reporting guidelines of programs such as the Global Reporting Initiative (GRI) in recent years, but what is included is fundamentally at the discretion of each firm. Thus, environmental disclosures have remained predominantly a voluntary practice (Wilmshurst and Frost, 2000). Although environmental disclosures include not only positive information including fewer emissions, use of recycled materials, or certification of products or processes, but also negative information including polluting events, or suits and fines related to violations of environmental regulations (Philippe and Durand, 2011), environmental disclosures are also used to offset or mitigate the negative impact of actual environmental performance (Patten, 2002).

The perspectives to be applied to environmental disclosures can be classified into three broad study groups: decision usefulness studies, economic theory studies, and social and political theory

studies (Gray et al., 1995). Stakeholder theory, legitimacy theory, and political economy theory that are classified into social and political theory studies are most widely employed in the studies of social and environmental accounting. Note that these three types of qualitative theories (stakeholder theory, legitimacy theory and political economy theory) are not completely different from each other, as all three focus attention on the relationship between the organization and its operating environment (Joshi and Gao, 2008; Neu et al., 2008).

The application of these theories depends on the study's purpose. Because the main medium for environmental disclosures in Japanese firms, the target of this study, has been the independent environmental report[1] that provides useful information to influence (multi) stakeholder decisions and facilitates environmental communication (Japanese Ministry of the Environment, 2007), stakeholder theory is the appropriate theoretical perspective for this issue[2]. Indeed, 71.1% of Japanese listed firms published independent environmental reports in 2012 (Japanese Ministry of the Environment, 2014). Stakeholder theory suggests that a firm's continued existence requires the support of the stakeholders[3] and their approval must be sought and the activities of the firm adjusted to gain that approval (Gray et al., 1995; Joshi and Gao, 2008). Thus, the management of different stakeholder groups in society is critically important for the survival of the organization (Deegan, 2000). If environmental initiatives are viewed as an effective management strategy for dealing with stakeholders, a positive relationship between stakeholder power, environmental initiatives, and environmental disclosures is expected, because the more powerful the stakeholders, the more the firm must adapt (Gray et al., 1995; Roberts, 1992). In short, because firms adopt an active strategic posture that seeks to influence their relationship with important stakeholders, or a passive posture that is neither involved in continuous monitoring activities of stakeholders nor deliberately searching for an optimal stakeholder strategy, an active (passive) strategic posture would lead to high (low) levels of environmental initiatives and environmental disclosures (Joshi and Gao, 2008; Ullmann, 1985).

In the case of environmental disclosure in Japanese firms, previous studies found that consumers and stockholders/investors are generally the most important stakeholder groups for environmental

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[1] "Environmental reports" in this study include the so-called sustainability reports, corporate social responsibility (CSR) reports, etc.

[2] Legitimacy theory is an appropriate theoretical perspective to analyze environmental disclosures of US and EU firms whose main medium is the annual report that provides financial information influencing stockholder/investor decisions. This theory focuses on the nature of organizational legitimation activities.

[3] According to Freeman (1984), a stakeholder is defined as any group or individual who can affect or is affected by the achievement of a firm's objectives.

initiatives and disclosures (e.g. Higashida et al., 2005; Kokubu and Hirayama, 2004; Kokubu et al., 2012, 2002; Park, 1999). This suggests that Japanese firms regard consumers and stockholders/investors as important stakeholders regarding environmental issues for their survival. Given that, it is suspected that Japanese firms expect higher economic performance such as financial performance and stock returns from the environmental disclosures because higher economic performance is key for the survival of the firm. That is, it is possible that firms attempt to satisfy consumers and stockholders/investors as their important stakeholders in order to enhance their economic performance for their survival, because important stakeholders' environmental preferences influence their economic performance (Nishitani, 2009). It seems that this assumption does not conflict with stakeholder theory. However, because the empirical studies using stakeholder theory proved that a firm's important stakeholders such as consumers and stockholders/investors influence its survival by clarifying the influence of important stakeholders on environmental disclosures, few studies have analyzed the influence of a firm's environmental disclosures on its economic performance directly.

Accordingly, the above discussions of stakeholder theory used in studies of social and environmental accounting support the possibility that environmental disclosures play an important role in the influence of environmental initiatives through an increase in demand on economic performance, and suggest a need to consider the role of environmental disclosures when analyzing the relationship between environmental initiatives and economic performance, especially for Japanese firms.

4. Model

This section presents a simple theoretical model specified originally by Nishitani (2011) to analyze how a firm's environmental initiatives and environmental disclosures influence its economic performance. Economic performance in this study is measured by value added, which is total revenue minus material cost. The value added consists of profits and wages.

The regression model to estimate the influences of environmental initiatives and environmental disclosures on value added is derived from a Cobb–Douglas production function and an inverse demand function.

The Cobb–Douglas production function with labor, capital, and materials for firm i is:

$$X_i = A_i L_i^{\alpha} K_i^{\beta} M_i^{1-\alpha-\beta}, \tag{1}$$

where X is output, L is labor, K is capital, M is materials, A is total factor productivity, $0 < \alpha < 1$, $0 < \beta < 1$, and $0 < \alpha + \beta < 1$. We assume constant returns to scale in production.

Given total revenue $Y_i = p_i X_i$ where p is the price of output, labor cost $W_i = wL_i$ where w is the wage rate, capital cost $R_i = rK_i$ where r is the implicit rental rate of capital, and materials cost $Q_i = qM_i$ where q is the price of materials, it follows that:

$$\frac{Y_i}{p_i} = A_i\left(\frac{W_i}{w}\right)^{\alpha}\left(\frac{R_i}{r}\right)^{\beta}\left(\frac{Q_i}{q}\right)^{1-\alpha-\beta}. \tag{2}$$

The inverse demand function:

$$p_i = a_i X_i^{-\gamma} \tag{3}$$

yields the price[4], and then total revenue is expressed as follows:

$$Y_i = a_i\left\{A_i\left(\frac{W_i}{w}\right)^{\alpha}\left(\frac{R_i}{r}\right)^{\beta}\left(\frac{Q_i}{q}\right)^{1-\alpha-\beta}\right\}^{1-\gamma}$$

$$= a_i A_i^{1-\gamma}\left(\frac{W_i}{w}\right)^{\alpha-\alpha\gamma}\left(\frac{R_i}{r}\right)^{\beta-\beta\gamma}\left(\frac{Q_i}{q}\right)^{1-\alpha-\beta-\gamma+\alpha\gamma+\beta\gamma}, \tag{4}$$

where $1-\gamma > 0$. Accordingly, value added is:

$$Y_i - Q_i = a_i A_i^{1-\gamma}\left(\frac{W_i}{w}\right)^{\alpha-\alpha\gamma}\left(\frac{R_i}{r}\right)^{\beta-\beta\gamma}\left(\frac{Q_i}{q}\right)^{1-\alpha-\beta-\gamma+\alpha\gamma+\beta\gamma} - Q_i. \tag{5}$$

Because $\frac{Y_i - Q_i}{R_i}$ is the ratio of value added to capital cost, equation (5) is transformed into:

$$\frac{Y_i}{R_i} = a_i A_i^{1-\gamma}\left(\frac{W_i}{w}\right)^{\alpha-\alpha\gamma}\frac{R_i^{\beta-\beta\gamma-1}}{r^{\beta-\beta\gamma}}\left(\frac{Q_i}{q}\right)^{1-\alpha-\beta-\gamma+\alpha\gamma+\beta\gamma}. \tag{6}$$

Suppose that A_i is a function describing the environmental initiatives through an improvement in productivity Env and a_i is that describing environmental initiatives through an increase in demand, in other words environmental disclosures, $Disc$, and they are described as:

[4] We assume that parameter a is replaced by a_i.

$$A_i = e^{\delta^{(0)} + \delta^{(1)} Env_i}, \tag{7}$$

where $\delta^{(1)} > 0$ is the influence of the environmental initiatives that occurs through an improvement in productivity, and:

$$a_i = e^{\omega^{(0)} + \omega^{(1)} Disc_i}, \tag{8}$$

where $\omega^{(1)} > 0$ is the influence of the environmental disclosures that occurs through an increase in demand.

Taking logarithms of both sides of equation (6) and substituting equations (7) and (8) yields:

$$\begin{aligned} ln\frac{Y_i}{R_i} &= (\alpha - \alpha\gamma) ln W_i + (\beta - \beta\gamma - 1) ln R_i + (1 - \alpha - \beta - \gamma + \alpha\gamma + \beta\gamma) ln Q_i \\ &+ (1-\gamma)\delta^{(1)} Env_i + \omega^{(1)} Disc_i + (1-\gamma)\delta^{(0)} + \omega^{(0)} - (\alpha - \alpha\gamma) ln w \\ &- (\beta - \beta\gamma) ln r - (1 - \alpha - \beta - \gamma + \alpha\lambda + \beta\gamma) ln q . \end{aligned} \tag{9}$$

Equation (9) indicates that the environmental initiatives and environmental disclosures influence a firm's value added (the ratio of value added over capital cost) through an improvement in productivity and an increase in demand, respectively. Consequently, equation (9) with an error term is the regression model for estimating the parameter of the environmental initiatives $(1-\gamma)\delta^{(1)}$ and environmental disclosures $\omega^{(1)}$, where
$(1-\gamma)\delta^{(0)} + \omega^{(0)} - (\alpha - \alpha\gamma)\ln w - (\beta - \beta\gamma)\ln r - (1 - \alpha - \beta - \gamma + \alpha\lambda + \beta\gamma)\ln q$ is the constant term.

Although the parameter for the influence of environmental initiatives through improvement in productivity $\delta^{(1)}$ cannot be estimated directly, it is calculated from the estimated parameters because γ can be obtained by solving the following equations: $(\alpha - \alpha\gamma) = B_1$, $(\beta - \beta\gamma - 1) = B_2$, and $(1 - \alpha - \beta - \gamma + \alpha\gamma + \beta\gamma) = B_3$.

According to the model specifications (namely, $0 < \alpha < 1$, $0 < \beta < 1$, $\omega^{(1)} > 0$, $\delta^{(1)} > 0$, and $1 - \gamma > 0$), the predicted signs of these parameters are positive for $(\alpha - \alpha\gamma)$, $(1 - \alpha - \beta - \gamma + \alpha\gamma + \beta\gamma)$, $\omega^{(1)}$, and $(1-\gamma)\delta^{(1)}$, and negative for $(\beta - \beta\gamma - 1)$.

5. Data

We used panel data on 196 Japanese manufacturing firms (in the food, textiles, pulp and paper, chemicals, pharmaceuticals, petroleum, rubber, glass, steel, nonferrous metals, metals, general machinery, electrical appliances, transportation machinery, precision instruments, and other

manufacturing industries) listed on the first and second sections of the Tokyo Stock Exchange from 2010 to 2012 to estimate the parameters in equation (9). Holding companies are not included in the sample. The total number of firm-year observations is 524 because of the use of an unbalanced panel of data. The descriptive statistics of the dependent and independent variables are given in Table 2, and they are defined as follows.

The dependent variable is the logarithm of net sales over the book value of tangible fixed assets proxying for $ln\frac{Y}{R}$. The independent variables are the logarithm of wages proxying for lnW, the logarithm of the book value of tangible fixed assets for lnR, the logarithm of raw materials expense for lnQ, the environmental initiatives score evaluated by Toyo Keizai Inc. for Env, and ESG (Environment, Society, and Governance) disclosures score evaluated by Bloomberg for $Disc$.

In regard to the proxy for Env, Toyo Keizai Inc. evaluates and scores the CSR (corporate social responsibility) initiatives of approximately 1,200 Japanese listed and nonlisted firms based on the questionnaire surveys since 2005, and it publishes the evaluated scores in several specific areas including the environmental initiatives area of the highest ranked firms (500 firms in 2010, and 700 firms in 2011 and 2012). Because the environmental initiatives score suggests the level of environmental initiatives of firms despite third party evaluation, it is appropriate to use the score as the proxy for Env not $Disc$.

In regard to the proxy for $Disc$, Bloomberg collects firm's ESG data in a fashion unique to themselves, and evaluates each ESG initiative, and then publishes its standardized values. ESG disclosure scores regarding a firm's disclosure initiatives is one of these evaluated values. Although we use ESG disclosure scores that are aggregated scores of the environment, society, and governance because of data availability, environmental disclosures are the major disclosures among ESG disclosures for many Japanese firms. ESG disclosure scores are also the score evaluated by a third party, as previous studies employed. However, this is the score of environmental (ESG) disclosures, not that of environmental initiatives, which directly focuses on disclosures. For example, Nishitani et al. (2011), who analyzed the influence on a firm's value added of a reduction of pollution emissions by improving productivity and increasing demand, employed a score based on the actual pollution reduction rate as a proxy for improving productivity, and the score derived from the chemical material emissions management rank evaluated by Nikkei Environmental Management Survey as a proxy for reduction of pollution emissions through increasing demand. The chemical material emissions management rank could more or less depend on the disclosed information by the firm. Thus, ESG disclosure scores are more direct and more preferable as a proxy for environmental initiatives through an increase in demand.

Because environmental disclosures are not a component of the environmental initiatives score, the environmental initiatives score and ESG disclosures score are independent, and they are not necessarily proportional. Indeed, their correlation is only 0.0852.

The data for all variables except Env and $Disc$ are taken from the Nikkei Economic Electronic Databank System. The data for the environmental initiatives score are from the Toyo Keizai CSR Survey and those for the ESG disclosures score are from the Bloomberg database. All financial values are deflated using the GDP deflator.

(Tables 2)

6. Estimation results

Table 3 shows the estimation results. Models (1) to (3) in the table are estimated using a fixed effects instrumental variables (FE-IV) model, which uses the logarithm of the book value of tangible fixed assets in t–1 as the instrumental variable, to avoid endogeneity bias derived from the theoretical model (equation (9)). Year dummies are additionally included in the estimation models to capture the influence of macroeconomic shocks. The Hausman test, supplemented by Sargan–Hansen test statistics, suggests that the FE-IV models are more reliable than the random effects instrumental variables models (RE-IV) in all models.

In Models (1) to (3), the logarithm of wages and logarithm of raw materials expense are significantly positive, and the logarithm of the book value of tangible fixed assets is significantly negative. They are consistent with the predicted values in the theoretical model, which suggests that γ is significant as well. According to the calculations, γ = 0.4903, 0.4954, and 0.5235 in Models (1) to (3), respectively.

Model (1) includes only the environmental initiatives score. The coefficient of the environmental initiatives score is 0.0015 and is statistically significant. Accordingly, $\delta^{(1)}$ = 0.0029 $\left(= \dfrac{0.0015}{(1-0.4903)}\right)$. Because the dependent variable is the logarithm of net sales over the book value of tangible fixed assets, the (marginal) effect on the logarithm of net sales over the book value of tangible fixed assets of the environmental initiatives score can be calculated using the parameter exponent. Accordingly, a firm that implements environmental initiatives enhances its value added by 2.94% (per 1 point of the environmental initiatives score) through an improvement in productivity.

Model (2) adds ESG disclosures score in Model (1). This is to estimate the influence of environmental initiatives through an increase in demand, given the influence through an improvement in productivity. The coefficient of the environmental initiatives score is 0.0015 and is statistically significant. Thus, $\delta^{(1)}$ = 0.0030. This value is almost equivalent to that in Model (1). The coefficient of the ESG disclosure score is 0.0013 and is statistically significant as well. The

results in Models (1) and (2) suggest that it does not mean that the influence through an improvement in productivity in Model (1) will be divided into the influence through an improvement in productivity and through an increase in demand in Model (2). Thus, the estimations that focus only on the influence of environmental initiatives through an improvement in productivity will underestimate the total influence of a firm's implementation of environmental initiatives on its value added. Accordingly, a firm that implements environmental initiatives enhances its value added by 1.30% (per 1 point of the ESG disclosures score) through an increase in demand, in addition to 2.98% through an improvement in productivity. Note that these influences through an improvement in productivity and an increase in demand are not comparable directly because the standard to score the point is different between the environmental initiatives score and ESG disclosures score.

Model (3) includes the interaction term of the environmental initiatives score and B-to-C dummy, that of the environmental initiatives score and B-to-B dummy, that of the ESG disclosures score and B-to-C dummy, and that of the ESG disclosures score and B-to-B dummy, instead of the environmental initiatives score and ESG disclosures score. This is to additionally analyze the influence of the ESG disclosures score on value added for the B-to-C firms and that for B-to-B firms, to confirm whether the influence of environmental initiatives through an increase in demand is different between final consumers and business consumers, given that previous studies in social and environmental accounting suggest that consumers are one of the important stakeholders for Japanese firms to disclose environmental information. The classification of B-to-C firms or B-to-B firms for the analysis depends on the advertising expenditure ratio (advertising expenditure divided by net sales), because B-to-C firms who are close to final consumers are expected to be more likely to undertake advertising expenditure. Then, this study assumed, for convenience, firms whose advertising expenditure ratio is equal to or greater than the value of the 75th percentile of samples of B-to-C firms and those whose advertising expenditure ratio is lower than the value of the 75th percentile of samples of B-to-B firms. The influences of the environmental initiatives score for B-to-C and B-to-B firms are estimated as well. The coefficient of the interaction term of the environmental initiatives score and B-to-C dummy is 0.0022 and that of the interaction term of the environmental initiatives score and B-to-B dummy is 0.0014; and they are statistically significant. On the other hand, the coefficient of the interaction term of the ESG disclosures score and B-to-C dummy is 0.0030 and that of the interaction term of the ESG disclosures score and B-to-B dummy is 0.0004; however, only the former is statistically significant. Accordingly, a B-to-C firm that implements environmental initiatives enhances its value added by 4.63% through an improvement in productivity and 3.01% through an increase in demand, and a B-to-B firm that implements environmental initiatives enhances its value added by 2.94% through an improvement in productivity. However, although the influences of environmental initiatives through an improvement in productivity are statistically different between B-to-C and B-to-B firms, those influences through an

increase in demand are not. Thus, the influence of environmental initiatives through an increase in demand does not differ so much between B-to-C and B-to-B firms, nevertheless specific values for them are observed or not.

In summary, because a firm that implements environmental initiatives is more likely to enhance its value added through an improvement in productivity and an increase in demand, estimation focusing only on the former will underestimate the total influence of implementation of environmental initiatives. Besides, although the influence of implementation of environmental initiatives through an increase in demand is only observed for B-to-C firms, the influence for B-to-C firms is not statistically different from that for B-to-B firms.

(Table 3)

7. Conclusion and implications

This study empirically analyzed the influence of a firm's environmental initiatives on its economic performance taking into account the role of environmental disclosures, based on a theoretical model derived from a Cobb–Douglas production function and an inverse demand function. The main findings using panel data on Japanese manufacturing firms and their relevant implications are as follows.

First, a firm that implements environmental initiatives more proactively is more likely to enhance economic performance through an improvement in productivity, even if the influence of the environmental initiatives through an increase in demand is not considered. This suggests that environmental initiatives will enhance a firm's economic performance even only through an improvement in productivity. For example, this could occur by a shift from end-of-pipe technologies to a cleaner production approach (Baas, 1995; Nishitani et al., 2011). Then, firms can reduce material and energy inputs, which lead to cost reduction, as well as environmental impacts such as pollution and GHG emissions reductions. Furthermore, the employment of evaluation tools such as material flow cost accounting, a method for environmental management accounting, is helpful for these reductions (Kokubu, 2010). However, an individual firm's environmental initiatives have a limited influence in reducing them, because the environmental impacts and material and energy inputs associated with the production of a product depend not only on the product manufacturer, but also across the entire supply chain. Thus, it is possible that green supply chain management (GSCM), environmental initiatives in cooperation with suppliers, that concern not only traditional management performance including timeliness, transaction cost, product quality, and effective communication, but also environmental initiatives, function effectively as well (Faruk et al., 2002). For example, in the case of GSCM intending to reduce GHG, the carbon footprint and Scope 3 of the GHG Protocol are the specific methods of GSCM and the number of firms implementing GSCM

using these methods is increasing (Kajiwara and Kokubu, 2012). Therefore, a firm can enhance its economic performance by performing these specific environmental initiatives effectively.

Second, a firm that implements environmental initiatives more proactively is more likely to enhance economic performance through an improvement in productivity and an increase in demand if the influences of the environmental initiatives through both paths are simultaneously considered. This supports the importance of considering the influence of environmental initiatives through an increase in demand and the role of environmental disclosures, when analyzing the relationship between environmental initiatives and economic performance. The result is consistent with the studies of social and environmental accounting that revealed that consumers are one of the most important stakeholders for environmental disclosures. Accordingly, a firm that satisfies its customers by disclosing environmental information can enhance its economic performance through an increase in demand, which is key for the survival of the firm. It is important to find that the magnitude of the influence of environmental initiatives through an improvement in productivity is almost equivalent, either with or without considering the influence of the environmental initiatives through an increase in demand. Thus, because the total influence of environmental initiatives includes not only the influence through an improvement in productivity but also the influence through an increase in demand, estimation focusing only on the influence of environmental initiatives through an improvement in productivity will underestimate the total influence of environmental initiatives. Furthermore, these results are suggestive for the business practice of environmental disclosures as well. This is because there is a global movement of environmental disclosures towards “integrated reporting” that unifies financial and nonfinancial information needed for investment decisions (IIRC, 2013; Jensen and Berg, 2012). Because stockholders/investors are target readers of integrated reporting, the movement implies that firms will be required to disclose environmental information that mainly satisfies stockholders/investors. Given that, consumers may be regarded as secondary stakeholders or less important stakeholders of a firm’s environmental disclosures, at this rate. However, our estimation results create a stir in such situations. That is, environmental disclosures only targeting stockholders/investors are not enough for a firm’s survival, and environmental disclosures targeting consumers are also necessary for survival. Thus, environmental disclosures by means of not only integrated reports but also environmental reports would be preferable. Even so, because a higher quality of the information will be required because of for example the impact of the GRI’s G4 Sustainability Reporting Guidelines (GRI, 2013), it is necessary to analyze the role of environmental disclosures on the relationship between environmental initiatives and economic performance in terms of the quality of the information in future research. Such studies will be important in clarifying the issue of greenwashing as well.

Third, a B-to-C firm that implements environmental initiatives more proactively is more likely to enhance economic performance through both an improvement in productivity and an increase in

demand, whereas a B-to-B firm that implements environmental initiatives more proactively is more likely to enhance economic performance through only an improvement in productivity. The influence of environmental initiatives through an improvement in productivity is observed for both B-to-C and B-to-B firms. This implies that the specific environmental initiatives function effectively for both firms. However, the influence for B-to-C firms is greater than that for B-to-B firms. This could be because, as Nishitani (2011) suggests, B-to-C firms consist of many assemblers, and it is easier for them to improve environmental performance and productivity simultaneously, for example, by partially reforming a complicated manufacturing process. In addition, because they implemented a comprehensive environmental management system earlier, they could acquire a first-mover's advantage from their improved productivity (Nishitani, 2011). Furthermore, given this, GSCM for B-to-C could function more effectively. On the other hand, the influence of environmental initiatives through an increase in demand is only observed in B-to-C firms. However, the influence is not statistically different between B-to-C and B-to-B firms whereas its specific value for B-to-B firms is not observed. It is possible that they imply that the influences of final consumers and business consumers for a firm are in the transition stage. This is because Kokubu et al. (2012) suggested the possibility that the influence of final consumers on environmental disclosures in Japanese firms has decreased, based on comparisons with their findings and previous research findings. This implies that the environmental disclosures have been becoming important for not only B-to-C firms but also B-to-B firms. Therefore, our finding is at least consistent with Kokubu et al.'s (2012) suggestion. Besides, because information sharing between suppliers and customers is necessary for GSCM, our finding is reasonable at this point as well. If a firm does business with only small numbers of customers, its environmental information will be disclosed to these customers individually. However, if the firm does business with large numbers of customers, its environmental information will be disclosed publicly by, for example, an environmental report.

Thus, our empirical analyses found that a firm's environmental initiatives will enhance its economic performance through an improvement in productivity and an increase in demand, and supported the view that environmental disclosures play an important role for the latter influence. Accordingly, although environmental initiatives will enhance economic performance, it is not enough for firms to only implement environmental initiatives, it is also important for firms to disclose environmental information to the public.

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Table 1 Literature analyzing the relationship between environmental initiatives/performances and economic performances

F/S	Literature	Sample	Method	Influences of environmental initiatives/ performances	Economic performance
S	Hamilton (1995)	436 US firms in 1989	Event study	Toxic Release Inventory announcements (–)	Abnormal returns
S	Klassen and McLaughlin (1996)	96 US firms during 1989–1990	Event study	Winning environmental awards (+)	Stock returns
F	Hart and Ahuja (1996)	127 US manufacturing firms during 1989–1992	OLS	Total chemical substance emissions reduction (+)	ROA; ROS; ROE
S	Yamashita et al. (1999)	26 US firms in 1993	Event study	Environmental conscientiousness scores in Fortune magazine (+)	Stock returns
F	Russo and Fouts (1997)	243 firms assigned environmental ratings by the Franklin Research and Development Corporation (FRDC) during 1991–1992	OLS	Environmental rating scores by FRDC (+)	ROA
S	Dowell et al. (2000)	89 US firms during 1994–1997	Interval regression analysis	Adoption of stricter environmental standards at a global level (+)	Tobin's q
S	Konar and Cohen (2001)	321 US firms in 1989	OLS	Poor environmental management (–)	Tobin's q–1
F	Sarkis and Cordeiro (2001)	482 US firms in 1993	OLS	Pollution prevention approach (–); end-of-pipe approach (–)	ROS

S	Thomas (2001)	291 UK firms during 1985–1997	OLS	Adoption of an environmental policy (+); prosecution for breach of environmental standards (–)	Excess returns
F/S	King and Lenox (2002)	614 US manufacturing firms during 1991–1996	Fixed effects model	Pollution prevention (+)	ROA; Tobin's q
F	Zhu and Sarkis (2004)	186 Chinese manufacturing firms during 2002–2003	Hierarchical regression	Green supply chain management practices (+/–)	Economic performance indicators
S	Gupta and Goldar (2005)	50 Indian firms in pulp and paper, automobile and chlor-alkali industries in 1999, 2001 or 2002	Event study	Environmental rating given by India's leading environmental NGO, the Delhi-based Centre for Science and Environment (+)	Abnormal returns
F	Darnall et al. (2007)	4,200 manufacturing facilities in Canada, France, Germany, Hungary, Japan, Norway, and US in 2003	Bivariate probit model	Decrease in wastewater effluent (+); decrease in air pollution (+); decrease in global pollutants (e.g. greenhouse gas) (+)	Profitability; sales volume
S	Nakao et al. (2007)	121 Japanese firms during 2002–2003	OLS	Nikkei Corporate Environmental Management score	Tobin's q–1
S	Ziegler et al. (2007)	212 European firms during 1996–2001	Time-series regressions of asset pricing models	An industry's average environmental performance	Stock returns
S	Yamaguchi (2008)	69 Japanese firms during 1998–2006	Event study	Nikkei Corporate Environmental Management score	Stock prices
S	Jacobs et al. (2010)	340 US firms during	Event study	Announcements of	Abnormal returns

		2004–2006		philanthropic gifts for environmental causes (+); ISO 14001 certifications (+); voluntary emission reductions (–)	
F	Heras-Saizarbitoria et al. (2011)	196 Spanish firms during 2000–2005	Multivariate panel data analysis	ISO 14001 certification (+)	ROA; sales volume
F/S	Iwata and Okada (2011)	Japanese manufacturing firms during 2004–2008	Industry-specific fixed effects model	Reduction of greenhouse gas emissions (+)	ROA; ROI; ROIC; Tobin's q–1
F	Nishitani (2011)	871 Japanese manufacturing firms during 1996–2007	Fixed effects instrumental variables model	Implementation of an environmental management system (+)	Value added
F	Nishitani et al. (2011)	426 Japanese manufacturing firms during 2002–2008	Random effects instrumental variables model	Reduction of pollution emissions (+)	Value added
F	Hatakeda et al. (2012)	1,089 Japanese manufacturing firms in 2007	Switching regression model	Less GHG emissions (–)	ROA
S	Nishitani and Kokubu (2012)	641 Japanese manufacturing firms during 2006–2008	Random effects instrumental variables model	Carbon dioxide productivity (+)	Tobin's q
F	Thoumy and Vachon (2012)	79 environmental projects that took place in Canadian manufacturing firms during 2001–2009	OLS	Pollution prevention technologies (–); environmental projects related to the main product (+); environmental project size (–)	Profitability index; internal rate of return
F	de Burgos-Jime´nez et al. (2013)	186 Welsh firms during 2003–2004	OLS	Environmental proactivity (+); environmental performance (+)	ROA; ROS

F	Qi et al. (2014)	39 Chinese industrial sectors during 1990–2010	Dynamic generalized method of moments instrumental variables model	SO_2 emissions per unit of industry value added (+)	Industry-level ROA
F	Nishitani et al. (2014)	423 Japanese manufacturing firms during 2007–2008	Random effects instrumental variables model	GHG emissions management (+)	Value added

Note: F means financial performance and S means stock market performance. OLS means ordinary least squares. ROA means return on assets, ROS means return on sales, ROE means return on equities, ROI means return on investment, and ROIC means return on invested capital.

Table 2 Descriptive statistics

	Observations	Mean	S.D.	Min	Max
Logarithm of net sales over the book value of tangible fixed assets	524	1.3893	0.6156	0.1393	4.4604
Logarithm of wage expense	524	9.8837	1.1045	7.7022	12.7981
Logarithm of the book value of tangible fixed assets	524	10.6885	1.2148	6.6826	13.5271
Logarithm of raw materials expense	524	10.7895	1.5975	3.8238	14.6916
Environmental initiatives score	524	73.8563	15.4734	20	100
ESG disclosures score	524	8.5831	13.2794	1.2397	52.0661
B-to-C	524	0.2500	0.4334	0	1
B-to-B	524	0.7500	0.4334	0	1
Logarithm of the book value of tangible fixed assets (t−1)	524	10.7162	1.2273	6.6826	13.6321
Year 2010	524	0.2691	0.4439	0	1
Year 2011	524	0.3702	0.4833	0	1
Year 2012	524	0.3607	0.4807	0	1

Table 3 Estimation results

	(1) FE-IV	(2) FE-IV	(3) FE-IV
Logarithm of wage expense	0.4771 ***	0.4840 ***	0.4716 ***
	(0.0854)	(0.0853)	(0.0846)
Logarithm of the book value of tangible fixed assets	-1.0427 ***	-1.0550 ***	-1.0703 ***
	(0.1577)	(0.1571)	(0.1580)
Logarithm of raw materials expense	0.0753 ***	0.0756 ***	0.0752 ***
	(0.0204)	(0.0204)	(0.0204)
Environmental initiatives score	0.0015 *	0.0015 *	-
	(0.0009)	(0.0009)	
×B-to-C	-	-	0.0022 **
			(0.0010)
×B-to-B	-	-	0.0014 * †
			(0.0008)
ESG disclosures score	-	0.0013 *	-
		(0.0007)	
×B-to-C	-	-	0.0030 **
			(0.0014)
×B-to-B	-	-	0.0004
			(0.0008)
Year 2011	-0.0203 **	-0.0173 *	-0.0186 *
	(0.0095)	(0.0098)	(0.0098)
Year 2012	-0.0276 ***	-0.0243 **	-0.0258 **
	(0.0100)	(0.0103)	(0.0103)
Centered R^2	0.5275	0.5267	0.5300
Endogeneity test	0.0904	0.0697	0.0594
Hausman test (p-value)	0.0006	0.0003	0.0004
Under-identification test (p-value)	0.0000	0.0000	0.0000
Weak-identification test (F-value)	22.3690	22.5590	22.0490
Observations	524	524	524

Note 1: Standard errors are shown in parentheses.

Note 2: ***, ** and * implies that the coefficient is significantly different from zero at the 1, 5, and 10% levels, respectively.

Note 3: † implies that the coefficient of the interaction term between Env and B-to-B is significantly different from that between Env and B-to-C at the 10% level.

Note 4: The Stock–Yogo critical values for the weak identification test at 10% relative IV bias are 16.38.