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## **The Effects of Corporate Governance on ESG-related Information Disclosure: Evidence from Japanese Firms**

**Tatsuya Kato\***

### **Abstract**

Given the voluntary nature of environmental, social, and governance (ESG)-related information disclosure in Japan, we use a sample of TOPIX firms from 2011 to 2019 to examine the relevance of internal and external corporate governance factors and ESG-related information disclosure for Japanese firms. For the internal governance factors, the results of the logistic regression analysis show that variables such as board independence and board activity significantly influence a company's ESG disclosure strategy, whereas the results of the generalized additive 2 model show that the internal governance variables are relatively less important than the external governance variables such as share ownership structure. For the external governance factors, the logistic regression results show that all the explanatory variables are significant. Although the results from the generalized additive 2 model are generally similar, non-linear relationships for institutional ownership and the Government Pension Investment Fund (GPIF) are also found. These empirical results suggest that the development of corporate governance frameworks such as Japan's Stewardship Code and Corporate Governance Code influences firms' ESG disclosure strategy and encourages them to disclose ESG-related information. This study provides new insights into the relationship between corporate governance and ESG-related information disclosure practices in Japanese firms.

**Keywords:** ESG; Corporate Governance; GRI Standards; Disclosure; Machine Learning; GA2M

**JEL classification:** M41

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## I. Introduction

Environmental, social, and governance (ESG)-related information disclosure in Japan is not mandated by either accounting standards or laws and regulations. In addition to a firm's characteristics such as size and profitability, its corporate governance factors are important in the decision to voluntarily disclose ESG-related information. These include internal corporate governance factors such as the composition of the board of directors and external corporate governance factors such as the ownership of shares. In other words, as argued by Millstein (1991), the corporate disclosure of ESG-related information is mostly voluntary and the extent of such disclosure is ultimately a business decision influenced by the board and shareholders. However, as companies increasingly rely on voluntary ESG-related information disclosure to meet stakeholders' demands for transparency and accountability, it is increasingly important to examine the link between corporate governance and ESG disclosure.

Related frameworks on corporate governance and information disclosure have been developed, such as Japan's Stewardship Code introduced in 2014 as a guideline for institutional investors and Japan's Corporate Governance Code introduced in 2015 as a guideline for corporations. From a longer-term perspective, since the collapse of Lehman Brothers, some institutional investors, which had been the proponents of shareholder capitalism, have been shifting or expanding their fiduciary responsibility from a shareholder orientation to a stakeholder orientation, along with ESG investment<sup>1</sup>. From the perspective of information disclosure, all these moves are encouraging companies to disclose a wide range of information, including ESG-related information.

Previous research both in Japan and overseas has analyzed the relationship between corporate governance and ESG disclosure. However, some issues remain to be addressed, especially for research in Japan, such as the analysis method and limited corporate governance factors analyzed. Further, although one objective of the series of corporate governance reforms underway in Japan is to improve the appropriate disclosure of information by companies, research on the relationship between the two is insufficient, particularly that focusing on ESG disclosure. To bridge this gap in the literature, this study empirically examines the relevance of internal and external corporate governance factors and ESG-related information disclosure for Japanese companies.

Methodologically, in addition to logistic regression, a machine learning-based method is adopted to perform a more considered analysis. Specifically, we examine the

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<sup>1</sup> Although there is no clear definition, this generally refers to efforts by investors to appropriately assess the risk characteristics of companies based on ESG factors, including climate change risk, and use this information in investment decisions.

impact of the expansion of ESG investment since 2015 on ESG-related information disclosure. The signing of the United Nations' Principles for Responsible Investment<sup>2</sup> by the Government Pension Investment Fund (GPIF) in 2015 triggered the expansion of ESG investment in Japan. A wide range of indicators of both internal and external corporate governance are selected to examine their relevance to ESG disclosure. In particular, GPIF holdings are analyzed as one of the variables of external governance, which is unique to Japan and one of the novel features of this study.

The remainder of the paper is organized as follows. Section II provides the background on the growing focus on ESG information, while Section III develops our hypotheses based on a review of the literature. Section IV describes our research design, Section V presents our empirical results, and Section VI concludes.

## **II. Background**

### **A. Spread of ESG Disclosure**

The activities of companies are supported by natural capital and stakeholder relationships. Therefore, socially responsible companies should disclose information about their activities in a transparent manner<sup>3</sup>. Thus, ESG disclosure has traditionally been seen as a type of CSR that must be carried out independently of any economic benefit to the company. However, Porter and Kramer (2011) presented the concept of “shared value” from which many companies today are tackling ESG disclosure. Such firms aim to increase economic value by creating social value by addressing social needs and tackling difficult problems<sup>4</sup>.

In recent years, demand for companies to expand their disclosure of ESG-related information has been rising globally for three main reasons. First, changes in corporate business models such as the shift in the source of added value generated by companies from tangible assets to intangible assets<sup>5</sup> have increased the need for information not

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<sup>2</sup> The Principles for Responsible Investment outline six principles that investors, who play a major role in the global economy, must follow to take responsibility for ESG issues through their investments. As of April 2020, 3,038 pension institutions and asset managers globally had signed the Principles and overall assets under management had reached \$103.4 trillion.

<sup>3</sup> In this regard, the relevance of corporate social responsibility (CSR) and ESG disclosure is often explained by legitimacy theory, which holds that companies disclose ESG information to justify their role in society and actions to stakeholders. Many studies of ESG disclosure rely on legitimacy theory. For example, Gómez-Carrasco, Guillamón-Saorín, and Osma (2020) analyze the content of CSR-related information on Twitter.

<sup>4</sup> However, the debate about whether shared value is a theoretical concept or just a management buzzword continues. For more details, see Dembek, Singh, and Bhakoo (2016).

<sup>5</sup> For example, according to European Financial Reporting Advisory Group (2021), intangible assets can be classified into the following three categories. Category A: Intangibles controlled by an entity

adequately disclosed in traditional financial reporting. For example, intangibles such as trademarks and brand names, which are classified into Category A by the European Financial Reporting Advisory Group (2021), are closely related to ESG disclosure, as a company's brand image and reputation can change depending on how proactively it discloses ESG information. In general, companies that engage in ESG activities and appropriately disclose such information are expected to improve their corporate brand and other intangible assets. The second reason is that some institutional investors, who have been the proponents of shareholder capitalism, are shifting or expanding their fiduciary duty<sup>6</sup> from a shareholder orientation to a stakeholder orientation as ESG investments expand<sup>7</sup>, as noted above. Third, criticism of investors' short-term orientation in the wake of the collapse of Lehman Brothers has led to demand for more future-oriented information disclosure, as both investors and companies are now required to create and enhance firm value in the medium and long term. Thus, the importance of ESG-related information disclosure is increasing because of the need to expand information disclosure in all areas, including the scope of information to be disclosed, timeframe, and target of information disclosure. In other words, to achieve sustainable growth and create firm value in the medium to long term, companies must collaborate with a wide range of stakeholders and actively address ESG issues. Moreover, they must take a proactive approach to disclosing both ESG-related information and financial information such as financial results and operating performance.

The disclosure of ESG-related information in Japan is not clearly mandated by either accounting standards or laws and regulations. The 2019 amendment to the Cabinet Office Order on the Disclosure of Corporate Affairs requires certain companies to expand the

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for which ownership rights are relatively clear and for which markets exist (generally they can be bought and sold). Within this category, two types of intangibles can be distinguished: (i) marketing-related intangibles such as trademarks and brand names and (ii) technology-based intangible assets such as patented technology, computer software, databases, Internet domain names, and film copyrights. Category B: Intangibles controlled by the entity but for which well-defined and legally protected ownership rights may not exist and markets are weak or non-existent. Examples include in-process R&D, non-patented technology, and trade secrets. Category C: Intangibles for which the firm has few, if any, control rights and markets do not exist. Within this category, two types of intangibles can be distinguished: (i) those related to the people who work for the entity (e.g., labor, skills and experience, staff loyalty, and training) and (ii) those related to relationship capital (e.g., relationships, including reputation with customers, suppliers, partners, and governments).

<sup>6</sup> The relationship between ESG investment and fiduciary duty has been the subject of frequent debate. Unlike individual investors, who manage their assets at their own discretion, institutional investors are entrusted by asset holders to manage their assets. Therefore, institutional investors have a responsibility to manage assets and this is called their fiduciary duty.

<sup>7</sup> The Japan Sustainable Investment Forum surveys sustainable investment every year. According to Japan Sustainable Investment Forum (2021), sustainable investment in Japan was 310 trillion yen in 2020. This was lower than that in 2019 (336 trillion yen) because of market conditions, but significantly more than that in 2018 (231 trillion yen).

disclosure of financial information and narrative (non-financial) information in their securities reports<sup>8</sup>. The amendment calls for the enhancement of financial and descriptive information, specifically extended descriptions of management policies and strategies, business and other risks, and accounting estimates. This is not limited to ESG-related information, but is intended to enhance the disclosure of a wide range of non-financial information. These changes suggest that the disclosure of ESG-related information is progressing due to social demand and the introduction of relevant regulations and guidelines.

## **B. Japan's Corporate Governance Code**

Japan's Corporate Governance Code<sup>9</sup> comprises the fundamental principle for corporate governance. This Code has been incorporated into the listing rules of the Tokyo Stock Exchange (TSE) to improve corporate governance. It was formulated to support companies in their efforts to improve their capital productivity in the medium to long term and regain the strong management capabilities to enable them to compete globally. Furthermore, with the growing focus on ESG, the Code is essential to ESG disclosure, as an appropriate corporate governance system is expected to encourage appropriate information disclosure, including on ESG.

As Table 1 reports, Japan's Corporate Governance Code consists of five general principles. Since this study focuses on ESG-related information disclosure, the most relevant part of the Code is General Principle 3 (Ensuring Appropriate Information Disclosure and Transparency). General Principle 3 states that “[c]ompanies should disclose the appropriate information in compliance with the relevant laws and regulations, but should also strive to actively provide information beyond that required by law.” In particular, Supplementary Principle 3.1.3 argues that “companies listed on the Prime Market should collect and analyze the necessary data on the impact of climate change-related risks and earnings opportunities on their business activities and profits and enhance the quality and quantity of disclosure based on the TCFD recommendations, which are an internationally established disclosure framework, or an equivalent framework.” Thus, Japan's Corporate Governance Code calls for the proactive disclosure of non-financial information, including ESG-related information, by companies.

The application of the Code differs depending on the listing category. A TSE 1<sup>st</sup> or

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<sup>8</sup> The Financial Services Agency also encourages companies to enhance their disclosure beyond formal compliance with the rules. For more details, see Financial Services Agency (2019).

<sup>9</sup> Japan's Corporate Governance Code was established in 2015 and revised in 2018 and 2021. In the 2021 revision, one of the main changes was to address the issues surrounding sustainability. For example, climate change must be recognized as an important management issue that not only reduces risk but also leads to profit opportunities, and must be addressed proactively.

2<sup>nd</sup> Section-listed company must explain if it violates any principle of the Code, while a Mothers or JASDAQ-listed company must explain if it violates any general principle. According to Tokyo Stock Exchange (2019), as of July 2019, in the TSE 1<sup>st</sup> Section (2,148 companies), 21.3% (457 companies) complied with the full principles and 65.4% (1,404 companies) complied with 90% or more of the principles. In the TSE 2<sup>nd</sup> section (488 companies), only 1.2% (six companies) complied with the full principles, but 61.7% (301 companies) complied with 90% or more of the principles. This indicates that listed companies are moving toward compliance with the Code.

### **C. Japan's Stewardship Code**

Japan's Stewardship Code was established in 2014 and revised in 2017 and 2020. As stated by the Council of Experts on Japan's Stewardship Code (2020, p. 5), "[t]his Code defines the principles considered to be helpful for institutional investors who behave as responsible institutional investors in fulfilling their stewardship responsibilities with due regard both to their clients and beneficiaries and to investee companies." The significance of the Code is that it defines the duty of loyalty owed by agents (institutional investors) to their true shareholders (or beneficiaries in the case of pension funds and mutual funds) as principals. As a result, institutional investors should exercise their voting rights for the benefit of beneficiaries and trustees. In addition, they must now engage in constructive dialogue to enhance the firm value and capital efficiency of investee companies and promote their sustainable growth.

Table 2 provides the principles of Japan's Stewardship Code. The most recent revision in 2020 responded to sustainability issues, including ESG factors. Several principles, mainly Principles 3 and 4, are directly or indirectly related to sustainability. For example, Principle 3 states that institutional investors should monitor investee companies to encourage their sustainable growth, including their governance, strategy, performance, capital structure, business risks, and opportunities (including the risks and opportunities arising from social and environmental matters). According to Principle 4, institutional investors are expected to share a common understanding with investee companies and work to solve problems through constructive engagement<sup>10</sup>. In this process, companies must disclose information on sustainability issues, including ESG information, in an appropriate manner. When information disclosure by companies is

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<sup>10</sup> Guidance 4-2, which is considered to be the most relevant to ESG disclosure, states that "[w]hen they engage in sustainability issues, institutional investors should consciously engage in dialogue that is consistent with their investment management strategies and that leads to a medium- to long-term increase in firm value and the sustainable growth of companies."



lacking, institutional investors are expected to make the necessary efforts to encourage companies to disclose ESG information.

Japan's Stewardship Code is not legally binding and takes the form of a so-called soft law. Specifically, institutional investors who support and are prepared to accept the Code are expected to publicly disclose their intention. In addition, the Code is characterized by a principle-based approach and a "comply or explain" policy (comply with the principles or explain why not). In particular, the application of each principle of Japan's Stewardship Code is designed to allow institutional investors to respond flexibly according to their conditions and situations. The number of institutional investors accepting Japan's Stewardship Code has risen steadily. As of April 30, 2021, 307 institutional investors had notified the Financial Services Agency of their intention to accept the Code, comprising 199 investment managers, 66 pension funds, 24 insurance companies, and six trust banks<sup>11</sup>.

### **III. Literature Review and Hypotheses Development**

#### **A. Literature Review**

With society's growing focus on ESG-related activities and their disclosure, many studies have been conducted of the relationship between corporate governance and ESG-related information disclosure. In the following, we review the content of both overseas and Japanese studies, focusing on recent publications.

##### **1. Previous studies in other countries**

First, overseas research on the relationship between corporate governance and ESG-related information disclosure has been conducted since the early 2000s. The relevance of specific variables related to ESG-related information disclosure is discussed in Section III.B, and this literature review focuses on recent survey papers and major papers reviewed in previous studies in this area. First, Velte (2017) reviews studies of the link between board composition and ESG-related information disclosure. This literature review evaluates 47 empirical studies of the influence of board composition on the quantity and quality of ESG disclosure. In addition, Velte (2020) surveys 81 empirical studies of the relationship between ownership structure and ESG-related information disclosure. Fifka (2013) examines the determinants of ESG disclosure in 186 studies. Most of these studies empirically investigate the determinants of responsibility reporting and examine whether corporate characteristics such as size and industry and external factors such as stakeholder pressure influence ESG disclosure. The results indicate that

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<sup>11</sup> For more details, see Council of Experts on Japan's Stewardship Code (2021).

researchers from different regions are taking different empirical research routes, but they do not suggest that specific determinants have different effects on ESG disclosure.

Haniffa and Cooke (2005) argue that corporate governance and cultures may affect social disclosures. Velte (2017, p. 24) notes that “[m]any studies rely on Haniffa and Cooke (2005) as one of the first empirical studies worldwide that recognizes the link between board composition and corporate social responsibility reporting.” The empirical results of Haniffa and Cooke (2005) indicate a significant relationship between corporate social disclosure and boards dominated by executive directors, chairs with multiple directorships, and foreign share ownership. Rupley, Brown, and Marshall (2012) examine the associations among specific aspects of corporate governance, media coverage, and the quality of voluntary ESG-related information disclosure. Using a sample of 127 U.S. firms from 2000 to 2005, the results suggests that voluntary ESG-related information disclosure is positively associated with external media coverage as well as the board attributes of independence, diversity, and expertise. Khan, Muttakin, and Siddiqui (2013) also examine the relationship between corporate governance and CSR disclosures in the annual reports of Bangladeshi companies. The results suggest that public ownership, foreign ownership, board independence, and the presence of an audit committee have positive and significant impacts on CSR disclosures. In summary, the body of global research on the relation between corporate governance and ESG-related information disclosure is vast.

## **2. Previous studies in Japan**

In Japan, fewer studies of the disclosure of ESG-related information focus on its relevance to corporate governance. For example, Kimura and Omori (2016) point out that fewer studies analyze the determinants of ESG disclosure in Japan than in other countries. As mentioned by Kimura and Omori (2016), Tanimoto and Suzuki (2005) and Hayashi (2014) both analyze the determinants of ESG-related information disclosure for Japanese companies. Tanimoto and Suzuki (2005) examine 300 Japanese companies and find that those that disclosed sustainability reports in accordance with the Global Reporting Initiative (GRI) were large, belonged to specific industries such as the energy industry, had high foreign shareholdings, and had high overseas sales. Hayashi (2014) also examines the relationship between firms’ characteristics and ESG disclosure using cross-sectional data from FY2012 for approximately 200 large Japanese companies, finding that characteristics such as overseas sales, size, profitability, and growth potential affect ESG disclosure.

However, no recent studies in Japan have directly examined corporate governance and ESG-related information disclosure. Although not related to ESG disclosure, Motta

and Uchida (2018) do examine the relationship between ESG ratings and the investor-specific ownership of companies, an aspect of corporate governance, in Japanese firms. The analysis finds that institutional ownership is positively associated with the probability of subsequent improvement in the environmental rating of Japanese companies and that this result is pronounced for domestic institutional investors registered with the Principles for Responsible Investment. Saka and Noda (2013) examine the influence of stakeholders on CSR disclosure for a sample of over 180 listed Japanese companies and find that the informational needs of external stakeholders such as the governments, creditors, consumers, and local residents encourage companies to disclose CSR information, while internal stakeholders have no influence on CSR disclosure. In a recent study, Miyamoto and Sato (2019) examine the corporate governance and ESG-related behaviors<sup>12</sup> of more than 1,500 Japanese companies. They point out that the traditional governance structure of Japanese companies, which is insider- or manager-dominated, does not lead to ESG behaviors, whereas the introduction of independent directors does.

Several issues have been pointed out in previous studies. For example, Velte (2020) emphasizes the need to use a more flexible model to examine the relationship between corporate governance and ESG disclosure, since many studies have adopted linear regression models despite the possibility of a non-linear relationship between the two. Velte (2020) also points out that it is desirable to subdivide institutional investor holdings, which are employed as explanatory variables.

## **B. Hypotheses Development**

This study analyzes the relevance of ESG-related information disclosure from the perspective of both internal and external governance. As shown in Figure 1, internal governance factors include indicators related to board composition as group-level governance, whereas external governance factors include indicators of the ownership structure as firm-level governance. We selected the specific external and internal governance variables based on the corporate governance factors that are considered significant in the corporate governance code as well as the results obtained in previous studies. For example, internal governance variables such as gender, age, and appropriate size were identified as important elements in the corporate governance code from the perspective of ensuring board effectiveness and fulfilling its roles and responsibilities. In this study, based on previous studies and considering the data limitations, no corporate governance factors at the individual level or institutional level<sup>13</sup> are included in the

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<sup>12</sup> ESG-related behaviors include the establishment of a CSR committee, the presence of a CSR officer, and disclosure in accordance with the GRI Standards.

<sup>13</sup> Studies have analyzed the elements of corporate governance included at the institutional level in

analysis.

### 1. Internal governance factors<sup>14</sup>

Boards of directors typically oversee the actions and decisions of firms' managers. However, Jensen and Meckling (1976) state that external members are needed to monitor and control the behavior of internal directors to mitigate their opportunistic behaviors. In relation to ESG-related information disclosure, Rao, Tilt, and Lester (2012) examine the relationship between the proportion of independent directors and extent of ESG reporting by the largest 100 Australian firms and supports the positive relationship between the two. Webb (2004) finds that socially responsible firms have more effective board structures such as more outsiders and women directors. Japan's Corporate Governance Code also requires boards to disclose appropriate information, although this is not limited to independent directors<sup>15</sup>. For example, Tokyo Stock Exchange (2018, p. 13) observes that "non-financial information, such as financial standing, business strategies, risks and ESG matters, is often boiler-plate and lacking in detail, therefore less valuable. The board should actively commit to ensure that disclosed information, including non-financial information, is as valuable and useful as possible." Based on these discussions, we propose

**H1a.** Independent board of director representation is positively associated with the voluntary disclosure of ESG-related information.

The gender diversity of a board might affect its decisions and activities. For example, as highlighted by Adams and Ferreira (2009, p. 307), "the gender composition of the board is positively related to measures of board effectiveness. Female directors appear to have a similar impact as the independent directors described in governance theory do."

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terms of the norms, values, and culture at the country level. For more details, see, for example, Miras-Rodríguez, Martínez-Martínez, and Escobar-Pérez (2019).

<sup>14</sup> Several variables related to internal governance such as the ratio of independent directors and ratio of female directors vary according to firms' characteristics, as shown by Saito (2015). In addition, firms' characteristics affect ESG disclosure. In such cases, the presence of unobservable firm characteristics makes it impossible to distinguish whether a correlation between internal governance and ESG disclosure is a causal effect of internal governance on ESG disclosure or a false correlation caused by unobservable firm characteristics, even if a correlation is found. In this study, these issues are addressed as much as possible by using control variables, but it is necessary to recognize this as one of the issues to be considered.

<sup>15</sup> In addition to Japan's Corporate Governance Code, another systemic change related to independent directors was the introduction of audit and supervisory committees in companies following the revision of the Companies Act in 2014. As a result of this amendment, in principle, all listed companies are required to appoint independent directors. In recent years, an increasing number of companies have established an audit and supervisory committee to comply with the new regulations while limiting the number of directors.

This increased diversity in the board of directors is expected to increase the independence of the board and result in more stakeholder-conscious decision-making. For example, Carter, Simkins, and Simpson (2003, p. 37) argue that “diversity increases board independence because people with a different gender, ethnicity, or cultural background ask questions that would not come from directors with traditional backgrounds. In other words, a more diverse board might be a more activist board because independent directors with nontraditional characteristics could be considered the ultimate outsider.” From another perspective, Adams and Ferreira (2009) point out the better attendance records of female directors than that of male directors and proactive participation in monitoring committees by female directors. Regarding the link with ESG disclosure, Rao, Tilt, and Lester (2012) find a positive relationship between gender diversity and ESG-related information disclosure. Hence,

**H1b.** Gender diversity on the board of directors is positively associated with the voluntary disclosure of ESG-related information.

Halme and Huse (1997) and Cheng and Courtenay (2006) find no positive association between the number of board members and external focus of the firm. However, Velte (2017, p. 25) argues that “board size is a very common board composition variable with an unclear impact on CSR reporting from a theoretical perspective as indicated. However, the significant results are homogeneous in included studies for developing countries. Excluding the financial industry, a positive relationship is found.” Based on the discussion above, we propose

**H1c.** Board size is positively associated with the voluntary disclosure of ESG-related information.

Measuring the frequency of board or committee meetings as a proxy for board activity is a common practice in previous studies. Kent and Monem (2008) indicate that triple bottom line<sup>16</sup> reporting by Australian companies is significantly and positively related to the frequency of audit committee meetings. Therefore,

**H1d.** Board activity is positively associated with the voluntary disclosure of ESG-related information.

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<sup>16</sup> The “triple bottom line” is the idea that companies should not only focus on profits, but also on social and environmental considerations; this theory states that there should be three bottom lines: profit, people, and planet.

According to Velte (2017), age diversity is another factor that indicates board diversity. However, studies of age diversity are scarce compared with those on gender diversity. Handajani *et al.* (2014) examine the association between board age and ESG disclosure for public firms listed on the Indonesia Stock Exchange, observing that “board age showed a positive effect on corporate social disclosure. [...] These findings indicate that domination of generation differences on board influence on differences in decision making strategies” (p. 12). Therefore,

**H1e.** Age diversity on the board of directors is positively associated with the voluntary disclosure of ESG information.

## **2. External governance factors**

Foreign investors have different cultures and values from domestic investors as well as diverse experiences and expertise from working in different environments; therefore, they can observe and suggest to management how to improve the firm’s value and reputation. From another point of view, as foreign investors tend to make various demands on investees to improve investment returns, companies with higher foreign shareholding ratios are more likely to receive strong demands from shareholders. In terms of the spread of ESG investment, Japan lags relatively far behind that of other countries<sup>17</sup>. Therefore, an increase in the percentage of foreign investor holdings is expected to encourage the greater disclosure of ESG-related information. Previous studies such as Haniffa and Cooke (2005) find a positive and significant relationship between foreign ownership and ESG-related information disclosure. In addition, Oh, Chang, and Martynov (2011) examine the effects of foreign ownership on firms’ CSR in the sample of 118 large Korean firms and find a significant and positive relationship. Previous studies in Japan such as Tanimoto and Suzuki (2005) also find a significant and positive relationship between foreign ownership and ESG disclosure. Hence,

**H2a.** Foreign investors’ equity shareholdings are positively associated with the voluntary disclosure of ESG-related information.

Since ESG-related information includes important factors that affect a firm’s finances in the medium to long term, institutional investors are highly interested in such information that aids investment decision-making. Institutional investors actively

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<sup>17</sup> Arao, Shimizu, and Ogawa (2020) find that while the signing of the Principles for Responsible Investment by the GPIF in 2015 triggered the expansion of ESG investment in Japan, some areas have not been developed in the subsequent five years in terms of the awareness of the purpose of ESG investment, investment policies, and systems compared with in the United States and Europe.



participate in board meetings to create value for their shareholders. They are thus considered to be powerful stakeholders because they generally own large amounts of stock and have significant voting power. As agency theory<sup>18</sup> suggests, institutional investors can closely monitor management and encourage them to disclose more information, including ESG-related information. They can also influence an organization's environmental policies and strategic impact by taking control of the board and appointing experienced and resourceful directors. A number of researchers such as Harjoto and Jo (2011), Oh, Chang, and Martynov (2011), and Saleh, Zulkifli, and Muhamad (2010) have found a significant positive relationship between institutional ownership and ESG disclosure, suggesting that institutional investors have a significant influence on the decisions of organizations that impact society and the environment. Velte (2020, p. 288) also finds "[a] positive impact of the institutional ownership ratio on ESG disclosure, integrated reporting, and carbon disclosure." Therefore,

**H2b.** Institutional investors' equity shareholdings are positively associated with the voluntary disclosure of ESG-related information.

Insiders, the managers and directors of the company, play an important role on the board of directors regarding the operation and strategic decision-making of the organization. Insiders, the agents of the owner, can have agency conflicts because of their desire to pursue personal benefits or opportunities. Because insiders are motivated by short-term investments, they tend to be reluctant to invest in social and environmental projects or disclose ESG-related information. Some previous studies find a negative relationship between insider ownership and disclosure practice. For example, Oh, Chang, and Martynov (2011) find that a large insider shareholding encourages them to exercise greater power for their own financial benefits and interests rather than to maximize shareholder wealth. Hence,

**H2c.** Insider equity shareholdings are negatively associated with the voluntary disclosure of ESG-related information.

The GPIF invests large amounts of money and diversifies its investments widely across capital markets. In addition, the pension funds managed by the GPIF are used to ensure that the burden of insurance premiums on the future working-age population does

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<sup>18</sup> Agency theory is based on the principal-agent relationship in which one or more people (principal) authorize another person (agent) to act on their behalf. In this relationship, the principal provides the agent with appropriate incentives and bears the cost of monitoring the agent's behavior, thereby restricting the agent from acting against its interests. For more details, see Jensen and Meckling (1976).

not become too large. To earn stable profits, the value of the companies in which it invests must increase in the long term and capital markets must grow sustainably and stably. Moreover, since capital markets cannot escape the impact of environmental and social problems in the long term, reducing the negative impact of these problems on capital markets is essential to the sustainable pursuit of investment returns<sup>19</sup>. Therefore,

**H2d.** GPIF equity shareholdings are positively associated with the voluntary disclosure of ESG-related information.

## IV. Research Design

### A. Sample Design and Data Collection

To examine a large number of firms, this study analyzes those firms that make up the Tokyo Stock Price Index (TOPIX) as of the end of FY2019. Some previous studies<sup>20</sup> in Japan have focused on the firms in Nikkei Stock Average (Nikkei 225) constituent stocks because ESG-related information disclosure is concentrated in large firms. The analysis period runs from FY2011 to FY2019<sup>21</sup>. However, the model that includes the GPIF<sup>22</sup> as an explanatory variable runs from FY2015 to FY2019 because of data constraints. The extension of the sample in both the time series and the cross-sectional directions is one of the strengths of this study compared with previous studies in Japan.

As proxy variables for ESG-related information disclosure, we use dummy variables for whether GRI Standards-based ESG disclosures are made. The dependent variable of  $GRI_{i,t}$ , which indicates that disclosures are made based on the GRI Standards, is hand-collected from the GRI's Sustainability Disclosure Database<sup>23</sup>. The dependent variable of  $GRI\_Citing_{i,t}$ <sup>24</sup>, which indicates partial reference to the GRI Standards elements in ESG-

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<sup>19</sup> For more details on ESG investment by the GPIF, see Government Pension Investment Fund (2020).

<sup>20</sup> For instance, Hayashi (2014) analyzes Nikkei 225 companies excluding the financial sector.

<sup>21</sup> Although how a policy such as the introduction of the Japan's Corporate Governance Code affects ESG disclosure could be analyzed by subdividing the sample by time period, the analysis is conducted using the sample for the entire time period, as the focus of this study is not on identifying the impact of a specific policy.

<sup>22</sup> As mentioned in Section III.A, one of the issues pointed out in previous studies is adding the breakdown of institutional investors as an explanatory variable. In this study, we address this issue by examining the GPIF, a major pension fund manager.

<sup>23</sup> The report type of the GRI Standards has developed from G1 (published in 2000) to those published in 2016 and currently valid. This study targets the disclosure based on G3.1 (published in 2011), G4 (published in 2013), and the Standards. To ensure a certain sample size, the adherence level, which reflects the extent to which the GRI Standards have been applied to a report, is not considered.

<sup>24</sup> According to Global Reporting Initiative (2019), Citing-GRI represents "[s]ustainability/integrated reports that make specific reference to Standards elements (e.g. contain a GRI Content Index or claim) but do not meet the requirements set out by the GRI Standards or reports that make reference to being based on the GRI Guidelines (G3, G3.1, and G4) outside the expiry date of the respective Guidelines



related information disclosure, and other variables such as corporate governance-related variables and controls are obtained from Bloomberg<sup>25</sup>. Table 4 shows the industry classification of the sample by TOPIX 17 series.

Figure 2 compares the characteristics of the GRI Standards with those of other ESG disclosure standards. The disclosure standards and frameworks for ESG-related information are categorized into four types based on two perspectives: (1) whether to focus on the financial impact or social impact and (2) whether to focus on standardized indicators or descriptive information such as strategies and business models<sup>26</sup>. According to this classification framework, the GRI Standards focus on the social impact and standardized indicators rather than the financial impact and descriptive information.

This study adopts disclosure based on the GRI Standards as a proxy variable for ESG-related information disclosure for several reasons<sup>27</sup>. One is that, as of April 2020, 3,281 organizations worldwide referred to the GRI Standards, making them the de facto international standard (Global Reporting Initiative [2020]). In academia, the GRI Standards are also highly regarded by researchers and practitioners for their reliability, transparency, and comparability (Fernández-Gago, Cabeza-García and Nieto [2018]). In Japan, KPMG Japan (2020) shows that the GRI Standards account for 90% of the guidelines and standards adopted in sustainability reporting. For these reasons, this study adopts disclosure based on the GRI Standards as a proxy for ESG-related information disclosure.

## **B. Logistic Regression Model**

First, we test our hypotheses on the determinants of ESG-related information disclosure using logistic regression as our baseline model. To address reverse causality, the explanatory variables except the control variables are lagged by one period<sup>28</sup>. The external factors are estimated using separate regression models. The specific regression equation is as follows:

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version.”

<sup>25</sup> See Table 3 for the details and sources of the variables.

<sup>26</sup> For more details, see Government Pension Investment Fund (2019).

<sup>27</sup> Previous studies such as Hayashi (2014) and Legendre and Coderre (2013) adopt GRI Standards-based disclosure as a proxy variable for ESG disclosure.

<sup>28</sup> The problem of simultaneity is another factor that causes endogeneity; however, in many previous studies, this problem is overcome to a certain extent by lagging the explanatory variable by one period relative to the dependent variable.

$$\begin{aligned}
\Pr(GRI_{i,t}) = & \beta_0 + \beta_1 Independence_{i,t-1} + \beta_2 Gender_{i,t-1} + \beta_3 BD_{Size_{i,t-1}} \\
& + \beta_4 BD\_Activity_{i,t-1} + \beta_5 Age\_Diversity_{i,t-1} \\
& + \beta_6 Foreign\_Ownership_{i,t-1} + \beta_7 Institutional\_Ownership_{i,t-1} \\
& + \beta_8 Insider\_Ownership_{i,t-1} + \beta_9 GPIF_{i,t-1} + Controls + D\_YEAR \\
& + D\_INDUSTRY + \varepsilon_{i,t}
\end{aligned}$$

$GRI_{i,t}$  is a binary variable coded 1 for companies that disclose ESG information based on the GRI Standards and 0 for companies that do not.  $GRI\_Citing_{i,t}$ , which is coded 1 for companies that disclose ESG information by referring to the GRI Standards elements and 0 for companies that do not, is used instead of  $GRI_{i,t}$  to analyze the determinants of the ESG disclosure of firms that disclose a relatively large amount of ESG information. As shown in Table 4,  $GRI_{i,t}(=1)$  accounts for a small (less than 3%) proportion of the total sample, making it desirable to conduct a complementary analysis for  $GRI\_Citing_{i,t}$ <sup>29</sup>. Table 5 and Table 6 respectively show the descriptive statistics and correlations.

### C. Machine Learning: Generalized Additive 2 Model

In our analysis, we use the generalized additive 2 model (GA2M)<sup>30</sup>, a type of machine learning approach, to handle the large number of variables and complex structures. The GA2M features both high predictive accuracy with complex models and the high interpretability of the estimation results. Although commonly known machine learning methods such as random forests, support vector machine, and neural networks can build complex models and achieve high predictive accuracy, they cannot interpret the relationship between the explanatory variables and dependent variables in detail owing to their complexity. Hence, using the GA2M provides a more intuitive interpretation of which explanatory variables affect the dependent variable.

In the GA2M, a non-linear function is first estimated for each explanatory variable. The non-linear function is the key factor to the GA2M's combination of high predictive accuracy and interpretability because it incorporates the complex effects of each explanatory variable on the dependent variable into the model; at the same time, it separates the relationship between an explanatory variable and the dependent variable from that with the other explanatory variables. In addition, the GA2M not only uses the input explanatory variables, but also adds the interaction terms of the explanatory

<sup>29</sup> In some cases, over-sampling or under-sampling is used as a sample adjustment in research on machine learning, especially when the emphasis is on predicting the dependent variable. In this study, we do not make such sample adjustments because we are primarily interested in the association between the explanatory variables and dependent variable.

<sup>30</sup> InterpretML (version 0.2.4), an implementation in Python developed by Microsoft Research, is used to estimate the GA2M. For more details, see the Appendix and Sameki, Bird, and Walker (2020).

variables (the product of two explanatory variables) as new explanatory variables to account for complex effects and improve the predictive accuracy of the model. As mentioned in Section III.A, using the GA2M can thus overcome the limitations of linear regression<sup>31</sup>. For example, external governance variables, institutional investor ratio, and foreign investor ratio may have a non-linear relationship with ESG disclosure, such that the probability of disclosure does not proportionally with an increase in the same ratios, but rather rapidly once a certain threshold is exceeded. Therefore, GA2M is considered to be an effective analytical method.

## V. Empirical Results

### A. Logistic Regression Model: Baseline Results

Table 7 reports the results of the logistic regression model. Models (1) to (4) are the estimation results of the model using  $GRI_{i,t}$  as the dependent variable and models (5) to (8) are the results of the model using  $GRI\_Citing_{i,t}$  as the dependent variable. First, looking at the estimation results for the variables related to the internal governance factors, in models (1) to (4), only  $BD\_Activity_{i,t}$  is positive and statistically significant at the 1% or 5% level, whereas little statistical significance is found for the other variables,  $Independence_{i,t}$ ,  $Gender_{i,t}$ ,  $BD\_Size_{i,t}$ , and  $Age\_Diversity_{i,t}$ . The results of models (5) to (8) show that in addition to  $BD\_Activity_{i,t}$ ,  $Independence_{i,t}$  and  $Age\_Diversity_{i,t}$  are statistically significant at the 1% level and that the signs of their coefficients are positive and negative, respectively. For  $Age\_Diversity_{i,t}$ , although we hypothesize that a larger age range on the board of directors leads to greater diversity, more consideration of ESG issues from various perspectives, and consequently greater ESG disclosure, the opposite seems to be true for Japan.

Next, looking at the estimation results for the variables related to the external governance factors, in models (1) to (4),  $Foreign\_Ownership_{i,t}$ ,  $Institutional\_Ownership_{i,t}$ , and  $GPIF_{i,t}$  are positive and statistically significant at the 1% or 5% level. For  $Insider\_Ownership_{i,t}$ , the results are negative and statistically significant at the 1% level. These results are in line with our hypothesis. Looking at the estimation results of the model using  $GRI\_Citing_{i,t}$ , except for  $Insider\_Ownership_{i,t}$ , which is statistically significant at the 10% level, the other three variables are not significant.

The regression results of both  $GRI_{i,t}$  and  $GRI\_Citing_{i,t}$  suggest that external factors influence a limited number of companies that disclose ESG-related information

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<sup>31</sup> Using the GA2M, Hattori (2020) examines the relationships among human mobility, the government's policy response, and COVID-19 infection status.

based on the GRI Standards, but not those that only refer to the GRI Standards elements. Indeed, the coefficients of the internal factors of the  $GRI\_Citing_{i,t}$ -based model are generally larger for most of the variables, including  $Independence_{i,t}$  and  $BD\_Activity_{i,t}$ , which are statistically significant. This suggests that for companies that only refer to the GRI Standards elements, internal factors affect ESG disclosure markedly, while the impact of external factors is limited.

For the control variables, the results are generally similar to those of previous studies in terms of sign and statistical significance. For example,  $SIZE$  is positive and statistically significant at the 1% level, inferring that larger companies have more management resources and therefore are more proactive in ESG disclosure. On the contrary,  $ROA$  is negative and statistically significant at the 1% level: companies with higher profitability are sufficiently evaluated by investors without ESG disclosure. Finally,  $MB$ , a proxy variable for corporate growth potential, is negative and statistically significant at the 1% level. One interpretation is that companies with high growth potential do not actively disclose ESG information because they invest management resources in their core business.

Table 8 presents the logistic regression results of the industry dummy variables. As previous studies such as Rupley, Brown, and Marshall (2012) and Hayashi (2014) indicate, industry may be relevant to ESG disclosure. For example, firms in highly polluting industries including the chemical and oil and gas sectors are more likely to disclose ESG information. This is because firms that may damage the environment are more strongly required to disclose ESG information by stakeholders. In addition, from the perspective of the firm's brand, it is more important for them to be seen to be environmentally conscious. From another perspective, the manufacturing industry, which is close to final consumers, such as automobile and transportation equipment and electric appliances precision instruments, is also proactive in ESG disclosure. Table 8 shows that the empirical results of this study are similar to those of previous studies.

## **B. Results of the Generalized Additive 2 Model**

To evaluate the estimation results of the GA2M, we first identify the important explanatory variables (Figure 3) and then interpret their relationships with the dependent variable (Figure 4 to Figure 6). Taking the absolute value of the risk score<sup>32</sup> of each explanatory variable and calculating the average indicate the extent to which each significantly affects ESG disclosure based on the GRI Standards on average. In the

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<sup>32</sup> The risk score is calculated from the explanatory variables using a non-linear function in the GA2M and used to predict the explained variable. The sum of the risk scores can be converted into a probability of taking a value between 0 and 1 using the logistic function.

GA2M analysis, the dependent variable is  $GRI_{i,t}$  except for in Figure 3, and the explanatory variables are the same as in the logistic regression model. Since the GPIF is included as one of the explanatory variables, the estimation period runs from FY2015 to FY2019. The explanatory variables are again lagged by one period.

Looking at the highly important variables with GRI as the explained variable, except for the controls, the variables related to external governance factors such as  $Insider\_Ownership_{i,t}$ ,  $GPIF_{i,t}$ , and  $Foreign\_Ownership_{i,t}$  rank relatively high. Next, the variables related to internal governance factors such as  $BD\_Size_{i,t}$ ,  $Independence_{i,t}$ ,  $Age\_Diversity_{i,t}$ , and  $BD\_Activity_{i,t}$  are ranked as important, although their importance is lower than that for the variables related to external governance factors.

In addition to these single variables, multiple interaction terms are ranked as variables of high importance following Zaid, Abuhijleh, and Consuelo (2020)<sup>33</sup>. In this analysis, the cross-terms between the corporate governance variables are not selected as important variables. Turning to the high importance variables with GRI-Citing as the explained variable, in contrast to the result with GRI as the explained variable, external factors such as  $GPIF_{i,t}$  and  $Institutional\_Ownership_{i,t}$  are not selected as highly important. This is consistent with the fact that many of the variables related to external factors were not statistically significant in the logistic regression analysis. However,  $Foreign\_Ownership_{i,t}$  was not statistically significant in the logistic regression, while it is ranked as relatively highly important in the GA2M analysis. The logistic regression may not capture these relationships well when non-linear relationships exist between the variables and this factor may have influenced the results. Further, the magnitude of the impact of an explanatory variable on the explained variable is a different criterion to be captured.

Figure 4 reports the relationship between each explanatory variable related to the internal governance factors and the probability of ESG disclosure based on the GRI Standards. Specifically, the value of each explanatory variable indicates the extent of the impact on ESG disclosure based on the GRI Standards. In the GA2M, if the risk score is close to zero, it means that there is no effect on ESG disclosure based on the GRI Standards; if it is positive, it means that the probability of ESG disclosure increases; and if it is negative, it means that the probability decreases.

Looking at the results for  $Independence_{i,t}$ , in the range of 5% to 20%, where a

<sup>33</sup> Zaid, Abuhijleh, and Consuelo (2020) suggest that the effect of government, institutional, and foreign investors on CSR disclosure is more positive under high board independence. In this GA2M estimation, excluding the cross-terms between the control variables, we find that the intersection term of insider ownership and size is highly important.

certain number of samples can be secured, as also suggested by the positive coefficient in the logistic regression analysis, the probability of ESG disclosure based on the GRI Standards rises as  $Independence_{i,t}$  increases. However, there is a discontinuous decrease in the risk score when  $Independence_{i,t}$  exceeds about 23%. This percentage is close to the average ratio of independent directors in companies listed on the TSE 1<sup>st</sup> Section, which indicates a step change in the relevance of ESG disclosure around the average value. To summarize, the relationship between board independence and ESG disclosure is rather negative in the GA2M analysis, contrary to our hypothesis and making the relationship between board independence and ESG disclosure unclear. Similarly, Saito (2016) finds an inverse U-shaped relationship between the ratio of outside directors and board efficiency based on the idea that the optimal ratio of independent directors differs depending on the growth stage of a company<sup>34</sup>. A similar relationship between the ratio of outside directors and ESG disclosure might exist, which would imply that the empirical results could be similar to those presented here. Nonetheless, the relationship between the ratio of outside directors and ESG disclosure needs to be analyzed more in depth in future work.

The results for  $Gender_{i,t}$  are also difficult to evaluate because most of the samples are concentrated near 0%. Looking at the 5–15% range, which holds a relatively large sample, shows that as  $Gender_{i,t}$  increases, the probability of ESG disclosure based on the GRI Standards rises. However, as the proportion of female directors in Japanese companies rises further, it will be necessary to conduct a further analysis using a sufficient sample size.

The results for  $BD\_Size_{i,t}$  show that in the 0–20 range, where there is a relatively large sample, the probability of ESG disclosure based on the GRI Standards tends to increase up to 10 directors; however, as the number of directors increases further, the probability decreases. This non-linear relationship between the two is also consistent with the fact that  $BD\_Size_{i,t}$  does not reach statistical significance in the logistic regression analysis. One interpretation of this result is that increasing the number of directors to a certain number has a positive effect on ESG disclosure because of the increased diversity of the larger board. However, increasing the number past this threshold reduces this effect, leading to a negative effect in some cases. This suggests an inverse U-shaped non-linear relationship between ESG disclosure and  $BD\_Size_{i,t}$ .

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<sup>34</sup> For example, Saito (2016) indicates that large, mature companies tend to have abundant cash reserves due to limited investment opportunities and that it is desirable to have a high proportion of independent directors to prevent management from squandering this cash. On the contrary, in emerging companies, the proportion of independent directors should be low, as management is unlikely to waste the cash.



For  $BD\_Activity_{i,t}$ , except for 20 or more board meetings per year for which the sample size is extremely small, the probability of ESG disclosure based on the GRI Standards rises as the number of meetings increases. This is consistent with the results of the logistic regression analysis.

Finally, for  $Age\_Diversity_{i,t}$  at a the range excluding age differences of 10 years or less and 30 years or more, which have large standard errors, the probability of ESG disclosure based on the GRI Standards decreases slightly as the age difference increases. This finding is also consistent with the logistic regression results. However, the link between age diversity and ESG disclosure is typically limited and considered to be weak.

Figure 5 reports the relationship between each explanatory variable related to the external governance factors and the probability of ESG disclosure based on the GRI Standards. The results for  $Foreign\_Ownership_{i,t}$  show that the impact on the probability of ESG disclosure based on the GRI Standards becomes positive around 15% and that the probability increases as the ratio rises thereafter up to about 25%. However, above 25%, the probability of ESG disclosure based on the GRI Standards is unchanged even as the ratio of  $Foreign\_Ownership_{i,t}$  increases. This suggests that the impact of  $Foreign\_Ownership_{i,t}$  on the probability of ESG disclosure based on the GRI Standards rises proportionally to a certain value, while the additional impact almost disappears after that threshold is passed.

The results of  $Institutional\_Ownership_{i,t}$  show the same trend as that of  $Foreign\_Ownership_{i,t}$ . Again, the impact on the probability of ESG disclosure based on the GRI Standards becomes positive when the ratio of  $Institutional\_Ownership_{i,t}$  exceeds approximately 35% and thereafter the probability increases as the ratio rises to about 50%.

For  $Insider\_Ownership_{i,t}$ , although the sample is concentrated near 0% and therefore only a relatively small sample is available above 5%, the results suggest a relationship in which the probability of ESG disclosure based on the GRI Standards decreases as the ratio increases. This relationship is consistent with the results of the logistic regression analysis.

Finally, the results for the GPIF are also similar to those for foreign and institutional ownership, with different GPIF ratios having different effects on the probability of ESG disclosure based on the GRI Standards. That is, in a GPIF range of 3–6%, the probability of ESG disclosure based on the GRI Standards increases as the GPIF rises, while the probability remains almost unchanged even as the GPIF rises further.

As shown above, the results of the GA2M analysis on the external governance factors and ESG disclosure are generally in line with our hypotheses. However, they reveal a

non-linear relationship for many of the variables as well as a stepped relationship at a certain threshold. Similarly, McConnell and Servaes (1990) examine the relationships among insider ownership, institutional ownership, and Tobin's  $Q$ , pointing out that the sign of shareholder composition on Tobin's  $Q$  changes after a certain threshold. A similar relationship may exist in this study.

Figure 6 reports the relationship between the control variables and probability of GRI Standards-based disclosure. The results are generally consistent with those of the logistic regression analysis. However, for size, although the probability of ESG disclosure tends to increase as firm size grows, the GA2M analysis reveals a non-linear relationship between them.

## VI. Discussion and Conclusion

Research attention on ESG-related information disclosure has recently grown. Previous research in Japan has considered firms' financial performance and governance factors as drivers of ESG-related information disclosure. However, the majority of research has limitations in terms of small sample sizes and unsuitable analysis methods. To address these issues, this study uses a large sample of firms and analyzes both a logistic regression model and a GA2M, thereby providing valuable empirical evidence on the relationship between corporate governance factors (both internal and external) and ESG-related information disclosure for Japanese companies.

First, the results of the logistic regression analysis show that internal governance factors such as board independence and board activity are significant as hypothesized, suggesting that they influence a company's ESG disclosure; however, the results of the GA2M analysis show that internal governance variables are less important than external governance variables. The GA2M results also suggest that gender has a relationship with the probability of ESG disclosure, which rises as the proportion of female directors increases within a certain range. In addition, a board of about 10 people has the most positive effect on ESG disclosure and the probability of ESG disclosure decreases as the board size moves away from this number. However, the probability of ESG disclosure based on the GRI Standards is unrelated to the age diversity on the board.

For external governance factors, the logistic regression results show that all the explanatory variables (foreign ownership, institutional ownership, insider ownership, and the GPIF) are significant, suggesting that all four influence a company's ESG disclosure. Although the results of the GA2M are generally similar, non-linear relationships for institutional ownership and the GPIF are found. In addition, when  $GRI\_Citing_{i,t}$  is examined as the dependent variable, few of the explanatory variables become significant, suggesting that the effect of external governance depends on the extent of ESG disclosure.



However, the background to the relationship is unclear and future research is thus needed.

The results of these analyses suggest that the development of corporate governance frameworks such as Japan's Stewardship Code and Corporate Governance Code is encouraging companies to disclose ESG-related information. In other words, the strengthening of corporate governance systems in companies is likely to play a role in ESG disclosure as originally expected. We hope that companies will continue to accelerate the disclosure of appropriate ESG-related information and that the virtuous cycle between companies and investors will continue.

Although the present study makes significant contributions, it is not without its limitations. First, public attention on ESG-related information disclosure has increased recently, and more globally standardized and unified rules and regulations on ESG-related information disclosure may be introduced in the future<sup>35,36</sup>. It would thus be meaningful to observe the impact of such regulatory changes on the estimation results. In particular, ESG disclosure is not guaranteed by a third party because it is voluntary and differs by company. In this regard, using a dummy variable for ESG disclosure based on the GRI Standards or its elements is insufficient to measure the fullness of ESG disclosure. If global standards for ESG disclosure are unified and made mandatory, companies' ESG disclosure could change. Analysis from this perspective is also a topic for the future. Indeed, if ESG disclosure becomes mandatory for all companies, it would be necessary to analyze the relationship between disclosure quality and firms' characteristics such as corporate governance.

Second, this study does not examine governance factors at the institutional or individual level. In particular, expanding the sample of companies to be analyzed to include overseas companies as well as Japanese companies would make it necessary to add these factors as explanatory variables and conduct a more precise analysis. The influence of CEOs on management decisions including ESG disclosure, particularly in small and medium-sized companies, is high and it would therefore be meaningful to examine the relationship between such CEO characteristics and ESG disclosure. In addition, the corporate governance code mentions that for internal governance, characteristics such as international and work experiences are highly important from the

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<sup>35</sup> For example, as a move toward unifying the standards of ESG-related information disclosure, the International Financial Reporting Standards Foundation published a Consultation Paper on Sustainability Reporting in September 2020 to determine the need for global sustainability standards, whether the Foundation should play a role, and the scope of that role.

<sup>36</sup> In addition to the legal and accounting mandates, ESG disclosure by companies is expected to receive more media coverage in response to structural changes such as ESG investment's global expansion. Therefore, it is possible that corporate characteristics related to ESG disclosure have changed dynamically over time, and analysis is also expected to be conducted from this perspective.

perspective of board effectiveness, and additional analysis of these variables is also expected to be conducted.

Third, for the analysis of external governance factors, although the ratios of institutional investors and foreign investors are adopted as explanatory variables, it is desirable to conduct a more precise analysis. For instance, the variable of institutional investors refers to a wide range of investment strategies (e.g., active and passive management) and investment periods. In relation to ESG disclosure, it is thus important to consider such investment strategies and investment periods. For example, since the ESG activities of a company are generally considered to be related to its long-term performance, investors with a longer investment period are expected to be more involved in ESG disclosure. In this study, we could not conduct such an in-depth analysis due to data limitations; future research on this topic is thus encouraged.

## Appendix: Illustration of GA2Ms

GA2Ms, or *generalized additive models plus interactions*, consist of univariate terms and pairwise interaction terms<sup>37</sup>. Such models keep the additive structure (interpretability of the linear model) but make them more flexible and accurate. The overview of the GA2Ms algorithm is as follows.

1. The first step is to build the best additive model using only one-dimensional components. In this process, additive effects are modeled and only the interaction and noise are in the residuals if the step is conducted perfectly. Standard GAMs have the following form:

$$Y = \beta_0 + \sum f_j(x_j) \quad (A - 1)$$

Modern machine learning techniques, including bagging and gradient boosting, are used to learn each feature function  $f_j$ <sup>38</sup>.

2. The second step is to detect the pairwise interactions on the residuals<sup>39</sup>. Although interactions are added into the model, two-dimensional interactions can still be rendered as heat-maps of  $f_{ij}(x_i, x_j)$  on the two-dimensional  $x_i, x_j$ - plane. By adding an interaction, GAMs can be rewritten as the following form, which are called GA2Ms:

$$Y = \beta_0 + \sum_j f_j(x_j) + \sum_{i \neq j} f_{ij}(x_i, x_j) \quad (A - 2)$$

3. The third step is to sort the terms by importance and evaluate the overall performance and relationship between the explanatory variable and dependent variable. As with most machine learning methods, cross-validation is used to address overfitting and the hyper-parameters such as the number of pairwise interaction terms are optimized<sup>40,41</sup>.

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<sup>37</sup> For example, Caruana *et al.* (2015) apply GA2Ms in healthcare cases because they require high predictive accuracy as well as the interpretability of the results.

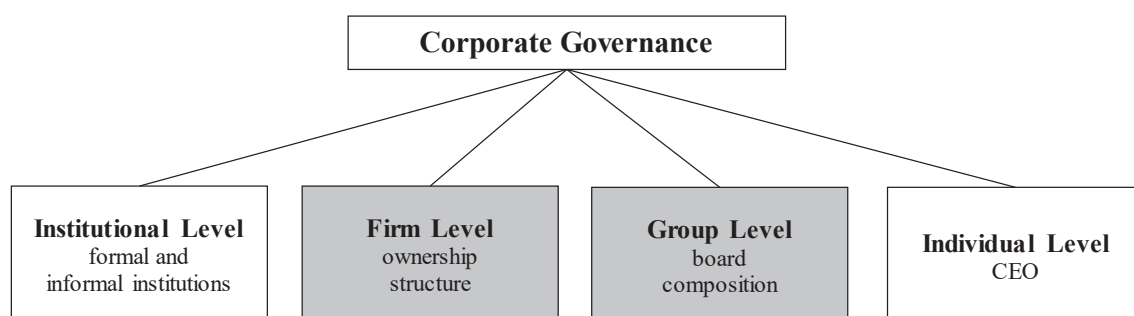
<sup>38</sup> According to Lou, Caruana, and Gehrke (2012), gradient boosting with ensembles of a shallow regression tree is the most accurate method.

<sup>39</sup> One of the main challenges in building GA2Ms is the large number of pairs of features to consider. It is thus necessary to include important interactions that pass a certain statistical test. To construct GA2Ms, a novel, extremely efficient method called “FAST” is applied to measure and rank the strength of the interaction of all pairs of variables. The approach selects the best interaction pair and includes it in the model until there is no rise in accuracy. For more details, see Lou *et al.* (2013).

<sup>40</sup> In this study, the number of interaction terms is tuned by grid search, while the others are set as default settings. The model is constructed by dividing all the samples into 70% training data and 30% test data, and then estimation is conducted for all the samples to calculate the importance of the features.

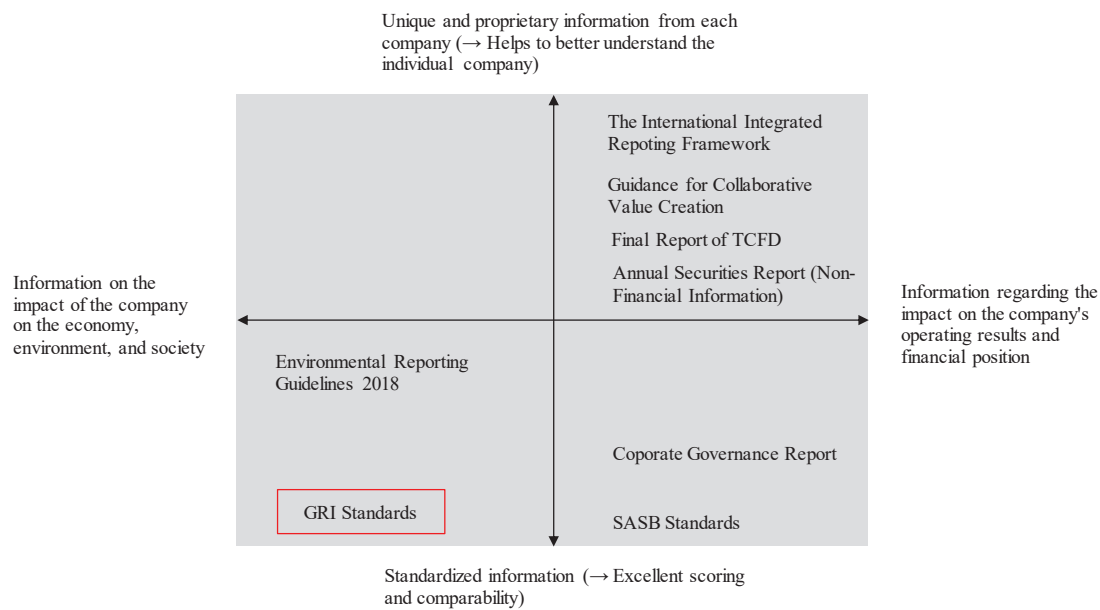
<sup>41</sup> For more details, see Lou, Caruana and Gehrke (2012).

**Figure 1 Breakdown of Corporate Governance**



Note: Prepared by the author based on Velte (2017). The shaded area is the element of corporate governance targeted in this study.

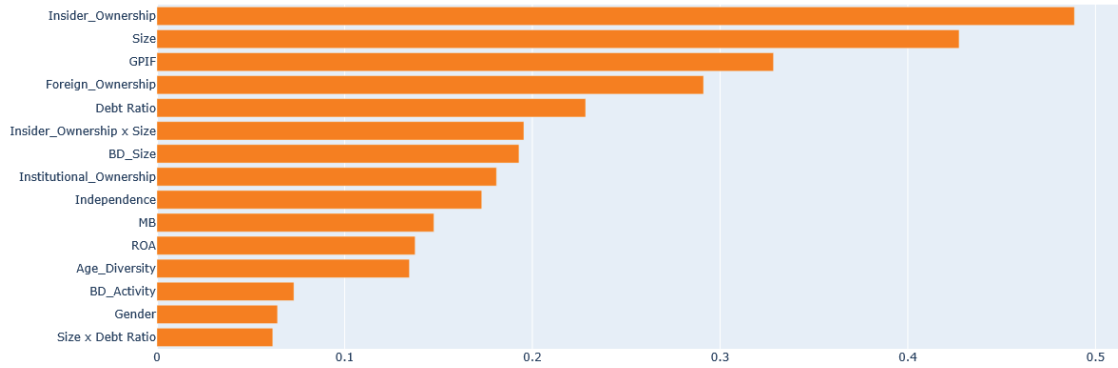
**Figure 2    Classification of ESG Disclosure Standards**



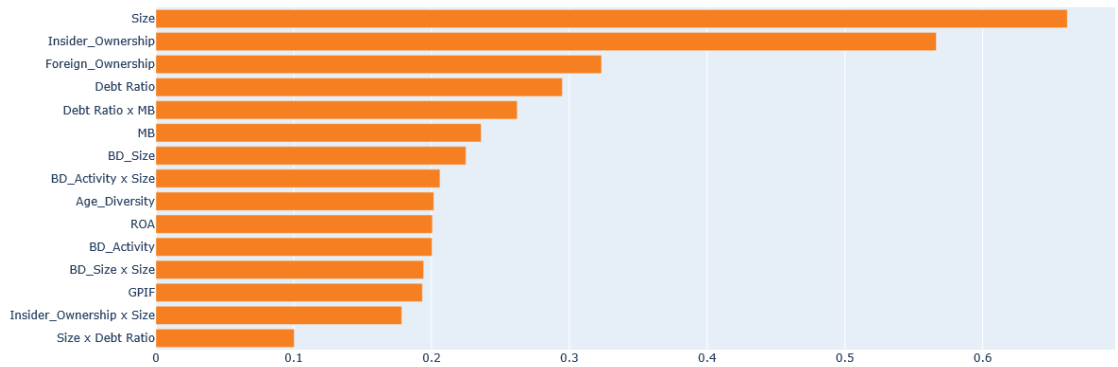
Note: Prepared by the author based on Government Pension Investment Fund (2019).

**Figure 3 GA2M Estimation Results**

(a) Estimation Results with GRI as the explained variable



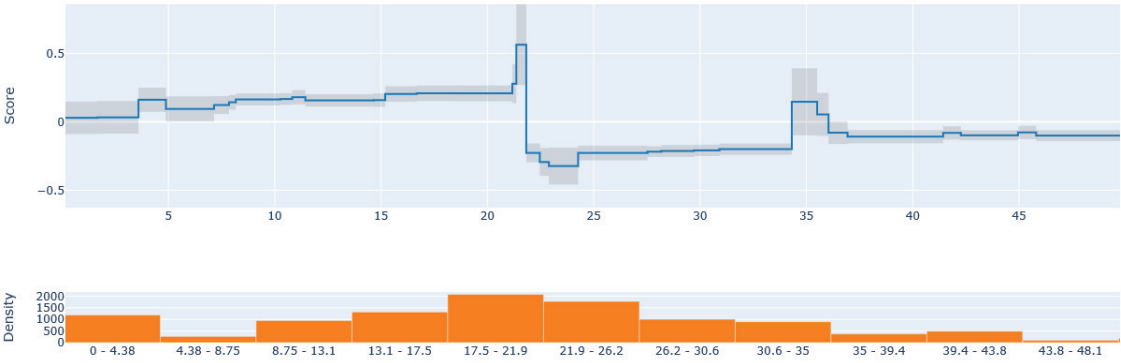
(b) Estimation Results with GRI\_Citing as explained variable



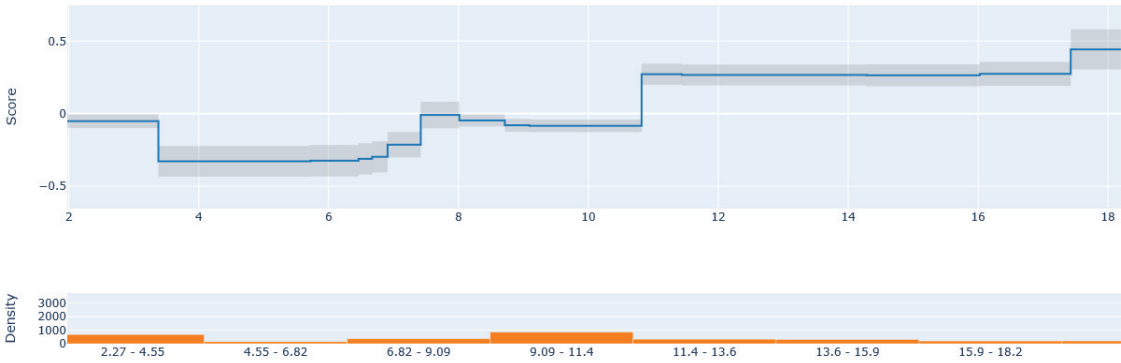
Note: This figure shows the overall importance (mean absolute score) estimated by the GA2M. Each feature is ranked from the most important variable to the least important. The overall importance of the GA2M is calculated by taking the absolute value of the risk score of each explanatory variable for all the samples and calculating the average.

**Figure 4 GA2M Results for the Internal Governance Factors**

(a) Independence



(b) Gender



(c) BD\_Size

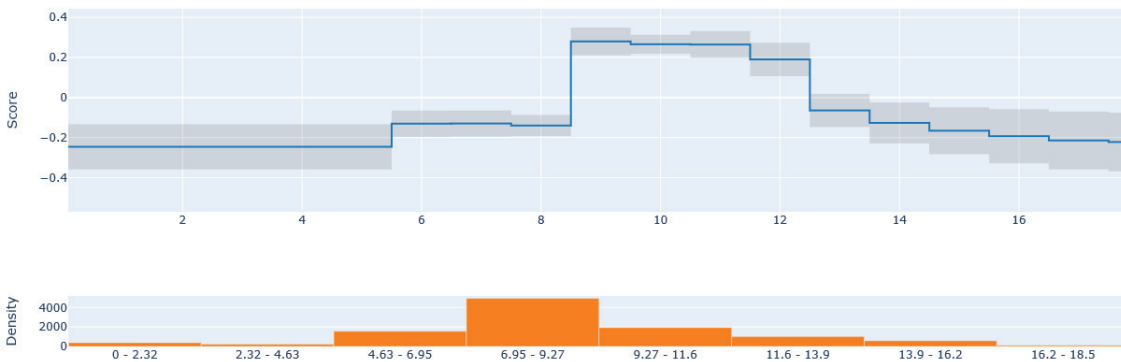
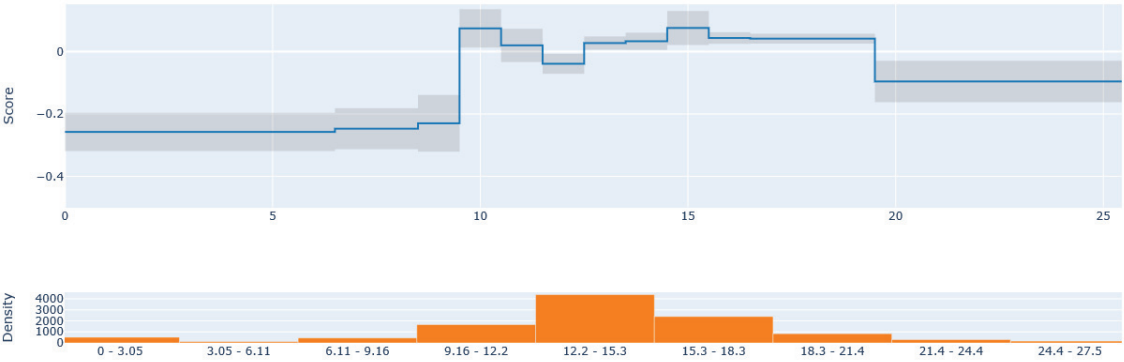
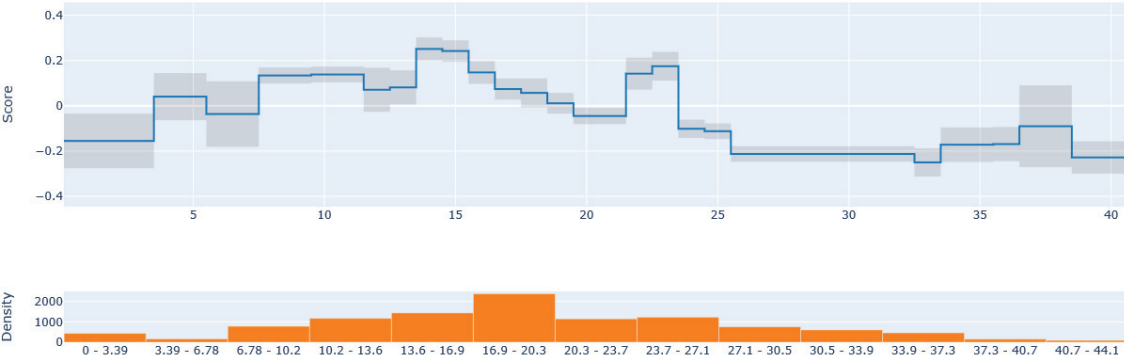


Figure 4 (Continued)

(d) BD\_Activity



(e) Age\_Diversity

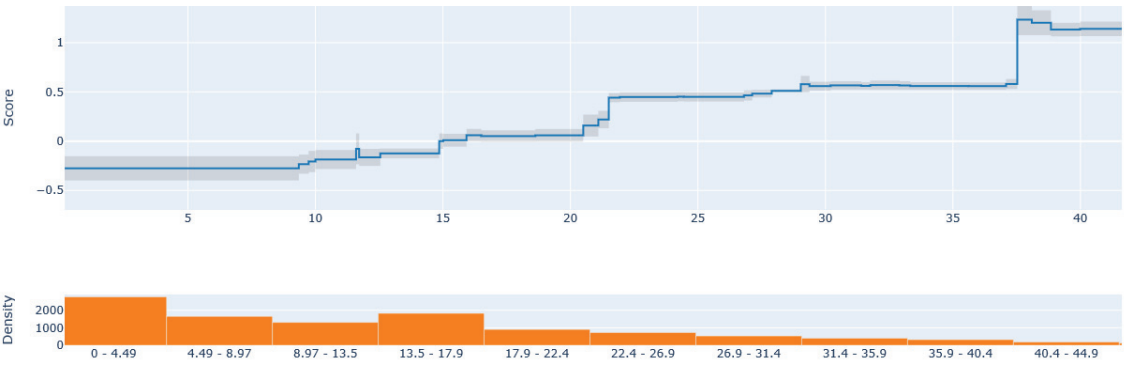


Note: For each explanatory variable, the top chart provides the contribution of the feature to the overall score and the bottom chart provides the histograms of the feature values to show the distribution. The shaded gray area represents the confidence region.

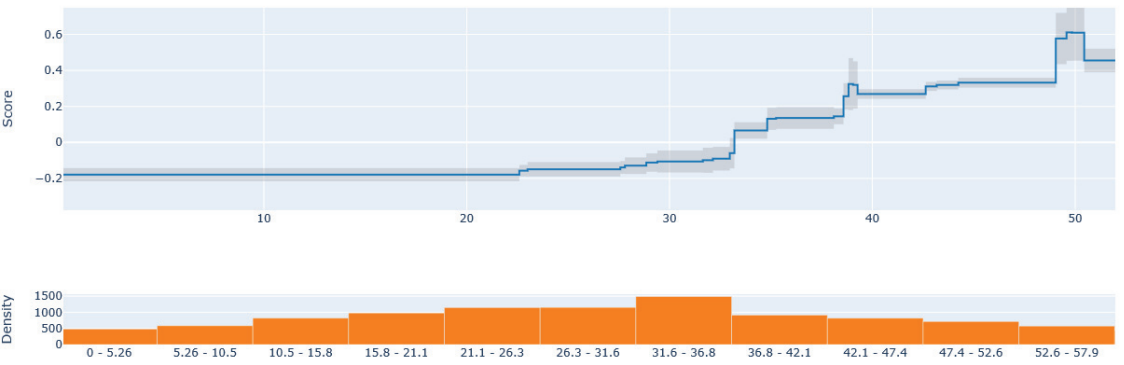


**Figure 5 GA2M Results for the External Governance Factors**

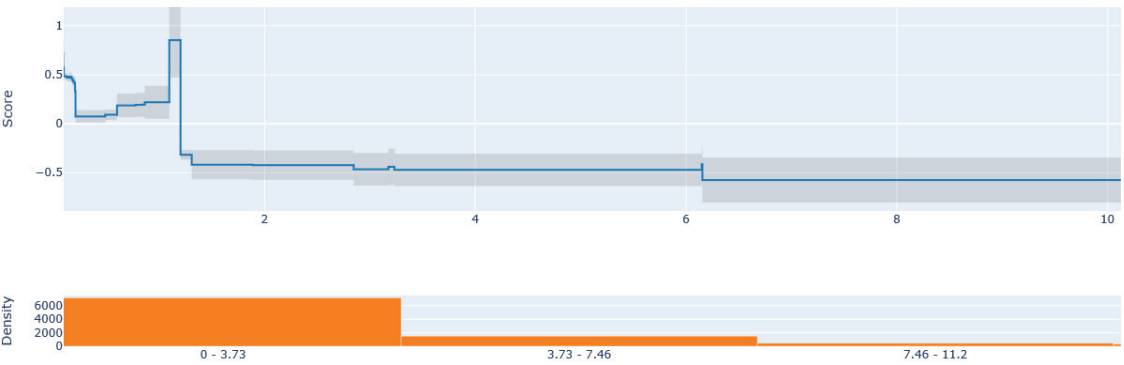
**(a) Foreign\_Ownership**



**(b) Institutional\_Ownership**

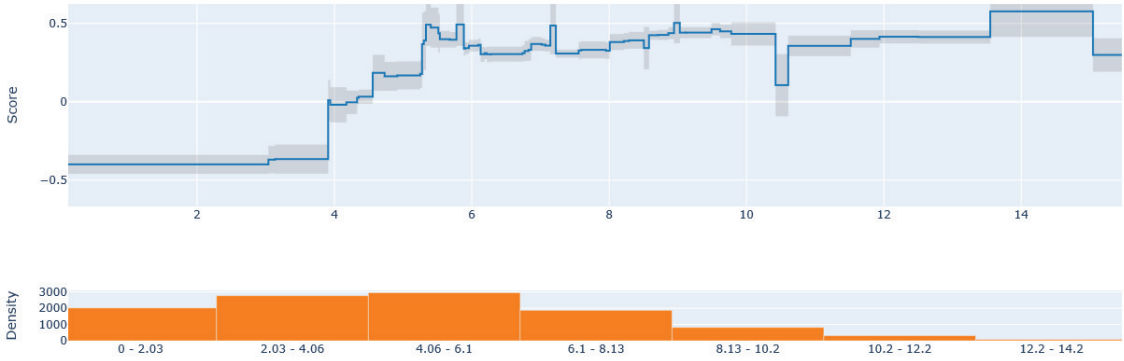


**(c) Insider\_Ownership**



**Figure 5 (Continued)**

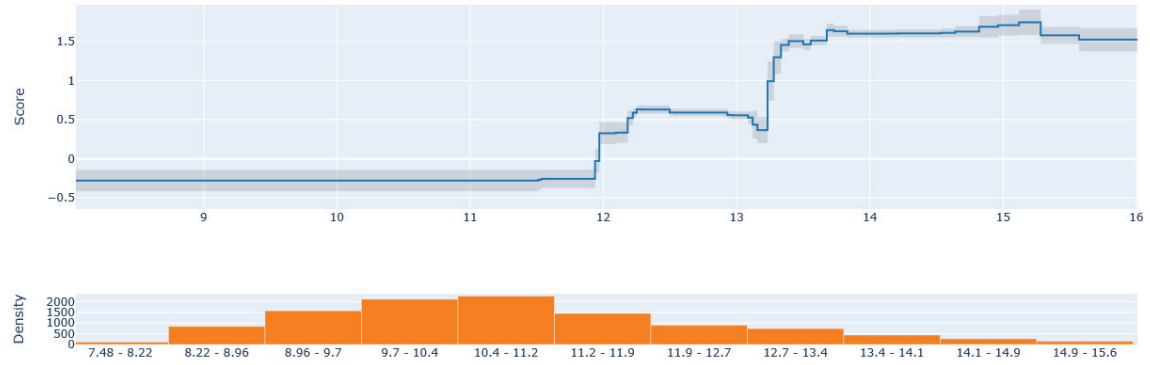
(d) GPIF



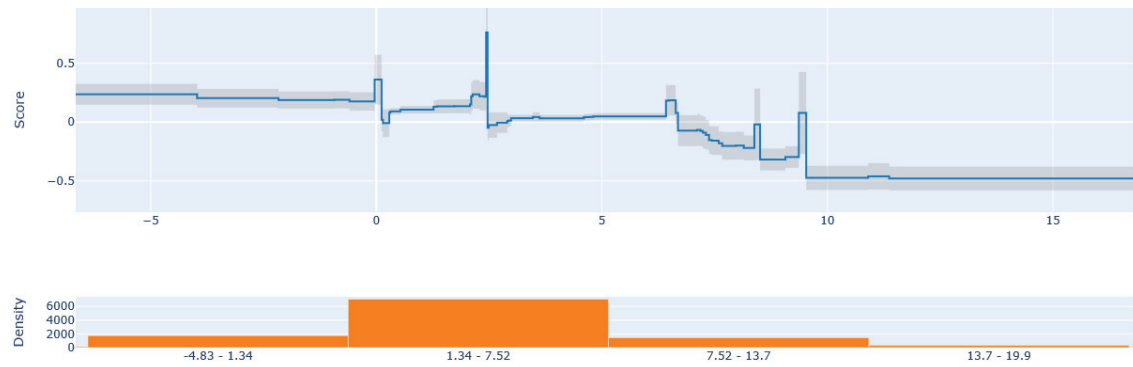
Note: For each explanatory variable, the top chart provides the contribution of the feature to the overall score and the bottom chart provides the histograms of the feature values to show the distribution. The shaded gray area represents the confidence region.

**Figure 6 GA2M Results for the Control Variables**

(a) Size



(b) ROA



(c) Debt Ratio

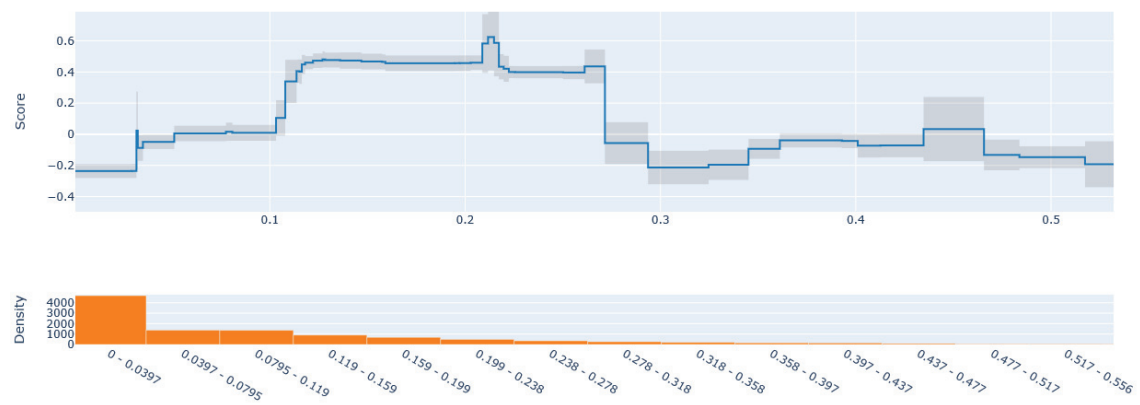
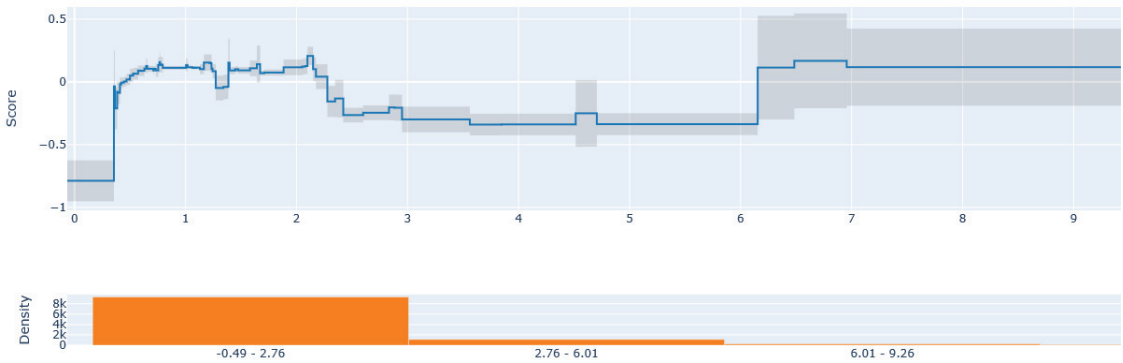


Figure 6 (Continued)

(d) MB



Note: For each explanatory variable, the top chart provides the contribution of the feature to the overall score and the bottom chart provides the histograms of the feature values to show the distribution. The shaded gray area represents the confidence region.

**Table 1 Principles of Japan's Corporate Governance Code**

General Principle 1: Securing the Rights and Equal Treatment of Shareholders	
Principle 1.1	Securing the Rights of Shareholders
Principle 1.2	Exercise of Shareholder Rights at General Shareholder Meetings
Principle 1.3	Basic Strategy for Capital Policy
Principle 1.4	Cross-Shareholdings
Principle 1.5	Anti-Takeover Measures
Principle 1.6	Capital Policy that May Harm Shareholder Interests
Principle 1.7	Related Party Transactions
General Principle 2: Appropriate Cooperation with Stakeholders Other Than	
Principle 2.1	Business Principles as the Foundation of Corporate Value Creation
Principle 2.2	Code of Conduct
Principle 2.3	Sustainability Issues, Including Social and Environmental Matters
Principle 2.4	Ensuring Diversity, Including Active Participation of Women
Principle 2.5	Whistleblowing
Principle 2.6	Roles of Corporate Pension Funds as Asset Owners
General Principle 3: Ensuring Appropriate Information Disclosure and Transparency	
Principle 3.1	Full Disclosure
Principle 3.2	External Auditors
General Principle 4: Responsibilities of the Board	
Principle 4.1-3	Roles of Responsibilities of the Board
Principle 4.4	Roles and Responsibilities of Kansayaku and Kansayaku Board
Principle 4.5	Fiduciary Responsibilities of Directors and Kansayaku
Principle 4.6	Business Execution and Oversight of the Management
Principle 4.7	Roles and Responsibilities of Independent Directors
Principle 4.8	Effective Use of Independent Directors
Principle 4.9	Independence Standards and Qualification for Independent Directors
Principle 4.10	Use of Optional Approach
Principle 4.11	Preconditions for Board and Kansayaku Board Effectiveness
Principle 4.12	Active Board Deliberations
Principle 4.13	Information Gathering and Support Structure
Principle 4.14	Director and Kansayaku Training
General Principle 5: Dialogue with Shareholders	
Principle 5.1	Policy for Constructive Dialogue with Shareholders
Principle 5.2	Establishing and Disclosing Business Strategies and Business Plans

Source: Tokyo Stock Exchange (2018)

**Table 2 Principles of Japan's Stewardship Code**

1. Institutional investors should have a clear policy on how they fulfill their stewardship responsibilities and publicly disclose it.
2. Institutional investors should have a clear policy on how they manage conflicts of interest in fulfilling their stewardship responsibilities and publicly disclose it.
3. Institutional investors should monitor investee companies so that they can appropriately fulfill their stewardship responsibilities with an orientation toward the sustainable growth of the companies.
4. Institutional investors should seek to arrive at an understanding in common with investee companies and work to solve problems through constructive engagement with investee companies.
5. Institutional investors should have a clear policy on voting and disclosure of voting activity. The policy on voting should not be comprised only of a mechanical checklist; it should be designed to contribute to the sustainable growth of investee companies.
6. Institutional investors in principle should report periodically on how they fulfill their stewardship responsibilities, including their voting responsibilities, to their clients and beneficiaries.
7. To contribute positively to the sustainable growth of investee companies, institutional investors should develop skills and resources needed to appropriately engage with the companies and to make proper judgments in fulfilling their stewardship activities based on in-depth knowledge of the investee companies and their business environment and consideration of sustainability consistent with their investment management strategies.
8. Service providers for institutional investors should endeavor to contribute to the enhancement of the functions of the entire investment chain by appropriately providing services for institutional investors to fulfill their stewardship responsibilities.

Source: The Council of Experts on Japan's Stewardship Code (2020)

**Table 3 Variable Definitions**

Variable	Definition	Data sources
<b>Dependent Variable</b>		
<i>GRI</i>	Binary variable with 1 for companies that disclose based on GRI and 0 for companies that do not.	GRI
<i>GRI_Citing</i>	Binary variable with 1 for companies that disclose with GRI-Citing and 0 for companies that do not.	Bloomberg
<b>Internal Factors</b>		
<i>Independence</i>	Ratio of outside directors to total number of directors	Bloomberg
<i>Gender</i>	Ratio of female directors to total number of directors	Bloomberg
<i>BD_Size</i>	Number of directors	Bloomberg
<i>BD_Activity</i>	Number of meetings of the Board of Directors per year	Bloomberg
<i>Age_Diversity</i>	Difference between the maximum and minimum age of directors	Bloomberg
<b>External Factors</b>		
<i>Foreign_Ownership</i>	Percentage of overseas investors among shareholders	Bloomberg
<i>Institutional_Ownership</i>	Percentage of institutional investors among shareholders	Bloomberg
<i>Insider_Ownership</i>	Percentage of shareholders who are insiders	Bloomberg
<i>GPIF</i>	Percentage of GPIF among shareholders	GPIF
<b>Controls</b>		
<i>Size</i>	Logarithmic value of market capitalization	Bloomberg
<i>ROA</i>	Percentage of net income divided by total assets	Bloomberg
<i>Debt Ratio</i>	Total debts divided by total assets	Bloomberg
<i>MB</i>	Market value divided by book value	Bloomberg

**Table 4 Sample Distribution by Industry**

	Number of Samples: (1)	GRI: (2)	(2)/(1)	GRI Citing: (3)	(3)/(1)
<i>FOODS</i>	819	28	3.4%	171	20.9%
<i>ENERGY RESOURCES</i>	135	16	11.9%	37	27.4%
<i>CONSTRUCTION &amp; MATERIALS</i>	1,584	41	2.6%	266	16.8%
<i>RAW MATERIALS &amp; CHEMICALS</i>	1,773	72	4.1%	325	18.3%
<i>PHARMACEUTICAL</i>	342	17	5.0%	78	22.8%
<i>AUTOMOBILES &amp; TRANSPORTATION EQUIPMENT</i>	630	55	8.7%	209	33.2%
<i>STEEL &amp; NONFERROUS METALS</i>	495	28	5.7%	118	23.8%
<i>MACHINERY</i>	1,269	18	1.4%	164	12.9%
<i>ELECTRIC APPLIANCES PRECISION INSTRUMENTS</i>	1,719	124	7.2%	462	26.9%
<i>IT &amp; SERVICES, OTHERS</i>	4,572	37	0.8%	228	5.0%
<i>ELECTRIC POWER &amp; GAS</i>	198	12	6.1%	97	49.0%
<i>TRANSPORTATION &amp; LOGISTICS</i>	702	20	2.8%	104	14.8%
<i>COMMERCIAL &amp; WHOLESALE TRADE</i>	1,611	15	0.9%	109	6.8%
<i>RETAIL TRADE</i>	1,809	15	0.8%	73	4.0%
<i>BANKS</i>	738	18	2.4%	47	6.4%
<i>FINANCIALS(EX BANKS)</i>	513	29	5.7%	78	15.2%
<i>REAL ESTATE</i>	639	5	0.8%	34	5.3%
<i>TOTAL</i>	19,548	550	2.8%	2,600	13.3%

Note: Sample with FY2011 to FY2019 as the estimation period.



**Table 5 Descriptive Statistics**

Variable	Mean	P25	Median	P75	Std. Dev.
<b>Internal Factors</b>					
<i>Independence</i>	22.93	15.39	22.22	30.00	13.32
<i>Gender</i>	3.76	0.00	0.00	7.14	6.60
<i>BD_Size</i>	8.70	7.00	8.00	10.00	3.45
<i>BD_Activity</i>	14.10	12.00	14.00	17.00	4.88
<i>Age_Diversity</i>	19.75	14.00	19.00	26.00	9.00
<b>External Factors</b>					
<i>Foreign_Ownership</i>	14.74	4.53	12.65	21.29	12.79
<i>Institutional_Ownership</i>	34.60	20.86	32.14	47.15	18.87
<i>Insider_Ownership</i>	6.19	0.17	0.99	6.15	11.64
<i>GPIF</i>	4.55	2.65	4.36	6.29	2.93
<b>Controls</b>					
<i>Size</i>	10.86	9.74	10.69	11.76	1.58
<i>ROA</i>	4.26	1.97	3.68	6.12	5.34
<i>Debt Ratio</i>	0.10	0.01	0.06	0.15	0.12
<i>MB</i>	1.79	0.71	1.12	1.78	2.61

Note: Some outliers are removed and missing values are replaced by the mean for continuous variables or the median for discrete variables. All the variables are defined in Table 3.

**Table 6 Correlations (Pearson Above Diagonal; p-value Below Diagonal)**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1) <i>GRI</i>		0.445	0.079	0.069	0.108	0.016	-0.029	0.231	0.159	-0.094	0.181	0.309	-0.033	0.061	-0.032
2) <i>GRI_Citing</i>	0.000		0.140	0.118	0.200	0.054	-0.068	0.332	0.270	-0.178	0.268	0.492	-0.058	0.114	-0.071
3) <i>Independence</i>	0.000	0.000		0.287	0.250	0.287	0.287	0.241	0.289	-0.093	0.337	0.212	-0.046	0.020	-0.034
4) <i>Gender</i>	0.000	0.000	0.000		0.167	0.078	0.132	0.157	0.133	0.020	0.102	0.206	0.006	0.036	0.063
5) <i>BD_Size</i>	0.000	0.000	0.000	0.000		0.203	0.309	0.214	0.235	-0.175	0.296	0.356	-0.094	0.094	-0.100
6) <i>BD_Activity</i>	0.071	0.000	0.000	0.000	0.000		0.270	0.032	0.070	0.077	0.144	-0.024	-0.014	0.035	-0.006
7) <i>Age_Diversity</i>	0.001	0.000	0.000	0.000	0.000	0.000		0.072	0.073	0.136	0.078	0.036	0.037	0.011	0.067
8) <i>Foreign_Ownership</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.659	-0.186	0.428	0.662	0.101	0.021	0.054
9) <i>Institutional_Ownership</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		-0.279	0.458	0.525	0.055	0.035	-0.032
10) <i>Insider_Ownership</i>	0.000	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000		-0.286	-0.266	0.207	0.004	0.382
11) <i>GPIF</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.425	-0.074	0.011	-0.119
12) <i>Size</i>	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000		0.095	0.112	0.065
13) <i>ROA</i>	0.000	0.000	0.000	0.503	0.000	0.112	0.000	0.000	0.000	0.000	0.000	0.000		-0.191	0.299
14) <i>Debt_Ratio</i>	0.000	0.000	0.021	0.000	0.000	0.000	0.215	0.019	0.000	0.630	0.204	0.000	0.000		-0.042
15) <i>MB</i>	0.000	0.000	0.000	0.000	0.000	0.483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

**Table 7 Logistic Regression Results**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	GRI				GRI_Citing			
Internal Factors								
<i>Independence</i>	0.005	0.004	0.004	0.007	0.008	0.008	0.007	0.004
	1.503	1.326	1.368	1.724*	2.799***	2.826***	2.623***	1.296
<i>Gender</i>	0.009	0.010	0.010	0.012	0.004	0.004	0.005	0.010
	1.271	1.424	1.341	1.672*	0.667	0.674	0.841	1.655*
<i>BD_Size</i>	-0.003	-0.005	-0.017	-0.021	0.017	0.017	0.012	0.009
	-0.219	-0.371	-1.231	-1.417	1.388	1.378	1.019	0.684
<i>BD_Activity</i>	0.022	0.022	0.023	0.022	0.040	0.040	0.040	0.041
	2.538**	2.409**	2.583***	2.166**	5.464***	5.456***	5.496***	5.22***
<i>Age_Diversity</i>	-0.008	-0.007	0.000	-0.007	-0.020	-0.020	-0.016	-0.021
	-1.314	-1.149	0.058	-1.093	-4.366***	-4.367***	-3.513***	-4.246***
External Factors								
<i>Foreign_Ownership</i>	0.009				0.001			
	2.521**				0.197			
<i>Institutional_Ownership</i>		0.007				0.000		
		2.768***				0.181		
<i>Insider_Ownership</i>			-0.115				-0.021	
			-4.096***				-1.879*	
<i>GPIF</i>				0.055				0.018
				4.303***				1.478
Controls								
<i>Size</i>	0.513	0.536	0.535	0.547	0.637	0.639	0.626	0.626
	12.301***	13.561***	13.779***	13.147***	15.599***	18.069***	17.969***	16.847***
<i>ROA</i>	-0.027	-0.028	-0.027	-0.030	-0.032	-0.032	-0.031	-0.034
	-4.677***	-4.812***	-4.354***	-4.159***	-5.558***	-5.518***	-5.313***	-5.467***
<i>Debt Ratio</i>	0.730	0.587	0.708	0.549	0.719	0.712	0.702	0.604
	1.888*	1.507	1.816*	1.296	2.204**	2.187**	2.157**	1.666*
<i>MB</i>	-0.242	-0.244	-0.190	-0.226	-0.343	-0.342	-0.322	-0.299
	-3.481***	-3.408***	-2.946***	-3.036***	-6.368***	-6.374***	-5.914***	-5.652***
Intersept	-9.874	-10.121	-9.876	-9.016	-9.116	-9.132	-8.913	-9.117
	-15.846***	-16.73***	-15.696***	-15.1***	-18.146***	-19.148***	-18.097***	-16.997***
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	19,548	19,548	19,548	10,860	19,548	19,548	19,548	10,860
Adj. R <sup>2</sup>	0.423	0.424	0.434	0.435	0.423	0.423	0.426	0.425

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. z-statistics are based on standard errors clustered at the firm level. Industry dummies and year dummies are included in the regression analysis.

**Table 8 Logistic Regression Results of the Industry Dummy Variables**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	GRI				GRI_Citing			
<i>DM_FOO</i>	1.136***	1.019**	1.003**	1.007**	1.148***	1.142***	1.081***	1.166***
<i>DM_ENE</i>	1.614***	1.524***	1.627***	1.549***	1.096***	1.093***	1.041***	1.359***
<i>DM_CON</i>	1.138***	1.042***	1.13***	0.775*	1.129***	1.124***	1.076***	1.128***
<i>DM_RAW</i>	1.275***	1.164***	1.251***	1.039***	1.056***	1.051***	1.009***	1.1***
<i>DM_PHA</i>	0.859*	0.751*	0.782*	0.35	0.764**	0.759**	0.71**	0.624
<i>DM_AUT</i>	1.162***	1.12***	1.13***	0.94**	1.056***	1.053***	1.004***	1.102***
<i>DM_STE</i>	1.188***	1.12***	1.157***	1.001**	0.959***	0.955***	0.909***	1.007***
<i>DM_MAC</i>	0.658	0.547	0.662	0.412	0.839***	0.834***	0.792***	0.888**
<i>DM_ELE</i>	1.497***	1.38***	1.499***	1.221***	1.423***	1.418***	1.373***	1.416***
<i>DM_SER</i>	0.803**	0.727*	0.899**	0.515	0.651**	0.648**	0.643**	0.735**
<i>DM_GAS</i>	0.572	0.504	0.488	0.418	0.953**	0.948**	0.91**	1.125***
<i>DM_TRA</i>	0.634	0.536	0.546	0.522	0.323	0.317	0.288	0.34
<i>DM_COM</i>	0.332	0.288	0.355	0.008	0.524*	0.521*	0.495	0.422
<i>DM_RET</i>	0.665	0.595	0.798*	0.488	0.262	0.258	0.27	0.345
<i>DM_BAN</i>	0.236	0.132	0.188	-0.301	-0.667**	-0.673**	-0.708**	-0.621*
<i>DM_FIN</i>	0.732*	0.641	0.733*	0.316	0.122	0.117	0.082	0.169

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The terms beginning with DM indicate the following industry dummies; DM\_FOO: Foods, DM\_ENE: Energy Resources, DM\_CON: Construction & Materials, DM\_RAW: Raw Materials & Chemicals, DM\_PHA: Pharmaceutical, DM\_AUT: Automobiles & Transportation Equipment, DM\_STE: Steel and Nonferrous Metals, DM\_MAC: Machinery, DM\_ELE: Electric Appliances Precision Instruments, DM\_SER: IT & Service, Others, DM\_GAS: Electric Power & Gas, DM\_TRA: Transportation and Logistics, DM\_COM: Commercial & Wholesale Trade, DM\_RET: Retail Trade, DM\_BAN: Banks, DM\_FIN: Financials (Excluding Banks). Estimates are based on the real estate industry as a benchmark.

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