# DETERMINANTS AND CONSEQUENCES OF ENDORSEMENT FOR THE TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES: EVIDENCE FROM JAPANESE LISTED FIRMS[*]

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## Abstract

We examine the determinants for endorsing the Task Force on Climate-Related Financial Disclosures (TCFD) and the impact of this support on corporate value. We find that firms with the following characteristics tend to support TCFD: large size; belonging to industries sensitive to the environment; high environmental performance; high ratios of outside directors; and low ratios of stable shareholders. We also find that the corporate value of TCFD-supporting firms is more likely to be higher than that of non-supporting firms. The evidence suggests that TCFD support is associated with firms' needs and governance characteristics and results in an economically favorable outcome.

*Keywords:* The Task Force on Climate-Related Financial Disclosures (TCFD), climate-related disclosure, environmental disclosure, determinant, corporate value

# I. *Introduction*

Initiatives to curb climate change have received much attention and have become essential for financial and non-financial firms. The reduction of greenhouse gas and $CO_2$ emissions causing climate change has long been a common challenge for humankind. Many global actions (e.g., the Paris Agreement) have persuaded local governments to implement environmental policies and encourage private sector firms to take action against it. The Task Force on Climate-Related Financial Disclosures (TCFD), launched by the Financial Stability Board in response to the desire of the G20 countries/regions, is a leading initiative to encourage the information disclosure on the opportunities and risks associated with climate change and thereby achieve stability in financial markets and facilitate the transition to a low-carbon economy. The TCFD recommendations have been incorporated into existing sustainability-related disclosure frameworks, such as the Carbon Disclosure Project, the Climate Disclosure Standards Board, the Global Reporting Initiative, and the Sustainability Accounting Standards Board (Bingler et al., 2022). Since TCFD published its final report in June 2017, the number of organizations that support its aim and recommendations has been increasing, reaching as many as 2,301 organizations as of July 2021.

Meanwhile, since the TCFD framework largely depends on firms' voluntary actions in many countries, it is still unclear what forces shape firms' endorsement for TCFD. As of July 2021, about half of the supporting organizations (1,131 organizations) belong to the financial sector, while the number of non-financial supporting firms remains relatively small. Financial firms such as banks and institutional investors tend to have stronger incentives to endorse TCFD because, given their position as capital providers and information users, they seek more information on the investees' risks and opportunities. However, to achieve a decarbonized society, it will be essential to have the support of non-financial firms, the primary information providers to the capital market, and thus to better understand their motives and consequences of TCFD endorsement. In this study, we examine (1) the factors that lead non-financial firms to support TCFD and (2) the impact of this support on the firm's value.

We tackle these research questions using Japanese firms for the following two reasons. First, Japan is a leading country in the endorsement of TCFD. As of July 7, 2021, 436 organizations in Japan endorse TCFD, which is higher than any other country, corresponding to approximately 19% of the total supporters (see Table 1). In May 2019, Japan formed the TCFD Consortium, the first cooperation system between public and private organizations to accelerate activities that support the disclosure based on the TCFD recommendations. This elicited rapid and significant support from the business community. Second, with a help of the TCFD Consortium, Japan has many non-financial firms endorsing TCFD (see Table 2). In the UK and the US, which occupy second and third place in the number of TCFD supporters, financial sector firms account for nearly 60% of the total in each country. By contrast, the financial firms correspond to 25% in Japan, having many non-financial supporters in various sectors. This distribution is helpful to examine the motives and consequences of TCFD endorsement among non-financial firms.

Using a sample of Japanese listed firms between 2018 and 2020 (i.e., years immediately after the publication of the TCFD final reports), we investigate the determinants and consequences of TCFD support. First, the analysis of the determinants shows that firms that

TABLE 1.  TOP 15 COUNTRIES WITH TCFD-SUPPORTING ORGANIZATIONS

| By-location | N | % (to total supporters) |
|---|---|---|
| Japan | 436 | 18.9% |
| United Kingdom | 368 | 16.0% |
| United States | 319 | 13.9% |
| France | 111 | 4.8% |
| Australia | 110 | 4.8% |
| Canada | 94 | 4.1% |
| South Korea | 60 | 2.6% |
| Taiwan | 55 | 2.4% |
| Sweden | 53 | 2.3% |
| Switzerland | 49 | 2.1% |
| Germany | 46 | 2.0% |
| India | 46 | 2.0% |
| Singapore | 42 | 1.8% |
| Spain | 42 | 1.8% |
| Netherlands | 40 | 1.7% |

*Note:* We obtained these TCFD-supporting organizations from the TCFD homepage (https://www.fsb-tcfd.org/supporters/) (on July 7, 2021).

TABLE 2.  COMPARISON OF TCFD-SUPPORTING ORGANIZATIONS BY SECTOR (JAPAN, UK, US)

| | Japan | | UK | | US | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Central Bank | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Communication Services | 6 | 1.4% | 5 | 1.4% | 4 | 1.3% |
| Consumer Discretionary | 34 | 7.8% | 6 | 1.6% | 5 | 1.6% |
| Consumer Staples | 31 | 7.1% | 7 | 1.9% | 5 | 1.6% |
| Energy | 6 | 1.4% | 13 | 3.5% | 7 | 2.2% |
| Financials | 109 | 25.0% | 222 | 60.3% | 197 | 61.8% |
| Government | 8 | 1.8% | 4 | 1.1% | 2 | 0.6% |
| Health Care | 11 | 2.5% | 1 | 0.3% | 5 | 1.6% |
| Industrials | 89 | 20.4% | 26 | 7.1% | 19 | 6.0% |
| Information Technology | 36 | 8.3% | 15 | 4.1% | 12 | 3.8% |
| Materials | 46 | 10.6% | 7 | 1.9% | 10 | 3.1% |
| Other | 29 | 6.7% | 35 | 9.5% | 25 | 7.8% |
| Real Estate | 13 | 3.0% | 16 | 4.3% | 19 | 6.0% |
| Transportation | 6 | 1.4% | 2 | 0.5% | 0 | 0.0% |
| Utilities | 12 | 2.8% | 9 | 2.4% | 9 | 2.8% |
| Total | 436 | | 368 | | 319 | |

*Note:* We obtain the data on TCFD-supporting organizations from the TCFD homepage (https://www.fsb-tcfd.org/supporters/) (on July 7, 2021). The industry classification of these organizations is according to the sectors on the homepage.

announced support for TCFD are likely to have the following characteristics: namely, (1) they are larger, (2) belong to an environmentally sensitive industry, (3) exhibit higher environmental performance, (4) have more outside directors, and (5) have fewer stable shareholders. These findings suggest that the firms tend to determine the support for TCFD considering their governance environment, the level of attention from stakeholders, and the environmental load.

Therefore, TCFD endorsement is likely to be based on the firm's needs and rationale rather than appearance-only activities known as "greenwashing."

Second, the analysis of firm value reveals that TCFD-supporting firms tend to have a higher value (Tobin Q) than non-supporters after announcing their endorsement. This result is robust to sensitive tests regarding the endogeneity of TCFD endorsement, including a two-step treatment effect model and propensity score matching. This finding suggests that announcing support for TCFD can increase the firm value by revising investors' estimates for the firm's future cash flows or reducing the cost of capital with enhanced investors' confidence in potential risks regarding environmental costs.

We contribute to the literature in several important ways. First, this study is the first empirical study to examine the motives and consequences of TCFD support. While there has been a rapid increase in studies on corporate social responsibility (CSR) and sustainability (Christensen et al., 2018; 2021), previous studies mainly focus on disclosed CSR reports and CSR scores to examine firms' engagement and consequences. Moreover, recent studies on TCFD tend to shed light on the report's content (Demaria & Rigot, 2021; Bingler et al., 2022). By contrast, we focus on Japan, a leading country in the subject, and use a relatively large sample of non-financial firms to detect the factors influencing their environmental position and impact on the firm value. Given the current lack of organizational actions toward climate change and sustainability issues (Wade & Griffiths, 2021), the evidence is particularly important for accelerating them.

Second, unlike previous studies using firms' CSR reports and commercial databases, this study focuses on the phenomenon of *endorsement*. The downside of report-based analyses is that researchers need to control the quality and volume of the disclosed information and the differences in formats in CSR reports. Similarly, the analyses using CSR scores depend on the evaluation of data vendors and the researchers' choice of databases (Chatterji et al., 2016; Serafeim & Yoon, 2022). By contrast, a declaration of TCFD endorsement can be a low-noise and "pure" variable representing firms' commitment to climate change. Hence, the findings obtained in this study can become plausible and valuable evidence of how managers' motives to tackle this issue are formed and how this commitment affects the firm's value.

Moreover, the findings in this study should be of interest to regulators and policymaking institutions. The UK government has announced a policy that mandates firms listed on the London Stock Exchange to disclose climate change-related information in accordance with the TCFD recommendations. Similarly, with a revision of the Corporate Governance Code, Japanese firms listed on the prime market of Tokyo Stock Exchange should start receiving clear recommendations to disclose information equivalent to TCFD. The findings of this study indicate that firms announce their endorsement based on their needs and rationale and that this kind of voluntary initiative leads to higher firm values. Thus, this study does not indicate a strong necessity to mandate disclosures via regulations. Still, it supports TCFD policies based on how capital markets may welcome activities related to them.

# II.  *Hypotheses Development*

## 1.  **Theoretical Backgrounds**

While this study focuses on TCFD endorsements, references related to CSR-related information disclosure (including CSR reports, sustainability reports, integrated reports, etc.) are helpful in the analysis of the theoretical background of TCFD. In most cases, both TCFD endorsements and CSR disclosure mainly depend on firms' voluntary actions and contribute information concerning their environmental and social impact.

Explanations for the influencing factors of CSR disclosure stem mainly from four different logics: legitimacy theory, stakeholder theory, agency theory, and resource-based perspective. First, the legitimacy theory assumes a social contract between businesses and society and discusses that organizations will fulfill their social value to acquire or increase their legitimacy (Suchman, 1995). According to this theory, firms are required to provide more transparency about their activities to be consistent with the law and economic principles. By disclosing information to the public, firms can change the external perception of their legitimacy (Cho & Patten, 2007).

Stakeholder theory argues that firms carry out activities and disclose information to satisfy the demands of various stakeholders and improve their relationships with them (Freeman, 1983; McWilliams & Siegel, 2001). As the stakeholders increase and become more diverse, the firm must remain aware of various elements and entities that may encourage it to provide information and implement corporate activities concerning the environment and society instead of disclosing information or engaging in activities for a single stakeholder.

Agency theory suggests information disclosure as a vehicle to solve information asymmetry between firms and capital markets. In the presence of information asymmetry between capital suppliers and managers, information disclosure mitigates the problems of adverse selection and moral hazard. Capital suppliers seek information regarding the opportunities and risks of investee firms and evidence that they operate according to the regulations and laws. Thus, thorough and high-quality information disclosures can reduce the cost of capital (Dhaliwal et al., 2011). Moreover, managers have an incentive to build a good reputation in the capital market because of their career concerns and compensations (Prior et al., 2008). High-quality firms, in particular, are expected to disclose information to differentiate themselves from low-quality firms and to receive more praise from stakeholders (i.e., signaling theory).

Finally, the resource-based perspective considers CSR activities and disclosure as providing competitive advantages (e.g., Branco & Rodrigues, 2006; Li et al., 2022). Investments in socially and environmentally responsible projects can help firms develop new resources and capabilities. The information disclosure of firms' engagement in such projects can signal improved social and environmental business operations and thereby enhance corporate reputation from stakeholders, which can be another competitive resource (Branco & Rodrigues, 2006).

Therefore, firms' activities and reports regarding the environmental issues can be explained by multiple logics. However, it is not easy to make a comparative analysis of which view is more plausible. Specifically, corporate activities related to society and the environment are

multifaceted, complex, and therefore unable to be explained from a single theoretical point of view (McWilliams et al., 2006; Gray & Handley, 2015; Chi et al., 2020).

## 2.   Determinants of TCFD Endorsement

Based on the preceding four theories and prior literature on CSR-related information disclosure, we develop hypotheses for the determinants of TCFD endorsement. Specifically, we propose that the following three factors can affect managers' attitudes towards environmental problems and announcement of their commitment: namely, (1) firm characteristics, (2) financial characteristics, and (3) governance characteristics.

### 1)   Firm Characteristics

(1) Firm size

The larger the firm is, the more visibility and attention it attracts from external parties, making them more likely to be exposed to the judgment of stakeholders. Consequently, these firms have a stronger need to ensure legitimacy (Branco & Rodrigues, 2008). Moreover, the bigger the firm, the more resources it possesses, making it easier for them to cover the cost of CSR-related activities and disclosure (McWilliams & Siegel, 2001; Ho & Taylor, 2007; Luo et al., 2013). Therefore, the larger the firm, the more expected to support TCFD.

**Hypothesis 1-1:** There is a positive relationship between firm size and TCFD endorsement.

(2) Degree of diversification

The more diversified the firm is, the more it is expected to maintain relationships with various stakeholders. Unlike a single-business firm, diversified firms must make more responsible choices regarding business partners, customers, and supply chain elements that may affect their business. Thus, from the legitimacy and stakeholder theories, the more diversified the firm is, the more it needs to show environment-friendly business attitudes and legitimize its businesses by announcing its support for TCFD.

**Hypothesis 1-2:** There is a positive relationship between the degree of diversification and TCFD endorsement.

(3) Internationalization and geographic diversity

According to Kolk and Fortanier (2013), firms' internationalization and geographic diversity can positively and negatively affect environmental disclosure. Highly international firms must deal with various stakeholders and thus are required to disclose more information and demonstrate a stronger commitment to ensure legitimacy and improve stakeholder relationships in each region. Meanwhile, the geographical diversity of multinational firms may disperse and reduce the pressure for information disclosure. Moreover, the environmental requirements to gain legitimacy can be lower in emerging countries as these countries may prioritize economic growth rather than solving environmental problems. If this is the case, more internationalized firms feel less pressure to show their commitment to environmental problems. Based on both arguments above, this study proposes a null hypothesis:

**Hypothesis 1-3:** There is no relation between the degree of internationalization and TCFD endorsement.

(4) Environmentally sensitive industries

Firms in environmentally sensitive industries (i.e., industries with a high environmental load) have a stronger need to ensure the legitimacy of their business and therefore have incentives to show their commitment to environmental problems. Cho and Patten (2007) show that firms in environmentally sensitive industries are likely to use environmental reports as a tool to legitimize their business. We predict that firms in industries with a high environmental load have stronger motivation to ensure legitimacy and thus announce their supports for TCFD.

**Hypothesis 1-4:** There is a positive relationship between the environmental sensitivity of the industry to which a firm belongs and TCFD endorsement.

(5) Environmental performance

The legitimacy theory predicts that firms' environmental disclosure depends on public pressure. Thus, firms with lower environmental performance are likely to disclose environmental reports to alleviate doubts over their legitimacy (Patten, 2002; Cho & Patten, 2007). Wedari et al. (2021) find a negative relation between climate-related disclosure and lagged environmental performance and suggest a potential greenwashing by poor environmental performers. On the other hand, high environmental performance can reduce future environmental costs and be seen as good news by investors. Thus, following the signaling theory, firms with higher environmental performance have incentives to disclose relevant information and obtain higher reputations from the capital market (Al-Tuwaijri et al., 2004). Similarly, from the resource-based perspective, firms with high-quality environmental conduct will inform their activities to build a good corporate reputation. Therefore, we consider that both positive and negative relationships could be established and propose the following null hypothesis.

**Hypothesis 1-5:** There is no relation between environmental performance and TCFD endorsement.

## 2)  Financial Characteristics

(1) Profitability

Since firms with higher profitability have more flexibility in executing environmental activities, they may use this advantage to ensure legitimacy. Meanwhile, lower profitability may motivate managers to utilize environmental reporting to excuse and justify their lower profitability, showing that their activities are linked to social and environmental values rather than economic values. Consistent with these opposing views, prior studies have not found a consistent relationship between profitability and CSR disclosure (e.g., Al-Tuwaijri et al., 2004). Given the possibility of both positive and negative relationships, we thus propose a null hypothesis:

**Hypothesis 1-6:** There is no relation between profitability and TCFD endorsement.

(2) Financial leverage

Firms with higher reliance on debt are more likely to voluntarily disclose information to reduce the cost of debt (Girella et al., 2019). On the other hand, those firms can convey CSR information to bank lenders through private channels instead of disclosing them publicly, leading to less CSR disclosure. Since we can predict both positive and negative relationships regarding financial leverage, we propose a null hypothesis:

**Hypothesis 1-7:** There is no relation between liability ratio and TCFD endorsement.

### 3)  Governance Characteristics

(1) Size of the Board of Directors

According to the resource-based perspective, the size of the board of directors can indicate the diversity of directors' skillsets and the workload of individual members. Specifically, when the board of directors is significant, they can make up for the lack of skills and spend their resources to effectively communicate ideas and experiences between directors, stimulating their support for and involvement in CSR-related activities (Jizi et al., 2014). In the context of TCFD, directors are required to have expertise on climate change and knowledge of related regulations to discuss its impact on the firm's business and implement a scenario analysis (Huiskamp et al., 2022). Thus, we predict that firms with larger boards are more likely to support TCFD.

**Hypothesis 1-8:** There is a positive relationship between the size of the board of directors and TCFD endorsement.

(2) Board independence

From the agency theory, boards with a high proportion of outside directors are assumed to be more effective in monitoring and controlling managers (Jizi et al., 2014). They are more likely to direct management toward activities that enhance long-term firm value and transparency. Since outside directors are expected to represent the interests of different stakeholders and groups, they are likely to encourage the firm to conduct CSR-related activities and disclosures (Jizi et al., 2014). Thus, we predict that firms with more outside directors are more likely to support TCFD.

**Hypothesis 1-9:** There is a positive relationship between the ratio of outside directors and TCFD endorsement.

(3) Board diversity: Female directors

From the resource-based perspective, board diversity signifies the core competence of board members and enhances a firm's capability (Katmon et al., 2019). Specifically, the proportion of female directors on the board can indicate board diversity and ethical mindset. Since female directors are sensible to sustainability in the economic, social, and environmental sense, having more female directors can improve firms' sensitivities to CSR initiatives (Williams, 2003; Bear et al., 2010; Katmon et al., 2019). Consistent with the argument, empirical studies have shown that female directors improve CSR disclosure (e.g., Rupley et al., 2012; Harjoto et al., 2015; Liao et al., 2015; Katmon et al., 2019). Thus, we predict that firms with more female directors are more likely to endorse TCFD.

**Hypothesis 1-10:** There is a positive relationship between the ratio of female directors and TCFD endorsement.

(4) Ownership: institutional investors and stable shareholders

According to the agency theory, participants of the capital market play the role of monitoring the managers. When the firm's absence of response to environmental problems is expected to raise uncertainty about its future cash flow or increase environmental costs, investors are likely to pressure the managers to take action against such problems. In the context of TCFD, managers facing market pressure will clarify the firm's position on environmental issues to attenuate information asymmetries.

Institutional investors are likely to act according to "Principles for Responsible Investment (PRI)" and monitor the firm as representatives of the capital market. Compared to other investors, they need to follow the principles and have accountability to asset owners.[1] Meanwhile, the presence of stable shareholders may reduce the pressure from the capital market,  not encouraging the firm to implement environment-related activities and disclose information. There is a specific portion of stable shareholders in the Japanese markets, such as individuals and cross-shareholdings (Muramiya & Takada, 2020). Their presence may shield the respective firms against external pressures. From the above, we propose the following hypotheses regarding corporate ownership:

**Hypothesis 1-11:** There is a positive relationship between institutional investor shareholding ratio and TCFD endorsement.

**Hypothesis 1-12:** There is a negative relationship between stable shareholder ratio and TCFD endorsement.

## 3.   The Impact of TCFD Endorsement on Firm Value

Next, we focus on the consequence of TCFD endorsement and discuss whether and how it affects the supporting firm's value. Considering that climate change will more or less influence the firm's future performance, investors should welcome the disclosure of information about such effects. This is because they search for every opportunity and risk information to allocate their capital accordingly. This is true for investors who support the PRI and those aiming for efficient capital allocation. Since TCFD endorsement is an official announcement stating that managers will actively work on climate change-related opportunities and risks, it may decrease a firm's cost of capital and change how investors assess its future cash flows.

Specifically, TCFD-related activities can increase the future cash flow or attenuate its reduction. Because the framework of TCFD focuses on the opportunities and risks, TCFD-related activities may help expand the firm's business opportunities. Moreover, considering the potential costs of regulations related to carbon tax and emission disposal, firms that carry out TCFD-related activities will effectively reduce their future cash outflow and, as a result, contribute to the creation of corporate value. The announcement of TCFD support could signal these potential impacts on the future cash flows and revise investors' estimates and confidence in them.

Meanwhile, the capital market will not incorporate the TCFD endorsement into the firm's value for at least three reasons. First, there is a possibility that the announcement of support for TCFD may not contain sufficient information to change investors' expectations for the firm value. While this announcement is an event that hints at the managers' attitudes and higher probability of information disclosure in the future, it is not possible to determine in advance how much information the announcement includes and to what extent managers change their actual business following the TCFD guidelines. Second, there is a possibility of greenwashing. Managers may show their support for TCFD at a surface level to obtain a favorable reputation from stakeholders (Bingler et al., 2022). Seasoned investors may be able to assess whether

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[1] In an information session for the institutional investors of Sumitomo Corporation held in October 2018, there was a Q&A session regarding information disclosures, requiring managers to show their position for TCFD. See https://www.sumitomocorp.com/-/media/Files/hq/ir/explain/others/20181024QA.pdf?la=ja (access, April 2022).

managers are seriously engaged in tackling environmental problems. Therefore, they may not immediately welcome such environmental information simply because the firm has announced its support for TCFD. Third, the level of experience of the investors may have a role to play. Investors are generally assumed to constantly gather information on potential investee firms and rationally make investment decisions based on that information. However, this process generates information processing costs, preventing investors from adequately recognizing, collecting, and analyzing all information (Blankespoor et al., 2020).

In light of these arguments, we consider whether the announcements of TCFD supports have impact on the firm value is an empirical question. Thus, we propose the following null hypothesis:

**Hypothesis 2:** Announcement of TCFD endorsement has no impact on the subsequent firm value.

## III.   *Research Design*

### 1.   **Regression Estimation Model Related to Determinants**

To analyze the determinants of TCFD endorsement (Hypothesis 1), we use the following probit model, shown as Equation (1). We measure independent variables based on the fiscal year ending immediately before the announcement of TCFD to mitigate the endogeneity issues stemming from simultaneity and reverse causality.

$$Prob\ (TCFD_{i,t}=1)=\alpha_0+\beta_1 Size_{i,t-1}+\beta_2 Business\ Segment_{i,t-1}+\beta_3 Overseas\ Sales_{i,t-1}$$

$$+\beta_4 EnvSensitiveInd_{i,t-1}+\beta_5 MSCI\_EnvScore_{i,t-1}+\beta_6 Profitability_{i,t-1}$$

$$+\beta_7 Levarage_{i,t-1}+\beta_8 Board\ Size_{i,t-1}+\beta_9 Outside\ Director\%_{i,t-1}$$

$$+\beta_{10} Female\ Director\%_{i,t-1}+\beta_{11} InstOwn\%_{i,t-1}+\beta_{12} StableOwn\%_{i,t-1}$$

$$+Year\ fixed\ Effects+Industry\ fixed\ effects+\varepsilon_{i,t}.\qquad(1)$$

The dependent variable, *TCFD*, is an indicator variable that equals 1 if the firm endorses TCFD and 0 otherwise. There are 12 explanatory variables corresponding to Hypotheses 1-1 to 1-12. For the firm characteristics, first, *Size* is the natural logarithm of the total assets, representing the firm size. *Business Segment* is the number of business segments that indicates the degree of diversification. *Overseas Sales* is the ratio of overseas sales to total sales, indicating the degree of internationalization. *EnvSensitiveInd* is an indicator variable that equals 1 if the firm belongs to an environmentally sensitive industry (ESI) and 0 otherwise. Following Cho and Patten (2007) and Garcia et al. (2017), we consider the industries of Mining, Pulp/Paper, Chemical, Petroleum/Coal Products, Steel, and Electricity/Gas as ESI. We use the Tokyo Stock Exchange Industry Classification, classifying all listed firms into 33 industries. *MSCI_EnvScore* is a variable for the firm's environmental performance. We use the ESG Ratings provided by the MSCI and convert the ratings from AAA to CCC to equivalent numbers from 7 to 1. If there was no rating, we give a score of 0 for the firm-year.

Regarding the financial characteristics, *Profitability* is a variable for firms' profitability,

defined as a return on assets (i.e., net income scaled by total assets at the end of the previous fiscal year). *Leverage* is the debt ratio, defined as total liabilities divided by total assets.

For the governance characteristics, we included the number of directors (*Board Size*), the proportions of outside directors and female directors on the board (*Outside Director%* and *Female Director%*). *InstOwn%* and *StableOwn%* are variables for firms' shareholder structures, defined as institutional and stable shareholder ownerships. We control for year- and industry-fixed effects to mitigate the influence of the year and industry-specific factors. Table 3 summarizes the variable definitions and expected signs of the independent variables used in Equation (1).

TABLE 3.   VARIABLES, PREDICTED SIGNS, AND DEFINITIONS RELATED TO DETERMINANTS

| **Determinant Analysis (Hypothesis 1)** | | | |
|---|---|---|---|
| Variable | Hypothesis | Pred.sign | Definition |
| $TCFD_{i,t}$ | | | An indicator variable that equals 1 if the firm endorses TCFD and 0 otherwise. |
| $Size_{i,t-1}$ | H1-1 | $+$ | The natural logarithm of total assets at the end of year $t-1$. |
| $Business\ Segment_{i,t-1}$ | H1-2 | $+$ | The number of business segments in year $t-1$. |
| $Overseas\ Sales_{i,t-1}$ | H1-3 | $+/-$ | Overseas sales in year $t-1$, scaled by total sales in year $t-1$. |
| $EnvSensitiveInd_{i,t-1}$ | H1-4 | $+$ | An indicator variable that equals 1 if the firm belongs to an environmentally sensitive industry (Mining, Pulp/Paper, Chemistry, Petroleum/Coal Products, Steel, Electricity/Gas) and 0 otherwise. |
| $MSCI\_EnvScore_{i,t-1}$ | H1-5 | $+/-$ | MSCI ESG Ratings in year $t-1$ (AAA to CCC converted to 7 to 1, and 0 in case of no rating). |
| $Profitability_{i,t-1}$ | H1-6 | $+/-$ | Net income in year $t-1$, scaled by total assets at the end of $t-1$. |
| $Leverage_{i,t-1}$ | H1-7 | $+/-$ | Total liabilities at the end of year $t-1$, scaled by total assets at the end of year $t-1$. |
| $Board\ Size_{i,t-1}$ | H1-8 | $+$ | The number of directors in year $t-1$. |
| $Outside\ Director\%_{i,t-1}$ | H1-9 | $+$ | The ratio of outside directors on the board of directors in year $t-1$. |
| $Female\ Director\%_{i,t-1}$ | H1-10 | $+$ | The ratio of female directors on the board of directors in year $t-1$. |
| $InstOwn\%_{i,t-1}$ | H1-11 | $+$ | The percentage of ownership held by institutional investors in year $t-1$. |
| $StableOwn\%_{i,t-1}$ | H1-12 | $-$ | The percentage of ownership held by stable shareholder in year $t-1$. |
| **Consequence Analysis (Hypothesis 2)** | | | |
| Variable | | | Definition |
| $Tobin\ Q_{i,t}$ | | | The sum of the market value of equity and the book value of debts at the end of year $t$, scaled by total assets at the end of year $t$. |

## 2. Regression Estimation Model for Firm Value

Next, we test Hypothesis 2 using the following linear estimation model shown as Equation (2). As with Equation (1), we use lagged independent variables to mitigate endogeneity issues from simultaneity and align the timelines between dependent and independent variables. While we measure both *Tobin Q* and *TCFD* in year *t*, *Tobin Q* is the value of fiscal year-end measured after the TCFD endorsement during the term.

$$Tobin\ Q_{i,t} = \alpha_0 + \beta_1 TCFD_{i,t} + \beta_2 Size_{i,t-1} + \beta_3 Profitability_{i,t-1} + \beta_4 Leverage_{i,t-1}$$

$$+ Year\ fixed\ effects + Industry\ fixed\ effects + \varepsilon_{i,t}. \tag{2}$$

The dependent variable *Tobin Q* is Tobin's Q, representing the firm's value. It is the sum of the market value of equity and the book value of debts scaled by total assets. Our variable of interest is *TCFD*, an indicator variable that equals 1 if the firm supports TCFD and 0 otherwise. In Equation (2), we include the firm size (*Size*), profitability (*Profitability*), and capital structure (*Leverage*) as control variables. We also incorporate year- and industry-fixed effects. We note that Equation (2) is implicitly subject to the endogeneity regarding the TCDF supporters as we discuss that TCFD support is a function of its determinants in Equation (1). In the robustness section, we come back to this issue and apply alternative approaches as sensitivity tests.

# IV.  *Sample Selection and Descriptive Statistics*

Table 4 summarizes our sample selection procedure. Our initial sample consists of 11,427 firm-year observations of Japanese listed firms between 2018 and 2020. The sample period begins in 2018 as the final report of TCFD was published in June 2017, and organizations have started to announce their support since then. We obtain data for TCFD supporters and their date of announcement of support from the homepage of TCFD.[2] We collect financial data from the *Nikkei NEEDS Financial QUEST* (Nikkei Inc.), stock price data from *NPM Database* (Financial Solutions Inc.), ESG rating data from *ESG Ratings Time-Series-Equities* provided by MSCI, and the governance-related data from *Nikkei NEEDS Cges* (Nikkei Inc.).

To focus on the motives and consequences of TCFD support among non-financial firms, we exclude financial sector firms (i.e., firms in the banking, securities, and insurance sectors) based on the Tokyo Stock Exchange Industry Classification. Moreover, we match non-supporter firms with supporter firms by year and industry, excluding industry-year with no TCFD supporters from the sample. When firms do not prepare consolidated financial statements, we use unconsolidated accounting data. Thus, the final sample consists of 6,292 firm-year observations, in which 202 firm-years are TCFD supporters while 6,090 are not.

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[2] The TCFD-supporting firms and the date of endorsement were specified as follows. First, we accessed the list of supporters on the TCFD homepage (https://www.fsb-tcfd.org/supporters/) and filtered it for firms located in Japan. Then, we verified whether each firm had a security code to confirm that they were listed on the stock exchange. Lastly, we accessed each firm's homepage and looked for the date they announced their support to TCFD to determine the timing of the endorsement.

TABLE 4.    SAMPLES SELECTION

| Criteria | Firm-years | |
|---|---|---|
| | Supporters | Non-supporters |
| Firm-years that listed on Japanese stock markets for 2018–2020 | | 11,417 |
| Fiscal year period has just 12 months | | 11,334 |
| The industry classification is not as financial | | 10,793 |
| Firms support TCFD in year $t$ | 216 | |
| Firms do not support TCFD in year $t$ | | 10,577 |
| Data used for the estimation of Eq. (1) and (2) is available | 202 | 9,162 |
| Firms are matched on year and industry | | 6,090 |
| Final sample | 202 | 6,090 |

Table 5 shows the distribution of the sample firms by industry and the respective ratios that support TCFD. The industry with the highest percentage of TCFD supporters is Electricity/Gas (56.5%), followed by Shipping (23.1%), Oil/Coal Products (20.0%), and Air Transportation (20.0%). By contrast, the Wholesale (0.3%) and Information/Communication industries (0.4%) have very low support ratios. Moreover, compared to the overall trend (3.2%), the industries classified as environmentally sensitive have relatively high percentages: namely, Chemical (5.7%), Petroleum/Coal Products (20.0%), Steel (8.9%), and Electricity/Gas (56.5%). Thus, firms belonging to industries with a high environmental load are more likely to support TCFD.

TABLE 5.    DISTRIBUTIONS OF TCFD SUPPORTING FIRMS BY INDUSTRY

| TSE 33 Industry Classification | Supporters | Non-supporters | Ratio |
|---|---|---|---|
| | A | B | A/(A+B) |
| Construction | 11 | 295 | 3.6% |
| Foods | 15 | 347 | 4.1% |
| Textile & Apparels | 4 | 94 | 4.1% |
| Chemicals | 35 | 583 | 5.7% |
| Pharmaceutical | 5 | 57 | 8.1% |
| Oil & Coal Products | 2 | 8 | 20.0% |
| Glass & Ceramics Products | 5 | 108 | 4.4% |
| Iron & Steel | 4 | 41 | 8.9% |
| Nonferrous Metals | 4 | 30 | 11.8% |
| Metal Products | 3 | 168 | 1.8% |
| Machinery | 15 | 425 | 3.4% |
| Electric Appliances | 27 | 443 | 5.7% |
| Transport Equipment | 10 | 177 | 5.3% |
| Precision Instruments | 3 | 94 | 3.1% |
| Other Products | 7 | 191 | 3.5% |
| Electric Power & Gas | 13 | 10 | 56.5% |
| Land Transportation | 2 | 64 | 3.0% |
| Marine Transportation | 6 | 20 | 23.1% |
| Air Transportation | 2 | 8 | 20.0% |
| Information & Communication | 4 | 1,077 | 0.4% |
| Wholesale Trade | 1 | 289 | 0.3% |
| Retail Trade | 7 | 599 | 1.2% |
| Real Estate | 7 | 213 | 3.2% |
| Services | 10 | 749 | 1.3% |
| Total | 202 | 6,090 | 3.2% |

TABLE 6.   DESCRIPTIVE STATISTICS

|  | Mean | St.Dev | Min | 25% | Median | 75% | Max |
|---|---|---|---|---|---|---|---|
| $TCFD_{i,t}$ | 0.032 | 0.176 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $Size_{i,t-1}$ | 10.443 | 1.776 | 6.486 | 9.173 | 10.296 | 11.528 | 15.453 |
| $Business\ Segment_{i,t-1}$ | 2.390 | 1.408 | 1.000 | 1.000 | 2.000 | 3.000 | 10.000 |
| $Overseas\ Sales_{i,t-1}$ | 0.148 | 0.240 | 0.000 | 0.000 | 0.000 | 0.246 | 1.000 |
| $EnvSensitiveInd_{i,t-1}$ | 0.111 | 0.314 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $MSCI\_EnvScore_{i,t-1}$ | 0.760 | 1.656 | 0.000 | 0.000 | 0.000 | 0.000 | 7.000 |
| $Profitability_{i,t-1}$ | 0.035 | 0.070 | −0.426 | 0.019 | 0.038 | 0.062 | 0.198 |
| $Leverage_{i,t-1}$ | 0.447 | 0.193 | 0.071 | 0.296 | 0.442 | 0.588 | 0.889 |
| $Board\ Size_{i,t-1}$ | 8.219 | 2.772 | 3.000 | 6.000 | 8.000 | 10.000 | 30.000 |
| $Outside\ Director\%_{i,t-1}$ | 0.280 | 0.128 | 0.000 | 0.200 | 0.250 | 0.333 | 0.875 |
| $Female\ Director\%_{i,t-1}$ | 0.041 | 0.068 | 0.000 | 0.000 | 0.000 | 0.077 | 0.600 |
| $InstOwn\%_{i,t-1}$ | 0.079 | 0.078 | 0.000 | 0.010 | 0.062 | 0.124 | 0.682 |
| $StableOwn\%_{i,t-1}$ | 0.399 | 0.189 | 0.000 | 0.259 | 0.401 | 0.537 | 1.000 |
| $Tobin\ Q_{i,t}$ | 1.492 | 1.392 | 0.457 | 0.830 | 1.034 | 1.546 | 13.893 |

*Note:* This table shows descriptive statistics. All variables are defined in Table 3. All continuous variables are winsorized by year at the top and bottom 1%.

Table 6 shows the descriptive statistics. To mitigate the impact of outliers, we winsorize all continuous variables at the top and bottom 1% by year. The mean value of *TCFD* shows that 3.2% of the samples support TCFD. The mean value of *EnvSensitiveInd* indicates that 11.1% of the sample firms belong to an environmentally sensitive industry. Moreover, *MSCI_EnvScore* shows that the value of the third quartile is 0, implying that many sample firms have not obtained the ESG ratings from MSCI. Untabulated statistics show that approximately 80% of sample firms do not receive the ESG ratings.

# V.   *Empirical Results*

## 1.   **Univariate Analysis**

Before estimating Equations (1) and (2), we conduct a univariate analysis to examine the characteristics of firms supporting TCFD and its impact on their value. Specifically, we compared the firms that support TCFD (*TCFD* = 1) with those that do not (*TCFD* = 0) based on the mean and median values of the variables used to estimate Equations (1) and (2).

Table 7 shows the results of the univariate analysis. For the determinative factors used in Equation (1), all variables except *Profitability* have significant differences for the mean and median. The results indicate that TCFD-supporting firms are more likely to be large, diversified, internationalized, environmentally sensitive industries, and show high environmental performance and leverage. They also have larger boards of directors with more female and outside directors. For shareholder composition, they have more institutional ownership while less stable shareholder ownership. These results are largely consistent with our hypotheses.

Meanwhile, regarding *Tobin Q* (the dependent variable of Equation 2), the mean and median values are higher for non-supporter firms. However, the differences between supporters and non-supporters are relatively small and less statistically significant than other variables. Since the other factors can significantly affect the firm's value, we need to control them and test

TABLE 7.   UNIVARIATE ANALYSIS

| | Supporters ($TCFD_{i,t}=1$) | | Non-supporters ($TCFD_{i,t}=0$) | | Supporters vs. non-supporters | |
|---|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | Welch's $t$-test | Wilcoxon rank sum test |
| $Size_{i,t-1}$ | 13.915 | 14.157 | 10.328 | 10.237 | (<0.001) | (<0.001) |
| $Business\ Segment_{i,t-1}$ | 3.822 | 4.000 | 2.342 | 2.000 | (<0.001) | (<0.001) |
| $Overseas\ Sales_{i,t-1}$ | 0.353 | 0.343 | 0.141 | 0.000 | (<0.001) | (<0.001) |
| $EnvSensitiveInd_{i,t-1}$ | 0.267 | 0.000 | 0.105 | 0.000 | (<0.001) | (<0.001) |
| $MSCI\_EnvScore_{i,t-1}$ | 4.252 | 4.000 | 0.644 | 0.000 | (<0.001) | (<0.001) |
| $Profitability_{i,t-1}$ | 0.035 | 0.035 | 0.035 | 0.038 | (0.907) | (0.459) |
| $Leverage_{i,t-1}$ | 0.535 | 0.547 | 0.444 | 0.437 | (<0.001) | (<0.001) |
| $Board\ Size_{i,t-1}$ | 10.624 | 10.000 | 8.139 | 8.000 | (<0.001) | (<0.001) |
| $Outside\ Director\%_{i,t-1}$ | 0.346 | 0.333 | 0.278 | 0.250 | (<0.001) | (<0.001) |
| $Female\ Director\%_{i,t-1}$ | 0.082 | 0.071 | 0.039 | 0.000 | (<0.001) | (<0.001) |
| $InstOwn\%_{i,t-1}$ | 0.173 | 0.175 | 0.076 | 0.059 | (<0.001) | (<0.001) |
| $StableOwn\%_{i,t-1}$ | 0.202 | 0.156 | 0.405 | 0.407 | (<0.001) | (<0.001) |
| $Tobin\ Q_{i,t}$ | 1.346 | 0.972 | 1.497 | 1.038 | (0.046) | (0.764) |
| N | 202 | | 6,090 | | | |

*Note:* This table shows results of univariate comparison tests. All variables are defined in Table 3. All continuous variables are winsorized by year at the top and bottom 1%.

Hypothesis 2 by estimating Equation (2).

## 2.   Multivariate Analysis

Table 8 shows the regression results for Hypothesis 1 using Equation (1). We estimate our model using year- and industry-fixed probit regression. The reported *p*-values are based on standard errors clustered at the firm level. We find that the coefficients on *Size* (H1-1), *EnvSensitiveInd* (H1-4), *MSCI_EnvScore* (H1-5), and *Outside Director%* (H1-9) are positive and significant at the 1% level; the coefficient on *StableOwn%* is negative and significant (H1-12). These results are broadly consistent with hypotheses and indicate that TCFD-supporting firms are likely to be larger, belong to environmentally sensitive industries, exhibit higher environmental performance, appoint more outside directors, and have lower stable shareholders. While we propose the null hypothesis for the environment performance (H1-5), the result is likely to support the signaling rather than greenwashing view.

Overall, these results suggest that firms that support TCFD tend to consider their governance environment, levels of attention from their stakeholders, and environmental load in their support decision-making processes. Thus, announcing support for TCFD is likely to be a decision based on the firm's needs and rationale rather than greenwashing.

Table 9 shows the regression results for Hypothesis 2 using Equation (2). Again, we report *p*-values based on standard errors clustered at the firm level. We find that the coefficient on *TCFD* is positive and statistically significant at the 1% level, indicating that TCFD-supporting firms have higher values than non-supporters. Therefore, the announcements of TCFD endorsement have a potential to increase the firm's value by revising investors' estimates and increasing confidence in the firm's future cash flows.

TABLE 8.   REGRESSION RESULTS FOR THE DETERMINANTS OF
TCFD ENDORSEMENT (HYPOTHESIS 1)

| | Pred. signs | Dependent Variable = $TCFD_{i,t}$ | |
| --- | --- | --- | --- |
| | | Coef. | (p-value) |
| Constant | | −9.421 | (<0.001)*** |
| $Size_{i,t-1}$ | + | 0.424 | (<0.001)*** |
| $Business\ Segment_{i,t-1}$ | + | 0.053 | (0.101) |
| $Overseas\ Sales_{i,t-1}$ | +/− | −0.052 | (0.852) |
| $EnvSensitiveInd_{i,t-1}$ | + | 1.346 | (<0.001)*** |
| $MSCI\_EnvScore_{i,t-1}$ | +/− | 0.191 | (<0.001)*** |
| $Profitability_{i,t-1}$ | +/− | −1.776 | (0.217) |
| $Leverage_{i,t-1}$ | +/− | 0.660 | (0.254) |
| $Board\ Size_{i,t-1}$ | + | −0.004 | (0.859) |
| $Outside\ Director\%_{i,t-1}$ | + | 1.249 | (0.008)*** |
| $Female\ Director\%_{i,t-1}$ | + | 0.545 | (0.438) |
| $InstOwn\%_{i,t-1}$ | + | −0.119 | (0.877) |
| $StableOwn\%_{i,t-1}$ | − | −0.748 | (0.092)* |
| Year fixed effects | | Included | |
| Industry fixed effects | | Included | |
| Pseudo $R^2$ | | 0.552 | |
| N | | 6,292 | |

*Note:* This table shows results for the determinants of TCFD endorsement. We use probit estimation for Equation (1). All variables are defined in Table 3. The reported *p*-values are two-tailed and based on standard errors clustered at the firm level. *** and * indicate statistical significance at the 1% and 10% levels, respectively.

TABLE 9.   REGRESSION RESULTS FOR THE IMPACT OF TCFD ENDORSEMENT
(HYPOTHESIS 2)

| | Pred. signs | Dependent Variable = $Tobin\ Q_{i,t}$ | |
| --- | --- | --- | --- |
| | | Coef. | (p-value) |
| Constant | | 3.030 | (<0.001)*** |
| $TCFD_{i,t}$ | + | 0.734 | (<0.001)*** |
| $Size_{i,t-1}$ | +/− | −0.163 | (<0.001)*** |
| $Profitability_{i,t-1}$ | + | 2.056 | (0.003)*** |
| $Leverage_{i,t-1}$ | +/− | −0.351 | (0.002)*** |
| Year Fixed Effects | | Included | |
| Industry Fixed Effects | | Included | |
| Adj-$R^2$ | | 0.219 | |
| N | | 6,292 | |

*Note:* This table shows results for the consequences of TCFD endorsement. We use OLS estimation for Equation (2). All variables are defined in Table 3. The reported *p*-values are two-tailed and based on standard errors clustered at the firm level. *** indicates statistical significance at the 1% level.

### 3.  Robustness Analysis

The previous section investigates the impact of endorsing TCFD on a firm's value using Equation (2). While the results suggest that supporters of TCFD tend to have a higher value than non-supporters, the results in Table 7 using Equation (1) indicate that firms that support TCFD follow a specific trend. As such, the estimation results of Equation (2) can be subject to endogeneity problems. To mitigate this issue, we conduct alternative two approaches for Hypothesis 2.

The first is the two-step treatment effect model proposed by Heckman (1979). With this model, we incorporate the *Inverse Mills Ratio*$_{i,t}$, which is obtained by estimating Equation (1), into Equation (2) as an independent variable to control self-selection bias. Table 10 shows the results using the two-step treatment effect model. The coefficient on *Inverse Mills Ratio* is statistically significant, confirming selection bias in the estimation of Equation (2). Meanwhile, the coefficient of *TCFD* remains positive and statistically significant at the 1% level. The results are consistent with our main results and suggest that they are robust to the selection bias.

TABLE 10.  ROBUSTNESS TESTS: HECKMAN'S TWO-STEP TREATMENT EFFECT MODEL

|  | Pred. signs | Dependent Variable = *Tobin Q*$_{i,t}$ | |
|---|---|---|---|
|  |  | Coef. | (p-value) |
| Constant |  | 11.218 | (<0.001)*** |
| *TCFD*$_{i,t}$ | + | 0.543 | (<0.001)*** |
| *Size*$_{i,t-1}$ | +/− | −0.574 | (<0.001)*** |
| *Profitability*$_{i,t-1}$ | + | 3.777 | (<0.001)*** |
| *Leverage*$_{i,t-1}$ | +/− | −0.757 | (<0.001)*** |
| *Inverse Mills Ratio*$_{i,t}$ | +/− | −0.790 | (<0.001)*** |
| Year fixed effects |  | Included | |
| Industry fixed effects |  | Included | |
| Adj-R$^2$ |  | 0.248 | |
| N |  | 6,292 | |

*Note:* This table shows results for the consequences of TCFD endorsement using Heckman's two-step treatment effect model. We calculate the Inverse Mills Ratio with the probit estimation of Equation (1) and incorporate this as an independent variable to control selection bias of TCFD supporters (*Inverse Mills Ratio*$_{i,t}$). All other variables are defined in Table 3. The reported *p*-values are two-tailed and based on standard errors clustered at the firm level. *** indicates statistical significance at the 1% level.

The second approach uses propensity score matching as proposed by Rosenbaum and Rubin (1983). We calculate propensity scores with the logit estimation of Equation (1) and match TCFD supporters (treatment group) with non-supporters with similar characteristics (control group) based on the closest propensity scores, without replacement. This matching procedure is an ideal method to test the effect of differences in TCFD-supporting status with minimized variation in control variables. In the sample, 202 firm-years are TCFD supporters and matched to non-supporters, yielding 404 firm-years of the matched-pair subsample.

Table 11 shows the analysis results. Panel A compares the mean values of the covariates between the treatment group with the control group. We find no statistical difference for most variables between the two groups. While we still find statistically significant differences for

TABLE 11.   ROBUSTNESS TESTS: REGRESSION ANALYSIS USING MATCHED-
PAIR SUBSAMPLE

**Panel A: Mean comparison between treatment and control group**

| | Treatment group | Control group | Treatment vs. Control groups |
|---|---|---|---|
| | Mean | Mean | Welch's $t$-test |
| $Size_{i,t-1}$ | 13.915 | 13.529 | (0.003)*** |
| $Business\ Segment_{i,t-1}$ | 3.822 | 3.599 | (0.204) |
| $Overseas\ Sales_{i,t-1}$ | 0.353 | 0.371 | (0.531) |
| $EnvSensitiveInd_{i,t-1}$ | 0.267 | 0.183 | (0.043)** |
| $MSCI\_EnvScore_{i,t-1}$ | 4.252 | 4.094 | (0.341) |
| $Profitability_{i,t-1}$ | 0.035 | 0.039 | (0.419) |
| $Leverage_{i,t-1}$ | 0.535 | 0.491 | (0.011)** |
| $Board\ Size_{i,t-1}$ | 10.624 | 10.257 | (0.206) |
| $Outside\ Director\%_{i,t-1}$ | 0.346 | 0.338 | (0.548) |
| $Female\ Director\%_{i,t-1}$ | 0.082 | 0.067 | (0.045) |
| $InstOwn\%_{i,t-1}$ | 0.173 | 0.173 | (0.954) |
| $StableOwn\%_{i,t-1}$ | 0.202 | 0.233 | (0.045)** |
| N | 202 | 202 | |

**Panel B: Regression results using matched-pair sample**

| | Pred. signs | Dependent Variable = $Tobin\ Q_{i,t}$ | |
|---|---|---|---|
| | | Coef. | (p-value) |
| Constant | | 4.364 | (<0.001)*** |
| $TCFD_{i,t}$ | + | 0.240 | (0.027)** |
| $Size_{i,t-1}$ | +/− | −0.155 | (0.011)** |
| $Profitability_{i,t-1}$ | + | 1.824 | (0.531) |
| $Leverage_{i,t-1}$ | +/− | −1.440 | (0.013)** |
| Year Fixed Effects | | Included | |
| Industry Fixed Effects | | Included | |
| Adj-$R^2$ | | 0.268 | |
| N | | 404 | |

*Note:* This table shows the result using a matched-pair subsample based on propensity scores. we calculate the propensity scores with the logit estimation of Equation (1) and match TCFD supporter observations with non-supporter ones with similar characteristics based on the closest propensity scores, without replacement. In the sample, 202 firm-years are TCFD supporters and matched to non-supporters, yielding 404 firm-years of the matched-pair subsample. Panel A compares the mean values of the covariates using $t$-tests. Panel B presents regression results of Equation (2) using the matched-pair subsample. All variables are defined in Table 3. The reported $p$-values are two-tailed and based on standard errors clustered at the firm level. *** and ** indicate statistical significance at the 1% and 5% levels, respectively.

*Size*, *EnvSensitiveInd*, *Leverage*, *Female Director%*, and *StableOwn%*, the differences between the treatment and control groups become less significant than those shown in Table 7. These results suggest that the matching procedure is likely to mitigate concerns about heterogeneity in TCFD supporters. Panel B presents the results of Equation (2) using the matched-pair subsample. The coefficient on *TCFD* is positive and statistically significant. This result is consistent with those in the primary analysis and suggests that the positive relationship between TCFD endorsement and the firm value is robust to the effect of heterogeneity in underlying firm

characteristics.

## VI.   *Conclusion*

This study examines the determinants and consequences of TCFD endorsement. To this end, we focus on listed firms in Japan, where many non-financial firms announced their support for TCFD recommendations. Based on four theoretical backgrounds (i.e., legitimacy theory, stakeholder theory, agency theory, and resource-based perspective), we propose 12 determinants for TCFD support. Moreover, we focus on the impact of TCFD support in the capital market and investigate whether and how the announcement of support is associated with the firm's value.

In a sample of non-financial firms listed in Japanese stock markets, we first find that firms that announced support for TCFD tend to have the following characteristics: (1) they are larger, (2) belong to an environmentally sensitive industry, (3) exhibit higher environmental performance, (4) have more outside directors, and (5) have lower stable shareholders. Moreover, the analysis of firm value shows that TCFD-supporting firms tend to have a higher value (Tobin Q) than non-supporters after announcing their endorsement.

This study makes practical, political, and academic contributions to TCFD, which has been in the spotlight recently. First, TCFD endorsements can be considered the result of firms making decisions based on their needs and rationale rather than a greenwashing activity. Thus, supporting TCFD may be seen as a possible signal of the firm having a concrete response to environmental problems. Second, the findings of this study indicate that supporting TCFD can increase the firm's value. Announcing support for TCFD can revise investors' estimates and increase confidence in the firm's future cash flows. Since this study focused on firms' voluntary endorsements, it does not intend to show that TCFD disclosure should be mandated via regulations. However, considering the possibility that the capital market welcomes TCFD-related activities, it does support the policy to encourage information disclosure based on TCFD.

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