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投資人評價環境資訊嗎？

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摘要：本研究探討投資人是否評價永續（企業社會責任）報告書中各種類型的環境相關揭露（包括質性、歷史性財務、預測性財務等三種環境相關資訊），以 2017-2020 年的台灣上市櫃公司為樣本，分析結果顯示：(1)從公司評價的角度來看，投資人對單獨揭露的預測性財務資訊會給予較為負面的評價，然而報告書中若同時揭露歷史性與預測性兩類財務資訊，則投資人會給予公司較為正面的評價；(2)對於那些已發生環境相關負面事件的公司而言，其報告書中若同時涵蓋有歷史性及預測性財務之環境資訊，則能發揮類保險效果，減輕負面事件帶來的不利市場反應。另外，本研究對自願編製報告書的公司重新執行上述兩項議題的檢測，實證發現與上述全樣本之分析結果略有不同。明確來說，投資人對自願編製公司單獨揭露的預測性財務資訊會給予正面的評價，且在發生負面事件時，無論所揭露的內容為歷史性、預測性，抑或兩者同時揭露，均具有類保險效果。最後，本研究亦提供環境揭露與後續環境績效的初步證據，俾做為後續探究兩者是否脫鉤（即漂綠）的基礎。

關鍵詞：環境揭露、永續（企業社會責任）報告書、公司價值、環境相關負面事件

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Do Investors Value Environmental Information?

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Abstract: This study investigates whether investors value various types of environment-related disclosures (qualitative information, historical financial information, and estimated financial information) in sustainability (environmental, social, and governance [ESG]/corporate social responsibility [CSR]) reports. We examine a sample of Taiwanese firms that published ESG/CSR reports between 2017 and 2020 and report the following results. First, in terms of firm valuation, the disclosure of solely forward-looking financial data is negatively associated with firm value; however, this negative association is mitigated when historical financial data is disclosed alongside the forward-looking data. Second, for companies with environmental misconduct, the simultaneous disclosure of both historical and forward-looking financial data has an insurance-like effect that recues negative market reactions to this record of misconduct. Furthermore, our analysis of voluntary ESG/CSR report issuers reveals results that slightly differ from those observed in the full sample. Specifically, for voluntary issuers, the disclosure of solely forward-looking financial data is positively associated with firm value. Additionally, for these issuers with environmental misconduct events, the disclosure of financial information, regardless of whether it includes historical data, forward-looking data, or both, induces an insurance-like effect. Finally, this study provides preliminary evidence of a relationship between environmental disclosure and subsequent environmental performance, which can serve as a foundation for future research on the potential decoupling between disclosed environmental information and actual environmental performance, commonly referred to as greenwashing.

Keywords: environmental disclosure, sustainability reports (ESG/CSR reports), firm value, environmental misconduct event

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I. Introduction

Accounting researchers have long held an interest in environmental issues (e.g., Barth and McNichols, 1994; Barth, McNichols, and Wilson, 1997; Cormier and Magnan, 1997; Clarkson, Li, and Richardson, 2004). This study investigates the quality of environmental information in corporate reporting. Companies previously provided relevant information on environmental issues in corporate social responsibility (CSR) reports (e.g., Dahlsrud, 2008); however, to encourage the more detailed and transparent reporting by corporations, the United Nations (UN) proposed clear guidelines for environmental, social, and governance (ESG) reporting in 2015.[1] Gillan, Koch, and Starks (2021) define ESG and CSR reports as being interchangeable.[2] Because environmental issues are incorporated in both ESG and CSR reporting, we follow the view of Gillan et al. (2021) and use their terminology "ESG/CSR" in the following discussion. Specifically, this paper focuses on the environmental information presented in dollar format reported in ESG/CSR reports and examines the effects of such disclosures.

Studies have increasingly focused on the environmental information provided in ESG/CSR reports given the increasing emphasis placed on sustainability. Although investments in corporate sustainability have increased considerably over time, the quality of CSR and ESG reports must still be improved, particularly in developing countries (e.g., Kamal and Deegan, 2013; Huang, Lin, and Di, 2019). Because environment-related disclosures are gaining importance in corporate reporting, understanding whether investors consider these disclosures when they value a firm is crucial. Sustainability issues and carbon pricing have become increasingly relevant to investor decision-making. In particular, *accounting* may play a role in the analysis and reporting of such information.[3] Accounting tasks involved in climate change adaptation include assessments of vulnerability and adaptive capacity, evaluations of costs and benefits, and disclosures of related risks. Compared with other investment outcomes, the outcome of adaptation is considerably more difficult to measure because the success is less visible and its evaluation requires supporting data (e.g., Linnenluecke, Birt, and Griffiths, 2015; Linnenluecke, Birt, Chen, Ling, and Smith, 2017).

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1 United Nations. 2015. "Sustainable Development Goals kick off with start of new year." Available at https://www.un.org/sustainabledevelopment/blog/2015/12/sustainable-development-goals-kick-off-with-start-of-new-year/.

2 "The extent to which corporations benefit or harm social welfare has received increasing attention from many quarters. Corporate actions in this arena are often referred to as Environmental, Social and Governance (ESG), or Corporate Social Responsibility (CSR)." (Gillan et al., 2021, p.1).

3 For example, Puma issued an environmental profit and loss report in 2012; this report is an income statement that internalizes external costs (Huang et al., 2019) and is an example of a financial disclosure.

The aforementioned phenomenon reflects a challenge in the process of setting accounting standards because unverifiable nonfinancial information might not be useful for investors in decision-making, but environmental information is not always quantifiable (e.g., Clarkson, Overrell, and Chapple, 2011; Hartmann, Perego, and Young, 2013; Wegener, Labelle, and Jerman, 2019). Standard setters spend considerable effort in developing suitable reporting standards for investors. Different organizations, such as the Global Reporting Initiative (GRI), International Integrated Reporting Council (IIRC), and Task Force on Climate-Related Financial Disclosures (TCFD), have proposed a plethora of guidelines for sustainability-related reporting.[4] The Sustainability Accounting Standards Board (SASB) further developed sustainability accounting standards. After a consolidation of various organizations, in June 2023, the International Sustainability Standards Board (ISSB)[5] issued International Financial Reporting Standards (IFRS) S1 and S2, which regulate disclosures related to sustainability for capital markets. The aforementioned discussion indicates a trend toward formalizing the disclosure of specific ESG information in financial reporting. In light of this trend, the present study investigates whether the specificity of environmental information affects investor valuations of a firm.

Specifically, this paper explores the extent to which firms provide specific environmental information in monetary form (e.g., dollar amounts of costs and benefits) compared with general qualitative statements regarding environmental policies and missions. Prior studies have classified environmental disclosures into qualitative and quantitative disclosures; however, the present study classifies environmental disclosures into those providing nonmonetary information, historical monetary information, and future monetary estimates. The nonmonetary information in environmental disclosures includes qualitative information (e.g., general statements describing a company's environmental mission or environmental actions) and quantitative information (e.g., data on a company's carbon emissions or wastewater discharge). Moreover, the monetary information in environmental disclosures includes historical expenditures on environmental protection and expected cash inflow. In summary, we categorize environmental information into the following types: general baseline descriptions that do not involve dollar amounts (hereafter referred to as BASE information); historical financial information (hereafter referred to as FH information), such as past environmental expenditures; and estimated financial information for the future (hereafter referred to as FE information).

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4 The TCFD aims to provide useful climate-related information to investors. The website of the TCFD states that "The Financial Stability Board (FSB) created the TCFD to develop recommendations on the types of information that companies should disclose to support investors, lenders, and insurance underwriters in appropriately assessing and pricing a specific set of risks—risks related to climate change." (https://www.fsb-tcfd.org/about/).

5 The ISSB is a standard setting organization under the IFRS foundation.

Economic theories of voluntary disclosure suggest that companies that perform well have incentives to distinguish themselves from others by revealing their types (e.g., Verrecchia, 1983; Dye, 1985). Research has suggested that ESG/CSR reporting has capital market benefits (e.g., Dhaliwal, Radhakrishnan, Tsang, and Yang, 2012; Bachoo, Tan, and Wilson, 2013). On the other hand, if investors consider such reporting to be routine, the disclosure might not be informative of firm value (e.g., Cahan, De Villiers, Jeter, Naiker, and Van Staden, 2016). Alternatively, if investors consider ESG/CSR reporting to be an opportunistic tactic to alter company image, the disclosure might be negatively associated with firm value. Based on these different theories, we hypothesize that environmental disclosures are incrementally associated with firm value (positively or negatively) if they include either historical or projected monetary information in addition to general and descriptive statements.

Sociopolitical theories state that companies engage in environmental disclosure because of social and political pressure; therefore, companies with worse environmental performance are likely to issue more disclosures (e.g., Gray, Kouhy, and Lavers, 1995; Patten, 2002). Firms face negative market reactions when they harm the environment, such as by contributing to pollution; however, these negative reactions can be mitigated by environmental disclosures (e.g., Patten, 1992; Clarkson et al., 2011; Clarkson, Fang, Li, and Richardson, 2013). In addition to this "insurance-like" role, ESG/CSR reporting plays a role in *ex-ante* monitoring for reducing future company misconduct (e.g., Christensen, 2016). We hypothesize that, for investors, environmental information is likely to be of higher quality when it is quantified monetarily. Therefore, firms receive less of a negative reaction from the market for their environmental misconduct when they provide environment-related financial information in their ESG/CSR reports.

We investigate the aforementioned hypotheses by using a sample of Taiwanese firms that issued ESG/CSR reports during 2017–2020. We obtain BASE, FH, and FE information from these companies' ESG/CSR or sustainability reports. Taiwanese regulators have spent considerable effort to promote the implementation of environmental reporting. The Taiwanese stock market is characterized by a high proportion of retail investors and high turnover. As of 2020, domestic individual investors accounted for 36.10% of the investors in the Taiwan Stock Exchange (TWSE).[6] Moreover, financial news coverage and analyst following are relatively low in Taiwan (e.g., Chin, Kleinman, Lee, and Lin, 2006). Because of the high percentage of individual shareholders and limited number of information intermediaries in Taiwan, Taiwanese investors are highly vulnerable to problems related to

[6] Taiwan Stock Exchange Fact Book, which is available at: https://www.twse.com.tw/downloads/zh/about/company/factbook/2021/4.02.html.

information asymmetry; therefore, corporate disclosures are more valued in Taiwan than in mature markets, such as the United States. Since 2015, the "Corporate Governance Roadmap" established by the Financial Supervisory Commission (FSC) in Taiwan has required a specific set of listed companies to prepare CSR or sustainability reports,[7] and firms that are not on this list may provide ESG/CSR reports voluntarily; thus, the ESG/CSR disclosure of Taiwanese companies can be analyzed to identify scenarios in which the aforementioned theories are applicable.

The results of this study support our hypotheses in general. First, the results indicate that, in general, BASE information is not informative of firm value. By contrast, financial information is negatively associated with firm value, mainly when FE information is provided alone. In addition, if FH information is provided with FE information, the aforementioned negative effect is weakened. Thus, FH information from different channels, such as financial statements, provides credible support for FE information (e.g., Christensen, 2016). Furthermore, for firms that voluntarily provide ESG/CSR reports, the provision of only FE information is positively associated with firm value, which is consistent with voluntary disclosure theories (e.g., Verrecchia, 1983; Clarkson et al., 2011; Dhaliwal, Li, Tsang, and Yang, 2011); however, contrasting results are obtained for mandatory issuers.

Second, our analysis of a sample of firms engaging in environmental misconduct indicates that when firms violate environmental regulations, the market reaction during the days around the misconduct event is less negative for firms that simultaneously provide FH and FE information than for firms that do not. In the case of voluntary issuers, this "insurance-like" effect is pronounced for any type of financial disclosure (FH alone, FE alone, or both FE and FH). However, in the case of mandatory issuers, the aforementioned effect is notable only when FH information and FE information are simultaneously provided.

This study makes the following contributions to the literature. First, the ESG reporting scheme proposed by initiatives such as the GRI is "too distinct from financial reporting and insufficiently tailored toward investors" (Palepu, Healy, and Peek, 2022, p. 28). Organizations such as the Climate Disclosure Standards Board, SASB, and IIRC have attempted to address this problem by better integrating traditional financial statements with ESG/CSR reporting. Our paper sheds light on this debate by looking into "accounting-like"

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[7] This roadmap provides general guidance for listed companies in Taiwan. The firms subject to mandatory reporting include (1) firms from the chemical, food, and finance and insurance industries; (2) firms in which catering revenue accounts for over half of the total revenue; and (3) firms in which the paid-in capital is more than NT$5 billion. See https://cgc.twse.com.tw/pressReleases/promoteNewsArticleCh/694.

information in ESG/CSR reports and by examining whether the environment-related financial information provided in ESG/CSR reports affects disclosure quality and firm valuation.

Second, prior research has obtained mixed evidence regarding the motivation of ESG/CSR reporting. Some studies have found that ESG/CSR reporting reduces information asymmetry (e.g., Dhaliwal et al., 2012; Cahan et al., 2016), whereas other studies have found that such reporting can be opportunistic (e.g., Kim and Lyon, 2011; Bagnoli, Hoffman, and Watts, 2016). Such mixed evidence might be partially caused by the unconstrained content of ESG/CSR reports. Researchers have raised concerns that ESG/CSR reporting lacks comparability and is unverifiable (e.g., Hartmann et al., 2013; Wegener et al., 2019). Consequently, the demand for mandatory ESG reporting is increasing (e.g., Bolton, Kacperczyk, Leuz, Ormazabal, Reichelstein, and Schoenmaker, 2021; Krueger, Sautner, Tang, and Zhong, 2024). By investigating the differences between voluntary and mandatory issuers that report environment-related financial information, this study discusses the usefulness of specific types of disclosures (i.e., monetary form) as mandatory reporting disclosures.

Third, this paper provides insights for investors and standard setters in Taiwan. The FSC in Taiwan updated the Corporate Governance Roadmap in 2020 (version 3.0) to expand the list of firms subject to the mandatory filing of sustainability reports. By understanding the value of environmental disclosures in addition to audited financial statements, this study offers insights to standard setters regarding the quality of environmental disclosures in sustainability reports and the effect of such disclosures on firm valuation.

The remainder of this paper is structured as follows. Section II discusses the relevant literature and proposed hypotheses, Section III details the adopted empirical methodology, Section IV reports the empirical results, Section V details the robustness checks and additional tests conducted in this study, and Section VI provides the conclusions.

II. Institutional Background, Related Literature, and Hypothesis Development

1. ESG/CSR Disclosures in Taiwan

In 2018, the *Company Act* in Taiwan was amended to incorporate the idea of CSR (see *Company Act*, Article 1).[8] Governmental and nongovernmental agencies in Taiwan, such

[8] Specifically, Article 1 states that "…When conducting its business, every company shall comply with the laws and regulations as well as business ethics and may take actions which will promote public interests in

as the Ministry of Economic Affairs, FSC, TWSE, and Taipei Exchange (TPEx), have been promoting CSR and CSR reporting (Kuo, Kuo, and Chen, 2021). In addition, evaluation standards for ESG/CSR disclosures were gradually established during the 2000s. For example, the Common Wealth Magazine began giving the "Excellence in Corporate Social Responsibility" award in 2007,[9] and the Global Views Monthly magazine has been giving a CSR award since 2005 (currently named the ESG Corporate Sustainability Award).[10]

In 2010, the TWSE and TPEx announced the *Corporate Social Responsibility Best Practice Principles for TWSE/GTSM Listed Companies*, which began to encourage companies to disclose CSR information and compile CSR reports. In 2014, the FSC mandated that certain companies should start filing CSR reports from 2015. Moreover, the Securities and Futures Institute has incorporated CSR reporting in its "Information Disclosure and Transparency Ranking" and "Corporate Governance Evaluation System."

In response to the ESG movement, in 2020, the FSC introduced the third version of its Corporate Governance Roadmap, namely *Corporate Governance 3.0 - Sustainable Development Roadmap*.[11] This roadmap corresponds to the global trend toward ESG and aims to encourage the adoption of relevant international standards, such as TCFD standards, in Taiwan. On the basis of this roadmap, in 2021, the *Corporate Social Responsibility Best Practice Principles for TWSE/GTSM Listed Companies* was renamed to the *Sustainable Development Best Practice Principles for TWSE/TPEx Listed Companies*. Moreover, the TWSE has also modified the regulation for CSR reporting from "CSR report" to "Sustainability report."[12]

2. Environmental Sustainability as an Element in ESG/CSR Activities

Before the term "ESG" became widely used, the term "CSR" was commonly used instead. Bowen (1953) is the first researcher to focus on business ethics and CSR. The European Commission conceptualizes CSR in the following manner. "The actions of companies have significant impacts on the lives of citizens in the EU and around the world. … For this reason, EU citizens rightly expect that companies understand their positive and negative impacts on society and the environment. And, therefore, prevent, manage and mitigate any negative impact that they may cause…"[13] The term "ESG" emerged later and

order to fulfill its social responsibilities." (Company Act, Article 1, available at https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=J0080001). This article was amended August 1, 2018.

9 https://topic.cw.com.tw/csr/.

10 https://csr.gvm.com.tw/2023/award.html?v=1.

11 https://www.sfb.gov.tw/en/home.jsp?id=271&parentpath=0,117,118,120.

12 The regulation titled *Rules Governing the Preparation and Filing of Sustainability Reports by TWSE Listed Companies* was previously titled *Rules Governing the Preparation and Filing of Corporate Social Responsibility Reports by TWSE Listed Companies*.

13 https://single-market-economy.ec.europa.eu/industry/sustainability/corporate-social-responsibility-

covers corporate governance more explicitly than does CSR while encompassing the environmental and social activities covered by CSR (Gillan et al., 2021).[14]

The environment is a crucial aspect of ESG/CSR, and governmental and nongovernmental organizations have increasingly pushed for the internalization of accounting information related to the environment. For example, the ISSB made a key announcement at the 2022 UN Climate Change Conference (COP27) regarding climate-related disclosure standards for different jurisdictions and the alignment with key initiatives. This announcement highlights the importance of environmental disclosures in corporate reporting. Subsequently, the ISSB released IFRS S1 and S2 in June 2023. IFRS S1 is titled *General Requirements for Disclosure of Sustainability-related Financial Information*, and IFRS S2 is titled *Climate-related Disclosures* and regulates the disclosure of climate-related risks and corresponding response plans.

3. Motivation for Environmental Disclosures

Environmental disclosures serve as a channel for companies to communicate their environmental performance to investors (e.g., Hartmann et al., 2013). The consequences of environmental disclosures are manifold. One direct consequence of such disclosure is its reduction of information asymmetry (e.g., Cahan et al., 2016). Voluntary disclosure theories (e.g., Dye, 1985; Verrecchia, 1983) predict a positive relationship between environmental performance and the level of related disclosures because companies with good environmental performance are expected to have a strong intention to reveal their types. For example, Dhaliwal et al. (2012) show that analyst forecast errors are smaller with the issuance of standalone CSR reports, and this relationship is stronger in countries where financial disclosures are more opaque and where CSR performance is more influential on firms' financial performance. Bachoo et al. (2013) reported that Australian firms with superior quality sustainability reporting, particularly in environmentally sensitive industries, have lower costs of capital and higher expected future performance. Barth, Cahan, Chen, Venter, and Wang (2024) find a negative association between the quality of integrated reports and stock price synchronicity, which reflects firm-specific information.

ESG/CSR disclosures may also indirectly mitigate firms' negative publicity or even alter companies' negative images (e.g., Cahan et al., 2016). Sociopolitical theories,

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[14] Gillan et al. (2021, p. 2) state that "As it implies, ESG refers to how corporations and investors integrate environmental, social and governance concerns into their business models. CSR traditionally has referred to corporations' activities with regard to being more socially responsible, to being a better corporate citizen. One difference between the two terms is that ESG includes governance explicitly and CSR includes governance issues indirectly as they relate to environmental and social considerations. Thus, ESG tends to be a more expansive terminology than CSR.".

including political economy theories, stakeholder theory, and legitimacy theory, argue that environmental disclosures are caused by social and political pressures; therefore, firms with poor environmental performance tend to use unverifiable environmental disclosures to improve their image and reduce social and political pressure (e.g., Ullmann, 1985; Gray et al., 1995; Patten, 2002; Herbohn, Walker, and Loo, 2014; Elliott, Jackson, Peecher, and White, 2014; Loh, Deegan, and Inglis, 2015). Blacconiere and Patten (1994) find that firms that provide more environmental disclosures prior to a chemical leak event experience milder negative reactions. Cotter and Najah (2012) find that powerful stakeholders positively influence climate change disclosure. Regarding political interest, Griffin and Sun (2013) show that in the United States, ESG/CSR reporting intensity is higher in Democratic-leaning than Republican-leaning states.

Other studies have demonstrated that multiple incentives, such as information uncertainty, information asymmetry, and proprietary concerns, may concurrently drive environmental disclosures. For example, Barth et al. (1997) find that the extent of environmental-liability disclosures is significantly affected by information uncertainty about the allocation of costs across potentially responsible parties, concerns over litigation and negotiation, concerns related to the capital market, and other regulatory factors. Similarly, Li, Richardson, and Thornton (1997) document that firms are more likely to disclose environmental liabilities if their business operations predispose them to pollute the environment, if outsiders know more about the company's environmental liabilities, and if proprietary costs are less likely to be incurred. Finally, Barth et al. (2024) find that proprietary concerns limit the effect of integrated reporting on price informativeness.

4. Quality of Environmental Disclosures and Investor Valuation

Flammer, Toffel, and Viswanathan (2021) find that environmental shareholder activism increases the voluntary disclosure of climate-change-related risks by firms, and firms exhibit a higher valuation after such disclosure. Moreover, Ilhan, Krueger, Sautner, and Starks (2023) find a positive relationship between climate-conscious institutional ownership and the level of climate risk disclosure at the firm level. The aforementioned studies suggest that investors are attracted by information related to climate risks.

Studies have investigated attempts to report environment-related information in a measurable form, such as in the form of a dollar amount. Grewal, Hauptmann, and Serafeim (2021) show that information that reaches the SASB materiality threshold is informative. Therefore, if environmental events can be quantified using a monetary form, they are more likely to be presented as specific accounting-like environmental information and may be more relevant to investors. An example is the potentially uncapitalized environmental

assets or liabilities, which represent hidden reserves or liabilities that should be recognized by the market (e.g., Barth and McNichols, 1994; Clarkson et al., 2004). Compared with descriptive information, such as mission statements for environmental protection, specific monetary accounting information can be compared and verified more easily and is more relevant to investors.

Cahan et al. (2016) find that unexpected CSR disclosures are associated with firm values. On the basis of a proprietary disclosure rating from KPMG, they argue that CSR disclosure has cash flow implications for firm value. They also argue that investor expectations for voluntary disclosures may cause firms to disclose such information routinely. Consequently, it is the "unexpected" part that is more informative of firm value. As ESG/CSR reporting has become increasingly common over time, many companies have begun to regularly disclose environment-related information, such as their carbon emissions or water usage.

It is possible that the emission/usage data can be turned into financial information. Data on tons of CO_2 equivalents or water consumption might be expected by investors; however, investors might not expect the disclosure of environmental information in monetary form, which is a more accurate indicator of firm value for investors compared with tons of CO_2 equivalents or water consumption. Therefore, we conjecture that the disclosure of environmental information in monetary form reduces information asymmetry, which results in a positive association between such disclosure and firm valuation (e.g., Verrecchia, 1983; Dye, 1985; Dhaliwal et al., 2011; Dhaliwal et al., 2012).

Environmental disclosures have a crucial influence on firm value; however, such disclosures might be subject to quality concerns (e.g., Ingram and Frazier, 1980; Wiseman, 1982; Ilinitch, Soderstrom, and Thomas, 1998; Hughes, Anderson, and Golden, 2001). Clarkson et al. (2011) indicate that voluntarily disclosed environmental information might have low reliability. Hartmann et al. (2013) argue that environmental disclosures are forward-looking, noncomparable because of a lack of suitable standards or guidance, and possibly unreliable because of a lack of verification. Similarly, Wegener et al. (2019) show that the greenhouse gas emissions reported by a firm for its oil and gas facilities do not exhibit comparability and commensurability. Therefore, they recommend exercising caution when such data are used to evaluate companies' environmental performance. Moreover, environmental information that is reported in a financial form might be unreliable because this information is not audited. Studies have indicated that some companies use ESG/CSR disclosures to improve their negative image (Blacconiere and Patten, 1994; Griffin and Sun, 2013; Cahan et al., 2016). Gehrig and Moreno (2023) examine the disclosures of investment funds and investigate whether investors perceive the

disclosures as having potential greenwashing risks. They find that investors may perceive an investment fund to be engaging in greenwashing when they face difficulty in understanding the sustainability characteristics of the fund. They list problems in disclosures that may mislead investors, including omissions, unsubstantiated claims, inconsistency, and exaggeration. Koumbarakis, Tsankova, Vogt, Timmermann, Dobrauz, and Lassonde (2022) analyze 220 ESG-related funds in 2022 and find that the language used in these funds' disclosures is usually quite vague. When the language used in disclosures is vague, financial data, particularly predicted financial data, might play a role in greenwashing.

The aforementioned discussion indicates the existence of contradictory relationships between the disclosure of environment-related financial information and firm valuation. Therefore, we propose the following hypothesis:

H1: Disclosure of environmental information in monetary form is associated with firm value.

Firms that encounter adverse environmental events, such as chemical leaks, exhibit poor environmental performance and are thus motivated to improve their image through disclosures (e.g., Patten, 1992; Clarkson et al., 2013). Studies have indicated that companies use environmental disclosures to communicate their "environmental legitimacy," which is the perception that their environmental behavior is suitable and desirable (e.g., Aerts and Cormier, 2009); Disclosure quality influences whether this strategy works. If companies only provide positive disclosure, the effort to disclose may be viewed as greenwashing (e.g., Lyon and Maxwell, 2011).

An alternative view is that credible (i.e., high quality) reports provide insurance-like benefits because such reports affect investor perceptions regarding managerial intention (e.g., Du and Wu, 2019; Dhaliwal et al., 2011). For companies with an episode of environmental misconduct, the moral capital derived from engagement in CSR has insurance value because it assuages investors that the episode of environmental misconduct is a one-off event (Du and Wu, 2019; Christensen, 2016; Flammer, 2013; Godfrey, Merrill, and Hansen, 2009; Peloza, 2006). Consistent with this concept, Du and Wu (2019) show that firms that issue more credible CSR reports face less negative market reactions when they are found to have engaged in CSR-related misconduct.

When firms voluntarily provide financial information related to environmental activities rather than a general description of environmental procedures, the possibility exists that these firms understand that such disclosures might be subject to verification in the future. Such disclosure is a costly signal that indicates companies' commitment to a

high level of ESG/CSR (Bagnoli and Watts, 2017). Therefore, we conjecture that the provision of monetary environmental information in ESG/CSR reports indicates high disclosure quality, which mitigates negative market reactions when environmental misconduct occurs. Consequently, the following hypothesis is proposed:

H2: Market reaction to environmental misconduct is less negative for firms that provide environmental disclosures, including monetary information, than for firms that do not.

III. Research Methods

1. Variable Measurement: Categorization of Environmental Disclosures

To measure the level of environmental disclosure (*ENVD*) in ESG/CSR reports, we categorize the information in these reports into the following three types based on the literature:

(1) *ENVD_BASE*: Hughes et al. (2001) measure the level of environmental disclosure by classifying sentences as "quantitative," "descriptive," "vague," and "immaterial." Other studies have also followed a similar concept (e.g., Patten, 2002; Clarkson, Li, Richardson, and Vasvari, 2008, Clarkson et al., 2013). Therefore, we first separate vague descriptions from specific quantitative information. The indicator variable *ENVD_BASE* is coded as 1 if the company provides information covering environmental regulations, its environmental concerns, its environmental compliance status, and its environmentally friendly processes, facilities, or product innovations; otherwise, *ENVD_BASE* is coded as 0.

(2) *ENVD_FH*: Research has found that unrecognized environmental liabilities explain part of firms' market valuation (e.g., Barth and McNichols, 1994). Moreover, studies have found that regulations that impose potential environmental liabilities on certain industries affect firm valuation (e.g., Chapple, Clarkson, and Gold, 2013; Bird, Grosse, and Yeung, 2013). A firm's disclosure is categorized as an FH disclosure if it provides financial information (i.e., information in dollar format instead of nonfinancial information such as tons of CO_2 equivalents) covering its capital expenditures (or operating costs) for environmental protection in recent years. The indicator variable *ENVD_FH* is coded as 1 if the company provides historical financial information and 0 otherwise.

(3) *ENVD_FE*: Because preemptive investment in environmental protection may result in potential future benefits or opportunities (e.g., Clarkson et al., 2004; Tang and Luo, 2014), firms might also provide estimated financial information in their ESG/CSR reports. A firm's disclosure is categorized as an FE disclosure if it provides financial information covering future capital expenditure (or future operating costs or predicted

benefits). The indicator variable *ENVD_FE* is coded as 1 if the company provides such information and 0 otherwise.

2. Empirical Models

Test of H1

To examine H1, we apply the environmental disclosure variables *ENVD_BASE*, *ENVD_FH*, and *ENVD_FE* to a model similar to that of Cahan et al. (2016). The model used in this study is expressed as follows:

$$Tobin's\ Q_{it} = \alpha_0 + \alpha_1 ENVD\_BASE_{it} + \sum \alpha_k Controls_{it}^k + Industry\ FE + Year\ FE + \varepsilon_{it} \quad (1)$$

$$\begin{aligned} Tobin's\ Q_{it} = {} & \beta_0 + \beta_1 ENVD\_FH_{it} + \beta_2 ENVD\_FE_{it} \\ & + \beta_3 ENVD\_FH_{it} \times ENVD\_FE_{it} + \sum \beta_k Controls_t^k + Industry\ FE \\ & + Year\ FE + \varepsilon_{it} \end{aligned} \quad (2)$$

where *t* is the filing year and *t*-1 is the reporting year. The dependent variable of the adopted model is *Tobin's Q*, which is measured as the market value of common stockholders' equity plus the book value of preferred stock, long-term debt, and current liability, scaled by the book value of total assets. The terms *ENVD_BASE*, *ENVD_FH*, and *ENVD_FE* are described in Section III. Because *ENVD_FH* and *ENVD_FE* are not mutually exclusive, when a firm provides historical financial information (*ENVD_FH* = 1), it may or may not provide estimated financial information simultaneously (i.e., *ENVD_FE* = 0 or 1), and vice versa. To control for the influence of other types of financial disclosures, we include the interaction term *ENVD_FH*×*ENVD_FE* in (2) so that the effects of FH information alone and FE information alone can be identified.

The control variables in the adopted model are (1) firm size (*SIZE*); (2) annual share turnover (*STOCKTURN*); (3) return on assets (*ROA*), which is the ratio of net income to total assets; (4) ratio of capital expenditure to total assets (*CAPX*); (5) ratio of debt to total assets (*DEBT*); (6) whether the firm pays dividends (*DIV*); (7) research and development (R&D) intensity (*RDS*), which is the ratio of R&D expenditure to sales;[15] (8) standard deviation of daily stock returns during the sample year (*RETVOL*); (9) intensity of intangible assets (*INTANG*), which is obtained by subtracting the ratio of net property, plant, and equipment to total assets from 1; and (10) ratio of cash to total assets (*CASHTA*). We also include fixed effects for industry and year in the adopted model and use firm clustering to obtain robust errors.

Test of H2

[15] We assume that the R&D expenditure equals 0 if data are missing.

For measures of environmental sanctions, we download environment-related news from the Social Responsibility News database of Taiwan Economic Journal (TEJ) and identify events of environmental misconduct during our sample period. The observations for these events constitute the "misconduct sample" (e.g., Du and Wu, 2019). We measure the 3-day cumulative abnormal returns surrounding the event date from day -1 to day 1 (i.e., $CAR[-1, +1]_{t+1}$). The event date (day 0) is the date on which the negative environmental news is disseminated.

Next, on the basis of the research of Christensen (2016) and Du and Wu (2019), we use the following model that includes *ENVD_BASE*, *ENVD_FH*, and *ENVD_FE*:

$$CAR\left[-1,+1\right]_{t+1} = \alpha_0 + \alpha_1 ENVD\_BASE_t + \sum \alpha_k Controls_t^k + Industry\ FE + Year\ FE + \varepsilon_t \quad (3)$$

$$CAR\left[-1,+1\right]_{t+1} = \beta_0 + \beta_1 ENVD\_FH_t + \beta_2 ENVD\_FE_t + \beta_3 ENVD\_FH_t \times ENVD\_FE_t + \sum \beta_k Controls_t^k + Industry\ FE + Year\ FE + \varepsilon_t \quad (4)$$

The control variables in (3) and (4) are the natural logarithm of total assets (*SIZE*); market valuation (*Tobin's Q*); return on assets (*ROA*); stock liquidity (*LIQUID*), which is the natural logarithm of the sum of 1 and the ratio between the split-adjusted trading volume and outstanding shares during the fiscal year; institutional ownership (*ISHOLD*); 1-month cumulative abnormal return prior to the event (*PCAR*); and the natural logarithm of penalties for the environmental event (*lnPENALTY*). We also include fixed effects for industry and year in the aforementioned model (see the Appendix for detailed variable definitions).

IV. Empirical Results

1. Data and Sample Selection

We select firms listed in the TWSE and the TPEx during 2017–2020 as our sample firms because ESG/CSR reporting has increased during this period. Financial data and environmental sanction data are obtained from the TEJ database. Environmental information (*ENVD*) is hand-collected and coded from companies' ESG/CSR reports; these reports are available from company websites or the CSRone website.[16] Table 1 describes the sample selection procedure for testing H1 and H2, and Table 2 provides the distributions of these samples by year and industry. Our original sample for testing H1 contains 1,958 observations, and after excluding observations with unreadable ESG/CSR reports and missing values, the final sample consists of 1,725 firm-years. Moreover, the final sample for testing H2 consists of 286 environmental misconduct events.

[16] https://csrone.com.

TABLE 1 Sample Selection

Panel A: Sample Selection for Testing H1	
Observations for which ESG/CSR reports are available in the TEJ database	1,958
Less: Observations with unreadable ESG/CSR reports	(14)
Subtotal	1,944
Less: Observations with missing returns and accounting data for control variables	(219)
Final sample for testing H1 (firm-years)	1,725
Panel B: Sample Selection for Testing H2	
Initial environmental misconduct events in the TEJ database	495
Less: Insufficient data for estimating the cumulative abnormal return	(57)
Banking, insurance, and security firms	(21)
Firms with non-calendar fiscal year-ends	(9)
Firms for which ESG/CSR reports are unavailable or unissued	(122)
Final sample for testing H2 (event-years)	286

As presented in Panel A of Table 2, the number of ESG/CSR reports has a gradual increase from 389 in 2017 to 475 in 2020. Panel B of Table 2 indicates that the sample for testing H1 covers a wide range of industries, with chemical (8.87%), semiconductor (8.46%), and electronic parts/components (8.23%) industries being the most prominent in the sample. Moreover, this sample has an even distribution by firm across the four-year research period. Regarding the misconduct sample for testing H2, Panel C shows that the food and plastic industries account for large parts (14.34% and 16.78%, respectively) of the environment-related misconduct events, suggesting that these two industries are subject to strict environmental regulations and monitoring. Moreover, the aforementioned misconduct sample does not exhibit a consistent distribution by year. Relatively high percentages of environment-related misconduct events occurred in 2020 (33.92%) and 2017 (27.62%).

TABLE 2 Sample Distribution

Panel A: Distribution by Year of the Sample (Environmental Information Disclosure) Used for Testing H1					
Year	Total	2017	2018	2019	2020
Full Sample	1,725	389	415	446	475
Percent (%)	100	22.55	24.06	25.86	27.54
ENVD_FH=1	1,047	256	255	265	271
ENVD_FE=1	465	115	115	118	117
ENVD_All=1	375	90	94	96	95

TABLE 2 Sample Distribution (Continued)

Panel B: Distribution by Industry of the Sample (Environmental Information Disclosure) Used for Testing H1

Code	Industry	Total	Percent (%)	*ENVD*		
				_FH=1	*_FE*=1	*_All*=1
1	Cement	26	1.51	20	9	9
2	Food	109	6.32	87	32	31
3	Plastic	49	2.84	41	28	25
4	Textile	43	2.49	39	22	22
5	Electric Machinery	40	2.32	30	12	10
6	Electrical and Cable	12	0.70	10	9	9
8	Glass and Ceramic	4	0.23	4	1	1
9	Paper and Pulp	16	0.93	12	8	8
10	Iron and Steel	55	3.19	44	16	16
11	Rubber	20	1.16	19	6	6
12	Automobile	36	2.08	26	13	12
14	Building Material and Construction	76	4.41	34	15	6
15	Shipping and Transportation	50	2.90	34	8	7
16	Tourism	66	3.83	33	14	13
18	Trading and Consumers Goods	46	2.67	20	17	14
20	Other	120	6.96	61	30	24
21	Chemical	153	8.87	122	40	35
22	Biotechnology and Medical Care	85	4.93	32	7	5
23	Oil, Gas, and Electricity	12	0.70	4	4	4
24	Semiconductor	146	8.46	78	65	43
25	Computer and Peripheral Equipment	123	7.13	45	29	16
26	Optoelectronic	89	5.16	54	17	13
27	Communications and Internet	86	4.99	33	12	7
28	Electronic Parts/Components	142	8.23	121	28	28
29	Electronic Products Distribution	17	0.98	0	2	0
30	Information Service	17	0.98	9	3	0
31	Other Electronic	78	4.52	30	17	11
32	Cultural and Creative	9	0.52	5	1	0
	Total	1,725	100.00	1,047	465	375

TABLE 2 Sample Distribution (Continued)

Panel C: Distribution by Year and Industry of the Sample (Environment-related Negative Events) Used for Testing H2

Code	Industry	Total	Percent (%)	Year			
				2017	2018	2019	2020
1	Cement	18	6.29	7	1	4	6
2	Food	41	14.33	14	10	11	6
3	Plastic	48	16.78	23	4	10	11
4	Textile	5	1.75	1	0	1	3
5	Electric Machinery	5	1.75	1	1	0	3
6	Electrical and Cable	2	0.70	0	0	0	2
8	Glass and Ceramic	1	0.34	0	1	0	0
9	Paper and Pulp	15	5.24	6	5	3	1
10	Iron and Steel	8	2.80	0	1	3	4
11	Rubber	6	2.10	3	3	0	0
12	Automobile	8	2.80	0	0	0	8
14	Building Material and Construction	3	1.05	0	0	0	3
15	Shipping and Transportation	14	4.89	5	0	0	9
16	Tourism	5	1.75	3	0	0	2
18	Trading and Consumers Goods	6	2.10	0	0	2	4
20	Other	15	5.24	0	4	5	6
21	Chemical	13	4.55	3	7	1	2
22	Biotechnology and Medical Care	13	4.55	2	1	4	6
23	Oil, Gas, and Electricity	24	8.39	6	7	6	5
24	Semiconductor	9	3.15	3	0	2	4
25	Computer and Peripheral Equipment	3	1.05	0	1	1	1
27	Communications and Internet	9	3.15	0	1	3	5
28	Electronic Parts/Components	9	3.15	2	5	1	1
30	Information Service	3	1.05	0	0	0	3
31	Other Electronic	3	1.05	0	1	0	2
	Total	286	100.00	79 (27.62)	53 (18.53)	57 (19.93)	97 (33.92)

[a] In Panels A and B, *ENVD_FH*=1 if the company provides "historical financial" environmental information (in dollar amounts) covering its capital expenditures (or operating costs) for environmental protection in recent years, *ENVD_FE*=1 if the company provides "estimated financial" environmental information (in dollar amounts) covering future capital expenditures (or operating costs or predicted benefits) for environmental protection, and *ENVD_All* represents companies with *ENVD_FH* = 1 and *ENVD_FE* = 1.

2. Descriptive Statistics

Table 3 reports the descriptive statistics for H1 (Panel A) and H2 (Panel B). We winsorize all continuous variables by using the top and bottom 1% levels to avoid the influence of extreme values. As presented in Panel A of Table 3, almost all companies in the sample for testing H1 report general environmental information in their ESG/CSR reports (mean *ENVD_BASE* = 0.988). Thus, only a small portion of this sample has no

environment-related information provided in ESG/CSR reports. The mean value of *ENVD_FH* is 0.607, which implies that 61% of the sample firms' ESG/CSR reports contain expenditure or cost information for environmental protection. In contrast, the mean value of *ENVD_FE* is 0.270, which indicates that 27% of the sample firms provide estimated environmental benefits or costs. Note that a firm may provide both historical data and forecasts in the same report.

For company characteristics, the mean value of total assets of the sample is NT$73,375 million, whereas the median is NT$16,055 million. This suggests that the distribution of firm size in this sample is skewed. Therefore, we take its natural logarithm and obtain a new variable *SIZE*. The average capital expenditure is approximately 8% of total sales revenue (mean of *CAPX* = 0.075), and in general, the sample firms are profitable (mean of *ROA* = 0.049). The high values of *STOCKTURN* suggest that the stocks of these firms are actively traded, which is a typical characteristic of a shallow-dish market, such as that in the TWSE (e.g., Tsai, Shu, and Chiang, 2019).

TABLE 3 Descriptive Statistics

Panel A: Variables Related to H1						
Variables	n	Mean	Std. Dev.	Q1	Median	Q3
Tobin's Q	1,725	1.237	0.857	0.730	0.950	1.430
ENVD_BASE	1,725	0.988	0.107	1.000	1.000	1.000
ENVD_FH	1,725	0.607	0.489	0.000	1.000	1.000
ENVD_FE	1,725	0.270	0.444	0.000	0.000	1.000
SIZE	1,725	23.562	1.604	22.351	23.499	24.580
STOCKTURN	1,725	142.102	196.904	29.900	68.814	171.791
ROA	1,725	0.049	0.067	0.017	0.044	0.083
CAPX	1,725	0.075	0.064	0.029	0.058	0.105
DEBT	1,725	0.442	0.179	0.317	0.444	0.558
DIV	1,725	0.857	0.350	1.000	1.000	1.000
RDS	1,725	0.033	0.053	0.001	0.014	0.041
RETVOL	1,725	0.018	0.008	0.012	0.017	0.023
INTANG	1,725	0.728	0.178	0.606	0.751	0.872
CASHTA	1,725	0.167	0.123	0.074	0.141	0.228
Other information						
Total Assets (in millions)	1,725	73,375	232,788	5,092	16,055	47,301
Total_Pages	1,725	86.154	30.143	65.000	84.000	104.000
ENV_Pages	1,725	12.523	7.869	7.000	11.000	16.000

TABLE 3 Descriptive Statistics (Continued)

Panel B: Variables Related to H2

Variables	n	Mean	Std. Dev.	Q1	Median	Q3
CAR[-1,+1]$_{t+1}$	286	-0.390	3.828	-1.533	-0.520	0.834
ENVD_BASE	286	0.997	0.059	1.000	1.000	1.000
ENVD_FH	286	0.514	0.501	0.000	1.000	1.000
ENVD_FE	286	0.846	0.361	1.000	1.000	1.000
SIZE	286	24.836	1.773	23.306	24.818	26.688
Tobin's Q	286	1.262	0.715	0.780	0.965	1.480
ROA	286	0.060	0.052	0.027	0.057	0.091
LIQUID	286	0.519	0.456	0.205	0.387	0.707
ISHOLD	286	65.763	21.463	52.180	70.060	81.970
PCAR	286	-0.764	10.361	-4.870	-0.723	4.137
lnPENALTY	286	3.665	6.531	0.000	0.000	0.000

[a] This table reports the descriptive statistics of the main variables related to H1 (Panel A) and H2 (Panel B). Variable definitions are provided in the Appendix. All continuous variables are winsorized at the 1% and 99% levels.

In Panel B of Table 3, the values of *CAR*[-1, +1]$_{t+1}$ indicate that market reactions to environmental misconduct are usually negative (mean = -0.39; median = -0.52). Interestingly, while the percentage of firms from the sample for testing H2 (firms with environmental misconduct events) providing general environmental information remains high (*ENVD_BASE* = 0.997), the percentages of these firms that provide historical and estimated monetary information differ from that of the regular sample for testing H1 in Panel A of Table 3. Specifically, the mean *ENVD_FH* value of the sample used to test H2 is 0.514, which is lower than that in Panel A (0.607). By contrast, the mean *ENVD_FE* value of the sample used to test H2 is 0.846, which is considerably higher than that of the sample used to test H1 (0.270 in Panel A). Thus, the results imply that compared to regular firms, firms with environmental misconduct events are more likely to provide forecasted future information rather than historical expenditure.

3. Multivariate Analysis

Effect of Environmental Disclosures on Firm Valuation

Table 4 presents the regression results for H1. Column (1) reports the results for qualitative environmental information (Eq. (1)), and Column (2) reports the results for environmental financial information (Eq. (2)). In Column (1), the coefficient on *ENVD_BASE* is insignificant (coeff. = 0.015; t = 0.09), suggesting that general statements

on environmental issues in ESG/CSR reports are not informative about firm value. Almost all firms in the sample for testing H1 report such statements; thus, this information may constitute routine "soft talk" and therefore provide no additional value.

In contrast, Column (2) shows that the coefficient on *ENVD_FH* (β_1) is negative but insignificant (coeff. = -0.047; t = -1.09). This result suggests that FH information is not informative about firm value, probably because such information is reported in an alternative manner in financial statements. Note that the interaction term *ENVD_FH*×*ENVD_FE* (β_3) controls for the fact that *ENVD_FH* and *ENVD_FE* are not mutually exclusive. Therefore, β_1 represents the stand-alone effect of FH disclosure on firm valuation without the provision of FE information. On the other hand, the coefficient on *ENVD_FE* (β_2) is significantly negative at a 5% level (coeff. = -0.169; t = -2.24). This result suggests that the disclosure of *only* FE information has a negative effect on firm valuation. From this point of view, the provision of FE information is considered to be more opportunistic than credible (e.g., Cahan et al., 2016). Moreover, the result also implies that investors might consider such disclosure as an attempt at greenwashing (e.g., Gehrig and Moreno, 2023), and such a perception is reflected in firm valuation.

TABLE 4 Regression Results for the Effect of Environmental Disclosure on Firm Valuation

Dependent Variable: Tobin's Q

Variables	Pred. Sign	(1) Environmental Information	(2) Different Information Content
Intercept	?	0.817**	0.739**
		(2.05)	(1.98)
ENVD_BASE (α_1)	?	**0.015**	--
		(0.09)	
ENVD_FH (β_1)	?	--	**-0.047**
			(-1.09)
ENVD_FE (β_2)	?	--	**-0.169****
			(-2.24)
ENVD_FH×*ENVD_FE* (β_3)	?	--	0.125
			(1.44)
SIZE	–	-0.008	-0.001
		(-0.56)	(-0.07)
STOCKTURN	–	-0.001***	-0.001***
		(-3.34)	(-3.40)
ROA	+	6.057***	6.036***
		(10.54)	(10.57)
CAPX	+	1.976***	2.022***
		(4.01)	(4.15)

TABLE 4 Regression Results for the Effect of Environmental Disclosure on Firm Valuation (Continued)

Variables	Pred. Sign	(1) Environmental Information	(2) Different Information Content
DEBT	−	-0.502***	-0.525***
		(-3.94)	(-4.11)
DIV	−	-0.181***	-0.174***
		(-2.95)	(-2.82)
RDS	+	4.042***	4.091***
		(5.93)	(6.03)
RETVOL	?	30.313***	30.160***
		(7.55)	(7.55)
INTANG	+	-0.190	-0.214*
		(-1.20)	(-1.34)
CASHTA	?	0.713***	0.726***
		(3.00)	(3.09)
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$			**-0.091*** **(p=0.063)**
Number of Obs.		1,725	1,725
Adj. R^2		0.4134	0.4150
F-statistic		30.63***	29.45***

[a] This table reports the regression results of Model (1). Variable definitions are provided in the Appendix. The *t*-statistics (in parentheses) are based on the standard errors clustered by firm. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively (one-tailed for coefficients with a predicted sign and two-tailed otherwise).

In addition, the sum of the three coefficients of financial disclosure ($\beta_1 + \beta_2 + \beta_3$) reflects the effect of simultaneously disclosing FH and FE information on firm valuation. The results of the F-test indicate that $\beta_1 + \beta_2 + \beta_3 = -0.091$ (significant at the 10% level), which is less negative than the value of β_2. Overall, the results imply that while providing only FE information harms firm value; however, providing FH information together with FE information helps to mitigate such negative influence, possibly because historical information is verifiable and more credible than is estimated information. This finding is consistent with the argument that BASE information and FH information reflects the "expected" parts of environmental disclosures; such information is often routinely disclosed even if its disclosure is not compulsory (e.g., Cahan et al., 2016). On the other hand, FE information is reported considerably less frequently than are BASE information and FH information (as shown in Table 1), and the disclosure of FE information might be considered an opportunistic behavior and thus might reduce investors' valuation of a firm. The aforementioned finding is also consistent with the argument that environmental

disclosures are forward-looking and non-comparable (e.g., Hartmann et al., 2013; Wegener et al., 2019). Consequently, investors might perceive ESG disclosures that are unverifiable as representing potential greenwashing risks. In summary, the empirical results indicate that disclosure of environmental information in monetary form is associated with firm value, lending support to H1.[17]

Effect of Environmental Disclosures on Market Reaction to Environmental Misconduct

Table 5 presents the results obtained in the testing of H2. Panel A reports the descriptive statistics regarding the cumulative abnormal returns surrounding the 286 environmental misconduct events ($CAR[-1, +1]_{t+1}$). The results suggest that on average, market reactions are negative to these events (mean of $CAR[-1, +1]_{t+1}$ = -0.390, t = -1.72) (e.g., Grewal, Riedl, and Serafeim, 2019; Chen, Hung, and Wang, 2018). Among the 286 firms with environmental misconduct events, 108 report only FH information (Group 1), 13 report only FE information (Group 2), and 134 report both FH and FE information (Group 3); the mean values of $CAR[-1, +1]_{t+1}$ for these firm groups are -0.641, -0.891, and -0.235, respectively. Among the three groups, Group 3 (FH + FE) exhibits the least negative $CAR[-1, +1]_{t+1}$ values, followed by Group 1 (FH only) and Group 2 (FE only). This result has two implications. First, the reporting of FH and FE information together provides rich and credible data. Second, investors perceive the disclosure of solely FE information to be opportunistic rather than reliable.

Panel B of Table 5 reports the regression results. Column (1) presents the results for Eq. (3), which indicate that the coefficient on *ENVD_BASE* is significantly positive (coeff. =4.394, t =2.50), suggesting that providing certain environmental information in ESG/CSR reports helps to mitigate the negative market reactions to the environment-related misconduct events. In Column (2), the coefficients on *ENVD_FH* and *ENVD_FE* are both positive but insignificant; however, the coefficient for the simultaneous provision of FH and FE information is significantly positive at the 5% level ($\beta_1 + \beta_2 + \beta_3 = 3.897$, p =0.021). This result implies that disclosures that include both FH and FE information are perceived to be credible and mitigate the negative market reactions toward environmental misconduct events. In summary, the results presented in Table 5 support H2, indicating that ESG/CSR reports that include general statements related to the environment or both FH and FE information help to allay investors' concerns regarding environmental misconduct. This result is also consistent with the notion that companies provide environment-related disclosures to reduce their negative publicity (e.g., Cahan et al., 2016; Christensen, 2016; Du and Wu, 2019).

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[17] In addition to the current year *Tobin's Q*, we use the *Tobin's Q* of the next year and rerun the regression. The results are quantitatively similar.

TABLE 5 Regression Results for the Association between Environmental Disclosure and Market Reactions to the Environmental Misconduct Event

Panel A: Descriptive Statistics The Mean of $CAR[-1,+1]_{t+1}$	**Group 1:** *Only_FH*	**Group 2:** *Only_FE*	**Group 3:** *FH+FE*
Full misconduct sample [n=286] =-0.390 (*t*-stat. = -1.72)*	-0.641 [n=108]	-0.891 [n=13]	-0.235 [n=134]

Panel B: Regression Results
Dependent Variable: $CAR[-1,+1]_{t+1}$

Variables	Pred. Sign	(1) Environment Information	(2) Different Information Content
Intercept	?	-8.589*	0.785
		(-1.66)	(0.16)
ENVD_BASE (α_1)	?	**4.394****	--
		(2.50)	
ENVD_FH (β_1)	?	--	**0.404**
			(0.66)
ENVD_FE (β_2)	?	--	**0.851**
			(1.40)
ENVD_FH×*ENVD_FE* (β_3)	?	--	2.642**
			(2.04)
SIZE	?	-0.202	-0.422**
		(-1.26)	(-2.32)
Tobin's Q	?	0.278	0.323
		(0.53)	(0.63)
ROA	?	-1.475	-1.211
		(-0.32)	(-0.27)
LIQUID	?	0.533	0.680
		(0.72)	(0.97)
ISHOLD	?	0.037**	0.041**
		(2.08)	(2.36)
PCAR	?	-0.018	-0.018
		(-0.94)	(-0.94)
lnPENALTY	–	-0.067**	-0.075**
		(-1.76)	(-2.09)
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$			**3.897**** **(p=0.021)**
# of obs.		286	286
Adj. R^2		0.1020	0.1128
F-statistic		1.92***	1.98***

[a] This table reports the mean $CAR[-1, +1]_{t+1}$ values of the full misconduct sample used for testing H2 and three subsamples of this sample (Panel A). It also reports the main regression results for the association between environmental disclosure and market reactions to the environment-related misconduct event (Panel B). In Panel A, *Only_FH* refers to firms with *ENVD_FH* = 1 and *ENVD_FE* = 0, *Only_FE* refers to firms with *ENVD_FH* = 0 and *ENVD_FE* = 1, and *FH + FE* represents firms with *ENVD_FH* = 1 and *ENVD_FE* = 1. Variable definitions are provided in the Appendix. The *t*-statistics (in parentheses) are based on Huber–White robust standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively (one-tailed for coefficients with a predicted sign and two-tailed otherwise).

V. Robustness Tests and Additional Analysis

1. Robustness Checks for H1

Because the association between market value and the disclosure of environmental information may be subject to self-selection bias and endogeneity, we control for potential bias by applying a Heckman two-stage procedure. Specifically, we apply the following first-stage regression model, where *CSRR* is a dichotomous variable that equals 1 if a company issues an ESG/CSR report and 0 otherwise:

$$\begin{aligned}\Pr(CSRR=1) = {} & \delta_0 + \delta_1 RDS_{it} + \delta_2 AGE_{it} + \delta_3 PRIOR_{it} + \delta_4 COMPET_{it} + \delta_5 SIZE_{it} \\ & + \delta_6 ROA_{it} + \delta_7 FINSTR_{it} + \delta_8 Tobin's\ Q_{it} + \delta_9 COEC_{it} + \delta_{10} INDB_{it} \\ & + \delta_{11} ISHOLD_{it} + \delta_{12} BLOCK_{it} + \delta_{13} DEV_{it} + Industry\ FE + Year\ FE + \varepsilon_{it} \end{aligned} \quad (5)$$

The second-stage regression results are presented in Table 6. First, the inverse Mill's ratio (*IMR*) is insignificant in both columns, indicating that the results of ordinary least squares regression (OLS) that are presented in Table 4 does not suffer severe endogeneity problems. Second, the coefficients of α_1, β_1, β_2, and β_3 in Table 6 are similar to those in Table 4 in terms of sign and significance level, with β_2 being significantly negative (coeff. = -0.173, t = -2.31). Third, as in Table 4, the sum of β_1, β_2, and β_3 in Table 6 is significantly negative at the 5% level (coeff. = -0.099) but is less negative than β_2. Overall, the results presented in Table 6 indicate that depending on the types of disclosures provided, environmental information is associated with firm value, lending further support to H1. Specifically, the disclosure of only FE information is considered to be opportunistic and has a negative effect on firm value, whereas the disclosure of both FH information and FE information weakens this negative effect.

2. Additional Tests

Other Information from ESG/CSR Reports

In addition to examining BASE, FH, and FE information, we analyze other types of information from ESG/CSR reports. Dhaliwal et al. (2011) use the number of pages to examine the information in CSR reports. They find that CSR reports generally contain more pages and cover more issues compared to a similar section in annual reports. Therefore, we use the reporting length as an additional measure of information quality. Specifically, we replace the previous environment-related variables (i.e., *ENVD_BASE*, *ENVD_FH*, and *ENVD_FE*) in the model for H1 with the total number of pages of ESG/CSR reports (*Total_Pages*) and the number of pages covering environmental issues in ESG/CSR reports (*ENV_Pages*).

TABLE 6 Robustness Check of H1: Controlling for Sample Self-selection Bias by Using the Heckman's two-stage Procedure

Dependent Variable: Tobin's Q			
Variables	Pred. Sign	(1) Environmental Information	(2) Different Information Content
Intercept	?	0.705*	0.617*
		(1.77)	(1.65)
ENVD_BASE (α_1)	?	**0.030**	--
		(0.18)	
ENVD_FH (β_1)	?	--	**-0.048**
			(-1.11)
ENVD_FE (β_2)	?	--	**-0.173****
			(-2.31)
ENVD_FH×*ENVD_FE* (β_3)	?	--	0.122
			(1.41)
IMR	?	0.140	0.160
		(1.40)	(1.60)
Controls		Included	Included
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$			**-0.099****
			(p=0.045)
Number of Obs.		1,725	1,725
Adj. R^2		0.4138	0.4156
F-statistic		29.97***	28.87***

[a] This table reports the regression results of H1 using the Heckman's two-stage procedure to control for potential selection bias. In the first stage, we run a probit model regarding the determinants of firms' decision to issue CSR reports. For brevity, we do not report the results from the first-stage regression, and *IMR* denotes the inverse Mills ratio derived in the first-stage regression. Variable definitions are provided in the Appendix. The *t*-statistics (in parentheses) are based on the standard errors clustered by firm. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively (one-tailed for coefficients with a predicted sign and two-tailed otherwise).

The results are presented in Table 7. Column (1) reports the results for *Total_Pages*, and Column (2) reports the results for *ENV_Pages*. The coefficient on *Total_Pages* is significantly positive (coeff. =0.001, t =2.10), which suggests that the total number of pages of ESG/CSR reports is informative of firm value. This result is consistent with Dhaliwal et al. (2011) that longer reports contain more issues, which may be valued by investors. On the other hand, the coefficient on *ENV_Pages* is positive but insignificant. Thus, the number of pages covering environmental issues in ESG/CSR reports is less informative of firm valuation than is the total number of pages of ESG/CSR reports. One explanation for this finding is that *ENV_Pages* is similar to *ENVD_BASE*, which might be considered routine disclosure already expected by the market and therefore brings no incremental value in the evaluation of firm value (e.g., Cahan et al., 2016). In addition, the average number of pages covering environmental issues is 12.523, with a small standard deviation (See

Table 3). Thus, these pages account for a low proportion of the total pages of these ESG/CSR reports (mean =86.154). The aforementioned phenomena explain the insignificant result of *ENV_Pages*.

TABLE 7 Additional Test of H1: Using Other Information from ESG/CSR Reports

Dependent Variable: Tobin's Q			
Variables	Pred. Sign	(1) The total number of pages of ESG/CSR reports	(2) The total number of pages of the section on environmental information
Intercept	?	0.912**	0.885**
		(2.39)	(2.30)
Total_Pages	?	**0.001****	--
		(2.10)	
ENV_Pages	?	--	**0.003**
			(1.13)
SIZE	–	-0.018	-0.012
		(-1.27)	(-0.87)
STOCKTURN	–	-0.001***	-0.001***
		(-4.48)	(-4.46)
ROA	+	6.049***	6.044***
		(20.39)	(20.35)
CAPX	+	1.975***	1.998***
		(5.24)	(5.30)
DEBT	–	-0.518***	-0.511***
		(-4.50)	(-4.44)
DIV	–	-0.175***	-0.177***
		(-3.18)	(-3.20)
RDS	+	3.984***	4.027***
		(10.05)	(10.17)
RETVOL	?	30.943***	30.408***
		(9.15)	(9.02)
INTANG	+	-0.154	-0.166
		(-1.10)	(-1.19)
CASHTA	?	0.679***	0.700***
		(4.14)	(3.72)
Industry and year FEs		Yes	Yes
Number of Obs.		1,725	1,725
Adj. R^2		0.4156	0.4145
F-statistic		30.87***	30.73***

[a] This table reports the regression results for the associations of firm valuation with the number of pages of ESG/CSR reports (*Total_Pages*) and the number of pages providing environmental information in ESG/CSR reports (*ENV_Pages*). Variable definitions are provided in the Appendix. The *t*-statistics (in parentheses) are based on the standard errors clustered by firm. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively (one-tailed for coefficients with a predicted sign and two-tailed otherwise).

Subsample Tests: Voluntary Versus Mandatory Issuers of ESG/CSR Reports

We re-examine H1 and H2 by partitioning the samples based on whether a company voluntarily or mandatorily issues ESG/CSR reports. The literature has provided contrary arguments for the benefits of voluntary and mandatory reporting. Some researchers argue that mandatory disclosure requirements can be costly, thereby providing firms with incentives to not comply with these requirements (e.g., Ji and Deegan, 2011; Grewal et al., 2019; Chen et al., 2018). However, other researchers have argued that information users prefer compulsory reporting (e.g., De Villiers and Van Staden, 2011), which brings real benefits. Mandatory ESG/CSR disclosures are price-informative (e.g., Grewal et al., 2021); may increase stock liquidity and internal investment efficiency (e.g., Barth, Cahan, Chen, and Venter, 2017); and may reduce polluting emissions (e.g., Chen et al., 2018).

Tests for H1

The results obtained in tests of H1 for mandatory (Column (1)) and voluntary (Column (2)) issuers are presented in Panel A of Table 8. As for the overall sample, the coefficients of β_1 are insignificant in both columns, suggesting that reporting standalone FH information is not informative of firm value. By contrast, the coefficient of β_2 is significantly positive for the voluntary issuers (coeff. =0.438, t =2.39) but significantly negative for the mandatory issuers (coeff. =-0.357, t =-4.54). These results imply that for voluntary issuers of ESG/CSR reports, FE information is informative of and positively associated with firm value, which is consistent with the notion that such information is credible and reduces information asymmetry. However, for mandatory issuers of ESG/CSR reports, the disclosure of only FE information may be considered opportunistic and therefore is negatively associated with firm value.

When both FH information and FE information are disclosed, the sum of $\beta_1 + \beta_2 + \beta_3$ is significantly negative for the voluntary issuers (coeff. =-0.226) but insignificant for the mandatory issuers. The implication of these results is that for mandatory issuers, the disclosure of FE information accompanied by FH information does not help increase the credibility of FE information. Moreover, for voluntary issuers, the disclosure of both FH information and FE information is not as useful as the disclosure of only FE information, possibly because FH information is already reported and can be obtained from other channels, such as annual reports.[18]

[18] A possibility exists that our measure, which assigns a constant value of 1 for any type of environmental financial disclosure, reduces the usefulness of the *ENVD* variables.

Tests for H2

The results obtained in tests of H2 for the mandatory and voluntary issuers are presented in Panel B of Table 8. For the voluntary issuers, the coefficients of β_1 and β_2 are both positive and significant at the 10% level (coeff. = 1.320 and 5.032, respectively; t = 1.71 and 1.95, respectively), suggesting that, for firms that engage in environmental misconduct, the disclosure of only FH information or only FE information mitigates the negative market reaction to environmental misconduct events, and the provided information is perceived to be credible. In addition, the sum of $\beta_1 + \beta_2 + \beta_3$ is also positively significant (coeff. =2.391), which suggests that the disclosure of FH information accompanied by FE information positively affects stock returns during the event period. The aforementioned findings are consistent with the socio-political perspective that companies disclose more information in response to social or political pressure, and such disclosures can have an insurance-like effect (e.g., Christensen, 2016).

For the mandatory issuers, β_1 and β_2 are not significant, which suggests that for mandatory issuers of ESG/CSR reports, the disclosure of FH information or FE information does not affect the negative market reaction to environment-related misconduct events. This finding might be attributable to the fact that these disclosures are considered routine for mandatory issuers and do not bring new information. However, providing FH and FE information together helps increase the perceived credibility of such information and has a marginally positive effect on stock returns. In summary, the results presented in Table 8 validate H2, particularly for voluntary issuers.

Subsample Tests: Firms With High Versus Low Carbon Emissions

By following a similar procedure to that described in the previous sub-section, we partition the samples for testing H1 and H2 on the basis of whether the sample firms have high or low carbon emissions (CE). Clarkson et al. (2004) document incremental economic benefits of environmental capital expenditures by low-pollution firms, which usually overcomply with environmental regulations. However, they do not find such results for high-pollution firms, which usually barely meet the minimum environmental requirements. Table 9 presents the results obtained in this study in the testing of H1 and H2 for firms with high and low CE.

TABLE 8 Results of Subsample Tests for Voluntary and Mandatory Issuers of ESG/CSR Reports

Panel A: Test of H1 *Dependent Variable: Tobin's Q*			
Variables	Pred. Sign	(1) Voluntary Issuers	(2) Mandatory Issuers
Intercept	?	0.989*	1.011**
		(1.84)	(2.34)
ENVD_FH (β_1)	?	**-0.057**	**-0.049**
		(-0.87)	**(-0.94)**
ENVD_FE (β_2)	?	**0.438****	**-0.357*****
		(2.39)	**(-4.54)**
ENVD_FH×*ENVD_FE* (β_3)	?	-0.607***	0.378***
		(-3.14)	(4.18)
Controls		Included	Included
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$		**-0.226*****	**-0.028**
		(p=0.008)	**(p=0.632)**
Number of Obs.		486	1,239
Adj. R^2		0.4473	0.4576
F-statistic		10.81***	25.86***
Panel B: Test of H2 *Dependent Variable: CAR*[-1, +1]$_{t+1}$			
Variables	Pred. Sign	(1) Voluntary Issuers	(2) Mandatory Issuers
Intercept	?	-8.913	9.735
		(-1.36)	(1.32)
ENVD_FH (β_1)	?	**1.320***	**0.842**
		(1.71)	**(1.03)**
ENVD_FE (β_2)	?	**5.032***	**1.270**
		(1.95)	**(1.58)**
ENVD_FH×*ENVD_FE* (β_3)	?	-3.961*	2.632
		(-1.95)	(1.46)
Controls		Included	Included
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$		**2.391****	**4.744***
		(p=0.037)	**(p=0.079)**
Number of Obs.		138	148
Adj. R^2		0.3499	0.0320
F-statistic		3.46***	1.15

[a] This table presents the regression results obtained for voluntary (Column (1)) and mandatory (Column (2)) issuers of ESG/CSR reports. The results obtained for H1 and H2 are reported in Panel A and Panel B, respectively, and variable definitions are provided in the Appendix. The *t*-statistics in Panel A (in parentheses) are based on the standard errors clustered by firm, and the *t*-statistics in Panel B (in parentheses) are based on Huber–White robust standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively (one-tailed for coefficients with a predicted sign and two-tailed otherwise).

Tests for H1

Panel A of Table 9 reports the results obtained in the testing of H1 for the firms with low and high CE. As in the previous tests of H1, the coefficients of β_1 are insignificant for firms with low and high CE, which suggests that the disclosure of FH information alone is not incorporated into firm value. By contrast, the coefficient of β_2 is significantly negative for the firms with low CE (coeff. = -0.367, t = -3.93) but insignificantly positive for the firms with high CE (coeff. = 0.112, t = 0.84). Moreover, the sum of the *ENVD* coefficients ($\beta_1 + \beta_2 + \beta_3$) is significantly negative for the firms with low CE (coeff. = -0.203) but insignificant for the firms with high CE. These results indicate that for firms with low CE, FE information that is provided alone or with FH information is considered unreliable and negatively associated with firm value. However, FE information is insignificantly associated with firm value for firms with high CE (e.g., Clarkson et al., 2004).

Tests for H2

Panel A of Table 9 indicates that the disclosure of FH or FE information might not enhance firm value when such disclosure is unnecessary (i.e., for firms with low CE). However, contrasting results are obtained for the sample used to test H2 (Panel B of Table 9). Within this sample, the firms with high CE exhibit significantly positive coefficients of β_2 and $\beta_1 + \beta_2 + \beta_3$. These results suggest that when firms with high CE that engage in environmental misconduct disclose FE information alone or with FH information, the provided information is considered credible and mitigates the negative returns associated with the misconduct. We do not find such an effect for the firms with low CE. The results presented in Panel B of Table 9 indicate that FH information and FE information play an insurance-like role in mitigating negative market reactions associated with environmental misconduct events (e.g., Christensen, 2016); thus, these results support H2.

Environmental Disclosures and Subsequent Environmental Performance

Our previous discussion is based on the literature related to information asymmetry. If the disclosed FH information and FE information are credible, they should predict subsequent environmental performance. In particular, FE information indicates potential future environmental commitments of companies. Therefore, we investigate whether the *ENVD* disclosure is associated with subsequent environmental performance. We use the Taiwan ESG Sustainability Index (TESG) database of TEJ to obtain data on the Environmental Performance Index. This database provides an overall environmental performance score (*ENVP*) for different firms, with the overall score being a sum of various subcategory scores, such as the greenhouse gas emission score (*GHG*), energy management score (*ENERGY*), water management score (*WATER*), and waste management score (*WASTE*).

TABLE 9 Results of Subsample Tests for Firms with Low and High Carbon Emissions (CE)

Panel A: Test of H1 *Dependent Variable: Tobin's Q*			
Variables	Pred. Sign	(1) Low-CE Group	(2) High-CE Group
Intercept	?	-1.425**	2.077***
		(-2.34)	(3.56)
ENVD_FH (β_1)	?	**-0.047**	**-0.046**
		(-0.81)	**(-0.72)**
ENVD_FE (β_2)	?	**-0.367*****	**0.112**
		(-3.93)	**(0.84)**
ENVD_FH×*ENVD_FE* (β_3)	?	0.211*	-0.011
		(1.87)	(-0.08)
Controls		Included	Included
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$		**-0.203****	**0.055**
		(p=0.013)	**(p=0.379)**
Number of Obs.		912	813
Adj. R^2		0.4512	0.4606
F-statistic		19.27***	18.33***

Panel B: Test of H2 *Dependent Variable: CAR*$[-1, +1]_{t+1}$			
Variables	Pred. Sign	(1) Low-CE Group	(2) High-CE Group
Intercept	?	11.542	-1.214
		(1.19)	(-0.22)
ENVD_FH (β_1)	?	**0.779**	**-0.212**
		(0.39)	**(-0.25)**
ENVD_FE (β_2)	?	**-1.115**	**0.973***
		(-0.34)	**(1.70)**
ENVD_FH×*ENVD_FE* (β_3)	?	2.849	3.273**
		(0.75)	(2.22)
Controls		Included	Included
Industry and year FEs		Yes	Yes
F-test: $\beta_1+\beta_2+\beta_3$		**2.513**	**4.034***
		(p=0.196)	**(p=0.064)**
Number of Obs.		76	210
Adj. R^2		0.0406	0.2008
F-statistic		1.10	2.42***

[a] This table presents the regression results for firms with carbon emissions (CE) below (Column (1)) and above (Column (2)) the relevant sample median. The results obtained for H1 and H2 are reported in Panel A and Panel B, respectively, and variable definitions are provided in the Appendix. The *t*-statistics in Panel A (in parentheses) are based on the standard errors clustered by firm, and the *t*-statistics in Panel B (in parentheses) are based on Huber–White robust standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively (one-tailed for coefficients with a predicted sign and two-tailed otherwise).

Table 10 presents the overall *ENVP* scores and subcategory scores for the sample firms from year *t* (i.e., the reporting year) to year *t*+2. The firms are divided into three groups according to the information disclosed by them: Group 1 (firms that disclose only FH information), Group 2 (firms that disclose only FE information), and Group 3 (firms that disclose both FH information and FE information). We show the average scores of overall and subcategory performance. We compare the differences between these groups and report these differences by using *t*-statistics. First, the *ENVP* scores gradually increase from year *t* to year *t* + 2 for all three groups. Second, among the three groups, Group 3 exhibits higher *ENERGY* and *WASTE* scores than do the other two groups, particularly in years *t* and *t*+1, and the difference between Group 1 and Group 2 is insignificant. Third, the difference between Group 3 and the other two groups is most significant during year *t* and then gradually diminishes in the following 2 years.

Finally, Group 3 has lower *GHG* scores than do the other two groups, with its *t*-statistics being positively significant over the considered 3-year period. This result suggests that firms that disclose both FH and FE information emit more greenhouse gases in the following years than do firms that disclose either FH or FE information. A possible explanation for this finding is that firms that expect to emit more greenhouse gases in the future tend to provide detailed FE and FH information as a preemptive measure to avoid or reduce the negative market reaction caused by emissions.

VI. Conclusion

The effects of environmental disclosures on firm value and investor decision-making have become more pronounced as sustainability becomes increasingly important (e.g., Barth and McNichols, 1994). However, the literature provides mixed evidence regarding the association between environmental performance and environmental disclosures. Nevertheless, the related ESG/CSR information quality, particularly in developing countries, requires improvement (e.g., Kamal and Deegan, 2013; Huang et al., 2019). This study categorizes the information provided in environmental disclosures into three types (BASE, FH, and FE information) and investigates the following aspects for Taiwanese firms that published ESG/CSR reports during 2017–2020: (1) whether environment-related financial information is associated with firm value and (2) whether specific types of environmental disclosures mitigate negative market reactions when firms are found to have engaged in environmental misconduct.

The results of this study indicate that environmental disclosures are associated with firm value. Specifically, investors assign a lower value to a firm if the firm provides only

FE information without providing FH information concurrently. Interestingly, for voluntary issuers of ESG/CSR reports, the provision of FE information alone is positively associated with firm value, which is consistent with the argument of voluntary disclosure theories that such information is useful to investors and is incorporated in their valuation of a firm (e.g., Clarkson et al., 2011; Dhaliwal et al., 2011). Furthermore, the market reaction to environmental misconduct is less negative for firms that simultaneously provide FH and FE information. For voluntary issuers, the disclosure of any type of environment-related financial information (i.e., FH alone, FE alone, or both) is useful in mitigating negative market reactions.

This paper has certain limitations. First, we use univariate analysis to examine the association of the disclosure of FH and FE information with subsequent environmental performance. Future studies can examine this association through regression analysis. Second, although we attempted to control for the environmental performance of firms, they may self-select to engage in environmental reporting (e.g., Kaul and Luo, 2018). Unobservable firm characteristics that are not controlled for in the models used in this study might affect a firm's decision regarding what types of information to disclose (BASE, FH, or FE information or combinations of these types of information); therefore, this study's results should be interpreted with caution. Finally, environmental disclosures are coded as a dichotomous variable in this study; thus, potential variations in the disclosed content are ignored. Future studies can perform a more detailed coding of environmental disclosures to obtain further insights.

TABLE 10 Results of Univariate Analysis Regarding the Effect of Environmental Disclosure on Subsequent Environmental Performance

Panel A: Environmental Performance Index (Period *t*)						
Env. Perf. (*t*)	Group 1: *Only FH*	Group 2: *Only FE*	Group 3: *FH+FE*	Group 1 *vs*. Group 2	Group 1 *vs*. Group 3	Group 2 *vs*. Group 3
ENVP	**62.092**	**63.004**	**63.830**	(-0.61)	(-2.12)**	(-0.51)
GHG	57.766	62.620	49.067	(-1.14)	(3.50)***	(2.96)***
ENERGY	60.579	60.900	70.080	(-0.12)	(-6.01)***	(-3.10)***
WATER	65.958	64.796	64.672	(0.29)	(0.55)	(0.03)
WASTE	58.526	59.077	62.674	(-0.21)	(-2.79)***	(-1.34)
Panel B: Environmental Performance Index (Period *t*+1)						
Env. Perf. (*t*+1)	Group 1: *Only FH*	Group 2: *Only FE*	Group 3: *FH+FE*	Group 1 *vs*. Group 2	Group 1 *vs*. Group 3	Group 2 *vs*. Group 3
ENVP	**63.160**	**63.382**	**64.304**	(-0.13)	(-1.18)	(-0.53)
GHG	58.233	63.921	49.301	(-1.16)	(3.10)***	(2.79)***
ENERGY	62.092	60.665	71.155	(0.45)	(-4.87)***	(-3.06)***
WATER	66.532	65.697	63.199	(0.18)	(1.23)	(0.50)
WASTE	59.177	57.694	63.163	(0.49)	(-2.33)**	(-1.79)*
Panel C: Environmental Performance Index (Period *t*+2)						
Env. Perf. (*t*+2)	Group 1: *Only FH*	Group 2: *Only FE*	Group 3: *FH+FE*	Group 1 *vs*. Group 2	Group 1 *vs*. Group 3	Group 2 *vs*. Group 3
ENVP	**64.242**	**66.248**	**64.579**	(-0.94)	(-0.28)	(0.79)
GHG	58.088	62.760	47.476	(-0.77)	(2.96)***	(2.35)**
ENERGY	64.195	63.799	71.157	(0.10)	(0.59)	(-1.80)*
WATER	65.973	72.481	63.992	(-1.17)	(0.58)	(1.57)
WASTE	59.429	60.937	62.745	(-0.41)	(-1.58)	(-0.48)

[a] This table reports the mean subsequent Environmental Performance Index (overall and detailed indicators) of firms disclosing different environmental information. Group 1 comprises firms with *ENVD_FH* = 1 and *ENVD_FE* = 0 (*Only_FH*, *n* = 672), Group 2 comprises firms with *ENVD_FH* = 0 and *ENVD_FE* = 1 (*Only_FE*, *n* = 90), and Group 3 comprises firms with *ENVD_FH* = 1 and *ENVD_FE* = 1 (*FH + FE*, *n* = 375). All continuous variables are winsorized at the 1% and 99% levels. We conduct *t*-tests to determine the differences in mean values between the three groups. Variable definitions are provided in the Appendix. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

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Appendix Variable Definitions

Variable		Definitions
AGE	=	The natural logarithm of the number of years since the firm was listed.
BLOCK	=	Blockholder ownership, which is measured as the proportion of a firm's shares held by blockholders who own at least 5 percent of the total number of shares.
CAPX	=	Ratio of capital expenditure to total assets.
CAR[-1, +1]	=	Cumulative abnormal return over a 3-trading-day window [-1, +1] around the event date. Abnormal returns are defined as market model residuals, where the parameters are estimated over a 150-trading-day window [-180, -31] before the event date. The event date (day 0) is the date on which news related to the environment-related misconduct event is announced. In this study, event dates are downloaded from the ESG News database of TEJ.
CASHTA	=	Ratio of cash to total assets.
COEC	=	Cost of equity capital, which is estimated using the capital asset pricing model (CAPM), and equals the sum of the risk-free rate of return (R_f) and a risk premium ($\beta_i \cdot (E(R_m) - R_f)$). We use the average interest rate of a one-year time deposit calculated based on the top five Taiwanese banks (i.e., Bank of Taiwan, Taiwan Cooperative Commercial Bank, Hua Nan Commercial Bank, First Commercial Bank, and Land Bank of Taiwan) and the TWSE Weighted Index as proxies for R_f and $E(R_m)$, respectively. The term β_i equals $Cov(R_i, R_m)/Var(R_m)$, which is estimated using 3-years firm-specific and market-specific stock returns data.
COMPET	=	Herfindahl–Hirschman Index (HHI), which is measured by summing the squares of the market shares of firms in an industry. A firm's market share is calculated as the ratio of its sales to the total shares of firms in the same industry. A lower HHI indicates a more competitive industry.
CSRR	=	A dichotomous variable that equals 1 if a company issues an ESG/CSR report, and 0 otherwise.
DEBT	=	Ratio of debt to total assets.
DEV	=	The divergence in the control and cash flow rights of the ultimate controlling shareholders. The control rights (also known as voting rights) are measured as the sum of the direct control rights and the indirect control rights based on the weakest link in the control chains. The cash flow rights refer to the sum of the products of indirect shareholding in the control chains (Claessens, Djankov, and Lang, 2000).

Appendix Variable Definitions (Continued)

Variable		Definitions
DIV	=	An indicator of whether the firm pays dividends.
ENERGY	=	Energy management score (obtained from the TESG database).
ENV_Pages	=	Number of pages providing environmental information in the ESG/CSR report.
ENVD_BASE	=	An indicator variable that is coded as 1 if the company provides information covering discussion/statement of environmental regulations, company concerns, environmental compliance status, and environmentally-friendly processes, facilities, or product innovations, and 0 otherwise.
ENVD_FE	=	An indicator variable that is coded as 1 if the company provides "estimated financial" environmental information (in dollar amounts) covering future capital expenditures (or operating costs or predicted benefits) for environmental protection, and 0 otherwise.
ENVD_FH	=	An indicator variable that is coded as 1 if the company provides "historical financial" environmental information (in dollar amounts) covering its capital expenditures (or operating costs) for environmental protection in recent years, and 0 otherwise.
ENVP	=	Environmental Performance Index score (obtained from the TESG database).
FINSTR	=	Decile rank of the firm's *Z*-score. The *Z*-score is calculated using the following formula: (3.3 × earnings before interest and income tax + sales + 1.4 × retained earnings + 1.2 × working capital)/book value of total assets (Christensen, 2016).
GHG	=	Greenhouse gas emission score (obtained from the TESG database).
INDB	=	The percentage of independent directors on the board.
INTANG	=	Intensity of intangible assets, which is obtained by subtracting the ratio of net property, plant, and equipment to total assets from 1.
ISHOLD	=	Institutional ownership, which is measured as the proportion of a firm's shares held by institutional investors.
LIQUID	=	The natural logarithm of the sum of 1 and the ratio of the split-adjusted trading volume to outstanding shares during the fiscal year.

Appendix Variable Definitions (Continued)

Variable		Definitions
lnPENALTY	=	Natural logarithm of *PENALTY*, where *PENALTY* indicates the dollar amount of annual fines or levies for the events related to environmental pollution (violation of any of the following regulations: Soil and Groundwater Pollution Remediation Act, Water Pollution Control Act, Air Pollution Control Act, Marine Pollution Control Act, and Waste Disposal Act). The event date is the date on which news of the environment-related misconduct event is announced on the Market Observation Post System (M.O.P.S.). We assume that *PENALTY* equals 0 when environment-related misconduct events are not associated with data on fines.
PCAR	=	The cumulative abnormal return during the one month prior to the event window of the environment-related misconduct event.
PRIOR	=	An indicator variable that equals 1 if the firm was reported by the media to have engaged in CSR-related misconduct in the prior year, and 0 otherwise.
RDS	=	R&D intensity, which is the ratio of R&D expenditure to sales. We assume that the R&D expenditure equals 0 when data are missing.
RETVOL	=	The standard deviation of daily stock returns during the sample year.
ROA	=	Return on assets, which is equal to the ratio of net income to average total assets.
SIZE	=	Firm size, which is measured as the natural logarithm of total assets.
STOCKTURN	=	Annual share turnover.
Tobin's Q	=	Tobin's Q, which is measured by adding the market value of common stockholders' equity, the book value of preferred stock, book value of long-term debt, and current liability and dividing the sum by the book value of total assets.
Total_Pages	=	Total number of pages of the ESG/CSR report.
WASTE	=	Score for waste and toxic substance management (obtained from the TESG database).
WATER	=	Score for water and wastewater management (obtained from the TESG database).