

Mandatory Sustainability Disclosure and Stock Price Crash Risk^{*†}

Dragon Yongjun Tang

The University of Hong Kong
Email: yjtang@hku.hk

Rui Zhong

UWA Business School
University of Western Australia
Email: rui.zhong@uwa.edu.au

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* Dragon (Yongjun) Tang is a professor of finance at the University of Hong Kong. Rui Zhong is a Senior Lecturer in finance at UWA Business School at University of Western Australia.

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ABSTRACT

This study investigates the impact of the enforcement of mandatory sustainability (ESG) disclosure regulations on future stock price crash risk around the world. We document evidence that firms experience significantly lower likelihood of stock price crashes after the enactment of mandatory sustainability disclosure regulations. This negative relationship is causal and more pronounced for the firms with high opaqueness of non-financial information before the regulations are put in place. Further, we find that the negative impact of mandatory sustainability disclosure on stock price crash risk cannot be alleviated by accounting information transparency. Our findings shed light on the real impact of non-financial information disclosure on financial market stability and stock return distribution.

Keywords: Mandatory sustainability disclosure; Stock price crash risk; non-financial information; Information hoarding;

JEL Classification: G14; G15; G18; G32; G38;

1. Introduction

“... a company’s ability to manage environmental, social, and governance matters demonstrates the leadership and good governance that is so essential to sustainable growth, which is why we are increasingly integrating these issues into our investment process...”

----Quoted from Larry Fink (Chairman and CEO of BlackRock)’s 2018 Annual Letter to CEOs¹

How firms deal with environmental, social and governance (ESG) issues (or sustainability) has become an increasingly important factor for investing decisions made by institutional investors, as indicated by Larry Fink’s annual letter to CEOs². According to the survey done by EY in 2016, more than 90% of buy-side institutional investors around the world strongly-agree or agree that ESG issues have real and quantifiable impacts over the long term. However, the survey also shows that about 80% of institutions agree that the current disclosure of firm’s ESG risks that could affect institutional investors’ investing decisions is not adequate. In recent years, the policy makers around the world gradually realize the importance of sustainability in the long-term growth of an economy and the lack of ESG information disclosure. With the purpose of prompting firm’s sustainable growth, many countries and jurisdictions issue the regulations that force firms to disclose their ESG situations and activities. However, such disclosure is also costly and controversial. Whether such mandatory disclosure regulations are beneficial or not become to be an important question for future practices. In this study, we address this question by examining the effect of ESG disclosure on future stock price crash risk.

Stock price crash risk refers to the likelihood of experiencing extremely negative stock returns, which significantly affects the stability of equity market. The prevailing interpretation of stock price crash is the negative information hoarding

¹ Available at <https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>

² We use ESG as the abbreviation for environmental, social and governance, hereafter. We use ESG and sustainability interchangeably in this study.

argument (e.g. Jin and Myers 2006; Hutton et al 2009). Managers tend to hide bad news for a wide range of reasons, such as compensation contracts, career concerns, and empire buildings (Ball 2009; Kothari, Shu and Wysocki 2009). Withholding bad news consequently leads to the severe overvaluation of stock price. When the accumulated bad news reaches a tipping point and reveals to public all at once, it results in a sharp decline of stock price, so-called “crashes”. Hence, the crash risk of a firm’s stock is a good laboratory to examine the effects of ESG disclosure on informational environment.

There are two-fold effects of mandatory ESG disclosure on stock price crash risk. On one hand, after the enactment of mandatory ESG disclosure regulation, firms may release negative news in a more timely manner. Moreover, firms in compliance with ESG policies may face less litigation or government sanction risks, which are also drivers of stock price crashes. Furthermore, due to the mandatory disclosure, firms may alter their policies and take on projects that reduce ESG risk, leading to lower stock price crash risk.

On the other hand, when firms are under pressure to comply with government regulations, they may exert effort for regulatory arbitrage and superficially comply with regulatory requirements. It can also exacerbate the agency conflicts between managers and shareholders. In order to please shareholders while in compliance with government policies, corporate managers can hide profitable but environmentally detrimental projects with the assistance of creative accounting and financial transactions. Consequently, the firms may have higher crash risk after mandatory ESG disclosure from government.

We compile a comprehensive international sample to empirically test the effect of mandatory ESG disclosure on stock price crash risk. Our dataset includes 18 countries in which mandatory ESG disclosure is implemented during the period from 2000 to 2016, out of 46 countries. We construct three standard measures of stock price crash risk, including negative skewness, down-to-up volatility, and the probability of actual stock price crashes (e.g., Jin and Myers 2006; Hutton et al. 2009; Kim, Li, and Zhang 2011a, 2011b). We find that stock crash risk is mitigated

after the implementation of mandatory ESG disclosure. This finding is robust to alternative crash risk measures and econometric methodologies. The result is both statistically significant and economic meaningful. For instance, the implementation of mandatory ESG disclosure reduces the probability of experiencing stock price crashes in the following year by about 90%³.

Since the enforcement of mandatory ESG disclosure might not be a random event, there could be potential endogeneity concerns, such as reverse causality or simultaneity. We adopt propensity score matching and placebo tests to address these concerns, respectively. First, we construct treatment and control groups according to the similarity of industry, firm size and the propensity score of implementing mandatory ESG disclosure next year. By performing difference-in-difference analysis, we find that mandated ESG disclosure significantly reduces stock price crash risk measure in the treatment group. Second, to mitigate the simultaneity concerns about the possibility of latent omitted variables, we conduct placebo tests by incorrectly assigning the timing of the commencement of mandatory ESG disclosure. If the negative impact of mandatory ESG disclosure on future stock price crash risk is driven by certain unobserved factors, this negative relationship should exist regardless of the exact timing of the commencement of mandatory ESG disclosure regulation. However, we find that the negative impact of mandatory ESG disclosure on future stock price crash risk measures disappears when the implementation timing is incorrectly assigned to two or three years before the actual years, which adds more credence to our baseline results.

Then, we analyze the possible channels through which the implementation of mandatory sustainability disclosure on future stock price crash risk. The immediate consequence of the enforcement of mandatory ESG disclosure is to force firms to reveal more non-financial information timely, which results in an improvement of the transparency. The less likelihood of hiding negative news leads to a decrease of stock price crash risk in the future. If this conjecture holds, the negative relationship between mandatory ESG disclosure and stock price crash

³ 90% represents the percentage change in the probability of experiencing actual stock price crashes relative to the unconditional mean.

risk should be mitigated by the transparency of ESG information. To examine this conjecture, we perform a difference-in-difference analysis by incorporating an interaction term of mandated-disclosure indicator and ESG-transparency indicator. Consistent with our conjecture, we find that the negative influence of mandatory ESG disclosure on future stock price crash risk is alleviated in the firms with high ESG-transparency.

Moreover, the regulation of mandatory ESG disclosure have a positive impact on manager to increase their ethical and moral standard by disciplining their misconducts on environmental, social and governance issues. Manager's tendency to operate with integrity can also reduce the likelihood of earnings management and increase the transparency of accounting reports (e.g. Kim et al. 2012; Gelb and Strawser 2001; Kim et al. 2014), which leads to a lower stock price crash risk in the future (e.g. Jin and Myers 2006; Hutton et al. 2009). Hence, the negative relationship between mandatory ESG disclosure and future stock price crash risk should be more pronounced in the firms with high opacity of accounting reports provided this conjecture is true. We use two measures to proxy for the transparency of accounting reports: the absolute value of discretionary accruals and the auditor's quality. By conducting difference-in-difference analysis, we find that the transparency of accounting reports does not significantly affect the negative relationship between mandatory ESG disclosure and stock price crash risk in the future. It suggests that financial information transparency is not a valid channel through which mandatory ESG disclosure regulation reduces the likelihood of experiencing stock price crashes in the future.

This study contributes to the literature from at least three aspects. First, by demonstrating that the implementation of mandatory ESG disclosure policy alleviates firm-specific stock price crash risk in the future, this work adds to the literature that documents the externality of non-financial information disclosure on the equity price distribution, specifically the likelihood of experiencing extremely large and negative price drops. These findings have important implications for equity market participants, regulations and corporate executives to understand the real impact of mandatory ESG disclosure policy and manage

stock price crash risk. Second, our study enriches the related literature to examine the determinants of future stock price crash risk. We provide new evidence that the opaqueness of ESG information significantly affects stock price crash risk. We also show that the mandatory ESG disclosure could be an effective way to reduce the likelihood of experiencing price crashes by improving the transparency of ESG information. Third, our findings deepen the understanding of the relationship between financial and non-financial information in term of affecting future stock price crash risk. We show that the transparency of financial reports does not affects the relationship between mandatory ESG disclosure and future stock price crash risk. This finding highlights the importance of ESG-information transparency that can not be substituted by financial-reporting transparency.

The rest of this paper is organized as follows. Section 2 discusses the possible impact of mandatory ESG disclosure on firm-specific future stock price crash risk and develops testable hypotheses. Section 3 describes the statistics of our sample data and related variables. Section 4 presents our empirical design, reports our main empirical findings and addresses the potential endogeneity concerns. Section 5 provides a comprehensive analysis of the channel through which the implementation of mandatory ESG disclosure affects stock price crash risk in the future. Section 6 concludes the paper.

2. Hypotheses development

The influence of mandatory ESG disclosure on the likelihood of experiencing future stock price crashes is an ongoing debate. In this section, we discuss the impact of sustainability reports on firm specific stock price crash risk from two aspects.

Corporate sustainability report contains information about economic, environmental, social and governance performance. Mandatory sustainability reporting is not just report the non-financial information, instead it also internalizes and improves an organization's commitment to sustainable development. Consistent with this view, Ioannou and Serafeim (2017) find that

mandatory ESG disclosure increases the level of corporate ESG score reported by Bloomberg. The improvement of ESG score signals a higher ethical and moral standard of managers, which reduces manager's tendency to hide the bad news of non-financial performance. Further, the improved sustainability also leads to more transparent financial reporting by providing more financial disclosure (Gelb and Strawser 2001) and reducing the tendency of earnings management (Kim et al. 2012). Prior literature shows that the opacity of financial reports is positively related to the firm-specific stock price crash risk (Jin and Myers 2006; Hutton et al. 2009). According to these evidence and argument, we expect that mandatory ESG disclosure alleviates the likelihood of experiencing stock price crashes in the future.

On the other hand, although mandatory sustainability disclosure aims to increase the transparency of non-financial information, there are many valid reasons for firms to choose not to disclose more information or to certain extent to use superficial sustainability reporting to cover up corporate misbehavior. For instance, since there is no clear guidance on the metrics and disclosures that a firm must comply, the firms that have already disclosed sustainability report will simply stick to the existing disclosure pattern. In some countries, the mandatory ESG disclosure policy includes a "comply or explain". A firm could simply choose to explain why they do not disclose sustainability information in response to the regulation. In this vein, it is possible that the mandatory ESG disclosure regulation has no effect on a firm's informational environment and leads to no impact on stock price crash risk. Additionally, recent studies document the evidence that the corporate social responsible activities are used to divert shareholder attention and hide corporate improper behavior. For example, Petrovits (2006) find that managers strategically use corporate philanthropy to meet financial reporting objectives. Prior et al. (2008) find that corporate social responsibility score and earnings managements for regulated firms have a positive relationship. The mandatory ESG disclosure facilitates the usage of social responsible activities to withhold information of manager's misconduct, which consequently results in an increase of financial information opaqueness and higher future stock price crash

risk (e.g. Jin and Myers 2006; Hutton et al. 2009). Overall, to investigate the real impact of mandatory ESG reporting on firm-specific stock price crash risk in the future, we construct a hypothesis as follow:

Hypothesis 1 (Baseline): *The implication of mandatory ESG reporting decreases future firm specific stock price crash risk.*

Since stock price crashes are phenomenon in financial market, the majority studies on investigating the determinants of stock price crash risk focus on the opaqueness of financial information (e.g. Jin and Myers 2006; Hutton et al. 2009) or manager's tendency of hiding bad financial information (e.g. Kim et al. 2011a; 2011b; etc.). However, the ESG reporting specializes on disclosing non-financial information, such as environmental and social issues. If the implication of mandatory ESG reporting significantly affects future stock price crash risk, what's the channels through which non-financial information transparency affects the stability of equity market? To address this question, we investigate both the direct and indirect channels.

The direct channel refers to the direct impact of non-financial information opaqueness on future stock price crash risk. Corporate sustainability information is one of the primary components of non-financial information. Since managers have a tendency to hide the bad news about the non-financial information, such as environmental, social or ethical issues, the absence or the opaqueness of sustainability reports assists managers to withhold this negative information temporary. Once the accumulated bad news reaches the tipping points, such as generating significant negative consequence on environment or social issues, etc., all the accumulated bad news will cascade to the public quickly and result in stock price crashes or most likely litigation issues. For example, the well-known Enron case in which directors and executives fraudulently concealed large losses in Enron's projects, Chiquita Brands International who entered a pre-packaged insolvency because of a series of accusations relating to breaches of labour and environmental standards. Since the marginal effect of mandatory ESG disclosure on the firm without ESG information should be greater than that on the firm with

ESG information, we expect that the direct impact of mandatory sustainability disclosure policy on stock price crash risk is more pronounced for the firms with less transparency of non-financial information and construct the second hypothesis.

Hypothesis 2: *The negative influence of mandatory sustainability disclosure regulation is more pronounced for the firms with high opaqueness of non-financial information.*

The mandatory sustainability disclosure not only improve the transparency of non-financial information transparency, but also improves the transparency of accounting reports (Kim et al. 2012) and financial disclosure (Gelb and Strawser 2001). Since the opaqueness of accounting reports is one of the key determinants of stock price crash risk (e.g. Jin and Myers 2006; Hutton et al. 2009; etc.), the improved accounting reports after mandatory disclosure regulation constitute the indirect channel. Considering that the marginal impact of mandatory sustainability disclosure is greater for the firms with high opaqueness of accounting reports, we expect that the negative impact of mandatory sustainability disclosure regulation should be more pronounced for the firms with high opaqueness of financial information, which constitutes the third hypothesis.

Hypothesis 3: *The negative influence of mandatory sustainability disclosure regulation is more pronounced for the firms with high opaqueness of accounting information.*

3. Data description

3.1 Sustainability reporting

We extract the policies and regulations that mandate firms to disclose ESG information from multiple sources. The primary sources are Sustainable Stock Exchange Initiative (SSE), Global Reporting Initiative (GRI) and Initiative for Responsible Investment (IRI) at Harvard University. We focus on the listed firms because of the availability of performance and fundamental information. The SSE

initiative is organized by the United Nation Conference on Trade and Development (UNCTAD), the UN Global Compact, the UN Environment Program Finance Initiative (UNEP FI), and the Principles for Responsible Investment (PRI) to enhance corporate transparency on environmental, social and corporate governance issues and encourage sustainable investment. SSE Initiative collected sustainability reporting policies and regulations taken in jurisdictions around the world and compiled a summary table to report the details of these policies, including type of rules, scope of application, applicable firms, the way to comply (mandatory or voluntary) or explain, etc. Since the detailed information of some policies is not completed in this table, we verify the disclosure timing and contents using the disclosure information collected by GRI and IRI. Additionally, we also use internet searching engines, such as Google, Bing, Baidu, etc., to locate the related information from the website of government agencies, stock exchanges and related newspapers to cross check the accuracy of the mandatory disclosure information in the jurisdictions in our sample⁴.

We compose a novel dataset to reflect country-level regulations of mandatory ESG reporting by combining the related information from various sources mentioned above. We focus on the policies that mandate firms to disclose environmental, social and governance information. Because of the heterogeneity across jurisdictions in term of economic development, legal system and culture, the specific regulations for mandatory sustainability reporting vary significantly, especially the format of ESG disclosure and the contents of sustainability reports. For example, in Australia, the Financial Services Council and the Australian Council of Superannuation Investors issued ESG Reporting Guide and mandated listed firm to disclose social, environmental and governance data. In South Africa, Johannesburg Stock Exchange collaborated with the Institute of Directors in Southern Africa to issue guidance notes on reporting sustainability information. In European Unions, the member countries issued the guidance based on the EU Modernization Directive (Directive 2003/51/EC). While in some other countries,

⁴ We also consult regulators, practitioners and scholars in this field about the detailed requirements of sustainability reporting in some countries to increase the accuracy of mandatory disclosure timing.

the regulators mandates corporations to disclose sustainability information without providing written guidance on ESG reporting. Although it is not an easy task to quantify the transparency level of sustainability disclose cross countries, we expect that the implementation of mandatory sustainability disclosure should significantly improve the transparency of non-financial information in general (Ioannou and Serafeim 2017). Thus, we employ an indicator that equals to one after the commencement of mandatory sustainability reporting and zero otherwise. Specifically, we consider three cases as mandatory reporting: (1) the regulations or policies issued by the authorities in a country explicitly mandate all listed firms to disclose social and environmental information in annual report or separate sustainability reports; (2) If the authorities only mandate the firms that meet certain criteria to disclose sustainability information, we set the indicator equal to one only for the applicable firms after the issuance of regulations. For example, The Securities and Exchange Board of India (SEBI) issued a regulation that mandated the top 100 listed companies in term of market capitalization as on March 31, 2012 to include business responsibility reports as part of annual reports. The Norwegian government passed legislation that requires large companies to disclose sustainability information; (3) we consider the “comply or explain” as the mandatory sustainability disclosure. Even though the “comply or explain” offers an alternative option for firms to hide sustainability information, the explanation to address the reasons why firms do not comply is still able to reveal the sustainability information to public to certain extent.

Table 1 reports the distribution of observations across 46 countries during the period from 2000 to 2016. We identify 18 countries in which the sustainability information is mandated to disclose by 2016 in our sample. As exhibited in Figure 1, the countries that adopt sustainability reporting geographically spread quickly around the world in last decade. We use deep green to indicate mandatory disclosure for environmental, social and governance information and light green to indicate partial mandatory or voluntary disclosure. We find that many countries shift from partial mandatory or voluntary disclosure to mandatory disclosure in last decade to improve the transparency of non-financial information.

[Please Insert Table 1 and Figure 1 about Here]

Additionally, we use the ESG Score from Sustainalytic to quantify the level of firm's sustainability. Sustainalytic assesses a company's ESG performance from four dimensions, including preparedness, disclosure, quantitative performance and qualitative performance and compose the *ESG*-score, *E*-score, *S*-score and *G*-score to quantify total ESG, environmental, social and governance performance, respectively. Since Sustainalytic's database only covers the companies included in major global indices, we remove the firms that does not have ESG scores. We calculate the average of sustainability scores of all firms in a mandated-disclosed country after the commencement of the regulation. The bar chart in Figure 2 shows the variation of the mean of sustainability of large firms cross mandated-disclosed countries. The large listed firms in developed countries on average have better ESG scores in contrast to these in emerging countries. Moreover, as shown in Figure 3 that report the means of firm-level ESG scores in mandated-dsiclosed countries after mandatory ESG disclosure, the overall sustainability gradually improves in most of these countries, consistent with the evidence documented by Ioannou and Serafeim (2017) to certain extent.

[Please Insert Figure 2 and Figure 3 about Here]

3.2 Stock price crash risk

We use the negative conditional firm-specific skewness of weekly returns (*NCSKEW*) as a primary proxy for firm-specific crash risk (Hutton et al. 2009; Kim and Zhang 2011a, 2011b; Kim, Li, and Li 2014). Further, we adopt the down-to-up volatility (*DUVOL*) and the indicator of actual stock price crashes (*CRASH*) as alternative measures to check the robustness of our results.

The stock crash risk proxies are constructed using weekly stock returns from Thomas Reuter. To avoid a look-ahead bias and ensure that our analysis of stock price crash risk only considers the financial data available to investors, we follow Kim et al. (2011a, 2011b), among others, and use weekly returns for the 12-month period ending after the firm's fiscal year-end. Then, for all the firms, we regress the

weekly stock returns for a year in a country with respect to local MSCI market index in the current week, two weeks forward, and two weeks back, as follows:

$$r_{i,t,j} = \alpha_{i,j} + \beta_{1,i,j} r_{m,t,j} + \beta_{2,i,j} r_{m,t-1,j} + \beta_{3,i,j} r_{m,t-2,j} + \beta_{4,i,j} r_{m,t+1,j} + \beta_{5,i,j} r_{m,t+2,j} + \varepsilon_{i,t,j} \quad (1)$$

where $r_{i,t,j}$ is the stock return for firm i in week t in country j , $r_{m,t,j}$ is the return of local MSCI market index in week t in country j , and $\varepsilon_{i,t,j}$ is an error term. We use Equation (1) to break down the total return into systematic and firm-specific components after introducing the lead and lag returns to account for non-synchronous trading. The natural logarithm of one plus the residual in Equation (1), $\log(1 + \varepsilon_{i,t,j})$, proxies for the firm-specific weekly return for firm i in week t ($W_{i,t,j}$) in country j .

We calculate the *NCSKEW* by taking the negative of the third moment of the firm-specific weekly returns, $W_{i,t,j}$, for each sample year divided by the standard deviation of the firm-specific weekly returns raised to the third power. Specifically, we calculate *NCSKEW* for each firm i in year t in country j as follows:

$$NCSKEW_{i,t,j} = - \left[n(n-1)^{3/2} \sum W_{i,t,j}^3 \right] / \left[(n-1)(n-2) \left(\sum W_{i,t,j}^2 \right)^{3/2} \right] \quad (2)$$

where $W_{i,t,j}$ is as defined above and n is the number of weekly return observations in year t . A higher negatively skewed return distribution (i.e., a higher value for *NCSKEW*) indicates a higher crash risk.

The first alternative stock price crash proxy, *DUVOL*, is calculated as the natural logarithm of the standard deviation of the weekly stock returns, $W_{i,t,j}$, during the weeks in which $W_{i,t,j}$ is lower than its annual mean (down weeks) over the standard deviation of the weekly stock returns, $W_{i,t,j}$, during the weeks in which $W_{i,t,j}$ is higher than its annual mean (up weeks). Specifically, *DUVOL* for each firm i in year t in country j is calculated as follows:

$$DUVOL_{i,t,j} = \log \left\{ \left[(n_u - 1) \sum_{DOWN} W_{i,t,j}^2 \right] / \left[(n_d - 1) \sum_{UP} W_{i,t,j}^2 \right] \right\} \quad (3)$$

where n_u is the number of up weeks and n_d the number of down weeks. A higher value for *DUVOL* indicates a higher crash risk.

The second alternative proxy for stock price crashes, *CRASH*, is an indicator that equals to one if a firm experiences a stock price crash(es) in a year and zero otherwise. A stock price crash is defined as an extremely negative weekly stock return that is below the mean of the firm-specific weekly returns in a fiscal year by a standard deviation of 3.2. This standard deviation indicates approximately 0.1 percent in a normal distribution.

[Please Insert Table 2 about Here]

Table 2 reports the means of stock price crash measure in each year during our sample period. The likelihood of experiencing stock price crashes are greater during the burst of Dot-com bubble in 2001 and the sub-prime financial crisis in 2008. Before conducting rigorous multivariate regressions to examine the impact of mandatory sustainability reporting on stock price crash risk, we compare the descriptive statistics of crash risk measures in various subsamples and report the results in Table 3. We find that the means of crash risk measures in mandated-disclosure countries are relatively smaller in contrast to these in other countries. Further, the means of *NCSKEW* and *DUVOL* slightly decrease after the implementation of mandatory sustainability reporting regulation. These simple comparisons could not lead to any conclusive results. We will conduct the rigorous analysis in the subsequent sections.

3.3 Control variables

To investigate the implementation of mandatory ESG reporting on future stock price crash risk, we should control for the known determinants of firm specific future stock price crash risk. Following closely related literature to examine the determinants of stock price crash risk (e.g. Jin and Myers 2006; Hutton et al. 2009; Kim et al. 2011; etc.), we incorporate the control variables to reflect firm's fundamental, equity performance and country characteristics. In particular, we use firm size, profitability, financial leverage ratio, the discretionary accruals, the

quality of auditors, the international diversification of revenue to reflect a firm’s fundamental information. We use the change of monthly turnover ratio, market-to-book ratio, means and volatility of firm specific weekly returns, the availability of ADR, insider ownership to reflect equity performance. To control for the country characteristics, we incorporate the means and volatility of local MSCI equity market index, creditor rights index, rule of law index and the growth rate of GDP.

We extract the firms’ equity and fundamental information from Worldscope and Datastream at Thomas Reuters. The creditor right index is downloaded from Doing-Business Report. The rule of law index and the growth rate of GDP are extracted the data bank provided by the World Bank. We winsorize all control variables at the 1% quantiles to alleviate the impact of extreme values. The descriptive statistics of all the control variables are reported in Table 4 and the correlation matrix are reported in Table II on internet appendix.

[Please Insert Table 4 about Here]

4. Mandatory ESG disclosure and stock price crash risk

4.1 Multivariate regression model

We compose a multivariate regression model to examine the influence of the commencement of mandatory ESG reporting on future firm-specific stock price crash risk. This regression model links crash risk measures in year t to the indicator of mandatory ESG disclosure in year $t-1$ and to a set of control variables in year $t-1$:

$$\begin{aligned}
 Stock\ Crash\ Risk_t = & \alpha_0 + \alpha_1 ESG_{D_{t-1}} + \alpha_2 ESG_{C_{t-1}} \\
 & + \sum_{i=1}^m \beta_i ControlVariable_{i,t-1} + \varepsilon_t.
 \end{aligned} \tag{4}$$

where $Stock\ Crash\ Risk_t$ refers to stock price crash risk measures employed in our analysis. Specifically, we use the negative skewness of the firm-specific weekly return ($NCSKEW_t$) as the primary measure and the down-to-up volatility ($DUVOL_t$)

and the actual probability of stock price crashes in a firm-year ($CRASH_t$) as alternative measures of firm-specific stock price crash risk. ESG_D_{t-1} is an indicator variable that equals to one for years after the implementation of mandatory ESG disclosure, zero otherwise.⁵ Equation (4) is estimated using an ordinary least squares (OLS) approach for $NCSKEW_t$ and $DUVOL_t$ and a probit regression for $CRASH_t$, due to its truncated distribution.

The set of control variables includes $DTURN_{t-1}$, RET_{t-1} , $SIGMA_{t-1}$, $SIZE_{t-1}$, ROA_{t-1} , LEV_{t-1} , MB_{t-1} , $DISACC_{t-1}$, $AUDI_{t-1}$, ADR_{t-1} , $CLOSE_{t-1}$, $ISALE_{t-1}$, $IVOL_{t-1}$, CR_{t-1} , RL_{t-1} and $GDPG_{t-1}$. We use these variables to isolate the effect of well-documented determinants of stock price crash risk (e.g., Chen, Hong, and Stein 2001; Hutton et al. 2009; Kim et al. 2011a, 2011b). $DTURN_{t-1}$ is the average monthly share turnover ratio in year t minus that in year $t-1$ and a proxy for the differences of opinion among investors. Since Chen et al. (2001) show that the existence of heterogeneous opinions is positively related to the probability of experiencing extremely negative stock returns in the future, we expect the coefficient for $DTURN_{t-1}$ to be positive. RET_{t-1} and $SIGMA_{t-1}$ are the arithmetic mean and the standard deviation of firm-specific weekly returns in year $t-1$, respectively. According to the evidence documented in closely related literature (e.g., Chen et al. 2001; Jin and Myer 2006; Hutton et al. 2009) using firm information in U.S. market, stocks with higher past volatility or returns are more likely to experience price crashes in year t . However, our sample contains the firms in 46 countries that includes both developed and emerging markets. Since the stock price movement pattern varies across countries, the relationship between past firm-specific stock returns (volatility) and future stock price crash risk is undetermined. $SIZE_{t-1}$ and MB_{t-1} are the logarithm of a firm's total assets and the market value of equity divided by the book value of equity in year $t-1$, respectively. As stocks with a large size and a high market-to-book ratio are more likely to experience future stock price crashes (e.g., Chen et al. 2001; Hutton et al. 2009; Kim et al. 2001), we expect positive coefficients for $SIZE_{t-1}$ and MB_{t-1} . LEV_{t-1} is the total long-term debt divided

⁵The regulation or policies that is considered as a mandatory sustainability disclosure is described in section 3.1.

by total assets. Hutton et al. (2009), Kim et al. (2001), and Callen and Fang (2013) show that financial leverage is negatively related to stock price crash risk. ROA_{t-1} is the return on assets reflecting firm's profitability. The effect of profitability in year $t-1$ on stock price crash risk is inconclusive. For instance, Hutton et al. (2009) and Kim et al. (2011a, 2011b) find that the return on equity (ROE) and the return on assets (ROA) are negatively related to stock price crash risk, whereas Callen and Fang (2013) and Kim et al. (2014) find that ROE and ROA are positively related to crash risk, respectively. $DISACC_{t-1}$ is the absolute value of discretionary accruals that reflect the opaqueness of accounting reports. Since Hutton et al. (2009) find that the opacity of financial reports is significantly positively related to stock price crash risk, we expect positive coefficients for $DISACC_{t-1}$. $AUDI_{t-1}$ indicate the quality of auditors. It equals to one if a firm hire the big four auditors and zero otherwise⁶. Since good auditors could improve the accounting information accuracy and discipline the managers from manipulating information, we expect negative coefficients of $AUDI_{t-1}$. ADR_{t-1} indicates the availability of ADR shares in U.S. market. Because the accounting rule in U.S. market is more rigorous in contrast to emerging countries, the availability of ADR is expected to increase the transparency of accounting report of firms in emerging countries. However, as our sample spans 46 countries, including both emerging and developed markets, the coefficients of ADR_{t-1} is not clear. $CLOSE_{t-1}$ is the ownership of insiders. Insiders are informed traders who have privilege to access to the private information and trade on these information, which provides an alternative channel to reveal bad news. Thus, we expect negative coefficients for $CLOSE_{t-1}$. $ISALE_{t-1}$ is the ratio of international sales over total sales of a firm, reflecting the international diversification of revenue. $IRET_{t-1}$ and $IVOL_{t-1}$ are the annual return and volatility of monthly return of local equity market index in a country, respectively. We use these proxies to control for the local equity market performance. CR_{t-1} and RL_{t-1} are the index of creditor's rights and rule of law, respectively. Since strong creditor's rights and strict rule of law enhances creditors' monitoring and discipline manager's misconduct, we expect negative coefficients for both CR_{t-1} and RL_{t-1} .

⁶ The big four auditors are PwC, Deloitte, EY and KPMG.

$GDPG_{t-1}$ denotes the annual growth rate of GDP, which reflects the economic development in a country. Moreover, as Chen et al. (2001) report that firms with a high stock price crash risk in year $t-1$ are likely to also have a high crash risk in year t , we control for the corresponding lagged stock price crash risk measures. Additionally, we also control for the country, year and industry fixed effects.

4.2 Baseline results

We report the baseline regression results using negative skewness as primary crash risk measure under various scenarios in Table 5. The corrected standard errors clustered by firm are report in the parentheses (Petersen, 2009). Our results using the full model (Model (2)) show a significantly negative coefficient for ESG_D_{t-1} , indicating that the implementation of mandatory ESG disclosure in year $t-1$ alleviates the stock crash risk in year t .

To check the robustness of this finding, we examine the effect of mandatory sustainability reporting on stock price crash risk using restricted models and alternative econometric approaches. First, we exclude firm-specific and country-level control variables from full model and, as shown in Model (1) of Table 5, still find significantly a negative coefficient for ESG_D_{t-1} . Second, we substitute the firm-fixed effects for industry-fixed effects and a ESG-disclosed country dummy and document consistent negative relationship between mandatory ESG disclosure and future stock price crash risk, as reported in Model (4) of Table 5. Third, Since the observations in U.S. and Japan account for almost 40% of total observations, there is a possibility that the results we documented might be significantly biased. To alleviate this concern, we use two approaches: (1) weighted-OLS regression to adjust the weights of observations in each country; (2) removing the observations in U.S. and Japan. According to the Model (3) in Table 5 and Panel B in Table 6, we find that the robust negative impact of mandatory sustainability reporting on future crash risk.

[Please Insert Table 5 and Table 6 about Here]

Further, we use the down-to-up volatility ($DUVOL_t$) and the indicator of actual crashes ($CRASH_t$) as alternative crash risk measures to run the regressions similar

to equation (4) and report results in Panel A of Table 6. Since the distribution of actual crash indicator is truncated, we conduct Probit regressions for $CRASH_t$. We find significant and negative coefficients for the indicator of mandatory sustainability reporting, which adds more credence to the negative relationship between the commencement of mandatory ESG disclosure and future stock price crash risk.

In our baseline regression model, we use one-year forward stock price crash risk measures to proxy for future crash risk. As the regulations of mandatory ESG disclosure are not temporary policies, the commencement of these policies on stock price crash risk is highly likely to generate a long-run impact on stock price crash risk. To examine this conjecture and further check the robustness of our results, we use the average of stock price crash risk measures in the two-, three-, four- and five-year forward windows to proxy for future stock price crash risk, respectively. According to the regression results in Table 7, we find significantly negative coefficients for the indicator of mandatory ESG disclosure in all scenarios using all crash risk measures, respectively. This evidence provides further support for our baseline results and indicates a consistently long-run negative influence of mandatory sustainability disclosure on future stock price crash risk.

[Please Insert Table 7 about Here]

Additionally, the specific information that is required to disclose after the mandatory ESG disclosure regulation directly affect the transparency of sustainability information. The regulations that mandate firms to disclose more sustainable information is expected to increase the information transparency further in contrast to the regulations that require less disclosure. In most of countries, the regulators provide guidance or offer training to assist firms to prepare sustainability reporting. The items listed in the guidance for mandatory disclosure are different across jurisdictions. Meanwhile, the firms to certain extent have flexibility to voluntarily disclose ESG information according to their willingness. For instance, firms that use ESG disclosure to distinguish themselves from peers will choose to disclose more information on the base of guidance after

the implementation of mandatory ESG disclosure. Therefore, the comparison of mandatory disclosure guidance item by item cannot reflect the real impact on the disclosure level after the commencement of mandatory disclosure policy. We use the country-level average ESG score provided by Sustainalytic to represent the materiality of disclosure in a country. Implicitly, we assume that the firms with high ESG score disclose more materialized information in sustainability reports, which suggests a better transparency of ESG information. Specifically, we use the means of ESG scores of all firms in a country-year after the commencement of mandatory ESG reporting to conduct regressions. As reported in Panel A in Table 8, we find significantly negative coefficients for the country-level scores of the materiality of ESG disclosure. It suggests that the negative impact of mandatory ESG reporting on future stock price crash risk is enhanced by better materiality of disclosure. Further, we break down the total ESG performance into three components: environmental, social and governance. We use the country-level scores of each component to examine the impact of each dimension on future stock price crash risk, respectively. According to the results in Panel B, C and D in Table 8, we find significantly negative impact of all component on future stock price crash, indicating the contribution of environmental, social and governance dimensions on alleviating the likelihood of experiencing stock price crashes in the future.

[Please Insert Table 8 about Here]

To evaluate the economic significance of the inception of mandatory ESG reporting on stock price crash risk, we estimate the marginally expected decrease in the probability of the occurrence of actual crashes as a function of the implementation of mandatory ESG disclosure, with all the other variables at their sample mean. Numerically, the marginal effects for the indicator of actual crashes ($CRASH_t$) in the following year is about -0.118. As the unconditional likelihood of the occurrence of actual crashes is about 0.1325, the implementation of mandatory sustainability reporting reduces approximately 90% of the likelihood of

experiencing actual crashes in the following year⁷. Additionally, the marginal effects for one-year forward $NCSKEW_t$ and $DUVOL_t$ are -0.104 and -0.074, as reported in the unrestricted models in Tables 5 and 6, respectively. In contrast to the means of the unconditional $NCSKEW_t$ and $DUVOL_t$ in full sample, which are about -0.093 and -0.053, respectively, the marginal effect of mandatory sustainability disclosure on the likelihood of an increase in the stock price crash risk is economically significant.

The coefficients for the control variables are generally consistent with our expectation elaborated in section 4.1 as well as the evidence in closely related studies. Specifically, we find significantly positive coefficients for $DTURN_{t-1}$, $SIZE_{t-1}$ and MB_{t-1} , consistent with prior research (e.g., Chen et al. 2001; Hutton et al. 2009; Kim et al. 2011a, 2011b). We find negative coefficients for RET_{t-1} and $SIGMA_{t-1}$, which indicates that the positive relationship between past return (volatility) and future stock price crash risk does not hold in some countries other than U.S.⁸. We also find positive coefficients for $CLOSE_{t-1}$, which is consistent with our expectation and suggests that insider ownership could mitigate future stock price crash risk. Consistent with Hutton et al. (2009), we find a positive coefficient for the opacity of financial reports, measured by $DISACC_{t-1}$, suggesting that firms with high financial report opacity experience a severe stock price crash risk. Moreover, regarding the variables describing country characteristics, we find that creditors' rights and the strictness of rule of law negatively related to firm-specific future crash risk. The equity index volatility is positively related to the likelihood of experiencing actual stock price crashes in the future.

To summarize, we find a significantly negative relationship between the implementation of mandatory ESG reporting and firm-specific stock price crash risk in the future after controlling for the opacity of financial reports (Hutton et al. 2009), investor heterogeneity (Chen et al. 2001), auditor quality, insider ownership, international diversification of revenue, equity index performance,

⁷ The percentage change of the likelihood of experiencing actual stock price crashes in the following year equals to $-0.118 / 0.1325 = 89\%$.

⁸ We find the significantly positive coefficients for RET_{t-1} and $SIGMA_{t-1}$ if we only use the observations in U.S., which is consistent with previous studies that use U.S. data only.

creditors' rights and other known determinants of crash risk. These results are robust to the use of two alternative proxies for stock price crash and to the restricted models that remove fixed effects and firm-specific characteristics.

4.3 Endogeneity analysis

We document that the commencement of mandatory ESG reporting significantly reduces firm-specific price crash risk in the future in previous sections. Such negative relationship might be jeopardized by potential endogeneity issues. In general, there are two main type of endogeneity issues: reverse causality and simultaneity. First, the reverse causality indicates that the expected stock price crash risk in the future might be able to affect the likelihood of implementing mandatory ESG reporting. The policies of mandatory ESG disclosure issued by governments or stock exchanges are mostly driven by the increasing demands for responsible investing and the transparency of non-financial information. So far it is unclear how responsible investing and non-financial information transparency affects firm-specific stock price crash risk in the future directly, the decision of adopting mandatory sustainability reporting is less likely to be affected by stock price crash risk. Thus, the reverse causality is not a serious endogeneity issue in this work. Second, the simultaneity suggests that the relationship between the implementation of mandatory sustainability reporting regulation and stock price crash risk might be caused by the possibly omitted variables that drives both the likelihood of adopting mandatory disclosure policy and future stock price crash risk. In this section, we use and propensity score matching approach and placebo tests to address the potential endogeneity concerns and examine the robustness of our baseline results.

4.3.1 Propensity Score Matching

The propensity score matching (PSM) approach accounts for the covariates that predict the likelihood of receiving the treatment. We use PSM to control for the possibility that an increase of the likelihood of implementing mandatory ESG reporting is caused by expected future stock price crash risk. We divided the firms into two subsamples, mandated-disclosed group and no-mandated-disclosed

group, according to availability of mandatory ESG reporting. The firms in the mandated-disclosed group are treatment group. We match the treatment and control groups based on firm size, industry and propensity score for implementing mandatory ESG disclosure in the year when mandatory ESG reporting is enforced for treated firms.

We compute the propensity score for implementation of mandatory ESG reporting in year t using the following multivariate regression:

$$ESG_D_t = \alpha_0 + \sum_{i=1}^m \gamma_i (i^{th} \text{Determinants}_{t-1}) + \varepsilon_t. \quad (5)$$

where ESG_D_t is an indicator that equals one after the commencement of mandatory sustainability disclosure in year t and zero otherwise. The determinants include country-level characteristics, such as rule of law (RL), control of corruption (CC), government effectiveness (GE), political stability (PS), regulatory quality (RQ), voice of accountability (VA), the level of disclosure ($IDIS$), creditors' right (CR), GDP growth rate ($GDPG$), local equity index return ($IRET$) and volatility ($IVOL$). Table 9 reports the results of Probit regression for the propensity score of implementing mandatory ESG disclosure. We find that the countries with strict rule of law and better regulatory quality are more likely to issue the regulation of mandatory ESG disclosure.

Using this matching procedure, we construct a control group that is similar to the treatment group in terms of firm size, industry and the propensity of implementing mandatory ESG disclosure, but mandatory disclosure requirement only occurs in treatment group. Thus, the change in stock price crash risk in the control group is equivalent to the change in crash risk that would have occurred during the event window had the treatment group not received the treatment. Therefore, the difference between the change in the stock price crash risk in following year for the treatment group and that for the control group reflects the causal effect of CDS trading on stock price crash risk. Figure 4 depicts the difference of crash risk measure between treatment and control groups around the event date. After the enforcement of mandatory ESG reporting, we observe a

decrease in the average stock price crash risk measures. The stock price crash risk measures continues to decline in the following year, which consistent with the negative relationship between the enforcement of mandatory disclosure regulation and stock price crash risk in the future.

Next, we use a multivariate regression model to rigorously examine the relationship between stock price crash risk and the commencement of mandatory ESG disclosure. In this regression model, $Treated_{t-1}$ is an indicator for treatment group; $AFTER_{t-1}$ is an indicator for the enforcement of mandatory ESG disclosure regulation. The regression results are reported in Table 10. We find a significantly negative coefficient for the interaction term of $AFTER_{t-1}$ and $Treated_{t-1}$, suggesting that the implementation of mandatory disclosure decreases future stock price crash risk in treatment group in contrast to that in control group, which further supports our conjecture in hypothesis 1. We perform a similar difference-in-difference analysis using the alternative stock price crash risk measures and find consistent results.⁹

4.3.2 Placebo tests

We use placebo tests to address the simultaneity concern that the negative relationship between the enforcement of mandatory ESG disclosure and stock price crash risk measures is driven by possibly omitted unobserved factors but in opposite directions. We incorrectly assign the timing of the treatment (the enforcement of mandatory sustainability disclosure) to two or three years before the actual event. If the negative relationship between mandatory disclosure and stock price crash risk is driven by a predetermined trend or unobserved variables, we would expect to observe a similar effect when using the wrong date for CDS trading. On the other hand, if the decrease of stock price crash risk is driven by the implementation of mandatory ESG disclosure only, the negative relationship we documented in Table 5 should disappear when we use wrong dates. The Model (2) and Model (3) in Table 10 report the regression results when we use two or three years before the actual date of implementation, respectively. We find that the

⁹ The detailed results are reported in Table III and Table IV on the Internet Appendix.

coefficients for the interaction term are both negative but not significant at the conventional level. This evidence alleviates potential simultaneity concern and lends credence to the negative influence of mandatory ESG disclosure on future firm-specific stock price crash risk. Additionally, we also use *DUVOL* as an alternative measure of stock price crash risk to check the robustness and find consistent results¹⁰.

5. Mechanism

Previous sections demonstrate that the implementation of mandatory ESG disclosure significantly reduce firm-specific stock price crash risk in the future. In this section, we investigate the possible mechanism through which the mandated ESG disclosure affects stock price crash. Specifically, we will examine both financial information transparency and non-financial information transparency channels.

5.1 The opaqueness of non-financial information

The non-financial information refers to the information that falls outside the scope of mainstream financial statement, such as social accounting, corporate social responsibility, environmental reporting, governance and etc.. The enforcement of sustainability reporting mandates firms to reveal materialized environmental, social and governance information to public, which consequently reduces the opaqueness of non-financial information. To comply with the minimum disclosure requirement, the firms who have not release sustainability information before have to reveal a significant amount of non-financial information suddenly, which results in a more prominent change of non-financial information transparency. Alternatively, if a firm choose to hide the sustainability information under the “comply or explain” clause, they have to provide detailed explanation. Although the explanation is not a direct disclosure of sustainable

¹⁰ The regression results using *DUVOL* as stock price crash risk measures are reported in Table IV on the internet appendix.

information, investors still able to capture the status of sustainability of a firm to certain extent according to the explanation. In a nut shell, if the transparency of non-financial information is a channel through which mandatory ESG disclosure affects future stock price crash risk, we expect that the negative impact of the implementation of mandatory ESG disclosure should be mitigated by the non-financial information transparency.

[Please Insert Table 11 about Here]

We use the availability of ESG score in Sustainalytic dataset to proxy for the transparency of non-financial information. Specifically, we use ESG_S_t as an indicator that equals to one if a firm has ESG score in year t and zero otherwise. Table 11 reports the regression results for all crash risk measures. Consistent with our baseline results, the coefficients for the indicator of mandatory ESG disclosure (ESG_D_{t-1}) is negative and significant at the conventional level. Most importantly, we find a positive and significant coefficient for the interaction term of mandatory disclosure indicator (ESG_D_{t-1}) and ESG-score indicator (ESG_S_{t-1}) when we use $NCSKEW_t$ and $DUVOL_t$ to proxy for the likelihood of the occurrence of stock price crashes. It suggests that the negative impact of mandatory sustainable disclosure on stock price crash risk is more pronounced in the firms with high opaqueness of non-financial disclosure, which support the conjecture that the enforcement of mandatory sustainability disclosure alleviates future stock price crash risk through increasing the non-financial information transparency.

5.2 The opaqueness of accounting information

Previous literature shows that the opaqueness of accounting information is one of the key determinants of future stock price crash risk (e.g. Jin and Myers 2006; Hutton et al. 2009; Kim et al. 2011a; 2011b; etc.). Since socially responsible firms exhibit less evidence of earning management (Kim et al. 2012) and provide more financial disclosure (Gelb and Strawser 2011), the corporate social responsibility performance of a firm is expected to mitigate future crash risk (Kim et al. 2014). According to this argument, the impact of mandatory ESG disclosure on future stock price crash risk should be alleviated by the transparency of accounting

reports because the marginal effect of implementing mandatory disclosure policy on improving financial disclosure is weak for the firms with low opaqueness of accounting information.

[Please Insert Table 12 about Here]

To examine this conjecture, we use two measures to reflect the opaqueness of accounting reports: (1) the absolute value of discretionary accruals (*DISACC*) and (2) the quality of auditors. Specifically, first, we divide the whole sample into two groups according to the median of the absolute value of discretionary accruals. We use *ESG_AC_{t-1}* as an indicator to reflect the relative opaqueness of accounting reports. *ESG_AC_{t-1}* equals to one for the observations with high *DISACC* and zero otherwise. Table 12 reports the regression results using crash risk measures. We find that the interaction term of mandated disclosure indicator (*ESG_D_{t-1}*) and accounting opacity indicator (*ESG_AC_{t-1}*) is not significant at the conventional level. This result suggests that the opacity of accounting information does not affect the negative relationship between mandatory sustainability disclosure and future stock price crash risk.

[Please Insert Table 13 about Here]

Second, we use the quality of auditor as an alternative proxy for the transparency of accounting information. Since auditors oversee the financial reporting and disclosure process, and monitor choice of accounting policies and principles, the quality of auditor is positively related to the transparency of accounting information. We consider the top four accounting firm, including Ernst & Young, KPMG, Price Waterhouse Coopers and Deloitte, as the high-quality auditors in contrast to the rest of accounting firms. We incorporate *ESG_AU_{t-1}* as an indicator for the quality of auditor. *ESG_AU_{t-1}* equals to one if a firm's auditor belongs to the top four accounting firms and zero otherwise. As reported in Table 13, we find that the coefficients for the interaction terms of mandatory ESG disclosure indicator and auditor-quality indicator are not significant for all crash risk measures. It further rejects the channel of improving financial information

transparency through which mandatory sustainability disclosure affects future stock price crash risk.

6. Conclusion

In this study, we demonstrate that the commencement of mandatory ESG disclosure significantly reduces the likelihood of experiencing extremely firm-specific price drop in the future. This finding is robust to controlling for the well documented determinants of stock price crash risk, alternative stock price crash measures and various subsamples. Further, this result is also persistent after using propensity score approach and Placebo tests to alleviate the potential endogeneity concerns.

By conducting difference-in-difference analysis, we find that the negative influence of mandatory ESG disclosure on future stock price crash risk is more pronounced in the firms that have high opaqueness of ESG information. However, the opacity of financial information does not affect such negative relationship. These findings shed light on the importance of the impact of ESG information transparency on stock price crash risk in the future in addition to financial information.

This paper to the best of our knowledge is the first to systematically investigate the impact of mandatory ESG disclosure on stock price crash risk in the future. It uncovers the real impact of non-financial information transparency on the stability of equity market and shed light on the importance of mandatory ESG disclosure on alleviating stock price crash risk in the future.

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Appendix A: Variable Description

Variable Name	Definition	Sources
<u><i>The Equity Ownership of Institutional Investors</i></u>		
<i>NCSKEW</i>	The negative coefficient of skewness is calculated by taking the negative of the third moment of firm-specific weekly returns for each sample year divided by the standard deviation of firm-specific weekly returns raised to the third power. See Equation (2) for details.	
<i>DUVOL</i>	The down-to-up volatility is calculated as the natural logarithm of the standard deviation of weekly-stock returns during the weeks in which they are lower than their annual mean (down weeks) over the standard deviation of weekly-stock returns during the weeks in which they are higher than their annual mean (up weeks).	Worldscope & Author's Calculation
<i>CRASH</i>	The variable is equal to one if a firm experienced one or more crash week(s) in a year, and zero otherwise. A crash week is a week in which a firm-specific weekly return fell 3.2 standard deviations below the mean of the firm-specific weekly returns over a fiscal year. 3.2 standard deviations generate a frequency of 0.1 percent in the normal distribution.	
<u><i>ESG disclosure proxies</i></u>		
<i>ESG_D</i>	This is an indicator that equals to one after the implementation of mandatory ESG disclosure policy in a country and zero otherwise.	
<i>ESG_C</i>	This is an indicator that equals to one in a country that adopted mandatory ESG disclosure during our sample period and zero otherwise.	Author Collected
<i>ESG_S</i>	This is an indicator that equals to one for a firm that has MSCI ESG Score in a year and zero otherwise. It reflects the transparency of ESG information for a firm.	
<u><i>Firm-level control variables</i></u>		
<i>SIZE_{t-1}</i>	The logarithm of total asset value.	Worldscope
<i>ROA_{t-1}</i>	The net income before extraordinary items scaled by the total assets.	Worldscope
<i>MB_{t-1}</i>	The market-to-book ratio.	Worldscope
<i>LEV_{t-1}</i>	The total debt scaled by the total assets.	Worldscope
<i>ISALE_{t-1}</i>	The aggregated foreign sales scaled by the total sales in a firm.	Worldscope
<i>CLOSE</i>	The number of shares held by insiders as a proportion of the number of shares outstanding.	Worldscope

<i>DISACC</i>	The absolute value of discretionary accruals (DISACC) in the previous three fiscal years.	Worldscope
<i>DTURN</i>	The change of average monthly turnover ratio in a year.	Datastream
<i>SIGMA</i>	The volatility of firm-specific weekly return for a firm in a year.	Datastream
<i>RET</i>	The mean of firm-specific weekly return for a firm in a year.	Datastream
<i>ADR</i>	This is an indicator that equals to one when a firm has ADR and zero otherwise.	Worldscope
<i>AUDI</i>	This is an indicator that equals to one when a firm's auditor belong to the top four accounting firm (Ernst & Young, KPMG, Price Waterhouse Coopers and Deloitte).	Worldscope
<hr/> <i>Country-level control variables</i> <hr/>		
<i>IVOL</i>	The volatility of monthly return of equity market index in a country.	Datastream
<i>IRET</i>	The annual return of equity market index in a country.	
<i>IDIS</i>	The country-level disclosure index.	World Bank
<i>D_LO</i>	The indicator that equals to one for the common-law countries and zero otherwise.	La Porta, Lopez-de-Silance, Shleifer and Vishny (1998)
<i>D_CR</i>	The indicator that equals to one for the countries whose creditor right score is above the median of all the countries and zero otherwise. High score of creditor right indicates better creditor protection.	Doing Business Report
<i>D_SR</i>	The indicator that equals to one for the countries whose minority shareholder right score is above the median of all the countries and zero otherwise. High score of shareholder right indicates better protection of minority shareholders.	Doing Business Report
<i>D_RL</i>	The indicator that equals to one for the countries whose score of rule of law is above the median of all the countries and zero otherwise. High score of rule of law indicates better quality of contract enforcement, property rights, the police and the courts.	World Bank
<i>D_RQ</i>	The indicator that equals to one for the countries whose score of regulatory quality is above the median of all the countries and zero otherwise. High score of regulatory quality is associated with stronger ability of	World Bank

<i>D_CC</i>	the government to formulate and implement sound policies and regulations. The indicator that equals to one for the countries whose score of corruption control is above the median of all the countries and zero otherwise. High score of corruption control is associated with better control of corruption.	World Bank
<i>D_IDV</i>	The indicator that equals to one for the countries whose score of individualism is above the median and zero otherwise. High score is associate with high individualism.	Geert Hofstede's website
<i>D_LTO</i>	The indicator that equals to one for the countries whose score of indulgence is above the median of all the countries and zero otherwise. High score is associated with better long-term orientation.	Geert Hofstede's website
<i>D_IVR</i>	The indicator that equals to one for the countries whose score of indulgence is above the median of all the countries and zero otherwise. High score is associated with high indulgence.	Geert Hofstede's website
<i>RL_{t-1}</i>	The index of rule of law in a country	World Governance Indicator
<i>SR_{t-1}</i>	The extent of shareholder rights index from Doing Business Report	World bank
<i>GDP_{t-1}</i>	The growth rate of GDP in a country.	World Bank

Table 1: The distribution of observations by country

This table reports the distribution of observations by country in our sample. The last column reports the year in which the mandatory ESG disclosure policy was commenced. * indicates that mandatory disclosure only applies to partial of listed firms. The detailed information of mandatory ESG disclosure is in Table I on internet appendix.

Country	No. of Obs	No. of Obs/Total Obs	Year of Mandatory Environmental Disclosure	Year of Social Mandatory Disclosure
ARGENTINA	498	0.26	2008	2008
AUSTRALIA	7,074	3.65	2003	2003
AUSTRIA	579	0.3		
BELGIUM	816	0.42		
BRAZIL	1,096	0.57	2012	2012
CANADA	7,082	3.66		
CHILE	1,001	0.52		
CHINA	11,362	5.87	2008	
DENMARK	1,189	0.61	2001	2009
EGYPT	512	0.26		
FINLAND	1,239	0.64		
FRANCE	4,971	2.57	2002	2002
GERMANY	4,836	2.5		
GREECE	1,265	0.65	2006	2006
HONGKONG	1,691	0.87	2016	2016
INDIA	9,396	4.85	2013*	2013*
INDONESIA	2,405	1.24	2010	2010
IRELAND	430	0.22		
ISRAEL	1,789	0.92		
ITALY	1,654	0.85	2007	2007
JAPAN	35565	18	2005*	
KUWAIT	700	0.36		
MALAYSIA	7,864	4.06	2007	2007
MEXICO	733	0.38	2013	
NETHERLANDS	1,337	0.69	1999	2015
NORWAY	999	0.52	2013	2013
NEW ZEALAND	732	56.17		
PAKISTAN	976	0.5	2009	2009
PERU	375	0.19		
PHILIPPINES	1,503	0.78		
POLAND	1,711	0.88		
PORTUGAL	360	0.19		

RUSSIAN	492	58.97	2011	
SAUDI ARABIA	415	59.18		
SINGAPORE	4,179	2.16	2016	2016
SOUTH AFRICA	2,255	62.51	2010	2010
SPAIN	593	0.31	2012	2012
SRI LANKA	688	63.17		
SWEDEN	2,374	1.23	2012	2009
SWITZERLAND	2,147	1.11		
TAIWAN of CHINA	11,904	6.15	2008	2008
THAILAND	3,777	1.95		
TURKEY	1,264	0.65		
UNITED KINGDOM	9,347	79.07	2006	2006
UNITED STATES	39,530	99.48	2002	2002
VIETNAM	1,009	0.52		
Total	193,714	100		

Table 2: Year distribution of stock price crash risk

This table reports the means of stock price crash risk measures in each year during our sample periods. The definitions of *NCSKEW*, *DUVOL* and *CRASH* are reported in Appendix A.

Year	No. of Obs	No. of Obs / Total Obs	<i>NCSKEW</i>	<i>DUVOL</i>	<i>CRASH</i>
2001	4,977	2.57	0.0363	0.0350	16.85%
2002	5,691	2.94	-0.0202	0.0019	15.09%
2003	6,316	3.26	-0.1248	-0.0881	12.42%
2004	9,634	4.97	-0.1596	-0.1207	13.01%
2005	10,612	5.48	-0.1593	-0.1099	13.22%
2006	11,392	5.88	-0.1788	-0.1266	12.84%
2007	12,024	6.21	-0.0989	-0.0651	14.55%
2008	12,684	6.55	0.1678	0.1642	18.79%
2009	13,176	6.8	-0.0786	-0.0346	11.81%
2010	13,993	7.22	-0.1975	-0.1383	10.65%
2011	15,564	8.03	-0.0492	0.0006	13.66%
2012	16,006	8.26	-0.0871	-0.0464	13.33%
2013	16,184	8.35	-0.1360	-0.0824	13.47%
2014	15,931	8.22	-0.1216	-0.0685	13.71%
2015	15,211	7.85	-0.1094	-0.0648	13.73%
2016	14,319	7.39	-0.1198	-0.0690	13.65%
Total	193,714	100			

Figure 1: The ESG Disclosure Scores After the Mandatory ESG Disclosure

This figure depicts the means of the firm-level scores of total ESG disclosure and each component of ESG (Environmental, Social and Governance) in each country after the mandatory ESG disclosure policy. The ESG disclosure scores are extracted from Sustainalytic dataset.

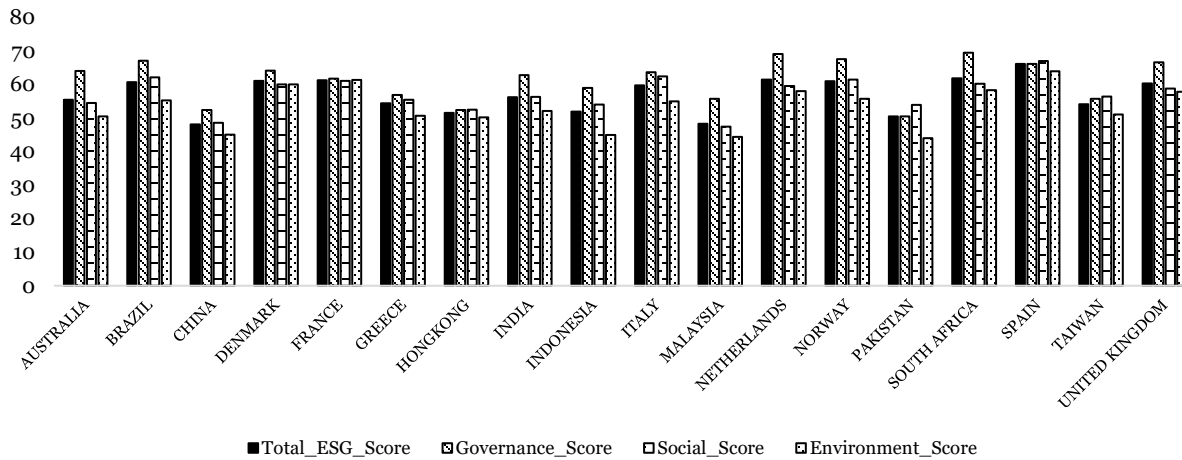


Figure 2: The Evolution of Total ESG Score after Mandatory ESG Disclosure

This figure depicts the means of the scores of total ESG disclosure after the mandatory ESG disclosure in a country-year. The ESG disclosure scores are extracted from Sustainalytic dataset.

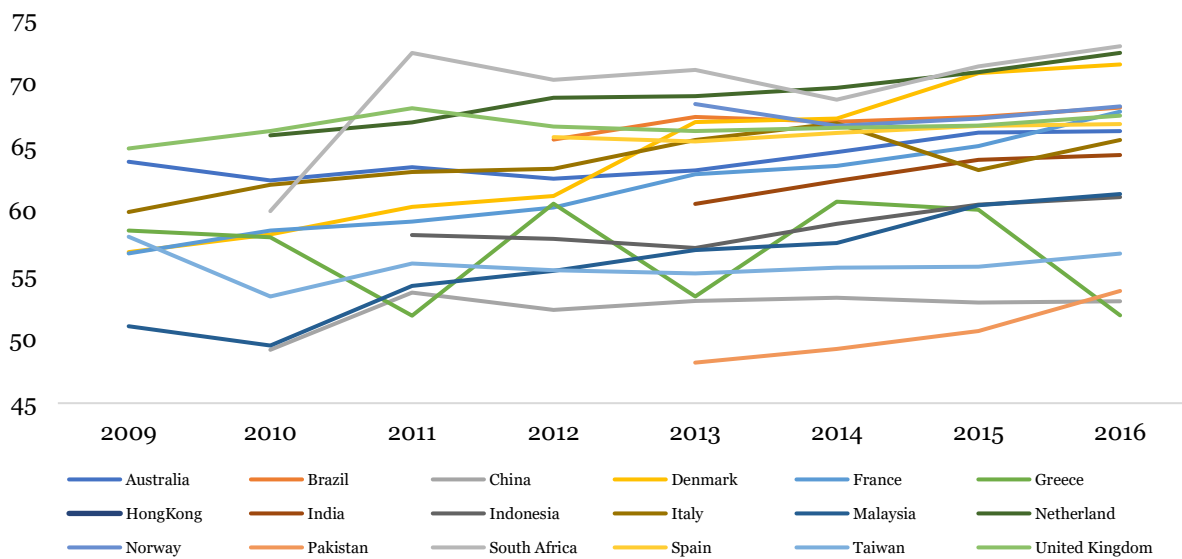


Table 3: Descriptive statistics of crash risk measures

This table reports the summary statistics of crash risk for different subsamples. We use *NCSKEW*, *DUVOL* and *CRASH* to reflect firm specific crash risk in a year. The definition of *NCSKEW*, *DUVOL* and *CRASH* are in appendix. Panel A, Panel B and Panel C report the summary statistics of crash risk measures for all observations, the observations in ESG-disclosed countries and the observations in ESG-disclosed countries after the adoption of mandatory ESG disclosure, respectively.

<i>Variable</i>	<i>N</i>	<i>MEAN</i>	<i>STD</i>	<i>P5</i>	<i>P50</i>	<i>P95</i>
<i>Panel A: All Observations</i>						
<i>NCSKEW</i>	193714	-0.0934	0.7428	-1.3445	-0.0792	1.0960
<i>DUVOL</i>	193714	-0.0531	0.5093	-0.8982	-0.0541	0.7915
<i>CRASH</i>	193714	0.1325	0.3391	0.0000	0.0000	1.0000
<i>Panel B: ESG Disclosed Countries</i>						
<i>NCSKEW</i>	77378	-0.1398	0.7465	-1.4101	-0.1198	1.0390
<i>DUVOL</i>	77378	-0.0841	0.5199	-0.9516	-0.0850	0.7788
<i>CRASH</i>	77378	0.1223	0.3277	0.0000	0.0000	1.0000
<i>Panel C: ESG Disclosed Countries After Mandatory Disclosure</i>						
<i>NCSKEW</i>	48439	-0.1342	0.7444	-1.4036	-0.1097	1.0330
<i>DUVOL</i>	48439	-0.0764	0.5189	-0.9483	-0.0744	0.7797
<i>CRASH</i>	48439	0.1229	0.3284	0.0000	0.0000	1.0000

Table 4: Descriptive Statistics of Control Variables

This table reports the summary statistics of control variables for all observations. The definitions of these control variables are reported in appendix.

<i>Variable</i>	<i>N</i>	<i>MEAN</i>	<i>STD</i>	<i>P5</i>	<i>P50</i>	<i>P95</i>
<i>ESG_D</i> _{<i>t-1</i>}	193714	0.2402	0.4272	0.0000	0.0000	1.0000
<i>ESG_C</i> _{<i>t-1</i>}	193714	0.3923	0.4883	0.0000	0.0000	1.0000
<i>DTURN</i> _{<i>t-1</i>}	193714	0.0005	0.0700	-0.0981	-0.0001	0.1021
<i>RET</i> _{<i>t-1</i>}	193714	-0.0016	0.0019	-0.0053	-0.0009	-0.0002
<i>SIGMA</i> _{<i>t-1</i>}	193714	0.0502	0.0265	0.0200	0.0438	0.1032
<i>SIZE</i> _{<i>t-1</i>}	193714	19.6883	1.9436	16.6549	19.5702	23.2053
<i>ROA</i> _{<i>t-1</i>}	193714	0.0354	0.0871	-0.1122	0.0396	0.1547
<i>LEV</i> _{<i>t-1</i>}	193714	0.2098	0.1767	0.0000	0.1852	0.5398
<i>MB</i> _{<i>t-1</i>}	193714	1.8552	1.7803	0.3848	1.3019	5.2228
<i>DISACC</i> _{<i>t-1</i>}	193714	0.0557	0.0677	0.0017	0.0336	0.1829
<i>AUDI</i> _{<i>t-1</i>}	193714	0.6466	0.4780	0.0000	1.0000	1.0000
<i>ADR</i> _{<i>t-1</i>}	193714	0.0457	0.2088	0.0000	0.0000	0.0000
<i>CLOSE</i> _{<i>t-1</i>}	193714	32.0256	28.2258	0.0000	28.4071	81.0774
<i>ISALE</i> _{<i>t-1</i>}	193714	36.6547	6775.1230	0.0000	0.0000	86.3538
<i>IRET</i> _{<i>t-1</i>}	193714	0.0659	0.2557	-0.3636	0.0731	0.5038
<i>IVOL</i> _{<i>t-1</i>}	193714	0.1790	0.0831	0.0739	0.1639	0.3494
<i>CR</i> _{<i>t-1</i>}	193714	6.6585	2.9007	2.0000	6.0000	11.0000
<i>RL</i> _{<i>t-1</i>}	193714	1.0873	0.7695	-0.4648	1.4268	1.8582
<i>GDPG</i> _{<i>t-1</i>}	193714	0.0320	0.0334	-0.0253	0.0257	0.0911

Table 5: Mandatory Sustainability Disclosure and Stock Price Crash Risk

This table reports the multivariate regressions results of the influence of the commence of mandatory ESG disclosure on firm stock price crash risk in the future. The dependent variables are *NCSKEW* in all models. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. *ESG_D* is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	OLS Model (1) <i>NCSKEW_t</i>	OLS Model (2) <i>NCSKEW_t</i>	Weighted OLS Model (3) <i>NCSKEW_t</i>	OLS Model (4) <i>NCSKEW_t</i>
<i>ESG_D_{t-1}</i>	-0.097*** (0.008)	-0.104*** (0.008)	-0.104*** (0.008)	-0.119*** (0.010)
<i>ESG_C_{t-1}</i>	0.197*** (0.041)	0.526*** (0.111)	0.096** (0.047)	
<i>NCSKEW_{t-1}</i>	0.062*** (0.003)	0.059*** (0.003)	0.059*** (0.002)	-0.087*** (0.003)
<i>DTURN_{t-1}</i>		0.137*** (0.023)	0.133*** (0.025)	0.071*** (0.024)
<i>RET_{t-1}</i>		-15.872*** (3.178)	-15.540*** (2.931)	-7.519** (3.798)
<i>SIGMA_{t-1}</i>		-1.207*** (0.248)	-1.141*** (0.227)	-1.170*** (0.307)
<i>SIZE_{t-1}</i>		0.030*** (0.001)	0.030*** (0.001)	0.127*** (0.006)
<i>ROA_{t-1}</i>		0.350*** (0.023)	0.359*** (0.021)	0.346*** (0.032)
<i>LEV_{t-1}</i>		-0.074*** (0.011)	-0.074*** (0.010)	-0.237*** (0.025)
<i>MB_{t-1}</i>		0.020*** (0.001)	0.020*** (0.001)	0.044*** (0.002)
<i>DISACC_{t-1}</i>		0.082*** (0.028)	0.084*** (0.028)	0.110*** (0.035)
<i>AUDI_{t-1}</i>		-0.003 (0.005)	-0.003 (0.004)	
<i>ADR_{t-1}</i>		0.007 (0.008)	0.006 (0.009)	
<i>CLOSE_{t-1}</i>		-0.001*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)
<i>ISALE_{t-1}</i>		0.000 (0.000)	0.000 (0.000)	0.000** (0.000)
<i>IRET_{t-1}</i>		-0.368*** (0.034)	-0.381*** (0.034)	-0.217*** (0.037)

<i>IVOL</i> _{<i>t</i>-1}		0.067*** (0.008)	0.073*** (0.009)	0.031*** (0.008)
<i>CR</i> _{<i>t</i>-1}		-0.044* (0.023)	0.044*** (0.010)	-0.035 (0.024)
<i>RL</i> _{<i>t</i>-1}		-0.106*** (0.021)	-0.102*** (0.021)	-0.072*** (0.025)
<i>GDPG</i> _{<i>t</i>-1}		-0.207* (0.113)	-0.052 (0.113)	-0.186 (0.121)
<i>Year Fixed Effect</i>	YES	YES	YES	YES
<i>Industry Fixed Effect</i>	YES	YES	YES	NO
<i>Country Fixed Effect</i>	YES	YES	YES	NO
<i>Firm Fixed Effect</i>	NO	NO	NO	YES
<i>Clustered by Firm</i>	YES	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714	193,714
<i>Adjusted R²</i>	0.03	0.05	0.05	0.04

Table 6: Mandatory ESG Disclosure and Stock Price Crash Risk: Alternative Crash Risk Measures

This table reports the multivariate regressions results of the influence of the commencement of mandatory ESG disclosure on firm stock price crash risk in the future. Panel A reports the regression results using DUVOL and CRASH as alternative crash risk measures. Panel B reports the regression results after removing the observations in United States and Japan. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. *ESG_D* is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	Panel A: Alternative Stock Price Crash Risk Measures		Panel B: Robustness without Observations in U.S. & Japan		
	OLS Model (1) <i>DUVOL_t</i>	Probit Model (2) <i>CRASH_t</i>	OLS Model (3) <i>NCSKEW_t</i>	OLS Model (4) <i>DUVOL_t</i>	Probit Model (5) <i>CRASH_t</i>
<i>ESG_D_{t-1}</i>	-0.074*** (0.006)	-0.118*** (0.017)	-0.095*** (0.009)	-0.066*** (0.006)	-0.102*** (0.020)
<i>ESG_C_{t-1}</i>	0.340*** (0.074)	0.267 (0.233)	0.498*** (0.113)	0.305*** (0.075)	0.342 (0.239)
<i>NCSKEW_{t-1}</i>	0.040*** (0.002)	0.063*** (0.005)	0.060*** (0.003)	0.042*** (0.002)	0.070*** (0.007)
<i>DTURN_{t-1}</i>	0.080*** (0.016)	0.259*** (0.055)	0.128*** (0.029)	0.063*** (0.020)	0.293*** (0.069)
<i>RET_{t-1}</i>	-12.866*** (2.160)	-54.078*** (6.520)	-20.552*** (4.036)	-15.873*** (2.775)	-81.176*** (8.226)
<i>SIGMA_{t-1}</i>	-0.800*** (0.168)	-5.714*** (0.522)	-1.379*** (0.321)	-0.871*** (0.220)	-7.887*** (0.673)
<i>SIZE_{t-1}</i>	0.017*** (0.001)	-0.047*** (0.003)	0.032*** (0.002)	0.019*** (0.001)	-0.052*** (0.004)
<i>ROA_{t-1}</i>	0.146*** (0.016)	0.348*** (0.048)	0.340*** (0.029)	0.120*** (0.020)	0.265*** (0.061)
<i>LEV_{t-1}</i>	-0.036*** (0.008)	0.049** (0.025)	-0.068*** (0.015)	-0.031*** (0.010)	0.037 (0.032)
<i>MB_{t-1}</i>	0.014*** (0.001)	0.005** (0.002)	0.022*** (0.001)	0.016*** (0.001)	0.007** (0.003)
<i>DISACC_{t-1}</i>	0.014 (0.019)	0.155*** (0.060)	0.066** (0.034)	0.013 (0.023)	0.072 (0.072)
<i>AUDI_{t-1}</i>	-0.008** (0.003)	0.015 (0.010)	-0.019*** (0.006)	-0.020*** (0.004)	-0.011 (0.013)
<i>ADR_{t-1}</i>	0.013** (0.006)	-0.073*** (0.021)	0.009 (0.009)	0.017** (0.007)	-0.057** (0.023)
<i>CLOSE_{t-1}</i>	-0.000*** (0.000)	0.000 (0.000)	-0.001*** (0.000)	-0.000*** (0.000)	0.001*** (0.000)

<i>ISALE</i> _{<i>t</i>-1}	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
<i>IRET</i> _{<i>t</i>-1}	-0.342*** (0.024)	-0.180** (0.077)	-0.213*** (0.041)	-0.228*** (0.028)	-0.157* (0.092)
<i>IVOL</i> _{<i>t</i>-1}	0.061*** (0.006)	0.123*** (0.019)	0.027** (0.011)	0.035*** (0.007)	0.088*** (0.024)
<i>CR</i> _{<i>t</i>-1}	-0.031** (0.014)	-0.013 (0.045)	-0.046** (0.023)	-0.031** (0.014)	-0.005 (0.045)
<i>RL</i> _{<i>t</i>-1}	-0.068*** (0.015)	0.077* (0.047)	-0.079*** (0.024)	-0.044*** (0.017)	0.036 (0.054)
<i>GDPG</i> _{<i>t</i>-1}	-0.192** (0.080)	-0.971*** (0.262)	-0.148 (0.124)	-0.206** (0.087)	-1.269*** (0.286)
<i>Year Fixed Effect</i>	YES	YES	YES	YES	YES
<i>Industry Fixed Effect</i>	YES	YES	YES	YES	YES
<i>Country Fixed Effect</i>	YES	YES	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	118,619	118,619	118,619
<i>Adjusted R²/Pseudo R²</i>	0.05	0.02	0.05	0.06	0.02

Table 7: Mandatory ESG Disclosure and Stock Price Crash Risk: Long Term Impacts

This table reports the multivariate regressions results of the influence of the commencement of mandatory ESG disclosure on firm stock price crash risk in the future. The dependent variables are *NCSKEW*, *DUVOL* and *CRASH* in Panel A, B and C, respectively. $NCSKEW_{t+i}$ is the mean of *NCSKEW* during a period from t to $t+i$ years. The same rule applies for $DUVOL_{t+i}$ and $CRASH_{t+i}$. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. *ESG_D* is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Panel A: NCSKEW				
<i>Variables</i>	OLS Model (1) $NCSKEW_{t+1}$	OLS Model (2) $NCSKEW_{t+2}$	OLS Model (3) $NCSKEW_{t+3}$	OLS Model (4) $NCSKEW_{t+4}$
<i>ESG_D</i> _{$t-1$}	-0.070*** (0.008)	-0.058*** (0.008)	-0.065*** (0.007)	-0.062*** (0.007)
<i>ESG_C</i> _{$t-1$}	0.086 (0.313)	-0.069 (0.058)	-0.154** (0.065)	-0.234*** (0.070)
<i>Other Controls</i>	YES	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES	YES
<i>No. of Obs</i>	160,166	132,407	109,074	89,342
<i>Adjusted R²</i>	0.07	0.09	0.11	0.12
Panel B: DUVOL				
<i>Variables</i>	OLS Model (5) $DUVOL_{t+1}$	OLS Model (6) $DUVOL_{t+2}$	OLS Model (7) $DUVOL_{t+3}$	OLS Model (8) $DUVOL_{t+4}$
<i>ESG_D</i> _{$t-1$}	-0.045*** (0.005)	-0.036*** (0.005)	-0.043*** (0.005)	-0.042*** (0.005)
<i>ESG_C</i> _{$t-1$}	0.161 (0.202)	-0.028 (0.040)	-0.097** (0.046)	-0.171*** (0.049)
<i>Other Controls</i>	YES	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES	YES
<i>No. of Obs</i>	160,166	132,407	109,074	89,342
<i>Adjusted R²</i>	0.08	0.09	0.11	0.13
Panel C: CRASH				
<i>Variables</i>	Probit Model (9) $CRASH_{t+1}$	Probit Model (10) $CRASH_{t+2}$	Probit Model (11) $CRASH_{t+3}$	Probit Model (12) $CRASH_{t+4}$
<i>ESG_D</i> _{$t-1$}	-0.158*** (0.035)	-0.152*** (0.038)	-0.180*** (0.041)	-0.172*** (0.044)
<i>ESG_C</i> _{$t-1$}	-0.241 (1.449)	-0.157 (0.287)	-0.173 (0.347)	0.113 (0.401)

<i>Other Controls</i>	YES	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES	YES
<i>No. of Obs</i>	160,166	132,407	109,074	89,342
<i>Pesudo R²</i>	0.02	0.02	0.02	0.03

Table 8: The Materiality of Mandatory Sustainability Disclosure

This table reports the multivariate regressions results of the influence of the commencement of mandatory ESG disclosure on firm stock price crash risk in the future. The dependent variables are *NCSKEW*, *DUVOL* and *CRASH*, respectively. *ESG_S_T* is the means of firm-level ESG score in a country-year after the mandatory ESG disclosure policy and zero before the mandatory ESG disclosure policy. *ESG_S_E* / *ESG_S_S* / *ESG_S_G* are the means of firm-level environmental / social / governance score in a country-year after the mandatory ESG disclosure policy and zero before the mandatory ESG disclosure policy, respectively. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Panel A: Total ESG Disclosure Score			
<i>Variables</i>	Model (1) <i>NCSKEW_t</i>	Model (2) <i>DUVOL_t</i>	Model (3) <i>CRASH_t</i>
<i>ESG_S_T_{t-1}</i>	-0.063*** (0.013)	-0.048*** (0.009)	-0.062** (0.028)
<i>ESG_C_{t-1}</i>	0.561*** (0.111)	0.367*** (0.074)	0.299 (0.234)
<i>Other Controls</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted / Pseudo R²</i>	0.05	0.05	0.02
Panel B: Environment Disclosure Score			
<i>Variables</i>	Model (1) <i>NCSKEW_t</i>	Model (2) <i>DUVOL_t</i>	Model (3) <i>CRASH_t</i>
<i>ESG_S_E_{t-1}</i>	-0.064*** (0.013)	-0.049*** (0.009)	-0.061** (0.030)
<i>ESG_C_{t-1}</i>	0.560*** (0.111)	0.366*** (0.074)	0.298 (0.234)
<i>Other Controls</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted / Pseudo R²</i>	0.05	0.05	0.02
Panel C: Social Disclosure Score			
<i>Variables</i>	Model (1) <i>NCSKEW_t</i>	Model (2) <i>DUVOL_t</i>	Model (3) <i>CRASH_t</i>
<i>ESG_S_S_{t-1}</i>	-0.066*** (0.012)	-0.050*** (0.009)	-0.067** (0.028)
<i>ESG_C_{t-1}</i>	0.563*** (0.111)	0.369*** (0.074)	0.302 (0.234)
<i>Other Controls</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES

<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted / Pseudo R²</i>	0.05	0.05	0.02
Panel D: Governance Disclosure Score			
<i>Variables</i>	Model (1)	Model (2)	Model (3)
	<i>NCSKEW_t</i>	<i>DUVOL_t</i>	<i>CRASH_t</i>
<i>ESG_S_G_{t-1}</i>	-0.056*** (0.011)	-0.043*** (0.008)	-0.055** (0.026)
<i>ESG_C_{t-1}</i>	0.559*** (0.111)	0.366*** (0.074)	0.296 (0.234)
<i>Other Controls</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted / Pseudo R²</i>	0.05	0.05	0.02

Table 9: The likelihood of Adopting Mandatory ESG Disclosure

This table reports the probit regression to examine the likelihood of the introduction of mandatory ESG disclosure. The dependent variable is *ESG_D*, is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. *RL* is the index for the rule of law in a country. *CC* is the index for the control of corruption in a country. *GE* is the index for the government effectiveness in a country. *PS* is the index for political stability and absence of violence in a country. *RQ* is the index for regulator quality in a country. *VA* is the index for voice and accountability in a country. *IDIS* is the country disclosure index from Doing Business dataset. The definitions of other variable are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	Probit Model (1) <i>ESG_D_t</i>
<i>RL_{t-1}</i>	1.171*** (0.028)
<i>CC_{t-1}</i>	-0.552*** (0.019)
<i>GE_{t-1}</i>	-1.565*** (0.023)
<i>PS_{t-1}</i>	0.144*** (0.009)
<i>RQ_{t-1}</i>	0.664*** (0.019)
<i>VA_{t-1}</i>	-0.149*** (0.009)
<i>IRET_{t-1}</i>	-1.025*** (0.050)
<i>IVOL_{t-1}</i>	-0.364*** (0.015)
<i>IDIS_{t-1}</i>	0.420*** (0.003)
<i>CR_{t-1}</i>	-0.090*** (0.002)
<i>GDPG_{t-1}</i>	-0.024*** (0.002)
<i>CONSTANT</i>	-2.579*** (0.029)
<i>No. of Obs</i>	184,076
<i>Pesudo R²</i>	0.24

Figure 3: The Change of stock price crash risk after the commencement of mandatory ESG disclosure policy

These figures depict the change of stock price crash risk after the commencement of mandatory ESG disclosure policy. Panel A and Panel B are the means of the difference of *NCSKEW* and *DUVOL* between treated and control groups, respectively. The dash lines depict the 95% confidence interval for each data point. The horizontal axis is the time. The mandatory ESG disclosure policy is implemented in time zero.

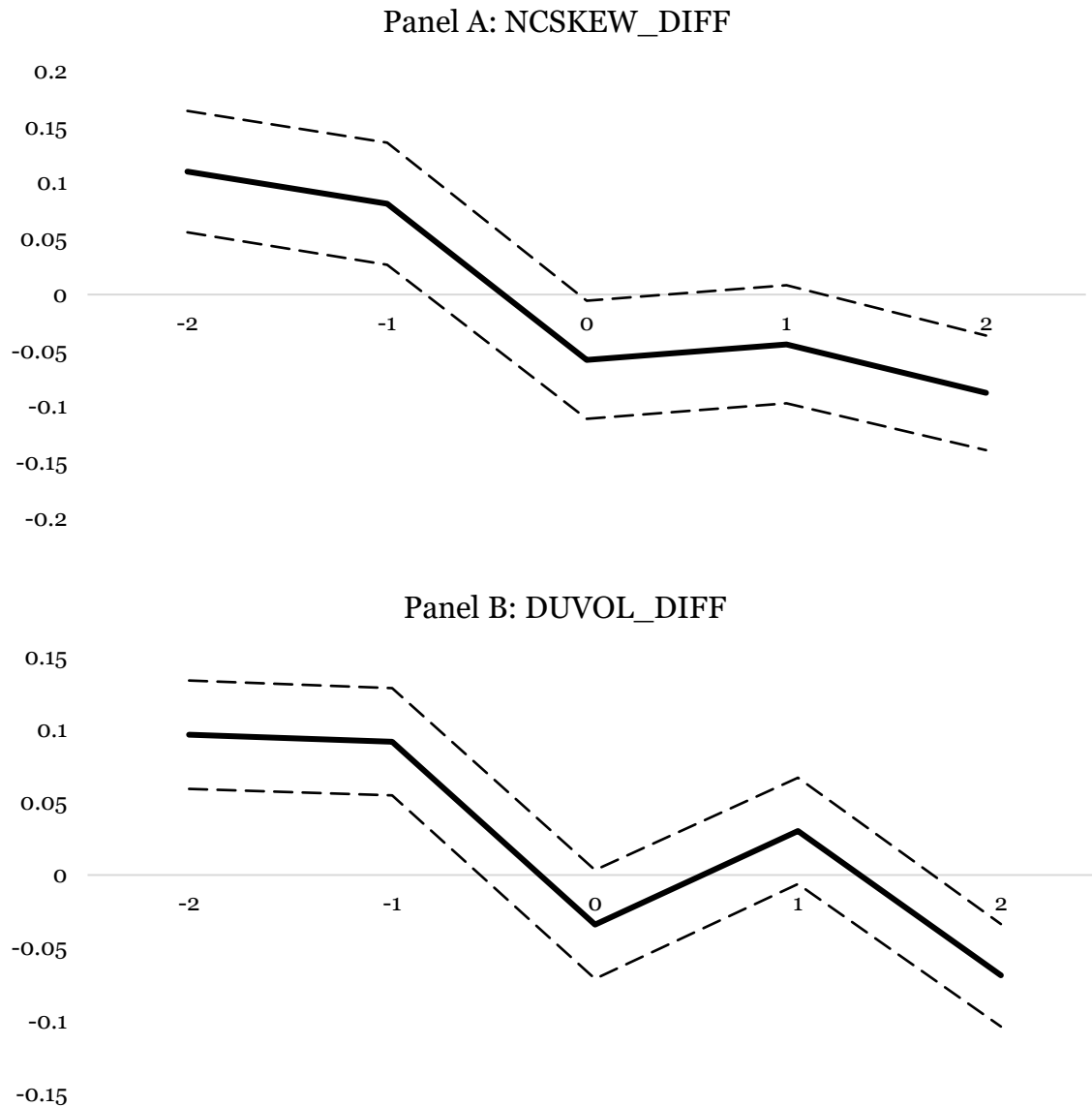


Table 10: Propensity Score Matching and Placebo Tests

This table reports the multivariate results using treated and control groups. The treated group includes observations for the firms in ESG-disclosed countries. For each treated firm, we identify the corresponding control firm by finding the firms that is in the same industry and has the closet size and likelihood of the implementation of mandatory ESG disclosure in the year when the mandatory ESG disclosure policy applies to the treated firm. The likelihood of the implementation of mandatory ESG disclosure is calculated using the regression model in Table 10. We use the correct years of the commencement of ESG disclosure in each country in model (1). We use the wrong years of the commencement of ESG disclosure in each country in model (2) and (3). The dependent variables are *NCSKEW* in all models. *Treated* is an indicator that equals to one for the firms in treated group and zero otherwise. *ESG_D* is an indicator that equals to one after the implementation of mandatory sustainability disclosure regulation in treated group and zero otherwise. The definitions of other variable are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	OLS	OLS	OLS
	Model (1) <i>NCSKEW_t</i> Correct Time	Model (2) <i>NCSKEW_t</i> Two-year Before	Model (3) <i>NCSKEW_t</i> Three-years Before
<i>Treated_{t-1} * ESG_D_{t-1}</i>	-0.077** (0.032)	-0.035 (0.033)	-0.022 (0.038)
<i>Treated_{t-1}</i>	0.362 (0.596)	0.435 (0.601)	0.455 (0.602)
<i>NCSKEW_{t-1}</i>	0.054*** (0.014)	0.054*** (0.014)	0.054*** (0.014)
<i>DTURN_{t-1}</i>	0.638*** (0.180)	0.650*** (0.179)	0.650*** (0.180)
<i>RET_{t-1}</i>	-12.730 (21.248)	-11.824 (21.264)	-11.637 (21.236)
<i>SIGMA_{t-1}</i>	-1.030 (1.536)	-1.002 (1.536)	-1.003 (1.535)
<i>SIZE_{t-1}</i>	0.042*** (0.007)	0.042*** (0.007)	0.042*** (0.007)
<i>ROA_{t-1}</i>	0.229* (0.127)	0.225* (0.127)	0.225* (0.127)
<i>LEV_{t-1}</i>	0.007 (0.055)	0.007 (0.056)	0.008 (0.056)
<i>MB_{t-1}</i>	0.029*** (0.006)	0.028*** (0.006)	0.028*** (0.006)
<i>DISACC_{t-1}</i>	0.024 (0.158)	0.028 (0.158)	0.030 (0.158)
<i>AUDI_{t-1}</i>	0.005 (0.022)	0.005 (0.022)	0.006 (0.022)
<i>ADR_{t-1}</i>	0.022	0.023	0.023

	(0.027)	(0.027)	(0.027)
<i>CLOSE</i> _{<i>t</i>-1}	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
<i>ISALE</i> _{<i>t</i>-1}	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
<i>IRET</i> _{<i>t</i>-1}	-0.280	-0.307	-0.319
	(0.217)	(0.217)	(0.217)
<i>IVOL</i> _{<i>t</i>-1}	0.042	0.047	0.044
	(0.050)	(0.050)	(0.050)
<i>CR</i> _{<i>t</i>-1}	-0.011	-0.027	-0.031
	(0.121)	(0.121)	(0.120)
<i>RL</i> _{<i>t</i>-1}	-0.184	-0.205	-0.211
	(0.133)	(0.135)	(0.134)
<i>GDPG</i> _{<i>t</i>-1}	-0.802	-0.776	-0.745
	(0.653)	(0.653)	(0.652)
<i>Year Fixed Effect</i>	YES	YES	YES
<i>Industry Fixed Effect</i>	YES	YES	YES
<i>Country Fixed Effect</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	11,753	11,753	11,753
<i>Adjusted R²</i>	0.08	0.08	0.08

Table 11: Mandatory ESG Disclosure and Stock Price Crash Risk: The Opaqueness of non-financial Information

This table reports the multivariate regressions results of the influence of the commencement of mandatory ESG disclosure on firm stock price crash risk in the future. The dependent variables are *NCSKEW*, *DUVOL*, *CRASH* in model (1), (2) and (3), respectively. *ESG_S* is an indicator that equals to one for the observations that has ESG score information in MSCI KLD dataset and zero otherwise. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. *ESG_D* is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. All the control variables in model (2) of Table 6 are included in all the models in this table. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	OLS	OLS	Probit
	Model (1) <i>NCSKEW_t</i>	Model (2) <i>DUVOL_t</i>	Model (3) <i>CRASH_t</i>
<i>ESG_D_{t-1} * ESG_S_{t-1}</i>	0.064*** (0.013)	0.045*** (0.009)	0.052 (0.032)
<i>ESG_S_{t-1}</i>	0.013 (0.008)	0.022*** (0.006)	0.008 (0.020)
<i>ESG_D_{t-1}</i>	-0.111*** (0.008)	-0.079*** (0.006)	-0.124*** (0.018)
<i>ESG_C_{t-1}</i>	0.509*** (0.111)	0.326*** (0.074)	0.255 (0.233)
<i>Other Controls</i>	YES	YES	YES
<i>Year Fixed Effect</i>	YES	YES	YES
<i>Industry Fixed Effect</i>	YES	YES	YES
<i>Country Fixed Effect</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted R²/Pesudo R²</i>	0.05	0.05	0.02

Table 12: Mandatory ESG Disclosure and Stock Price Crash Risk: The Opaqueness of Accounting Report

This table reports the multivariate regressions results of the influence of the commencement of mandatory ESG disclosure on firm stock price crash risk in the future. The dependent variables are *NCSKEW*, *DUVOL*, *CRASH* in model (1), (2) and (3), respectively. We use the absolute value of discretionary accruals (*DISACC*) to reflect the opaqueness of accounting information. We divide the whole sample into two groups according to the median of the absolute value of discretionary accruals. *ESG_AC* is an indicator that equals to one for a firm with high accounting accruals and zero otherwise. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. *ESG_D* is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. All the control variables in model (2) of Table 6 are includes in all the models in this table. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	OLS Model (1) <i>NCSKEW_t</i>	OLS Model (2) <i>DUVOL_t</i>	Probit Model (3) <i>CRASH_t</i>
<i>ESG_D_{t-1}</i> * <i>ESG_AC_{t-1}</i>	0.000 (0.008)	-0.001 (0.006)	0.006 (0.018)
<i>ESG_AC_{t-1}</i>	0.001 (0.004)	0.002 (0.003)	-0.002 (0.009)
<i>ESG_D_{t-1}</i>	-0.104*** (0.008)	-0.074*** (0.006)	-0.120*** (0.018)
<i>ESG_C_{t-1}</i>	0.527*** (0.111)	0.340*** (0.074)	0.269 (0.233)
<i>Other Controls</i>	YES	YES	YES
<i>Year Fixed Effect</i>	YES	YES	YES
<i>Industry Fixed Effect</i>	YES	YES	YES
<i>Country Fixed Effect</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted R²/Pseudo R²</i>	0.05	0.05	0.02

Table 13: Mandatory ESG Disclosure and Stock Price Crash Risk: The Quality of Auditor

This table reports the multivariate regressions results of the influence of the commencement of mandatory ESG disclosure on firm stock price crash risk in the future. The dependent variables are *NCSKEW*, *DUVOL*, *CRASH* in model (1), (2) and (3), respectively. We use the quality of auditor hired by a firm to reflect the accounting disclosure quality. *ESG_AU* is an indicator that equals to one for a firm who hires the top four accounting firms (Ernst & Young, KPMG, Price Waterhouse Coopers and Deloitte) as auditor in a year and zero otherwise. *ESG_C* is an indicator that equals to one for the observation in ESG-disclosed countries. *ESG_D* is an indicator that equals to one for the observations in ESG-disclosed countries after the commencement of mandatory ESG disclosure policy and zero otherwise. All the control variables in model (2) of Table 6 are included in all the models in this table. The variable definitions are given in Appendix A. The standard errors are robust and clustered at the firm level. The standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

<i>Variables</i>	OLS Model (1) <i>NCSKEW_t</i>	OLS Model (2) <i>DUVOL_t</i>	Probit Model (3) <i>CRASH_t</i>
<i>ESG_D_{t-1} * ESG_AU_{t-1}</i>	-0.004 (0.009)	-0.007 (0.006)	-0.031 (0.020)
<i>ESG_AU_{t-1}</i>	-0.002 (0.005)	-0.006* (0.004)	0.023** (0.011)
<i>ESG_D_{t-1}</i>	-0.101*** (0.010)	-0.069*** (0.007)	-0.098*** (0.022)
<i>ESG_C_{t-1}</i>	0.526*** (0.111)	0.341*** (0.073)	0.272 (0.233)
<i>Other Controls</i>	YES	YES	YES
<i>Year Fixed Effect</i>	YES	YES	YES
<i>Industry Fixed Effect</i>	YES	YES	YES
<i>Country Fixed Effect</i>	YES	YES	YES
<i>Clustered by Firm</i>	YES	YES	YES
<i>No. of Obs</i>	193,714	193,714	193,714
<i>Adjusted R²/Pseudo R²</i>	0.05	0.05	0.02