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Corporate Social Responsibility and External Disruptions

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Abstract

We propose that corporate social responsibility (CSR) investment serves as an intangible investment in stakeholder relationships to guard against external disruptions to firms' operations and tangible assets. Using a difference-in-differences setting and a database of factory locations, we show that manufacturing firms with higher CSR ratings are much less affected by major natural disasters in terms of operating performance. We then propose two mechanisms through which CSR engagement shields manufacturing firms against external disruptions: employee motivation and customer loyalty. Empirical evidence suggests that CSR helps manufacturing firms survive major natural disasters by motivating employees, which leads to higher post-disaster productivity, and keeping customers, which leads to more stable post-disaster sales.

Keywords: natural disasters; corporate social responsibility; operating performance; sustainability; customer loyalty; employee satisfaction.

JEL codes: L20, G31, M14, Q54

1. Introduction

Increased extreme weather and climate events in recent decades have made sustainability and stakeholders' interests under the spotlight of media and public attention, which make corporate social responsibility (CSR) an important issue for companies and managers (Besley and Ghatak, 2007).¹ In 2005, 64% of the 250 largest multinational companies published CSR reports (Porter and Kramer, 2006). This ratio increases to 95% in 2011 based on a recent study by KPMG (KPMG, 2011; de Bettignies and Robinson, 2018). More recently, over 50% of Fortune 100 companies have chosen to include CSR statements in their financial statements.² However, economists argue that CSR is associated with agency problems and incentive issues (Friedman, 1970; Jensen, 2002; Dionne and Spaeter, 2003; Brown, Helland, and Smith, 2006; Hong, Kubik, and Scheinkman, 2012; Cheng, Hong, and Shue, 2013; Masulis and Reza, 2014; List and Momeni, 2017), and firms should not engage in CSR activities. On the other hand, some recent studies provide empirical evidence suggesting that CSR activities can indeed enhance firms' operating performance and market value (Luo and Bhattacharya, 2006; Lev, Petrovits, and Radhakrishnan, 2010; Flammer, 2015; Khan, Serafeim, and Yoon, 2016; Lins, Servaes, and Tamayo, 2017).³

In this paper, we propose that CSR investment, while costly, serves as an intangible investment in stakeholder relationships to guard against external disruptions. We use natural disasters as our proxies for external disruptions because they are sudden, catastrophic events that occur by chance and severely disrupt the functioning of local economic activities.⁴ As local natural disasters are the most severe external disruption firms face, they offer an opportunity for us to examine whether CSR activities serve as intangible investments in stakeholder relationships

¹ The World Bank defines CSR as “the commitment of businesses to behave ethically and to contribute to sustainable economic development by working with all relevant stakeholders to improve their lives in ways that are good for business, the sustainable development agenda, and society at large” (Kitzmueller and Shimshack, 2012).

² Michael Sater in the Forbes CSR blog: <https://www.forbes.com/sites/csr/2011/07/20/csr-in-annual-reports-7-conflicting-trends/#23a3b639a114>

³ Wang, Choi, and Li (2008), on the other hand, suggest an inverse U-shape relationship between corporate philanthropy and financial performance.

⁴ According to the Emergency Events Database (EM-DAT), the total damage from natural disasters globally was around US\$ 2,908 billion between 1998 and 2017, and the total number of deaths was 1.3 million. The U.S. alone recorded a loss of \$945 billion that resulted from 482 disasters, whereas China alone recorded a \$492 billion loss from 577 disasters. Prior studies have documented that natural disasters significantly impacted GDP per capita, life satisfaction, labor markets, and mental health (Kahn, 2005; Anbarci, Escaleras, and Register, 2005; Raddatz, 2007; Toya and Skidmore, 2007; Luechinger and Raschky, 2009; Cavallo, Powell, and Becerra, 2010; Cavallo, Galiani, Noy, and Pantano, 2013).

that protect firms against external disruptions.⁵ To analyze the impact of natural disasters on firms, we use the U.S. Environmental Protection Agency's (EPA) toxic release inventory (TRI) database to identify the affected factory locations owned by U.S. public manufacturing firms at the county level. We benefit from the TRI database that provides us with factory locations of firms at the county level. As such, we differ from earlier literature on the role of CSR in mitigating negative shocks (Lins, Servaes, and Tamayo, 2017; Albuquerque et al., 2020; Shan and Tang, 2023) mainly by studying the effect of natural disasters or shocks at the local level instead of focusing on economy-wide shocks. We then use the Refinitiv ESG database to construct a firm's CSR score. Lastly, we collect financial and accounting data of U.S. public manufacturing firms from the Compustat/CRSP database. Due to the availability of our ESG data, our sample period starts from 2003 and ends in 2022.

We employ a difference-in-differences (DID) approach in which we regress firms' future return on assets (ROA) on their current CSR intensity interacted with the impact from natural disasters, controlling for various fixed effects and observable firm characteristics related to operating performance (Duchin, Ozbas, and Sensoy, 2010).⁶ This empirical design enables us to compare the difference in operating performance of high-CSR firms before and after natural disasters to that of low-CSR firms. The existence of various fixed effects absorbs all time-invariant or persistent unobserved characteristics, such as firm culture and managerial capability, as well as time-varying industry- or state-specific characteristics, such as industry cycles and state regulatory regimes. Local natural disasters are exogenous shocks that unexpectedly weaken firms' operating performance but are mostly *unrelated* to customer demand and economic conditions (see Hosono, Miyakawa, Uchino, Hazama, Ono, Uchida, and Uesugi, 2012). Thus, our DID design enables us to test our proposition with little interference of omitted variables.⁷

⁵ In the literature, the determinants of the speed of the recovery process from natural disasters include infrastructure (Kahn, 2005), access to capital (De Mel, McKenzie, and Woodruff, 2011; Hosono, Miyakawa, Uchino, Hazama, Ono, Uchida, and Uesugi, 2012), and technology capability (Hsu, Lee, Peng, and Yi, 2018).

⁶ In a sample of *non-U.S.* countries, Rajan and Zingales (1998) identify the effect of financial development on industrial production growth by interacting country-level financial development with *U.S.-based* industry-level external financial dependence that is exogenous to sample countries. This approach is followed by Claessens and Laeven (2003) and Raddatz (2006). In our analysis, high- and low-CSR firms are defined as firms with CSR scores above and below the top quartile of firms when disasters hit. Since we use CSR and natural disasters in year $t-1$ to explain firms' operating performance in year t , the change in operating performance reflects the role of firms' CSR in mitigating or intensifying the impact of natural disasters on future operating performance.

⁷ Critics of prior studies on the performance relevance of CSR observe that ruling out potentially omitted variables

We first find for low-CSR firms that face more severe natural disasters; they are associated with significantly lower ROA. However, we find that high-CSR firms are almost unaffected by these disasters. On the other hand, when there is no disaster, higher CSR investment negatively correlates with a focal firm's ROA.

In our robustness check, we first confirm the parallel trend assumptions. In addition, we have implemented a placebo test that randomly assigns a quarter of sample firms as pseudo high-CSR firms in each simulation and forms a null distribution of the coefficient on the interaction between natural disasters and CSR. Our sample estimate for the interaction term lies well to the right of the distribution of coefficient estimates from the placebo test. All these collective findings support our proposition that high-CSR firms are more resilient in responding to external disruptions.

We then propose and empirically examine three alternative explanations for our main finding: First, it is possible that other firm characteristics are associated with how firms' decisions to engage in CSR. We thus control the interaction of the impact of natural disasters with a high cash holding dummy, a high R&D capital dummy, a high SG&A dummy, a high advertisement dummy, and a high intangible asset dummy. Our baseline result is robust to the addition of these interaction terms that account for omitted variables that may explain firms' CSR decisions and their reactions to natural disasters. Second, it is possible that capable managers who are able to steer firms to recover from natural disasters also prefer CSR activities for reasons such as social status and visibility (Masulis and Reza, 2014). We estimate individual CEOs' CSR preferences using CEO fixed effects in a regression for CSR and find that they cannot explain our baseline result. As a result, our main finding cannot be simply attributed to capable managers' CSR preference. Third, firms may choose CSR to signal their abilities to the market, which are related to their speed in recovering from external disruptions. We address this selection issue using a propensity-score matching method to select control firms that are similar to high-CSR firms in observable characteristics, but that choose not to pursue high-CSR investment due to randomness. We find consistent results in this approach.

We next propose two mechanisms that may drive high-CSR firms' resilience to external

that affect firms' current CSR and future performance simultaneously remains challenging (Hong, Kubik, and Scheinkman, 2012).

disruptions: employee motivation and consumer loyalty. First, CSR may enhance employee satisfaction and cohesion through nonmonetary compensation, job security, affective affiliation, and pride. For example, Google's official slogan, "[y]ou can make money without doing evil," helped encourage employees to protest against the firm's involvement in the Pentagon's drone AI project; this protest eventually forced Google to back off from that initiative. When employees (and potential employees) have societal and environmental preferences, firms' CSR accumulates moral capital, which attracts talent and reduces employee turnover (Porter and Kramer, 2002; Greening and Turban, 2000; Barnett, 2007). Based on two survey data sets, Preston (1989) finds that the salary of managers and professionals working for nonprofit organizations is 0.18% lower than that for profit organizations. The surveys of Fombrun, Gardberg, and Barnett (2000) and Peterson (2004) suggest that the more employees value CSR, the more dedicated they will be to their company's operations and sustainability. In addition, the experiment of Tonin and Vlassopoulos (2010) shows that altruism leads to more efforts exerted.

Second, CSR activities strengthen market positions and create new opportunities by improving social image and brand awareness (Porter and van der Linde, 1995; Lev, Petrovits, and Radhakrishnan, 2010). Marketing surveys have documented that CSR has a positive effect on consumers' overall assessment of a firm's reputation (Brown and Dacin, 1997). According to Albuquerque, Koskinen, and Zhang (2019), consumers are important in determining a firm's CSR strategy and CSR is a product differentiation strategy. Therefore, high CSR firms are associated with high customer loyalty and as such, are less affected by natural disasters. In Pastor, Stambaugh, and Taylor (2021), investors can hold portfolios consist of high CSR firms to hedge climate risk as customer's concern for climate risk prompts higher demand for the products of high CSR firms. Moreover, Sen and Bhattacharya (2001) and Bhattacharya and Sen (2003) show that consumers are more loyal to high-CSR firms, and Navarro (1988) and Bagnoli and Watts (2003) propose models in which socially responsible consumers are willing to pay premium for products that such firms offer. Such affective value associated with CSR, which is proposed by both the psychology and marketing literature, is also confirmed by accounting research.⁸

⁸ Dhaliwal, Li, Tsang, and Yang (2011) and Dhaliwal, Radhakrishnan, Tsang, and Yang (2012) show that firms issue CSR reports to provide non-financial information to investors and analysts. Kim, Park, and Wier (2012) report that CSR firms are less likely to take part in earnings management or GAAP violations.

Supporting the employee motivation mechanism, we find a significant reduction in employee productivity among low-CSR firms after natural disasters, but not among high-CSR ones. To verify that because CSR is positively associated with employees' pride, feelings of affiliation, and satisfaction, all of which motivate them to work harder during disruptions to help their respective firms, we use the list of "100 Best Companies to Work For" (published by Fortune) as a proxy for high job satisfaction (Edmans 2011, 2012), and [we find that high CSR firms that are also in this list are significantly less affected by natural disasters](#). Thus, working for high-CSR firms offers employees not only benefits, but also pride.

The second mechanism through which CSR activities moderate the impact of natural disasters on firms is customer loyalty. We show that because CSR enhances customer loyalty, such that a firm's sales are less affected by natural disasters when that firm's CSR engagement is high; in such cases, higher customer loyalty gives firms more time to recover and supply their products (i.e., customers are more willing to wait). [We then further test the relationship between natural disasters, CSR, and customer loyalty](#) by using the list of "Top 100 Best Global Brands" (published by Interbrand and Businessweek) as a proxy of high customer loyalty, and we obtain results that support our proposition.

This study adds to the finance literature on CSR by highlighting the role of CSR as an important intangible investment that may protect firms' operations and values when they encounter external disruptions. In particular, we use the occurrence of local natural disasters that is less subject to omitted variable issue to identify firms' benefits associated with societal and environmental engagement. What we document in this paper, however, differs from prior study in which CSR acts as social capital that serves as insurance when negative publicity hits firms (Minor and Morgan, 2011) or there is a negative shock to trust (Lins, Servaes, and Tamayo, 2017).⁹ Our results, based on production disruption due to natural disasters, provide novel insights that CSR engagement serves as an investment in intangible assets that ameliorates the negative impact of exogenous shocks on operations and tangible assets.

⁹ Minor and Morgan (2011) find that high-CSR firms' stock prices are less adversely affected by product recall news. Lins, Servaes, and Tamayo (2017) find that high-CSR firms have higher stock returns during the 2008-2009 financial crisis.

This study also provides novel evidence that speaks to the role of CSR towards key stakeholders of firms: employees and customers (Christensen, Hail, and Leuz, 2018). Current studies that support employees' CSR preferences are mainly based on surveys and case studies (Greening and Turban, 2000; Fombrun, Gardberg, and Barnett, 2000; Peterson, 2004), and are *not* supported by large-scale empirical studies (see Kitzmueller and Shimshack, 2012).¹⁰ Using data that pertains to employee satisfaction, we present evidence that confirms employees' preferences for CSR and their dedication to firms that experience difficult times. In sum, our empirical analyses underscore an important connection between CSR and human capital that has implications for shareholders and stakeholders. We also contribute to the literature on how customers perceive CSR activities of firms (Luo and Bhattacharya 2006; Eichholtz, Kok, and Quigley 2013; Homburg, Stierl, and Bornemann 2013; Grimmer and Bingham 2013; Öberseder, Schlegelmilch, and Murphy 2013; Park, Lee, and Kim 2014; Habel, Schons, Alavi, and Wieseke 2016). We show in times of disruptions, high CSR firms tend to have higher customer loyalty, which gives firms more time to recover and supply their products.

2. Data, Summary Statistics, and Empirical Methodology

To empirically test our hypotheses, we combine major natural disaster data, factory-level location data, firm-level CSR data, and firm-level accounting data for U.S. public firms in manufacturing industries.

To assess the impact of natural disasters on firms' operating performance, we use the U.S. EPA's toxic release inventory (TRI) database to identify U.S. firms' factory locations.¹¹ The TRI database was established in response to the 1986 Emergency Planning and Community Right-to-

¹⁰ Most prior studies, in fact, do not support employees' special preferences and commitment to CSR. Goddeeris (1988) takes into account self-selection issues and finds that lawyers are not willing to accept lower salaries to work in the public sector. Frye, Nelling, and Webb (2006) show that CEOs in high-CSR firms receive similar compensation, but are subject to higher turnover than those in low-CSR firms. Hubbard, Christensen, and Graffin (2017) also find that CEOs' CSR initiatives intensify the negative relationship between financial performance and CEO dismissal. Using large-scale datasets (e.g., census data), Leete (2001) and Ruhm and Borkoski (2003) do not find systematic differences between wages in the nonprofit and for-profit sectors after controlling for individual, position, and workplace characteristics. Some studies even report higher compensation for nurse and child care workers in public sectors (Holtmann and Idson. 1993; Mocan and Tekin, 2003). Using an experiment based on a firm employing more than 3000 workers, List and Momeni (2017) find that the usage of CSR increases employee misbehavior.

¹¹ We use the organized TRI database constructed by Xiong and Png (2019), which is available at: <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/K4KBBR>.

Know Act (EPCRA), which requires firms in manufacturing industries with Standard Industrial Classification (SIC) codes between 2000 and 3999 to report their factories' locations as well as their storage, use, and releases of hazardous substances. While our paper does not focus on firms' toxic release data, this database nevertheless provides us with a rich source for identifying factories' locations.

We obtain the U.S. natural disaster data from the Spatial Hazard Events and Loss Database for the United States, which is maintained by the Arizona State University. This county-level hazard data set covers natural hazards such as thunderstorms, hurricanes, floods, wildfires, and tornados as well as perils such as flash floods, heavy rainfall, etc. As with the literature (Addoum, Ng, and Ortiz-Bobea, 2022), we focus on the impact of natural disasters at the county-level. We first assess the impact of these natural disasters on factories based on the property damage caused by these events at the county-level. We then assess the impact of natural disasters on firms by aggregating the impact of these events on factories. The main independent variable, *WEIGHTED_DAMAGE*, is calculated as the natural log of one plus the weighted property damage of natural disasters at firm's factories' locations, with the weight determined by the size of each factory proxied by the total production-related waste of each factory.

We then collect U.S. public firms' CSR data from the Refinitiv database. The data is available from 2003. As such, our sample period is from 2003 to 2022. Refinitiv CSR score is a combination of Environmental, Social, and Governance metrics of firms. The score measures a firm's CSR performance based on verifiable reported data. The score ranges from 0 to 1, with higher scores for better CSR performance.

To mitigate possible outliers in CSR scores calculated based on information from the Refinitiv database, we define firm-year observations as "high CSR" if the firm-year observation has a CSR score in the top quartile in a given year. We then use H_CSR as a dummy variable that equals one for those firms with high CSR, and that equals zero otherwise. We also consider various ways to define CSR to complete a robustness check. First, we use the overall CSR score (*CSR*) rather than the dummy variable H_CSR . Second, we consider different ways to define the dummy variable H_CSR using these scores, including defining firms with CSR scores above median as high-CSR firms and firms with CSR scores in the top decile as high-CSR firms. See Section 4.2 for more

details.

We use the Compustat database to obtain U.S. public firms' accounting data from 2003 to 2022. We then measure firm i 's operating performance in year t by ROA , which is defined as income before depreciation in year t divided by total assets in year $t - 1$. To examine the pure effect of natural disasters on operating performance, we construct the same control variables used in Giroud and Mueller (2010). To control firm size differences, we use the natural log of total assets to measure a firm's size ($SIZE$). To account for the possible non-linear effect of firm size, we also control for $SIZE2$ (i.e., the square of $SIZE$). Further, we control for the life-cycle differences of firms with AGE , which is defined as the natural log of the number of years a firm has been in the Compustat database. Additionally, we add several control variables to the regression, including $PAGE$, which is the average age of factories (defined as the number of years a factory has existed in the TRI database). We also control for asset intangibility ($INTANG$), amortized research and development expenses (RDC), selling, general, and administrative expenses (SGA), and advertisement expenses (AD) for the effects of intangible assets and potential differences in firm characteristics between high- and low-CSR firms.¹²

Finally, given the extent to which local development, institutional quality, income equality, and macroeconomic conditions might influence a firm's ability to respond to natural disasters, we use state times year fixed effects to control for the time-varying state effect. Similarly, we control for unobservable industry-level, time-varying shocks with industry times year fixed effects¹³. We define each industry in this paper at the three-digit SIC level following Hou and Robinson (2006).

We eliminate firm-year observations for which data on ROA and factory location are missing. To eliminate the impact of outliers, we follow Giroud and Mueller (2010) to trim ROA at 1% at each tail. In sum, we use a total of 6,130 firm-year observations. In Table 1, we present summary statistics for all variables used in this study. For an average firm in the dataset, its ROA is 0.14.

¹² $INTANG$ is the percentage of intangible assets defined as total assets minus current assets and net value of property, plants, and equipment scaled by total assets. RDC is the natural log of one plus amortized research and development (R&D) expenses in the past five years (i.e., $\sum_{k=0}^4 RD_{t-k}(1 - 0.2k)$), in which RD_t is R&D expenses at year t . SGA and AD are amortized sales, general, and administrative expenses and amortized advertisement expenses, respectively, similarly defined as RDC .

¹³ Cao, Liang, and Zhan (2019) find an industry effect of CSR.

The CSR that we report in Table 1 is the CSR score, which, on average, is 0.46 in the sample.

[Insert Table 1 Here]

3. Empirical Results

3.1 Natural disasters, CSR, and operating performance

In this section, we empirically examine whether CSR engagement could moderate the impact of natural disasters on firms.

3.1.1 The effect of CSR: baseline regression

In our baseline difference-in-differences (DID) regression, we regress firm i 's operating performance (ROA) in year t on disaster impact ($WEIGHTED_DAMAGE$) in year $t - 1$ interacted with the high CSR dummy (H_CSR) in year $t - 1$ as follows:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t-1} + \beta_3 H_CSR_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (1)$$

for which $WEIGHTED_DAMAGE$, the impact of natural disasters on firm i 's factories in calendar year $t - 1$, is matched with accounting data with a fiscal year end in year t . Firm i belongs to industry j and is headquartered in state s . For each firm and year, H_CSR equals one if the CSR score of firm i in year $t-1$ is within the top quartile in the year, and equals zero otherwise.¹⁴ This DID setting follows Duchin, Ozbas, and Sensoy (2010), and the coefficient of the interaction term, β_1 , is our variable of interest as it measures the moderating effect of CSR. We expect the coefficient to be positive and significant, based on our main hypothesis.

In our DID design, as natural disasters are unexpected and unrelated to demand side factors,¹⁵ the coefficient β_1 on the interaction between natural disasters and CSR that explains future operating performance is able to appropriately identify how CSR helps firms recover from natural

¹⁴ In a robustness check, we use raw CSR score and find consistent results.

¹⁵ Local natural disasters are exogenous shocks that hurt firms' operating performance, but are mostly unrelated to customer demand and economic conditions (see Hosono, Miyakawa, Uchino, Hazama, Ono, Uchida, and Uesugi, 2012).

disasters. This design follows Rajan and Zingales (1998), Claessens and Laeven (2003), Raddatz (2006), and Giroud and Mueller (2010) by interacting an exogenous variable (*WEIGHTED_DAMAGE* in our case) with a possibly endogenous explanatory variable (CSR in our case) to make causal inferences. If the association between CSR and operating performance were driven by an unobservable or omitted factor, then such a factor should also correlate with the occurrence of natural disasters in ways that deliver a significant coefficient on the interaction between CSR and natural disasters. As it is difficult to identify a potential factor that satisfies this condition, a more reasonable interpretation of significantly positive β_1 is that CSR affects the impact from natural disasters. Moreover, to further mitigate the endogeneity concerns, we further discuss selection issues and alternative explanations in Sections 3.1.2 to 3.1.3.

\mathbf{Xb} is a set of control variables that include *SIZE*, *SIZE2*, *AGE*, *PAGE*, *INTANG*, *RDC*, *SGA*, and *AD* in year t (all of them have been defined in Section 2). $\rho_{s,t}$, $\sigma_{j,t}$, μ_t , and η_i control for state-year, industry-year, year and firm fixed effects, respectively. This regression specification controls for time-varying industry and state conditions as well as time-invariant or persistent unobserved characteristics, such as firm culture and managerial capability. The standard errors of coefficients are double clustered at the state-year and industry-year level.

We report our results in Table 2. In columns (1) and (2) of Table 2, we confirm that firms that are not considered high spenders in terms of CSR ($H_CSR=0$) are negatively affected by natural disasters. The coefficient on *WEIGHTED_DAMAGE* is -0.061 with control variables; thus, a one standard deviation increase (0.06) in *WEIGHTED_DAMAGE* would lead to a firm's operating performance would decrease by 0.37 percentage points (0.061*6%).

[Insert Table 2 Here]

However, the coefficient on the interaction term (β_1) is positive and significant, which means that high-CSR firms suffer significantly less in terms of operating performance when hit by natural disasters. Considering the magnitude of β_1 is similar to that of the coefficient on *WEIGHTED_DAMAGE*, these high-CSR firms are barely affected by natural disasters, which supports our hypothesis. In the later robustness check section, we conduct a placebo test to check whether the coefficient on the interaction term (β_1) remains significant when we randomly pick a

quarter of sample firms to be pseudo high-CSR firms. On a related note, β_3 (the coefficient on H_CSR) is negative and significant, indicating that, without the consideration of disruptions, CSR is a costly investment, and its benefits may not outweigh its costs.

A concern of our result is that other firm characteristics may be associated with firms' CSR engagement and their ability in dealing with natural disasters. To ensure our results are not driven by these factors, we additionally control the interaction of the impact of natural disasters ($WEIGHTED_DAMAGE$) with these firm characteristics that include a high cash holding dummy (H_CASH), a high R&D capital dummy (H_RDC), a high SG&A dummy (H_SGA), a high advertisement dummy (H_AD), and a high intangible asset dummy (H_INTANG). These dummy variables are similarly defined as H_CSR . We report the results in Column (3). The result is quite similar to what we find in Column (2), suggesting our results are unlikely driven by omitted variables.

To better assess the economic magnitude of our results, we re-calculate $WEIGHTED_DAMAGE$ as a dummy variable instead. In this case, $WEIGHTED_DAMAGE$ is one for the firms with original $WEIGHTED_DAMAGE$ in the top quartile each year and zero otherwise. This dummy variable captures firms that are severely hit by natural disasters. We report the results in Column (4) of Table 2. The coefficient on $WEIGHTED_DAMAGE$ is -0.012, suggesting firms that are severely hit by natural disasters would have their operating performance lowered by 1.2 percentage points, higher than the estimate we had using one standard deviation increase. In addition, the coefficient on the interaction term is 0.009. Again, this is of similar magnitude as the coefficient on $WEIGHTED_DAMAGE$, suggesting high-CSR firms are mostly unaffected by natural disasters, even severe ones.

So far, we have assumed that natural disasters affect firms for one year. However, natural disasters may affect firms for more than one year. To address this issue, we re-calculate $WEIGHTED_DAMAGE$ as the average of previous two years' original $WEIGHTED_DAMAGE$ as the new main independent variable that assesses the impact of natural disasters on firms. We report the results in Column (5). We again find consistent results using natural disasters in the past two years: the coefficient on $WEIGHTED_DAMAGE$ is -0.137, which is almost double of the one-year counterpart, -0.069, in Column (3). More importantly, the coefficient on $WEIGHTED_DAMAGE^*$

H_CSR is 0.100, which is much higher than the one-year counterpart, 0.073, in Column (3). These differences in economic magnitude suggest that the impact of natural disasters last longer than one year.

3.1.2 Alternative explanation: Capable managers' preference for CSR

One possible explanation for our main result is that capable managers are able to help their firms to recover from natural disasters and somehow prefer CSR for reasons such as social status or media attention (Masulis and Reza, 2014). To examine if our main result is subject to such CSR preference, we first estimate CEOs' CSR preferences by regressing raw CSR scores in a model on ROA, several control variables, year fixed effects (μ_t), and CEO fixed effects (ρ_j) as follows:

$$CSR_{i,t} = \beta_0 + \beta_1 ROA_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 SIZE2_{i,t} + \beta_4 AGE_{i,t} + \beta_5 TANG_{i,t} + \beta_6 RDC_{i,t} + \beta_7 SGA_{i,t} + \beta_8 AD_{i,t} + \mu_t + \rho_j + \varepsilon_{i,t}. \quad (2)$$

The coefficients on CEO fixed effects are labelled CEO_CSR and reflect the preferences of individual CEOs for CSR. We then interact CEO_CSR with the main variables in our main regression of Equation (1) and estimate the following model:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t-1} + \beta_3 H_CSR_{i,t-1} + \beta_4 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} * CEO_CSR_{i,t-1} + \beta_5 WEIGHTED_DAMAGE_{i,t-1} * CEO_CSR_{i,t-1} + \beta_6 H_CSR_{i,t-1} * CEO_CSR_{i,t-1} + \beta_7 CEO_CSR_{i,t-1} + \mathbf{X}b_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t}. \quad (3)$$

If our main result is driven by better CEOs' CSR preferences, then the coefficients of $WEIGHTED_DAMAGE * CEO_CSR$ and $WEIGHTED_DAMAGE * H_CSR * CEO_CSR$ should be positive significant as these two interaction terms connect CEOs' CSR preference to post-disaster performance. This alternative explanation is not supported by the results shown in Table IA1 in the Internet Appendix. In Column (1), we only add CEO_CSR to the regression model and find that its coefficient is negative but statistically insignificant. In Column (2) we interact CEO_CSR with all main variables of interest and find that the coefficients on the interaction terms related to CEO_CSR are all insignificant except for the triple interaction term is negative and significant. This table suggests that our main result cannot be attributed to capable CEOs' preference for CSR.

3.1.3 Alternative explanation: the signaling of CSR choice

Another possible explanation is that firms choose CSR to signal their abilities to the market, which are related to their speed in recovering from external disruptions. In this subsection, we aim to mitigate the concern about firms' CSR choice as signaling. We use a propensity score matching method, a widely used and simple method to address selection problems (Roberts and Whited, 2013). We conduct propensity score matching to prepare a matched sample in which all sample firms are similar in observable characteristics. In particular, we conduct the first-stage logit regression to calculate the propensity score of a firm identified as a high-CSR (treated) firm as follows:

$$H_CSR_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 SIZE2_{i,t} + \beta_3 AGE_{i,t} + \beta_4 RDC_{i,t} + \beta_5 AD_{i,t} + \beta_6 SGA_{i,t} + \sigma_j + \varepsilon_{i,t}. \quad (4)$$

Estimating Equation (4) enables us to understand the determinants of firms' CSR choices. Because we define high-CSR as top quartile, we implement the following matching: for each high-CSR firm ($H_CSR = 1$), we find at most three control firms that is not a high-CSR firm, but that has a propensity score closest to the high-CSR firm (within 0.01 caliper). These control firms then can be regarded as firms that should have chosen to invest highly in CSR but did not do so due to randomness. We then estimate the impact of natural disasters on firms using a matched sample that includes only high-CSR firms and the matched control firms, which allows us to assess the effect of CSR in a pseudo-random assignment experiment.

In Table IA2 in the Internet Appendix, we obtain results similar to those in Table 2. Firms that are not considered high-CSR ones are negatively affected by natural disasters. High-CSR firms, however, are largely immune to these natural disasters. This table thus suggests that our baseline results are not driven by other observable characteristics related to firms' CSR choices.

3.2 Why high-CSR firms are less affected?

In this section, we empirically investigate why firms with high CSR investment are less affected by disasters along the two mechanisms that we discussed in the introduction: the employee mechanism, which we discuss in Sections 3.2.1 and 3.2.2, and the customer mechanism, which we discuss in Sections 3.2.3 and 3.2.4.

3.2.1 Natural disasters, CSR, and employee productivity

As explained earlier, CSR enhances employees' pride, feelings of affiliation, and satisfaction, which all motivate employees to work harder during external disruptions. To examine the employee mechanism, we examine the impact of natural disasters on labor productivity for high- and low-CSR firms using the following regression model:

$$PROD_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (5)$$

in which *PROD* is labor productivity as measured by the natural log of one plus the ratio of net income to the total number of employees (*PROD_NI*) or the ratio of sales to the total number of employees (*PROD_SALE*) (Lins, Servaes, and Tamayo, 2017). Because net income can be negative, we replace negative values by zero to ensure labor productivity is non-negative. We define all other variables as in Equation (1). In this model, β_1 measures the impact of natural disasters on labor productivity. We report our results in Table 3.

[Insert Table 3 Here]

The first three columns are for *PROD_NI* as the independent variable while the last three are for *PROD_SALE* as the dependent variable. Since the results are similar, we keep our discussion on the first three columns. In the first column, we include the whole sample of firms and find an insignificant coefficient on *WEIGHTED_DAMAGE*. We find a similar result in Column (2) in which we only include high-CSR firms. In Column (3), we keep only low-CSR firms¹⁶ and find a negative and significant coefficient on *WEIGHTED_DAMAGE*, suggesting a significant impact of natural disasters on labor productivity for low-CSR firms. These results suggest the impact of natural disasters on employee productivity is mitigated by CSR, which supports the employee mechanism.

3.2.2 The job satisfaction channel

Our employee mechanism assumes that CSR is positively associated with job satisfaction such

¹⁶ The sum of observations of two subsample is less than the whole sample because groups with singleton observation are dropped as a result of the fixed effects.

that when disasters hit, employees are more willing to work harder to help their firms if these firms invest heavily in CSR. Therefore, if the reason that high CSR firms are less affected by natural disasters is employees in these firms having a higher rate of job satisfaction, we would expect the weakened impact of natural disasters on the operating performance of firms with high CSR to be concentrated in firms with higher rates of job satisfaction. To validate this, we use the following model:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} * H_VALUE_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} + \beta_3 WEIGHTED_DAMAGE_{i,t-1} * H_VALUE_{i,t-1} + \beta_4 H_CSR_{i,t-1} * H_VALUE_{i,t-1} + \beta_5 WEIGHTED_DAMAGE_{i,t-1} + \beta_6 H_CSR_{i,t-1} + \beta_7 H_VALUE_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \varepsilon_{i,t} \quad (6)$$

in which *H_VALUE* is a dummy variable that equals one for firms in the list of “100 Best Firms To Work For In America” published by Fortune¹⁷. *H_VALUE* is a proxy for job satisfaction, and firms mentioned in the list have employees with higher rates of job satisfaction (Edmans, 2011, 2012). The control variables are the same as those in Column (3) of Table 2. In this specification, β_2 captures the impact of natural disasters on high CSR firms with relatively lower job satisfaction rates, while β_1 , the triple interaction term, captures the impact of natural disasters on high CSR firms with high job satisfaction rates. We expect this triple interaction term to be positive and significant if it is the job satisfaction rate, which is positively associated with CSR, helps firms during natural disasters hit. We define all other variables as we did previously. We also include state-year, industry-year, and time fixed effects in the model. We cannot use firm fixed effects in this setting because whether a firm has a brand on the list is a persistent pattern; thus, including firm fixed effects will absorb all cross-sectional variation and leave us only a very limited time series variation.

We report our results in Column (1) of Table 4. We see that the coefficient on the triple interaction term is positive and significant, suggesting that high-CSR firms that are in the “100 Best Firms To Work For In America” list are less affected by natural disasters. This confirms that a higher job satisfaction rate is one of the reasons high CSR firms are less affected by natural

¹⁷ We would like to thank Alex Edmans for making this data available online at <http://alexedmans.com/data/>. We have extended the data to 2022 to suit our sample.

disasters.

[Insert Table 4 Here]

3.2.3 Natural disasters, CSR, and sales

Natural disasters disrupt firms' operations and thus delay firms' supply to customers. However, customers with CSR preferences are more willing to tolerate longer lead times to purchase products from high-CSR firms. Therefore, although natural disasters negatively affect firms' production, firms with high CSR nevertheless have customers who are more willing to wait, and such firms, in turn, suffer little from disasters.

To test this proposition, we use the following model to estimate the impact of natural disasters on firms' sales:

$$SALE_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t}, \quad (7)$$

in which *SALE* is the ratio of total sales to beginning-of-the-year total assets, also known as asset turnover. All other variables are defined as in Equation (1), and we report our results in Table 5. We find negative significant coefficients on *WEIGHTED_DAMAGE* in Column (1), confirming our prediction that natural disasters disrupt firms' sales on average.

[Insert Table 5 Here]

To examine the heterogeneous impact of natural disasters on high- and low-CSR firms, we separate the sample into high CSR firms and low CSR firms, with the former having firms with *H_CSR* dummy equals to one. In Column (2), we find insignificant coefficient on *WEIGHTED_DAMAGE*, suggesting the sales of high-CSR firms are not significantly affected by natural disasters. Meanwhile, the coefficient on *WEIGHTED_DAMAGE* in Column (3) with firms having low-CSR is negative and significant, suggesting these firms are adversely affected by natural disasters. Our finding that high-CSR firms' sales are less affected by natural disasters supports the customer mechanism.

3.2.4 The customer loyalty channel

The customer mechanism assumes that CSR is positively associated with customer loyalty such that when disasters hit, customers are more willing to wait for high-CSR firms to recover their supply of products after disasters rather than switch to other suppliers. Because customer loyalty is difficult to measure, we instead use brand value as a proxy based on the premise that customer loyalty and brand value are highly correlated. Specifically, we use the Top 100 Best Global Brands¹⁸ published by Interbrand and Businessweek, which we select because of its long time-series of data. One key component of the index is brand strength, which measures the ability of a brand to create loyalty and, therefore, future sustainable demands and profits. Therefore, brands included in this list reflect high customer loyalty. To formally test that high-CSR firms tend to be less affected by natural disasters because of customer loyalty, we estimate model (6) by replacing *H_VALUE* as a dummy variable that equals one for firms having brands in the Top 100 Best Global Brands list in year *t*. We define all other variables as we did previously. We would again expect the triple interaction term to be positive and significant, which would indicate among high CSR firms, those with high customer loyalty are less affected by natural disasters.

We report these results in Column (2) in Table 4. We observe that the coefficient on the triple interaction term is positive and significant, suggesting high-CSR firms having brands that have high customer loyalty are less affected by natural disasters. This confirms our prediction that high customer loyalty associated with high CSR ratings is a reason why high CSR firms are less affected by natural disasters.

4. Robustness Tests

We provide several robustness tests of our results in this section. We start with validity tests for our DID setting, and then consider alternative ways of measuring CSR. Our results are robust to all these specifications.

¹⁸ Three key components determine brand value: an analysis of the financial performance of the branded products or services, the role the brand plays in purchase decisions, and the brand's competitive strength. Details can be found at <https://www.interbrand.com/best-brands/best-global-brands/methodology/>.

4.1 Validity of DID tests

4.1.1 Placebo test

To reassure the moderating effect of CSR, we perform a placebo test in this section. Specifically, in each year, we randomly select a quarter of sample firms and label them pseudo high-CSR firms. Using this simulated sample, we re-run our main regression as specified in Equation (1). We repeat the procedure 1,000 times and report the histogram of the coefficient estimates on *WEIGHTED_DAMAGE*H_CSR* in Figure 1, which corresponds to the null distribution for the coefficient on the interaction term.

[Insert Figure 1 Here]

The coefficient histogram corresponds to the model we use in Column (3) of Table 2. The 95% value of the coefficient distribution is 0.057, which is less than the coefficient of *WEIGHTED_DAMAGE*H_CSR* in Column (3) of Table 2. The figure indicates that, with more than 95% in probability, the coefficient on the interaction term from the placebo test is lower than our baseline estimate of 0.069. This confirms that the important role played by CSR in moderating the effect of natural disasters is not due to randomness or other factors unrelated to CSR.

4.1.2 Parallel trend assumption

To examine the parallel trend assumption for the validity of our DID regression, we check if firm-level ROA is different *before* natural disasters. We thus replace disaster impact in year $t - 1$ with disaster impact in year $t + 1$ in Equation (1) and estimate the following equation:

$$\begin{aligned} ROA_{i,t} = & \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t+1} * H_CSR_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t+1} \\ & + \beta_3 H_CSR_{i,t-1} + \mathbf{X}b_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t} \end{aligned} \quad (8)$$

The coefficient of the interaction term, β_1 , reflects if firms' ROA decreases before disaster impact and the coefficient of *WEIGHTED_DAMAGE*, β_2 , captures if high- and low-CSR firms' ROA differs before natural disasters. As shown in Table IA3 in Internet Appendix, we find that the coefficient on the interaction term and *WEIGHTED_DAMAGE* is insignificant. This finding suggests that our sample firms' ROA does not vary before disaster impact and that their CSR

activities do not change their pre-disaster ROA.

4.2 Alternative measures of CSR

So far, we have defined firms in the top quartile with respect to CSR within a year as high-CSR ones. In this subsection, we vary the cutoff points by using the 50th percentile or the 90th percentile to define H_CSR , and we estimate Equation (1) and report our results in Table IA4 in Internet Appendix.

From Columns (1) to (2), we observe the same pattern as we have seen when using the top quartile (the 75th percentile) as the cutoff point. We still find that non- H_CSR firms are negatively affected while high-CSR firms are not affected by natural disasters. Finally, we use the overall CSR score instead of H_CSR and modify Equation (1) as follows:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t+1} * CSR_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t+1} + \beta_3 CSR_{i,t-1} + \mathbf{X}b_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (9)$$

We report our regressions results in Column (3) of Table IA4 in the Internet Appendix. Our results are again consistent with our earlier findings. Thus, our results are not due to the way that we define high-CSR firms.

5. Conclusion

In this paper, we propose that corporate social responsibility (CSR) serves as an intangible investment in stakeholder relationships to guard against external disruptions to operations and tangible assets. We find that firms with higher CSR investment are much less affected by natural disasters compared with those firms without such investment. Our design, which is based on exogenous disasters, enables us to test our proposition that high-CSR firms are more resilient to external disruptions in a difference-in-differences setting. Further empirical evidence rules out three alternative explanations including capable managers' preference for CSR, firms' cash holdings, and firms' CSR choice serves as a signal. A placebo test and a parallel trend test validate our difference-in-differences setting.

We then propose two mechanisms through which CSR activities help firms overcome external disruptions: employee motivation and customer loyalty. These two mechanisms are supported by further empirical tests. For the employee mechanism, we find that a firm's productivity is less affected by natural disasters when the firm's CSR engagement is higher. For the customer mechanism, we find that a firm's sales are less affected by natural disasters when the firm's CSR engagement is high. Our empirical evidence supports that CSR engagement serves as an important intangible investment in human capital and social image.

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Figure 1 Histogram of Coefficient Estimates in Placebo Tests

These figures plot histograms of coefficient estimates of $WEIGHTED_DAMAGE * H_CSR$ from 1,000 regressions using randomly assigned pseudo CSR using the following equation:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t-1} + \beta_3 H_CSR_{i,t-1} + \mathbf{X}b_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t}$$

The coefficients in the figure are estimates corresponding to the model in Column (3) of Table 2. The dashed line is the coefficient estimates of $WEIGHTED_DAMAGE \times H_CSR$ from Column (3) of Table 2.

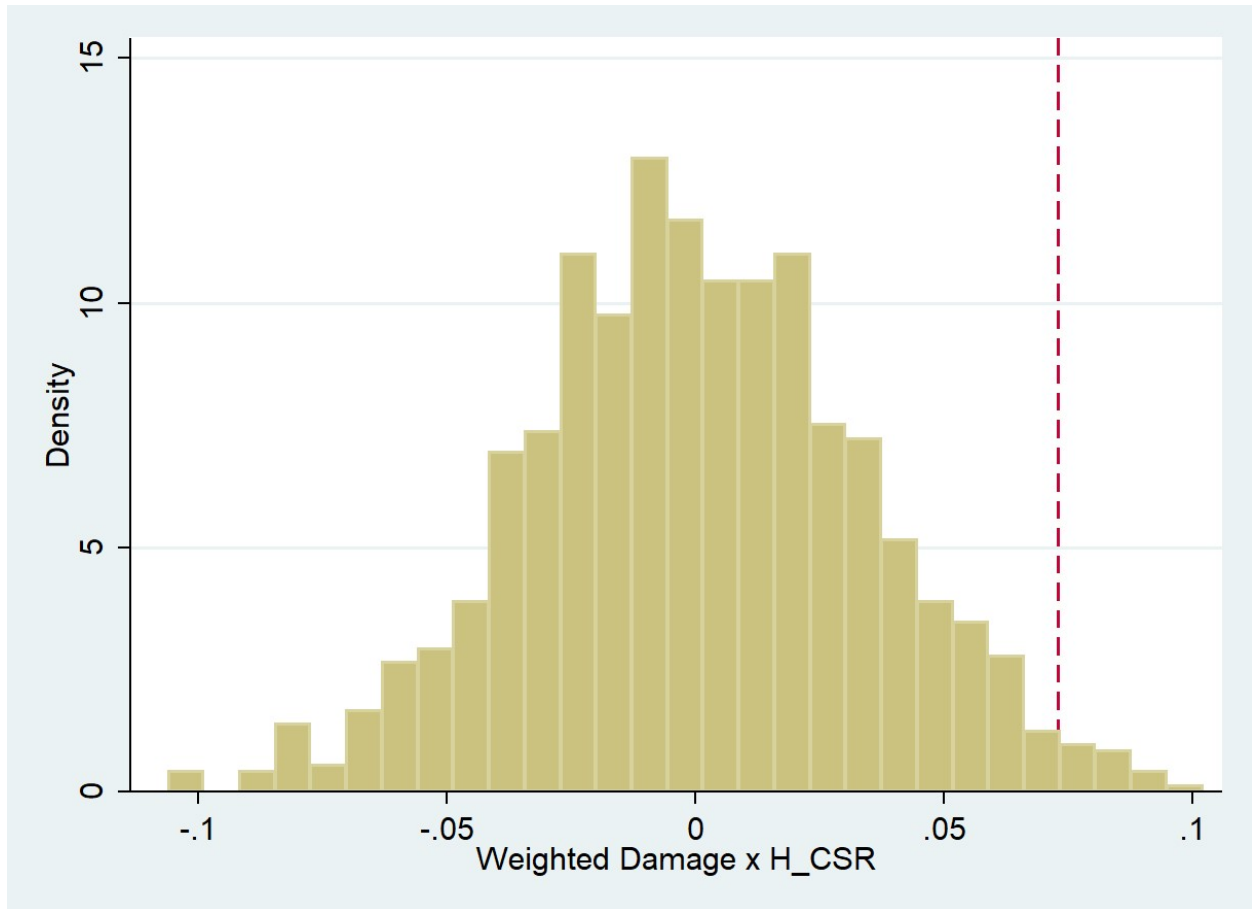


Figure 1

Table 1 Summary Statistics

This table presents summary statistics of variables that we used in the baseline regressions in our paper. *ROA* is defined as income before depreciation in year t divided by total assets in year $t-1$. *WEIGHTED_DAMAGE* is the weighted damage by natural disasters to the counties where a firm has factories in. It is calculated as the natural log of one plus the weighted property damage of natural disasters at firm's factories' locations, with the weight determined by the size of each factory proxied by the total production-related waste. *CSR* is the ESG score from Refinitiv. *SIZE* is the natural log of total assets. *SIZE2* is the square of *SIZE*. *AGE* is the number of years a firm has been in the Compustat database. *PAGE* is the average age of plants; the age of a plant is the number of years it has existed in the TRI database. *INTANG* is the percentage of tangible assets defined as total assets minus current assets and net value of property, plants, and equipment scaled by total assets. *RDC* is the natural log of one plus amortized research & development (R&D) expenses in the past five years (i.e., $\sum_{k=0}^4 RD_{t-k}(1 - 0.2k)$), in which RD_t is R&D expenses at year t . *SGA* and *AD* are amortized sales, general, and administrative expenses and amortized advertisement expenses, respectively, similarly defined as *RDC*. *PROD_SALE* is labor productivity measured by the ratio of sales to the total number of employees. *PROD_NI* is labor productivity measured by the ratio of net income to the total number of employees. The sample period covers 2003 to 2022.

Variable	OBS	Mean	S.D.	P25	P50	P75
ROA	6130	0.14	0.08	0.10	0.14	0.18
WEIGHTED_DAMAGE	6130	0.10	0.06	0.00	0.12	0.14
CSR	6130	0.46	0.21	0.29	0.44	0.62
SIZE	6130	8.83	1.43	7.87	8.76	9.80
AGE	6130	3.61	0.62	3.22	3.85	4.11
PAGE	6130	2.65	0.53	2.40	2.76	3.02
INTANG	6130	0.33	0.19	0.18	0.31	0.46
RDC	6130	3.99	3.05	0.00	4.72	6.29
SGA	6130	6.86	2.67	6.31	7.33	8.38
AD	6130	1.71	2.78	0.00	0.00	3.43
PROD_SALE	6118	6.02	0.72	5.55	5.89	6.40
PROD_NI	6118	2.99	1.54	2.32	3.25	4.03

Table 2 Natural Disaster, Corporate Social Responsibility, and Operating Performance

This table presents our regression results using the following equation:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t-1} + \beta_3 H_CSR_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t}.$$

ROA is defined as a firm's income before depreciation in fiscal year *t* divided by total assets in fiscal year *t-1*. *WEIGHTED_DAMAGE* is the weighted damage by natural disasters to the counties where a firm has factories in. It is calculated as the natural log of one plus the weighted property damage of natural disasters at firm's factories' locations, with the weight determined by the size of each factory proxied by the total production-related waste. *H_CSR*, a dummy variable for high CSR, equals one in year *t-1* if the raw CSR score is in the top quartile within the year. *Xb* is a set of control variables that include *SIZE*, *SIZE2*, *AGE*, *PAGE*, *TANG*, *RDC*, *SGA*, and *AD*. *SIZE* is the natural log of total assets. *SIZE2* is the square of *SIZE*. *AGE* is the number of years a firm has been in the Compustat database. *PAGE* is the average age of plants; the age of a plant is the number of years it has existed in the TRI database. *INTANG* is the percentage of intangible assets defined as total assets minus current assets and net value of property, plants, and equipment scaled by total assets. *RDC* is the natural log of one plus amortized research & development (R&D) expenses in the past five years (i.e., $\sum_{k=0}^4 RD_{t-k}(1 - 0.2k)$), in which RD_t is R&D expenses at year *t*. *SGA* and *AD* are amortized sales, general, and administrative expenses and amortized advertisement expenses, respectively, similarly defined as *RDC*. *H_RDC*, *H_SGA*, *H_AD*, *H_CASH*, and *H_INTANG* are similarly defined as *H_CSR*. The sample period covers 2003 to 2022. Robust standard errors are double clustered at the state-year and industry-year level. p-values are reported in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2 (continued)

VARIABLES	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA
				Dummy	Two-Year
Weighted Damage	-0.072** (0.011)	-0.061** (0.033)	-0.069** (0.041)	-0.012*** (0.006)	-0.137*** (0.002)
Weighted Damage × H_CSR	0.080*** (0.007)	0.065** (0.042)	0.073* (0.079)	0.009* (0.093)	0.100** (0.044)
H_CSR	-0.016*** (0.000)	-0.013*** (0.005)	-0.015*** (0.003)	-0.014*** (0.002)	-0.018*** (0.002)
SIZE		0.082*** (0.003)	0.079** (0.014)	0.081** (0.011)	0.078** (0.014)
SIZE2		-0.004*** (0.004)	-0.004** (0.021)	-0.004** (0.017)	-0.004** (0.022)
AGE		-0.038** (0.015)	-0.028* (0.092)	-0.027 (0.108)	-0.029* (0.080)
PAGE		0.002 (0.784)	-0.001 (0.860)	-0.001 (0.890)	-0.002 (0.810)
RDC		-0.001 (0.825)	0.000 (0.972)	0.000 (0.976)	0.000 (0.897)
SGA		-0.012*** (0.003)	-0.013*** (0.009)	-0.013*** (0.010)	-0.013*** (0.008)
AD		-0.000 (0.822)	0.003 (0.186)	0.003 (0.217)	0.003 (0.186)
INTANG		-0.081*** (0.000)	-0.065*** (0.000)	-0.065*** (0.000)	-0.066*** (0.000)
H_RDC			-0.002 (0.815)	0.001 (0.921)	-0.005 (0.589)
H_SGA			0.005 (0.531)	0.004 (0.573)	0.003 (0.770)
H_AD			-0.018 (0.108)	-0.020* (0.068)	-0.019 (0.140)
H_CASH			0.006 (0.330)	0.004 (0.425)	0.007 (0.330)
H_INTANG			-0.014** (0.020)	-0.015*** (0.006)	-0.016** (0.019)
Weighted Damage × H_RDC			-0.019 (0.688)	-0.007 (0.312)	0.011 (0.859)
Weighted Damage × H_SGA			0.024 (0.654)	0.004 (0.559)	0.036 (0.598)
Weighted Damage × H_AD			-0.024 (0.673)	-0.000 (0.984)	-0.014 (0.862)
Weighted Damage × H_CASH			0.013 (0.751)	0.004 (0.427)	0.039 (0.464)
Weighted Damage × H_INTANG			0.010 (0.796)	0.003 (0.520)	0.001 (0.981)
Constant	0.153*** (0.000)	0.010 (0.939)	-0.012 (0.935)	-0.024 (0.874)	0.001 (0.993)
Observations	5,157	4,995	4,385	4,385	4,385
Industry-Year Fixed Effects	YES	YES	YES	YES	YES
State-Year Fixed Effects	YES	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Adjusted R-Squared	0.635	0.654	0.679	0.679	0.679

Table 3 Natural Disaster, Corporate Social Responsibility, and Labor Productivity

This table presents our regression results using the following equation:

$$PROD_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t}$$

PROD is labor productivity defined as a firm's net income in fiscal year *t* divided by the total number of employees (denoted as *PROD_NI*) or sales divided by the total number of employees (denoted as *PROD_SALE*). Net income is replaced by zero if it is negative. *WEIGHTED_DAMAGE* is the weighted damage by natural disasters to the counties where a firm has factories in. It is calculated as the natural log of one plus the weighted property damage of natural disasters at firm's factories' locations, with the weight determined by the size of each factory proxied by the total production-related waste. *H_CSR*, a dummy variable for high CSR, equals one in year *t-1* if the raw CSR score is in the top quartile within the year. *Xb* is a set of control variables that include *SIZE*, *SIZE2*, *AGE*, *PAGE*, *INTANG*, *RDC*, *SGA*, *AD*, *IND_YEAR*, and *STATE_YEAR*. *SIZE* is the natural log of total assets. *SIZE2* is the square of *SIZE*. *AGE* is the number of years a firm has been in the Compustat database. *PAGE* is the average age of plants; the age of a plant is the number of years it has existed in the TRI database. *INTANG* is the percentage of intangible assets defined as total assets minus current assets and net value of property, plants, and equipment scaled by total assets. *RDC* is the natural log of one plus amortized research & development (R&D) expenses in the past five years (i.e., $\sum_{k=0}^4 RD_{t-k}(1 - 0.2k)$), in which RD_t is R&D expenses at year *t*. *SGA* and *AD* are amortized sales, general, and administrative expenses and amortized advertisement expenses, respectively, similarly defined as *RDC*. The sample period covers 2003 to 2022. Robust standard errors are double clustered at the state-year and industry-year level. p-values are reported in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3 (continued)

VARIABLES	(1) PROD NI	(2) PROD NI	(3) PROD NI	(4) PROD SALE	(5) PROD SALE	(6) PROD SALE
	Whole	H_CSR=1	H_CSR=0	Whole	H_CSR=1	H_CSR=0
Weighted Damage	-0.925 (0.112)	2.347 (0.125)	-1.872** (0.013)	-0.120 (0.188)	0.069 (0.807)	-0.295*** (0.006)
SIZE	1.483*** (0.003)	-1.285 (0.677)	0.649 (0.356)	0.194** (0.034)	0.149 (0.733)	0.204* (0.096)
SIZE2	-0.073** (0.012)	0.018 (0.901)	0.003 (0.947)	-0.008* (0.091)	-0.004 (0.858)	-0.007 (0.312)
AGE	-0.196 (0.512)	2.921* (0.089)	0.111 (0.787)	0.017 (0.738)	-0.239 (0.257)	0.090 (0.192)
PAGE	-0.033 (0.808)	-0.058 (0.890)	0.157 (0.387)	-0.024 (0.281)	0.012 (0.844)	-0.017 (0.577)
RDC	-0.073 (0.190)	0.164 (0.502)	-0.188*** (0.010)	0.031*** (0.000)	0.100** (0.012)	0.022** (0.043)
SGA	-0.174** (0.018)	-0.259 (0.728)	-0.224** (0.050)	-0.028 (0.175)	0.169 (0.206)	-0.023 (0.507)
AD	-0.046 (0.115)	-0.026 (0.582)	-0.194*** (0.003)	0.008 (0.186)	0.014* (0.073)	-0.004 (0.726)
TANG	-0.795** (0.017)	0.700 (0.428)	-1.952*** (0.000)	-0.092** (0.044)	-0.192* (0.088)	-0.257*** (0.001)
Constant	-1.469 (0.491)	4.615 (0.764)	-0.391 (0.896)	5.089*** (0.000)	4.243* (0.087)	4.695*** (0.000)
Observations	5,091	696	3,505	5,091	696	3,505
Industry-Year Fixed Effects	YES	YES	YES	YES	YES	YES
State-Year Fixed Effects	YES	YES	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R-Squared	0.532	0.282	0.538	0.956	0.961	0.954

Table 4 The Role of Job Satisfaction and Customer Loyalty

This table presents our regression results using the following equation:

$$ROA_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} * H_VALUE_{i,t-1} + \beta_2 WEIGHTED_DAMAGE_{i,t-1} * H_CSR_{i,t-1} + \beta_3 WEIGHTED_DAMAGE_{i,t-1} * H_VALUE_{i,t-1} + \beta_4 H_CSR_{i,t-1} * H_VALUE_{i,t-1} + \beta_5 WEIGHTED_DAMAGE_{i,t-1} + \beta_6 H_CSR_{i,t-1} + \beta_7 H_VALUE_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \varepsilon_{i,t}.$$

ROA is defined as a firm's income before depreciation in fiscal year *t* divided by total assets in fiscal year *t-1*. *WEIGHTED_DAMAGE* is the weighted damage by natural disasters to the counties where a firm has factories in. It is calculated as the natural log of one plus the weighted property damage of natural disasters at firm's factories' locations, with the weight determined by the size of each factory proxied by the total production-related waste. *H_CSR*, a dummy variable for high CSR, equals one in year *t-1* if the raw CSR score is in the top quartile within the year. *H_VALUE*, a dummy variable that equals one if a firm belongs to the "100 Best Companies to Work For in America" list (column (1)) or in the 100 Best Global Brands list (column (2)). *Xb* is a set of control variables that include *SIZE*, *SIZE2*, *AGE*, *PAGE*, *TANG*, *RDC*, *SGA*, and *AD*. *SIZE* is the natural log of total assets. *SIZE2* is the square of *SIZE*. *AGE* is the number of years a firm has been in the Compustat database. *PAGE* is the average age of plants; the age of a plant is the number of years it has existed in the TRI database. *INTANG* is the percentage of intangible assets defined as total assets minus current assets and net value of property, plants, and equipment scaled by total assets. *RDC* is the natural log of one plus amortized research & development (R&D) expenses in the past five years (i.e., $\sum_{k=0}^4 RD_{t-k}(1 - 0.2k)$), in which *RD_t* is R&D expenses at year *t*. *SGA* and *AD* are amortized sales, general, and administrative expenses and amortized advertisement expenses, respectively, similarly defined as *RDC*. *H_RDC*, *H_SGA*, *H_AD*, *H_CASH*, and *H_INTANG* are similarly defined as *H_CSR*. The sample period covers 2003 to 2022. Robust standard errors are double clustered at the state-year and industry-year level. p-values are reported in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4 (continued)

VARIABLES	(1) ROA	(2) ROA
H_VALUE defined by	Best Firm	Best Brands
Weighted Damage	-0.131*** (0.000)	-0.131*** (0.000)
Weighted Damage × H_CSR × H_VALUE	0.444** (0.029)	0.421** (0.046)
Weighted Damage × H_CSR	0.088* (0.072)	0.071 (0.161)
H_CSR × H_VALUE	-0.002 (0.932)	-0.026 (0.245)
Weighted Damage × H_VALUE	-0.412*** (0.004)	-0.293 (0.149)
H_VALUE	0.032* (0.100)	0.027 (0.177)
H_CSR	-0.003 (0.559)	-0.001 (0.848)
Constant	-0.137** (0.013)	-0.139** (0.013)
All Control Variables	YES	YES
Observations	4,423	4,423
Industry-Year Fixed Effects	YES	YES
State-Year Fixed Effects	YES	YES
Year Fixed Effects	YES	YES
Adjusted R-Squared	0.278	0.277

Table 5 Natural Disaster, Corporate Social Responsibility, and Sales

This table presents our regression results using the following equation:

$$SALE_{i,t} = \beta_0 + \beta_1 WEIGHTED_DAMAGE_{i,t-1} + \mathbf{Xb}_{i,t} + \rho_{s,t} + \sigma_{j,t} + \mu_t + \eta_i + \varepsilon_{i,t}$$

SALE is a firm's capability in generating sales from its assets measured by sales divided by beginning-of-the-year total assets. *WEIGHTED_DAMAGE* is the weighted damage by natural disasters to the counties where a firm has factories in. It is calculated as the natural log of one plus the weighted property damage of natural disasters at firm's factories' locations, with the weight determined by the size of each factory proxied by the total production-related waste. *H_CSR*, a dummy variable for high CSR, equals one in year *t*-1 if the raw CSR score is in the top quartile within the year. *L_CSR* is a dummy variable that equals one if *H_CSR* equals zero. *Xb* is a set of control variables that include *SIZE*, *SIZE2*, *AGE*, *PAGE*, *INTANG*, *RDC*, *SGA*, *AD*, *IND_YEAR*, and *STATE_YEAR*. *SIZE* is the natural log of total assets. *SIZE2* is the square of *SIZE*. *AGE* is the number of years a firm has been in the Compustat database. *PAGE* is the average age of plants; the age of a plant is the number of years it has existed in the TRI database. *INTANG* is the percentage of intangible assets defined as total assets minus current assets and net value of property, plants, and equipment scaled by total assets. *RDC* is the natural log of one plus amortized research & development (R&D) expenses in the past five years (i.e., $\sum_{k=0}^4 RD_{t-k}(1 - 0.2k)$), in which RD_t is R&D expenses at year *t*. *SGA* and *AD* are amortized sales, general, and administrative expenses and amortized advertisement expenses, respectively, similarly defined as *RDC*. The sample period covers 2003 to 2022. Robust standard errors are double clustered at the state-year and industry-year level. p-values are reported in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5 (continued)

VARIABLES	(1) SALE	(2) SALE	(3) SALE
	Whole	H_CSR=1	H_CSR=0
Weighted Damage	-0.090** (0.010)	-0.084 (0.326)	-0.107** (0.027)
SIZE	-0.180*** (0.000)	-0.472*** (0.000)	-0.301*** (0.000)
SIZE2	0.003 (0.135)	0.012** (0.016)	0.011*** (0.000)
AGE	0.032 (0.153)	-0.129* (0.081)	0.102*** (0.001)
PAGE	-0.009 (0.311)	0.025 (0.191)	-0.045*** (0.000)
RDC	0.020*** (0.000)	-0.024 (0.173)	0.021*** (0.000)
SGA	0.019** (0.016)	0.208*** (0.000)	0.015 (0.183)
AD	0.005*** (0.004)	0.007** (0.012)	0.000 (0.992)
TANG	-0.189*** (0.000)	0.012 (0.717)	-0.223*** (0.000)
Constant	1.682*** (0.000)	3.041*** (0.000)	1.988*** (0.000)
Observations	5,102	698	3,514
Industry-Year Fixed Effects	YES	YES	YES
State-Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Adjusted R-Squared	0.936	0.945	0.935