Rethinking Capital Structure Decision and Corporate Social Responsibility in Response to COVID-19*

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Abstract

COVID-19 has severely constricted the global economic activities. This paper examines the joint effect of capital structure and corporate social responsibility (CSR) activities on firm risk during COVID-19. We find that firms having excessive debt beyond the optimal level experienced high firm risk during the pandemic and the effect is more prevalent among firms with poor CSR performance. In contrast, firms with a debt level below the optimum are self-protected regardless of their CSR practices. Our study provides businesses with insights of post-pandemic directions on capital structure and CSR policies to build up sustainability and resilience in a volatile market.

1. Introduction

COVID-19 has attracted great attention from the public and researchers. Shops shutdown, travel restrictions, international border closures, all of which, devastatingly hit the global economy. The global financial markets plummeted in response to the uncertainty and public fear caused by COVID-19. For example, Dow Jones Industrial Average plunged by 36% in the U.S. market and Australian ASX200 index dropped by 24% within only about one month (from 20 February 2020 to 23 March 2020), to name a few. Many businesses have been negatively impacted by the public health crisis, suffering from financial distress by taking too much debt[1]. On the other hand, firms with strong corporate social responsibility (CSR) practices perform relatively better (see Albuquerque et al., 2020; Ding et al., 2020). Previous studies document that either firm's capital structure policy or CSR activities play a vital role during a market crash (see Bernanke et al., 1990, Reinhart and Rogoff, 2011; Lins et al., 2017). In this paper, we investigate how an effective use of both capital structure policy and CSR engagements can reduce firm risk from the perspectives of total risk, idiosyncratic risk, systematic risk and bankruptcy risk, through which avoids business failure. Our paper provides businesses with useful directions on capital structure and CSR policies that enhances their sustainability and resilience in the post-pandemic era.

It has been widely accepted that engagements in CSR increase shareholders' welfare. Many research papers study the impact of CSR on firm value and argue that CSR can bring various advantages to firms (see Godfrey, 2005; Luo and Bhattacharya, 2006; Lins et al., 2017; Liu and Tian, 2019; Chen et al., 2020) and reduce firm risk (see Sharfman and Fernando, 2008; Jo and Na, 2012; Albuquerque et al., 2018; Benlemlih et al., 2018). CSR also has been proved to be a protective measure that reduces drop in stock prices during a crisis period and immunises stakeholders against other sources of risk (Albuquerque et al., 2020; Ding et al., 2020). In addition, Bae et al. (2019) document that CSR prevents firms with high leverage from being crowded out by competitors and mitigates the cost of being highly leveraged and the associated risk. As a result,

[1] The number of U.S. listed companies filing for bankruptcy from January to May in 2020 doubled, compared with the same period in 2019. The bankruptcy information of public companies is obtained from UCLA-LoPucki Bankruptcy Research Database (BRD). According to BRD, there are 24 bankruptcy cases of public companies from January to May in 2020 and 12 public companies filed for bankruptcy during the same period in 2019. In addition, U.S. nationwide bankruptcy cases that filed for Chapter 11 rose by 23% in 2020, compared with the same period in 2019, according to American Bankruptcy Institute.

CSR can be viewed as a remedial tool for firms with high leverage, protecting firms from going bankrupt.

Firms with high financial flexibility (i.e. more cash holdings and less debt) are less influenced negatively by COVID-19 (see Ding et al., 2020; Fahlenbrach et al., 2020; Liu et al., 2020). In other words, firms with high leverage face greater risk than those with low leverage. This could be due to the fact that firms with high financial flexibility (low financial leverage) have more debt capacity so that they have easier access to funds when a shortage of cash flows caused by an exogenous shock results in a business liquidity problem. The recent literature on the impact of COVID-19 on firm performance and risk and its channel focuses on CSR and firm characteristics independently. Little empirical research to date examines the joint effect of CSR and corporate debt level on firm risk during COVID-19. Our paper fills this gap by addressing the effective way of determining capital structure policy and CSR activities that can reduce firm risk and survive the pandemic. We also highlight the possible changes in corporate capital structure decision to accommodate the CSR engagements, leading to a more sustainable future of the businesses.

In this paper, we apply a novel measure that determines the level of being highly leveraged. We call it "overleverage" – the difference between actual leverage and optimal leverage with the actual greater than the optimal, motivated by the trade-off theory of capital structure[2] (Kraus and Litzenberger, 1973). The trade-off theory suggests that every firm has an optimal capital structure that maximises firm value, at which marginal benefits of debt (e.g. interest tax benefits) equal marginal costs of debt (e.g. financial distress cost). We apply the Bayesian model proposed by Korteweg (2010) and derive our optimal leverage measure[3]. We argue that overleveraged firms are more vulnerable to COVID-19 and exposed to higher risk as they are more financially inflexible and face higher bankruptcy risk. Underleveraged firms, on the other hand, are not as risky as overleveraged ones for two reasons. First, being underleveraged protects firms from being insolvent due to a sudden shortage of cash flows. Underleveraged firms can still fulfill their debt obligation. Second, firms seek external funds, particularly bank borrowings and corporate debt issuance, to meet the dried-up liquidity needs arising from the onset COVID-19 (see Halling et al., 2020; Li et al., 2020). In this case, underleveraged firms have more debt capacity than

[2] Overleverage means that a firm's actual leverage is higher than its optimal level. Underleverage, on the other hand, suggests that a firm's actual leverage is lower than its optimum.
[3] The details on the construction of model-implied optimal leverage are presented in Section 3.

overleveraged ones so that they are more willing to increase debt levels while staying away from financial distress. However, overleveraged firms find it too costly to borrow more, which might drive them into an extremely dangerous situation, i.e. going bankrupt, especially during a global crisis period.

To further examine how commitments in CSR alter the risk exposure for overleveraged firms versus underleveraged ones, we run separate regressions for overleveraged and underleveraged subsamples based on tercile-sorted CSR scores (social score, environmental score, and community score), obtained from Thomson Reuters ASSET4. We first regress risk measures on excess leverage[4] conditional on social score and environmental score individually as social and environmental ratings represent different aspects of CSR. In addition, we particularly take community score into account since community score measures corporate engagements in protecting public health and behaving beneficially to the society. Therefore, community score is a crucial indicator of CSR strength during the public health crisis. Following Albuquerque et al. (2020), we also use the average of social and environmental scores as our robustness test. The dependent variables in the regressions are different types of risk, including total risk, idiosyncratic risk, systematic risk and bankruptcy risk. As strong CSR practices prove to reduce losses in market share for highly leveraged firms and stabilise these firms at low risk levels, we argue that overleveraged firms are more volatile during COVID-19 when firms have poor CSR engagements. Since CSR is a remedial tool for highly leveraged firms (Bae et al., 2019), strong commitments in CSR can also mitigate risk exposure for overleveraged firms. In contrast, being underleveraged provides various benefits during the crisis as mentioned above and therefore we argue that underleveraged firms are risk-resistant despite CSR practices.

Our results suggest the following. First, firms with more excess leverage experience higher risk during COVID-19, consistent with some COVID-19 studies that firms with high leverage react more negatively in market performance (see Ding et al., 2020; Fahlenbrach et al., 2020). We further split the sample into two subsamples based on whether firms are overleveraged or not. We find that the results remain unchanged for overleveraged firms whereas underleveraged ones display a significant risk reduction when excess leverage increases. This could be explained by the trade-off theory: Underleveraged firms do not fully utilise their debt capacity to take advantage of

[4] Excess leverage is the deviation from optimal leverage, defined as actual leverage minus optimal leverage.

interest tax benefits and therefore firm value increases with debt level until it reaches the optimal point. The benefits of using debt are amplified by the COVID-19 outbreak due to an immediate shortage of cash flow (see Halling et al., 2020; Li et al., 2020). Second, overleveraged firms with low social and environmental scores have more risk exposures to COVID-19. Firms with both overleverage and high social and environmental scores do not significantly react to the COVID-19 shock. The findings suggest that CSR plays an important role in reducing firm risk for overleveraged firms as an alternative way to rescue these businesses from the pandemic, supporting the findings in Bae et al. (2019). Underleveraged firms, on the other hand, appear immune from the public health crisis regardless of their CSR practices. The results show that underleveraged firms are self-protected from increasing firm risk with excess leverage in the volatile market. Community score yields the similar results. Third, we extend the baseline analysis with respect to total market volatility to investigate the differences in firm risk between overleveraged and underleveraged firms. Our results further suggest that risk exposures for overleveraged firms increase with market volatility whereas being underleveraged immunises businesses against the market volatility caused by the COVID-19 crisis.

This paper contributes to the existing literature on capital structure, CSR, and COVID-19 in the following ways. First, we provide evidence of how the effective corporate policies on capital structure and CSR reduce firm risk amid the outbreak of COVID-19. Previous studies shed light on the importance of CSR practices on firm value and risk. In particular, global business operations are severely interrupted by COVID-19 and therefore good CSR practices shield businesses from the crisis (Ding et al., 2020; Albuquerque et al., 2020). However, recent studies on the COVID-19 impact on firm performance focus on either CSR only or debt level only, and therefore ignore the possible joint effect. As a result, this paper addresses the remedial arrangement, efficiently determining financial leverage and engaging in CSR activities, to minimise the unfavourable impact of the crisis and develop sustainability and resilience during the market downturn. In addition, our sample period covers pre-COVID-19 and within-COVID-19 periods, including the full year of 2019 and the first five months of 2020 whereas most COVID-19 studies focus on the first quarter or the first half of 2020. We provide a clear cut between the pre-pandemic and pandemic periods, showing a strong and plausible connection between capital structure associated with CSR and firm risk.

Second, our paper brings additional insights on the two competing views of CSR (i.e. whether CSR is value-enhancing or value-destroying). Many studies support the value-added view of CSR (see Edman, 2011; Deng et al., 2013; Albuquerque et al., 2018; Bae et al., 2019), while the opposing view of CSR that destroys shareholders' wealth still exists, arguing that CSR is part of agency problems (see Friedman, 1970; Masulis and Reza, 2015). Our results support the value-added view of CSR for overleveraged firms and also draw attention to the underleveraged firms that could have the overinvestment problem of CSR.

Lastly, our study lends support to the studies emphasising the urgent needs for firms to adjust the ways they operate the business so that firms take into account the entire social welfare (Linnenluecke et al., 2016, 2017). Specifically, the outbreak of COVID-19 urges businesses to rethink the effectiveness of corporate policies, which can strengthen the ability to survive a crisis. Therefore, our paper suggests that to maintain stable business activities during market downturns such as COVID-19, firms need to construct a reasonable debt level and engage in proper CSR activities.

The rest of the paper is presented as follows. Section 2 reviews the related literature and develops the hypotheses. Section 3 describes the data and the methodology used in this paper. The main findings and analyses are presented in Section 4. Section 5 concludes.

2. Literature and Hypotheses Development

COVID-19 came as a shock to the financial markets all over the world, and as a consequence the markets became extremely volatile and more corporate bankruptcies were observed within such a short period of time. Businesses are seeking for financial assistance to remain in day-to-day operations. The questions arise: How can firms protect themselves from the market downturn and survive the economic recession caused by the public health crisis? Is there any lesson that can be learnt from COVID-19 in order to build a more sustainable future economy? This paper focuses on influencing firm risk through debt level and CSR channels and argues that corporate capital structure decisions in conjunction with engagements in CSR activities help firms immunise against the pandemic.

2.1 Capital structure and firm risk

The trade-off theory of capital structure (Kraus and Litzenberger, 1973) suggests that firm value is maximised at the optimal capital structure where marginal benefits and marginal costs of using debt are equal. Therefore, overuse of debt exceeding the optimal level leads to a firm value decline and a firm risk increase, called "overleverage". In addition, positive deviation from optimal capital structure increases the likelihood of financial distress, causing firms to file for bankruptcy. On the other hand, firm value continues to increase with the debt level that is below the optimal level of capital structure to capture the interest tax benefits whilst remaining at a low degree of bankruptcy risk. In other words, underleveraged firms have more debt capacity to undertake new investments through debt borrowing (Machica and Mura, 2010). As a result, being underleveraged provides firms with more liquidity and safety, especially in the event of a sudden cash flow shortage. However, a low debt level also causes agency problem between shareholders and managers. Entrenched managers have more spare cash holdings to spend for their own sake rather than at the best interest of shareholders (Jensen, 1986), but managerial entrenchment is mitigated in the economic recession (Kesten, 2010) and managers care more about their job security. Therefore, a low debt level may not be a concern of the presence of agency conflict between shareholders and managers during a crisis period. Moreover, since the main focus of this paper is not on the determinants of capital structure, we therefore develop our hypotheses on the basis of the trade-off theory and stress the importance of the trade-off theory of capital structure on firm risk during market downturns.

The demand for external funds increases in the presence of a cash flow shortage arising from COVID-19 as almost all the business activities are forced to close in order to stop the spread of the virus. As a result, firms are negatively impacted by the pandemic shock and seeking for more funds to manage the liquidity shortage. Halling et al. (2020) find that the bond market becomes more active from the outbreak of COVID-19 and Li et al. (2020) and Acharya and Steffen (2020) further document that the pandemic increases bank lending and credit line drawdowns, respectively. Firms' ability to borrow from either capital markets or banks depends on their current debt capacity. For example, when firms adopt the conservative debt policy that preserves financial flexibility, they can finance new investments with more debt issues (Marchica and Mura, 2010). Therefore, keeping financial leverage at a low level provides more debt capacity and financial

flexibility, which brings particular benefits to firms during market downturns. Fahlenbrach et al. (2020) find that firms with high financial flexibility lose less market value than those with low financial flexibility as a result of COVID-19. In other words, firms with more debt are exposed to higher risk than those with less debt as financial leverage is significantly positively correlated with stock return volatility (see Black, 1976; Christie, 1982; Schwert, 1989). Different from Fahlenbrach et al. (2020) using quartile sorting to classify high and low financial flexibility, we employ a more direct measure of firm debt capacity, i.e. deviation from optimal capital structure, to test the risk variations between overleveraged and underleveraged firms.

The trade-off theory of capital structure and the impact of financial leverage on firm risk during COVID-19 lead to the following hypothesis:

Hypothesis 1: Overleveraged (Underleveraged) firms have higher (lower) risk during COVID-19.

2.2 Capital structure and CSR

CSR has received popularity over the past decade. Engagements in CSR activities affect all stakeholders, to a broader extent, including anyone in the society that can be influenced. For example, if firms engage in more green energy activities that help slow down the global warming, everyone can benefit from such initiatives (Linnenluecke et al., 2019). Corporate considerations about employees' welfare such as health, safety and wellbeing are viewed positively by investors, which enhance firm value and reduce firm risk (Jo and Na, 2012; Pérez-Gladish et al., 2012; Lee and Kim, 2016; Benlemlih et al., 2018). As a result, CSR activities create value to the whole economy, increase social welfare, and build a more sustainable world. CSR engagements also strengthen the trust between a firm and its stakeholders and especially keep the firm immune from a crisis (Lins et al., 2017). Godfrey (2005) and Bae et al. (2019) claim that CSR acts as insurance that protects shareholders and therefore investments in CSR are regarded as insurance premium. The evidence from COVID-19 further confirms the insurance role of CSR. For example, Albuquerque et al. (2020) and Ding et al. (2020) find that CSR practices mitigate the decline in firm value triggered by the pandemic and reduce the risk exposure to the crisis. Such findings stress the importance of CSR in preserving firm value and reducing risk in a crisis, suggesting that companies can build up resilience to a negative market shock through investments in CSR. This paper differs from previous CSR-related studies in the way that it focuses on the joint effect of

CSR and capital structure on firm risk, particularly during a crisis period. COVID-19 forces firms to think about a new "normal" strategy to run the business such that they survive the crisis and enhance adaptability for the future. In addition to the protection that CSR provides, it is also necessary to consider how to reduce bankruptcy risk to avoid liquidation or restructuring during market downturns. Bankruptcy risk is closely related to a firm's debt level, and therefore how corporate executives determine the capital structure may directly affect the firm's future.

As discussed above, the trade-off theory of capital structure suggests that overleveraged firms are more likely to be in financial distress than underleveraged ones. Hence, making a good capital structure decision greatly helps reduce bankruptcy risk when firms are experiencing financial difficulty. Since CSR provides the insurance-like protection to preserve firm value and lowers volatility from the outbreak of the pandemic, a high debt level with great financial distress risk can further highlight the insurance role of CSR. Alternatively, CSR protects overleveraged firms from being bankrupt. Bae et al. (2019) find that CSR improves firm value through reducing adverse impact of high leverage on product market performance, implying that CSR is a remedial tool for firms with high leverage. In other words, CSR helps reduce risk when firms are highly leveraged. The effect is more pronounced during COVID-19 as more firms have financial trouble and are financially distressed. This paper empirically tests the protective role of CSR for highly leveraged firms. With the trade-off theory, we provide a clear definition of high leverage – overleverage, i.e. a positive deviation from optimal capital structure. We argue that the effective policies on capital structure and CSR can greatly reduce firm risk for overleveraged firms during the pandemic and keep them immune from the market downturn. Therefore, we extend Hypothesis 1 with CSR as follows:

Hypothesis 2: Overleveraged firms have (do not have) higher risk during COVID-19 whilst they have poor (good) CSR practices in place.

On the other hand, the insurance-like protection can be weakened for underleveraged firms as they are far away from financial distress and still have more benefits of using debt than the associated costs. Underleveraged firms also have more debt capacity to seek for external funds to meet the short-term operation needs. In this case, underleveraged firms are self-protected by adopting a low level of capital structure. As a result, CSR practices in underleveraged firms may

not be as effective in risk reduction as in overleveraged firms in response to the COVID-19 shock, leading to the following hypothesis:

Hypothesis 3: Underleveraged firms do not have higher risk during COVID-19 regardless of their CSR practices.

3. Data and Methodology

3.1 Sample selection

We obtain stock return data in CRSP and accounting records in COMPUSTAT from January 2016 to May 2020 for U.S. public companies but exclude financial and regulated utilities companies with SIC between 6000-6999 and 4900-4999, respectively. Our main results cover the period from January 2019 to May 2020, which is the full year before the pandemic started and five months after. Our sample ends in May 2020 to avoid the contamination of market volatility from other events such as "Black Lives Matter" protest. The data from January 2016 to December 2018 is used to calculate our rolling window firm risk, which is discussed in detail later. CSR performance is sourced from Thomson Reuters ASSET4 database. Table 1 shows variable definitions and Table 2 presents summary statistics, including the mean, standard deviation, minimum, median and maximum, on all the variables that are used throughout the paper. The details of constructing these variables are provided in Section 3.2.

[Insert Tables 1 and 2 about here]

3.2 Measures and model construction

3.2.1 Total risk, systematic risk, and idiosyncratic risk

We use firms' total risk, systematic risk, and idiosyncratic risk as proxies for firm risk. Total risk evaluates the aggregated risk exposure of a firm to COVID-19. Systematic risk measures the risk coming from the market and idiosyncratic risk reveals the firm-specific volatility. Since

the outbreak of COVID-19 impacted the financial markets globally, we examine the effect of capital structure and CSR on various sources of firm risk.

Following Favara et al. (2012), we first estimate the firms' total risk (*Stock volatility*) as the standard deviation of rolling monthly stock returns over the past 36 months. Instead of using 60-month rolling windows, we employ 36-month rolling windows to capture the COVID-19 shock. Choosing a longer rolling window can smooth the impact of COVID-19. We then use the CAPM (Sharpe, 1964) model to estimate the systematic risk (*Beta*) using 36-month rolling windows in a regression $r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$, where r_{it} is the excess return on the stock of firm i and r_{mt} is the market risk premium from Kenneth R. French Data Library. The firms' idiosyncratic risk (*Idiosyncratic risk*) is estimated as the standard deviation of residuals from CAPM based on the monthly returns using 36-month rolling windows.

3.2.2 Financial distress risk

In addition to firms' stock return volatilities, we measure firm's financial distress risk to evaluate the likelihood of being bankrupt. As COVID-19 has already resulted in many bankruptcy cases, it is crucial to examine the impact of deviation from optimal capital structure and CSR on the financial distress risk, which provides supporting evidence that the effective corporate policies on capital structure and CSR can reduce the chance of business failure.

We follow the Vassalou and Xing (2004) distance-to-default (DD) method, using an iterative procedure, to estimate expected default frequency (EDF) as a proxy for financial distress risk. Hillegeist et al. (2004) suggest that the market-based DD model is superior to the accounting-based models such as Z-Score and O-Score in studying corporate bankruptcy, and it has been employed in many studies on corporate bankruptcy to determine a firm's default probability (see Hillegeist et al., 2004; Gharghori et al., 2006; Acharya et al., 2007; Bharath and Shumway, 2008; Schultz et al., 2017).

Following Vassalou and Xing (2004), EDF is expressed as

$$\mathrm{EDF} = \mathrm{N}(-\mathrm{DD}) = \mathrm{N}\left(-\frac{\ln\left(\frac{\mathrm{V_t}}{\mathrm{F_t}}\right)+\left(\mu_{\mathrm{V}}-\frac{1}{2}\sigma_{\mathrm{V}}^2\right)\mathrm{T}}{\sigma_{\mathrm{V}}\sqrt{\mathrm{T}}}\right) \quad (1)$$

where F_t is the face value of corporate debt at time t; T is the time to maturity; V_t represents the market value of a firm's underlying assets and follows a geometric Brownian motion with a constant drift μ_V and a constant volatility σ_V

$$dV_t = \mu_V V dt + \sigma_V V dB_t \quad (2)$$

where B_t is a standard Brownian motion.

3.2.3 Excess leverage

Excess leverage is one of the variables of interest in this paper, measuring a firm's degree of deviating from optimal capital structure. We define excess leverage as actual leverage minus optimal leverage. Henceforth, excess leverage is positive for overleveraged firms and negative for underleveraged ones. Determining a firm's optimal capital structure is most challenging. Most existing studies on optimal capital structure focus on the target debt level using a regression approach rather than a value maximisation way (see Flannery and Rangan, 2006; Cook and Tang, 2010; Oztekin and Flannery, 2012; Zhou et al., 2016). However, firm value maximisation is central to the trade-off theory of capital structure. Therefore, we apply the methodology from Korteweg (2010), whose Bayesian estimation yields an optimal debt level that maximises firm value:

$$\frac{B_{it}}{V_{it}^L} = X'_{0it}\theta_0 + (X'_{1it} * L_{it})\theta_1 + (X'_{2it} * L_{it}^2)\theta_2 \quad (3)$$

where B_{it} is the net benefits of debt; V_{it}^L is the levered firm market value; X'_{0it}, X'_{1it}, X'_{2it} are the vectors that represent firm characteristics; θ_0, θ_1, θ_2 stand for parameter estimates for the corresponding firm characteristics, which are time-invariant and apply to all firms.

A firm's optimal leverage is estimated from Equation (3) based on a series of firm characteristics and parameters from Korteweg (2010). The parameter estimates θ_0, θ_1, θ_2 are directly applied in this paper as per Table 3 of Korteweg (2010). As suggested in the Korteweg website[5], the parameters can be adapted to any time period as they are time-invariant. Firm characteristic vectors X include profitability, depreciation, profitability volatility, PPE, market-to-book ratio, firm size. By maximising Equation (3) with the above firm characteristics and the θ

[5] Arthur Korteweg data website: http://www-bcf.usc.edu/~korteweg/datacode.html

parameters, the optimal leverage is obtained. In addition, we follow Korteweg (2010) to define the financial leverage as net debt value (i.e. total value of debt minus cash holdings) over the sum of net debt value and market value of equity. Therefore, this measure well captures the financial flexibility that requires low debt level and more cash holdings, which further indicates that excess leverage reflects debt capacity and financial flexibility and supports our arguments.

3.2.4 CSR

We employ three measures of CSR from Thomson Reuters ASSET4, *Social score*, *Environmental score*, and *Community score*. Corporate governance is not considered as part of CSR, since corporate governance is more related to agency problem between shareholders and managers (Servaes and Tamayo, 2013). Therefore, this paper puts emphasis on social and environmental aspects of CSR, similar to Chen et al. (2020), Ding et al. (2020) and Albuquerque et al. (2020). *Community score* measures the firm's commitments to public health protection, business ethics, and being good citizens, which is specifically incorporated in this paper as COVID-19 is a public health crisis and how a firm is devoted to public health protection can have a positive influence on risk reduction.

3.2.5 Control variables

Following Ding et al. (2020) and Albuquerque et al. (2020), we include firm-level controls such as firm size (*Size*), market to book ratio (*Market to Book*) and profitability (*ROA*), which are winsorised at 1% and 99%. We also include the optimal leverage (*Optimal leverage*) to control for financial leverage. We do not use a firm's actual leverage as the control variable to avoid the multicollinearity issue given the fact that the excess leverage as the variable of interest is part of the actual leverage, similar to Uysal (2011).

3.2.6 Model construction

Our results are based on the following regression:

$$\text{Risk}_{it} = \beta_0 + \beta_1 * \text{COVID} * \text{Excess leverage}_{it-1} + \beta_2 * \text{COVID} + \beta_3 * \text{Excess leverage}_{it-1} + \beta_4 * \text{Size}_{it-1} + \beta_5 * \text{ROA}_{it-1} + \beta_6 * \text{Optimal leverage}_{it-1} + \beta_7 * \text{Market to Book}_{it-1} + \text{Firm fixed effects} + \text{Industry fixed effects} + \varepsilon_{it} \quad (4)$$

To investigate the joint effect of capital structure and CSR on firm risk during COVID-19, we conduct a tercile sorting of the sample on CSR measures, split the sample into overleveraged and underleveraged ones and run the above regression for each subsample (i.e. low CSR & overleveraged, low CSR & underleveraged, high CSR & overleveraged, and high CSR & underleveraged).

4. Empirical Results

4.1 Excess leverage and firm risk

Table 3 presents the baseline regression results of the impact of COVID-19 and the deviation from the optimal leverage on firm risk. The variable of interest throughout Table 3 is the interaction term, *COVID*Excess leverage*. *COVID* is the indicator variable that indicates the COVID-19 period from January 2020 to May 2020. The interaction variable provides supporting evidence for Hypothesis 1. Our results show that firms experienced higher stock return volatility and financial distress risk during the COVID-19 pandemic as shown in Table 3 Panel A. The results are aligned with the findings by Albuquerque et al. (2020) and Ding et al. (2020) on stock market performance whereas this paper investigates the impact of COVID-19 from the risk perspectives. The effects are stronger for those with higher excess leverage, i.e. overleveraged firms.

To further examine the impact of the deviation from the optimal capital structure on firm risk in accordance with Hypothesis 1, we break down the sample into overleveraged (i.e. positive excess leverage) and underleveraged subsamples (i.e. negative excess leverage) in Panel B and C, respectively. The results show that during the pandemic higher firm risk is concentrated in overleveraged firms, while for firms in underleveraged subsample excess leverage results in lower firm risk. Specifically, Table 3 Panel B shows that overleveraged firms display higher total risk, idiosyncratic risk, and bankruptcy risk with higher excess leverage. The results suggest that overleveraged firms have much larger risk exposures to COVID-19 when firms deviate more from optimal capital structure in a positive direction, consistent with Hypothesis 1. For example, one standard deviation increase in excess leverage corresponds to a 0.77% increase in total risk, 0.61% increase in idiosyncratic risk and a noticeably large increase in EDF (i.e. bankruptcy risk)

accounting for 3.25%. Systematic risk is positively but insignificantly affected for overleveraged firms during COVID-19, implying that systematic risk may not be impacted by excess leverage during a crisis since systematic risk is a risk type comoving with the market. In other words, the financial markets become volatile during COVID-19 and therefore stocks move with the markets, which does not change much systematic risk with excess leverage. Overall, firm risk increases with excess leverage for overleveraged firms during the pandemic, among which bankruptcy risk is most impacted. This is consistent with the trade-off theory of capital structure that as a firm's capital structure exceeds its optimal level, the bankruptcy cost arising from debt outweighs the interest tax benefit of using debt. The effect is more pronounced during a crisis.

On the other hand, underleveraged firms exhibit risk reduction with increased excess leverage during COVID-19. The results are consistent with Hypothesis 1 that underleveraged firms have lower risk during the pandemic, suggesting that underleveraged firms have debt capacity to borrow more in order to fill the sudden shortage of cash flows caused by COVID-19. The outbreak of the pandemic triggered more corporate borrowing activities, indicating that firms have more external funding requirements to meet the internal cash flow shortfall (see Acharya and Steffen, 2020; Halling et al., 2020; Li et al., 2020). Table 3 Panel C shows that one standard deviation increase in excess leverage results in 0.65% decrease in stock volatility and 4.91% drop in EDF. Systematic risk also significantly drops by 0.16 with one standard deviation increase in excess leverage, which is contrary to overleveraged subsample. This suggests that financial flexibility plays an important role in a crisis, which helps reduce systematic risk. Though systematic risk is not exacerbated with low financial flexibility, high financial flexibility reduces risk, evidenced by the underleveraged subsample. Our findings confirm the trade-off theory of capital structure in the way that being underleveraged preserves debt capacity and keeps at a low degree of financial distress whereas taking excessive debt increases bankruptcy risk. The preservation of debt capacity is crucial in the event of a crisis such as COVID-19, which allows firms to borrow more and survive.

[Insert Table 3 about here]

Given that the overleveraged and underleveraged regressions yield opposing results regarding systematic risk, we therefore conduct further analysis to investigate the difference. We

replace the interaction term *COVID*Excess leverage* with a new interacted variable *COVID*Market Vol* and regress systematic risk on the main variable *COVID*Market Vol* and other control variables. Table 4 Column 1 presents the results for the overleveraged firms. We find that during the pandemic systematic risk for overleveraged firms is positively significant to market volatility (*coef.* = 12.082 and *t-statistics* = 2.921). This is consistent with the result in Table 3 Panel B that for overleveraged firms, systematic risk comes from the market and therefore increases with the market volatility. On the contrary, during COVID-19 no significant relationship exists between underleveraged firms' systematic risk and market volatility as shown in Table 4 Column 2 (*coef.* = -3.177 and *t-statistics* = -1.007). This finding implies that the insensitivity of systematic risk to market volatility is due to the fact that underleveraged firms have more debt capacity and financial flexibility to increase their debt level and meet the short-term financial needs during the pandemic, which mitigates the fluctuation with the market.

Our results from Tables 3 and 4 support Hypothesis 1 that overleveraged (underleveraged) firms have higher (lower) risk during COVID-19. In addition, the benefits of being underleveraged stand out from the market downturn. Firms are able to inject more funds to keep businesses running and avoid costly corporate bankruptcy.

[Insert Table 4 about here]

4.2 Excess leverage and firm risk conditional on firms' CSR performance

In this section, we examine the role that firms' CSR performance plays in the crash. Tables 5 and 6 report the results for overleveraged and underleveraged firms, conditional on their social and environmental performance, respectively. Firms are sorted into terciles based on their social and environmental scores. We retain top and bottom terciles and define that firms with high (low) scores are those in the top (bottom) tercile.

As previously discussed, we run the separate regressions to examine the individual impact of social/environmental practices on firm risk in conjunction with excess leverage. Again, the variable of interest is the interaction term *COVID*Excess leverage*. In addition to the tercile sorting on CSR performance, we split the sample into overleveraged and underleveraged subsamples to test Hypotheses 2 and 3. Our overall results show that excess leverage significantly affects firm

risk during COVID-19 when firms have poor social and environmental performance (i.e. low scores). For firms with good social and environmental practices in place, excess leverage does not necessarily play an important role in affecting firm risk during the crisis.

Table 5 presents the results for the impact of COVID-19 and excess leverage on firm risk conditional on corporate social score. Overleveraged firms with low social score have higher risk exposure to COVID-19 than underleveraged ones as shown in Panel A. For example, one standard deviation increase in excess leverage for overleveraged firms causes 0.97% increase in stock volatility. EDF is increased by 6.21% with one standard deviation increase in excess leverage, which is almost doubled in value compared with the whole sample (3.25%) as discussed in Section 4.1. In contrast, underleveraged firms with poor social score show significantly lower risk during COVID-19, suggesting that the ability to take up more debt during the crisis and the interest tax benefits lower the firm risk. One standard deviation increase in excess leverage for underleveraged firms leads to a total risk reduction of 1.42% as shown in Column 5 of Table 5 Panel A. Moreover, bankruptcy risk for underleveraged firms declines by 5.7% with one standard deviation increase in excess leverage. This supports the argument that firms are borrowing more to meet the cash flow shortfall and hence avoid filing for bankruptcy as the firms' liquidity dries up during the crash (see Acharya and Steffen, 2020; Halling et al., 2020; Li et al., 2020). The findings from Table 5 suggest that during COVID-19 firm risk significantly responds to excess leverage when corporate social score is low whereas excess leverage does not influence firm risk when firms have high social score.

[Insert Table 5 about here]

The regression results based on environmental score sorting are presented in Table 6. The overall results are consistent with the findings from Table 5. For example, one standard deviation increase in excess leverage drives stock volatility (EDF) up by 1.32% (3.55%). The only exception is the regressions for underleveraged subsample with low environmental score. In contrast with the results for the underleveraged subsample based on social score in Table 5 Panel A, underleveraged firms with low environmental score do not show significant risk reduction and neither appear significant increased risk, which can be explained by Limkriangkrai et al. (2017). They find that firms with low environmental rating have difficulty in borrowing funds as lenders

impose minimum social and environmental criteria on projects whereas there is no systematic difference in corporate borrowing decisions between firms with high social rating and those with low rating. Therefore, firms with low environmental rating in spite of being underleveraged do not have the borrowing ability (compared with the low-social-rating firms) to reduce risk. Our results are consistent with Hypothesis 3 that underleveraged firms do not have higher risk during COVID-19 regardless of their CSR practices.

Low environmental score puts overleveraged firms at greater risk while underleveraged firms are self-protected from the pandemic despite the low environmental commitments. Table 6 Panel B shows that no matter whether firms are overleveraged or underleveraged they are immune from the COVID-19 shock with good environmental practices, consistent with the results from Table 5 based on corporate social score sorting.

[Insert Table 6 about here]

As robustness, we follow Albuquerque et al. (2020) to sort our sample based on an *ES score*, which is the average between a firm's social and environmental scores. Our results remain qualitatively similar as those in Tables 5 and 6. For firms with low ES score, firm risk significantly increases with overleveraged firms' excess leverage during pandemic. Specifically, one standard deviation increase in excess leverage results in a 5.26% increase in EDF. In addition, we use a measure of firms' community performance (*Community score*) as another robustness criterion to sort our firms. *Community score*, sourced from Thomson Reuters ASSET4, is particularly relevant during the pandemic because it measures the company's commitment towards protecting public health. The results are reported in Table 8. Consistent with the results documented in previous tables, we find that the adverse effect that excess leverage exerted on firm risk during the crash only exists when firms' community performance is low. As a result, corporate commitments to the community provide firms with risk immunity during the public health crisis.

[Insert Tables 7 and 8 about here]

Overall, our findings from the above tables support Hypotheses 2 and 3 that excess leverage and CSR practices influence firm risk during COVID-19. Such influence is more pronounced when firms are overleveraged and have poor CSR practices. Underleveraged firms do not experience

significant risk increase with excess leverage during the pandemic regardless their CSR practices. This draws attention to the effective use of debt and investments in CSR that can keep firms immune from the market crash. For example, when firms are overleveraged, they are more vulnerable to an economic shock and therefore good CSR practices strengthen their business viability. On the other hand, overinvestment problem in CSR may be present if firms have already been underleveraged as CSR practices do not add extra benefits to firms in terms of risk reduction. As a result, well-designed policies on capital structure and CSR can effectively reduce firm risk and therefore enhance firm value, building a more sustainable and resilient future for firms.

5. Conclusion

The outbreak of the COVID-19 pandemic is an unexpected shock to the global stock markets. Everyone in the economy has been adversely impacted by the crisis and COVID-19 has changed the way people live in and businesses operate. Although the pandemic brings substantial uncertainty into the economy and people are still awaiting a successful vaccine, it also provides the opportunity for firms to rethink the corporate policies that can smoothly move the businesses forward.

We examine the joint effect of capital structure and CSR on firm risk during COVID-19 for two reasons. First, capital structure has a direct effect on corporate bankruptcy risk, which is a critical factor that determines a firm' solvency particularly during a crisis. Second, CSR has drawn great attention from investors and researchers. Firms' commitments to CSR can reduce firm risk during economic downturns. Therefore, carefully-developed policies on both capital structure and CSR can sufficiently reduce firm risk and help firms survive the negative economic shock. Using a sample that covers both pre-COVID-19 and within-COVID-19 periods, we document a plausible influence of capital structure associated with CSR on firm risk. Specifically, we find that overleveraged firms experienced higher stock return volatility and financial distress risk compared to underleveraged firms during the pandemic, with the pattern particularly significant for those with poor CSR performance measured by firms' social, environmental and community scores.

Our study contributes to existing literature by providing corporations with some insightful post-pandemic directions on capital structure decision and CSR activities. A practical combination of debt level and CSR practices facilitates a more sustainable and resilient economy that is more likely to be immune from a market crash such as COVID-19. In addition, being considerate of the environment, and therefore the whole society, leads to a more stable and defensible future, leaving a better world for our descendants. Therefore, investors and customers have recognised the importance of CSR initiatives. Our paper emphasises the needs for firms to adjust their ways to operate businesses so that the entire social welfare is taken into consideration. Further research in this area should focus on examining the impact of the joint effect of firms' other corporate policies and CSR activities on firm value and risk.

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Table 1: Variable definitions

Variable name	Variable definition	Source
Panel A: Dependent variables		
Stock volatility	Standard deviation of rolling monthly stock returns over the past 36 months	CRSP
Systematic risk (Beta)	Estimated from CAPM using rolling monthly stock returns over the past 36 months	CRSP
Idiosyncratic risk	Standard deviation of residuals from CAPM based on rolling monthly stock returns over the past 36 months	CRSP
EDF	Expected default frequency, defined as N(-DD), where DD refers to the distance to default estimated from Merton (1974) option model	Compustat, CRSP
Panel B: Firm-level variables		
Optimal leverage	Model-implied optimal leverage following Korteweg (2010)	Compustat
Excess leverage	The measure of deviation from the optimal leverage	Compustat
COVID	Indicator variable that equals one from Jan 2020 to May 2020, and zero from Jan 2019 to Dec 2019	
Social score	Refinitv's Social Pillar Score. It evaluates whether a firm has policies in relation to human rights protection, fair treatment to employees, flexible working arrangements, and employee safety and health	Thomson Reuters ASSET4
Environment score	Refinitv's Environment Pillar Score. It emphasises corporate investments or activities involving green energy, environmentally friendly products, waste recycling, and greenhouse gas emission reduction	Thomson Reuters ASSET4
ES score	Average between Refinitv's Environment Pillar Score and Social Pillar Score	Thomson Reuters ASSET4
Community score	Community category score measures the company's commitment towards being a good citizen, protecting public health and respecting business ethics	Thomson Reuters ASSET4
Size	The natural logarithm of total assets (ATQ)	Compustat
ROA	Net income (NIQ) divided by total assets (ATQ)	Compustat
Market to Book	Market to book ratio (PRCCQ*CSHOQ/CEQQ)	Compustat
Overleverage	Positive deviation from the optimal capital structure	Compustat
Underleverage	Negative deviation from the optimal capital structure	Compustat
Market Vol	Standard deviation of monthly market excess return using 36-month rolling windows	Kenneth R. French Data Library

Table 2: Summary statistics

Table 2 presents summary statistics on all the variables that are used between 2019 and 2020. Variable definitions are provided in Table 1.

Variables	N	Mean	Std.Dev	Min	Median	Max
Stock volatility	29010	0.124	0.059	0.044	0.109	0.322
Systematic risk (Beta)	29003	1.314	0.711	-0.773	1.254	3.664
Idiosyncratic risk	29003	0.109	0.058	0.035	0.094	0.310
EDF	29011	0.103	0.263	0.000	0.000	1.000
Excess leverage	23480	0.034	0.203	-0.806	0.000	0.992
Size	28993	7.736	1.636	1.667	7.647	13.614
ROA	29011	-0.008	0.057	-0.285	0.007	0.091
Optimal leverage	23480	0.164	0.152	0.000	0.144	1.000
Market to Book	28952	3.951	4.436	-1.910	2.499	16.939
Community score	23051	56.032	22.502	0.000	57.300	99.860
Environment score	23051	20.456	25.505	0.000	8.250	98.270
Social score	23051	39.558	20.589	0.150	35.700	99.150
ES score	23051	30.007	21.444	0.075	22.480	96.295
Market Vol	29011	0.038	0.005	0.033	0.037	0.051

Table 3: Excess leverage and firm risk in response to the Covid-19 pandemic

Regression analysis of the impact of COVID-19 and the deviation from the optimal leverage on firm risk. Variable definitions are provided in Table 1. Panel A reports the results for the full sample while Panel B (C) reports the results for the overleveraged (underleveraged) sub-sample. Robust standard errors are clustered at the firm level, and *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% level, respectively.

Panel A VARIABLES	Column 1 Stock volatility	Column 2 Systematic risk (Beta)	Column 3 Idiosyncratic risk	Column 4 EDF
COVID* Excess leverage	0.022***	0.094	0.017***	0.114***
	(5.516)	(1.525)	(4.747)	(4.070)
COVID	0.007***	0.014	0.001***	0.035***
	(13.669)	(1.508)	(2.707)	(10.135)
Excess leverage	0.017**	0.548***	0.016***	0.303***
	(2.474)	(4.461)	(2.581)	(5.344)
Size	-0.004*	-0.090**	-0.003	-0.021
	(-1.922)	(-2.575)	(-1.280)	(-1.317)
ROA	-0.045***	-0.709***	-0.012	-0.494***
	(-3.958)	(-4.482)	(-1.380)	(-5.559)
Optimal leverage	0.029**	0.339	0.033**	0.154
	(2.187)	(1.373)	(2.533)	(1.517)
Market to Book	-0.001***	-0.016***	-0.000***	-0.008***
	(-6.253)	(-5.144)	(-2.993)	(-5.838)
Constant	0.146***	1.991***	0.117***	0.249*
	(8.171)	(7.098)	(6.954)	(1.959)
Firm FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
Observations	23,436	23,436	23,436	23,436
Adjusted R-squared	0.925	0.851	0.941	0.832

Panel B - Overleveraged VARIABLES	Column 1 Stock volatility	Column 2 Systematic risk (Beta)	Column 3 Idiosyncratic risk	Column 4 EDF
COVID*Excess leverage	0.038***	0.177	0.030***	0.160***
	(5.249)	(1.515)	(4.302)	(2.919)
COVID	0.005***	0.032	-0.002	0.037***
	(3.243)	(1.226)	(-1.124)	(3.453)
Excess leverage	-0.004	0.338*	0.004	0.292***
	(-0.360)	(1.763)	(0.340)	(3.076)
Size	-0.005	-0.058	-0.003	-0.050*
	(-1.303)	(-1.023)	(-0.942)	(-1.769)
ROA	-0.040***	-0.757***	-0.010	-0.468***
	(-2.788)	(-3.675)	(-0.902)	(-3.678)
Optimal leverage	0.014	-0.439	0.034	0.191
	(0.478)	(-1.113)	(1.262)	(1.052)
Market to Book	-0.001***	-0.016***	-0.001***	-0.011***
	(-5.297)	(-3.851)	(-3.341)	(-4.936)
Constant	0.162***	1.924***	0.128***	0.490**

	(4.831)	(4.116)	(4.011)	(2.074)
Firm FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
Observations	10,955	10,955	10,955	10,955
Adjusted R-squared	0.910	0.849	0.932	0.824

Panel C - Underleveraged	Column 1	Column 2	Column 3	Column 4
VARIABLES	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF
COVID*Excess leverage	-0.032***	-0.775***	-0.010	-0.242***
	(-3.554)	(-5.071)	(-1.368)	(-4.132)
COVID	0.001	-0.124***	-0.001	-0.017**
	(0.509)	(-5.724)	(-1.172)	(-2.474)
Excess leverage	0.042**	1.183***	0.019	0.467***
	(2.302)	(4.252)	(1.223)	(4.136)
Size	-0.000	-0.068	-0.000	0.030*
	(-0.213)	(-1.631)	(-0.048)	(1.663)
ROA	-0.044***	-0.583**	-0.011	-0.477***
	(-2.680)	(-2.469)	(-0.797)	(-4.419)
Optimal leverage	0.034**	1.798***	0.009	0.476***
	(2.068)	(5.121)	(0.622)	(3.186)
Market to Book	-0.001***	-0.018***	-0.000	-0.004**
	(-3.691)	(-4.442)	(-1.001)	(-2.480)
Constant	0.116***	1.610***	0.100***	-0.194
	(6.814)	(4.937)	(6.440)	(-1.372)
Firm FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
Observations	12,481	12,481	12,481	12,481
Adjusted R-squared	0.946	0.865	0.954	0.866

Table 4: Market volatility and firm risk

Regression analysis of the impact of COVID-19 and the market volatility on firm risk. Variable definitions are provided in Table 1. Column 1 reports the results for the overleveraged subsample while Column 2 reports the results for the underleveraged one. Robust standard errors are clustered at the firm level, and *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% level, respectively.

	Column 1	Column 2
VARIABLES	Overleveraged Systematic risk (Beta)	Underleveraged Systematic risk (Beta)
COVID*Market Vol	12.082***	-3.177
	(2.921)	(-1.007)
COVID	-0.478***	0.088
	(-3.120)	(0.747)
Market Vol	2.270	2.532
	(0.641)	(0.879)
Size	-0.085	-0.086**
	(-1.493)	(-2.004)
ROA	-0.659***	-0.684**
	(-3.396)	(-2.580)
Optimal leverage	-0.781**	1.625***
	(-2.028)	(3.921)
Market to Book	-0.011***	-0.019***
	(-2.833)	(-4.368)
Constant	2.163***	1.564***
	(4.694)	(4.633)
Firm FEs	Yes	Yes
Industry FEs	Yes	Yes
Observations	10,955	12,481
Adjusted R-squared	0.853	0.861

Table 5: Excess leverage and firm risk conditional on firm's social score

Regression analysis of the impact of COVID-19 and the deviation from the optimal leverage on firm risk conditional on firm's CSR performance. Variable definitions are provided in Table 1. Panel A reports the results for firms with social score in the bottom tercile of the sample while Panel B reports the results for firms with social score in the top tercile of the sample. Column 1 - 4 (Column 5 - 8) report the results for the overleveraged (underleveraged) sub-sample. Control variables are not reported for brevity. Robust standard errors are clustered at the firm level, and *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% level, respectively.

Panel A: Low score		Overleveraged				Underleveraged		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
VARIABLES	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF
COVID*Excess leverage	0.048***	0.386	0.033***	0.306**	-0.070***	-1.083***	-0.043***	-0.281**
	(2.793)	(1.427)	(2.632)	(2.471)	(-3.335)	(-3.119)	(-2.623)	(-2.096)
COVID	0.004	0.065	-0.002	0.005	-0.005	-0.168**	-0.005	-0.011
	(1.018)	(0.972)	(-0.647)	(0.237)	(-1.147)	(-2.490)	(-1.421)	(-0.804)
Excess leverage	0.029	0.926*	0.020	0.177	0.079*	0.959*	0.066	0.817**
	(1.179)	(1.956)	(1.089)	(0.919)	(1.692)	(1.861)	(1.445)	(2.078)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,710	2,710	2,710	2,710	3,203	3,203	3,203	3,203
Adjusted R-squared	0.919	0.879	0.930	0.856	0.945	0.905	0.947	0.876

Panel B: High score		Overleveraged				Underleveraged		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
VARIABLES	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF
COVID*Excess leverage	0.030	0.034	0.019	-0.013	0.031	0.188	0.028	-0.157
	(1.499)	(0.089)	(1.390)	(-0.064)	(1.009)	(0.372)	(0.875)	(-1.261)
COVID	0.008*	0.083	0.001	0.058	0.008*	-0.055	0.004	-0.008
	(1.776)	(1.095)	(0.514)	(1.489)	(1.744)	(-0.881)	(0.885)	(-0.925)
Excess leverage	0.049	1.450*	0.038*	0.673**	-0.073*	0.609	-0.076*	0.179*

	(1.451)	(1.928)	(1.662)	(2.047)	(-1.808)	(0.780)	(-1.950)	(1.919)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,119	3,119	3,119	3,119	3,448	3,448	3,448	3,448
Adjusted R-squared	0.950	0.899	0.958	0.885	0.975	0.931	0.977	0.949

Table 6: Excess leverage and firm risk conditional on firm's environmental score

Regression analysis of the impact of COVID-19 and the deviation from the optimal leverage on firm risk conditional on firm's CSR performance. Variable definitions are provided in Table 1. Panel A reports the results for firms with environmental score in the bottom tercile of the sample while Panel B reports the results for firms with environmental score in the top tercile of the sample. Column 1 - 4 (Column 5 - 8) report the results for the overleveraged (underleveraged) sub-sample. Control variables are not reported for brevity. Robust standard errors are clustered at the firm level, and *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% level, respectively.

Panel A: Low score		Overleveraged				Underleveraged		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
VARIABLES	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF
COVID*Excess leverage	0.065***	1.035***	0.019**	0.175*	-0.001	-0.564	0.008	-0.133
	(4.173)	(3.070)	(2.223)	(1.735)	(-0.043)	(-1.232)	(0.462)	(-1.065)
COVID	-0.002	-0.111*	-0.001	0.026	0.008**	-0.098	0.006**	-0.020
	(-0.508)	(-1.839)	(-0.252)	(1.025)	(2.536)	(-1.520)	(1.987)	(-1.102)
Excess leverage	0.013	0.635	0.021	0.388	0.005	1.640**	-0.020	0.936***
	(0.770)	(1.418)	(1.176)	(1.572)	(0.115)	(2.430)	(-0.536)	(3.762)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,254	2,254	2,254	2,254	3,558	3,558	3,558	3,558
Adjusted R-squared	0.925	0.907	0.925	0.821	0.967	0.902	0.968	0.840

Panel B: High score		Overleveraged				Underleveraged		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
VARIABLES	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF	Stock volatility	Systematic risk (Beta)	Idiosyncratic risk	EDF
COVID*Excess leverage	0.027*	-0.255	0.024	-0.024	-0.006	0.148	0.007	-0.082
	(1.782)	(-0.549)	(1.238)	(-0.125)	(-0.444)	(0.513)	(0.453)	(-0.619)

COVID	0.005	0.014	-0.000	0.034	0.003	-0.061	0.001	0.005
	(1.546)	(0.176)	(-0.157)	(1.008)	(1.249)	(-1.390)	(0.576)	(0.313)
Excess leverage	0.016	0.572	0.010	0.251	0.057	0.861	0.034	0.697*
	(0.707)	(1.418)	(0.471)	(1.328)	(1.342)	(1.551)	(0.746)	(1.652)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,418	3,418	3,418	3,418	3,414	3,414	3,414	3,414
Adjusted R-squared	0.943	0.892	0.952	0.852	0.959	0.908	0.961	0.947

Table 7: Excess leverage and firm risk conditional on firm's ES score

Regression analysis of the impact of COVID-19 and the deviation from the optimal leverage on firm risk conditional on firm's CSR performance. Variable definitions are provided in Table 1. Panel A reports the results for firms with ES score in the bottom tercile of the sample while Panel B reports the results for firms with ES score in the top tercile of the sample. Column 1 - 4 (Column 5 - 8) report the results for the overleveraged (underleveraged) sub-sample. Control variables are not reported for brevity. Robust standard errors are clustered at the firm level, and *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% level, respectively.

Panel A: Low score	Overleveraged				Underleveraged			
VARIABLES	Column 1 Stock volatility	Column 2 Systematic risk (Beta)	Column 3 Idiosyncratic risk	Column 4 EDF	Column 5 Stock volatility	Column 6 Systematic risk (Beta)	Column 7 Idiosyncratic risk	Column 8 EDF
COVID*Excess leverage	0.081***	0.836**	0.047***	0.259***	-0.042**	-0.812***	-0.019	-0.189*
	(6.185)	(2.539)	(3.760)	(3.356)	(-2.559)	(-2.626)	(-1.604)	(-1.795)
COVID	-0.004	-0.023	-0.006	0.007	0.001	-0.086	0.000	-0.003
	(-0.835)	(-0.318)	(-1.617)	(0.469)	(0.473)	(-1.433)	(0.163)	(-0.263)
Excess leverage	-0.002	0.716	0.005	0.284**	0.044	0.896*	0.047*	0.354
	(-0.106)	(1.432)	(0.316)	(2.023)	(1.404)	(1.756)	(1.936)	(1.288)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,408	2,408	2,408	2,408	3,354	3,354	3,354	3,354
Adjusted R-squared	0.914	0.888	0.925	0.869	0.953	0.899	0.957	0.853

Panel B: High score	Overleveraged				Underleveraged			
VARIABLES	Column 1 Stock volatility	Column 2 Systematic risk (Beta)	Column 3 Idiosyncratic risk	Column 4 EDF	Column 5 Stock volatility	Column 6 Systematic risk (Beta)	Column 7 Idiosyncratic risk	Column 8 EDF
COVID*Excess leverage	0.048***	-0.568	0.045	-0.183	-0.015	0.586	-0.011	-0.106
	(2.605)	(-0.765)	(1.635)	(-0.685)	(-1.013)	(1.599)	(-0.654)	(-1.406)

COVID	0.004	0.098	-0.002	0.068*	-0.000	0.016	-0.003	-0.007
	(1.150)	(0.941)	(-0.510)	(1.756)	(-0.041)	(0.288)	(-1.084)	(-1.601)
Excess leverage	0.013	1.431**	-0.002	0.509*	-0.009	0.568	-0.029	0.125*
	(0.442)	(2.328)	(-0.084)	(1.884)	(-0.327)	(0.880)	(-1.094)	(1.764)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,393	3,393	3,393	3,393	3,462	3,462	3,462	3,462
Adjusted R-squared	0.940	0.898	0.948	0.882	0.963	0.919	0.966	0.955

Table 8: Excess leverage and firm risk conditional on firm's community score

Regression analysis of the impact of COVID-19 and the deviation from the optimal leverage on firm risk conditional on firm's CSR performance. Variable definitions are provided in Table 1. Panel A reports the results for firms with community score in the bottom tercile of the sample while Panel B reports the results for firms with community score in the top tercile of the sample. Column 1 - 4 (Column 5 - 8) report the results for the overleveraged (underleveraged) sub-sample. Control variables are not reported for brevity. Robust standard errors are clustered at the firm level, and *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% level, respectively.

Panel A: Low score	Overleveraged				Underleveraged			
VARIABLES	Column 1 Stock volatility	Column 2 Systematic risk (Beta)	Column 3 Idiosyncratic risk	Column 4 EDF	Column 5 Stock volatility	Column 6 Systematic risk (Beta)	Column 7 Idiosyncratic risk	Column 8 EDF
COVID*Excess leverage	0.052***	0.742**	0.024**	0.262***	-0.042*	-0.543	-0.023	-0.204
	(3.664)	(2.564)	(2.392)	(3.525)	(-1.939)	(-1.425)	(-1.113)	(-1.430)
COVID	0.004	-0.116	0.003	0.002	-0.000	-0.072	-0.002	-0.009
	(0.947)	(-1.121)	(0.692)	(0.103)	(-0.067)	(-1.080)	(-0.477)	(-0.679)
Excess leverage	0.032	0.394	0.031*	0.493**	0.093***	0.667	0.080**	0.752**
	(1.440)	(0.680)	(1.788)	(2.504)	(2.604)	(1.472)	(2.245)	(2.072)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,637	2,637	2,637	2,637	3,311	3,311	3,311	3,311
Adjusted R-squared	0.924	0.866	0.932	0.876	0.952	0.901	0.955	0.859

Panel B: High score	Overleveraged				Underleveraged			
VARIABLES	Column 1 Stock volatility	Column 2 Systematic risk (Beta)	Column 3 Idiosyncratic risk	Column 4 EDF	Column 5 Stock volatility	Column 6 Systematic risk (Beta)	Column 7 Idiosyncratic risk	Column 8 EDF
COVID*Excess leverage	-0.002	-0.040	-0.018	0.263**	0.030	0.609	0.020	-0.062
	(-0.074)	(-0.159)	(-0.663)	(2.048)	(1.320)	(1.170)	(0.954)	(-0.349)
COVID	0.003	-0.041	0.002	-0.031	0.011***	0.014	0.006*	-0.012

	(0.583)	(-0.588)	(0.527)	(-1.436)	(2.838)	(0.179)	(1.791)	(-0.369)
Excess leverage	-0.063***	-0.470	-0.032*	0.049	0.004	0.830	-0.022	0.072
	(-2.939)	(-1.133)	(-1.694)	(0.212)	(0.134)	(0.783)	(-0.922)	(0.590)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,123	3,123	3,123	3,123	3,269	3,269	3,269	3,269
Adjusted R-squared	0.940	0.894	0.953	0.875	0.974	0.915	0.977	0.906