Debt Rollover Risk, Credit Default Swap Spread and Stock Returns: Evidence from the COVID-19 Crisis*

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Abstract

This paper studies how the COVID-19 shock affects the CDS spread changes and abnormal stock returns of U.S. firms with different levels of debt rollover risk. We use the COVID-19 crisis as a quasi-natural experiment of adverse cash flow shock that increases the default risk of firms facing an immediate liquidity shortfall. We find that the COVID-19 shock significantly increased the CDS spread and decreased the shareholder value for firms facing higher debt rollover risk. The effect is stronger for firms that are non-financial, with higher volatility, and are more financially constrained. Moreover, we find that firms with immediate refinancing needs suffered more than firms with distant refinancing needs during the COVID-19 shock, which further confirms that firms' debt rollover risk is indeed a key factor that drives the heterogenous reactions to the shock. The paper provides fresh insights into the role of firms' debt rollover risk during the COVID-19 health crisis.

Keywords: Debt Rollover Risk; Credit Default Swap Spread; Stock Returns

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1. Introduction

The COVID-19 health crisis has caused significant disruptions to the economic activities around the globe. Businesses of all sizes have been adversely affected due to both the lockdown imposed by the local governments and the panic from local residence, causing a precipitous drop in customer attendance rates. The health crisis creates a liquidity shock by triggering a sudden plunge in firms' cash flow, leaving those firms with little cash reserve and pressing financing needs vulnerable to default. With unemployment rate skyrocketed to 14.7% within a few weeks' time and the unprecedented level of economic uncertainty due to the unpredictability of the COVID pandemic, it is expected that a bankruptcy boom will arrive with default rates over the next twelve months could rival or even exceed 2009 levels. In the event of actual bankruptcies, shareholders can only claim the residual value of the firms, which often results in a total loss to the shareholder value. How do investors react to the heightened bankruptcy risks at firms? Do firms facing significant debt rollover risk (i.e., firms that have the immediate needs of repaying maturing debt but may not have enough liquidity to meet the repayment obligation) suffer more from the health crisis? These are very pressing questions to understand the economic impact of the pandemic. In this paper, we use the COVID-19 crisis as a quasi-natural experiment of adverse cash flow shock to investigate the effects of debt rollover risk on firms' default risk and thus shareholder value.

The unprecedented health crisis provides a unique opportunity to study the heterogeneous impact of debt rollover risk on firms' default risk and shareholder value. The presence of capital market frictions makes firms' debt maturity structure matters (e.g., Diamond, 1991). The cash flow shock induced by COVID-19 crisis exacerbates the rollover risks for firms having a large amount of debt due shortly and insufficient cash reserves. First, the significant cash flow plunge caused by the COVID-19 crisis makes it difficult for firms with large amount of debt maturing and little cash

reserves to meet its debt payment obligation and thus need to roll over their maturing debt to future periods. Second, it is unclear ex ante whether such firms can rely on alternative sources for refinancing given it is costly to acquire external financing through new equity or bond issuance during the market downturns caused by COVID-19. Thus, without meaningful cash reserves, borrower firms with a large amount of debt due shortly face significant debt rollover risk, as lenders' possible refusal to roll over the maturing debt (due to poor cash flows and huge uncertainties) to future periods could force the borrower firms into default. If the cash reserve is large enough to pay back the debt due, there is no need to roll the maturing debt over to future periods. The literature also suggests that the negative impact of the Global Financial Crisis on firm investment is more pronounced for firms with lower level of pre-cautionary cash reserves and firms with more short-term debt outstanding (Duchin, Ozbas and Sensoy, 2010). Thus, we construct a debt-rollover-risk measure based on the ratio of firms' short-term debt (debt due within one year) to cash and short-term investment before the crisis, and identify firms facing significant debt rollover risk in the near future.

We focus on the credit default swap (CDS) spread changes and abnormal stock returns when evaluating the heterogeneous market reactions to the shock. To the extent that the financial markets are efficient enough to digest the potential effects from the shock, we will be able to capture the heterogeneous impacts on firms' default risk and shareholder value through these measures. As firms with debt maturing shortly and insufficient cash reserve to pay off the maturing debt may face severe debt rollover risk, their market measures are likely to react more strongly to the shock. Similar to the Great Recession, the recent COVID-19 shock features a sudden collapse in asset prices. With the S&P 500 stock price index dropping 34% within 33 days (from February 19 to March 23, 2020), the shock is severe enough to hit U.S. public firms unexpectedly. Although

COVID-19 shock is a systemic shock that affects the whole economy, the actual timing of the debt due is different across various firms, causing different levels of rollover risk for firms at the time of the COVID shock struck the market and thus the effects are likely to be more pronounced in firms that face significant debt rollover risk.

Using data on firms' CDS spread changes, we investigate whether the COVID-19 crisis significantly increases the default probabilities of firms with significant debt rollover risk. Figure 1 shows the average cumulative 6-month CDS spread changes for the debt-rollover-risk quartiles. Although CDS spread increases in February and March 2020 across all debt-rollover-risk quartiles, the increase is much more prominent for firms in the highest rollover risk quartile—the cumulative CDS spread change is a startling 900 basis points before declining subsequently. The cumulative 6-month CDS spread change for firms in the highest debt-rollover-risk quartile is more than four times larger than the cumulative change for firms in the other three quartiles. We further examine the cumulative 1-year, 5-year and 10-year CDS spread changes and document similar patterns, as shown in Figures A1, A2 and A3 in the Appendix.

[Please insert Figure 1 here]

Our regression results also confirm that the COVID-19 shock exerts heterogeneous impact on the default risk and CDS spread of firms with different levels of debt rollover risk. In particular, we find that the shorter the CDS contract maturity, the greater is the increase in CDS spread for firms with high debt rollover risk, indicating that investors are more concerned about the short-term default risk for high rollover-risk firms than these firms' long-term default risk. The COVID-19 shock leads to an increase in CDS spread of 349 to 880 basis points across different CDS contract maturities for firms in the highest rollover-risk quartile relative to firms in the other rollover-risk quartiles. We also find that the impact of the COVID-19 crisis on CDS spread of high

rollover-risk firms is much more pronounced in the later sample period (from 3/2/2020 to 3/26/2020) when the U.S. gradually becoming the most COVID-19 affected country in the world than in the first sample period (from 1/30/2020 to 2/28/2020) when the crisis mostly affecting Asia and Europe. Additionally, we find that the impact of the shock on CDS spread of high rollover-risk firms is much stronger if such firms also face tight financial constraints or have high firm volatilities.

Since shareholders are the residual claimers of a firm's assets once the firm defaults, an increase in firms' default risk negatively affects shareholder wealth. Consistent with the evidence on default risk, we find that the crisis leads to significant negative abnormal stock returns for firms with higher debt rollover risks. Figure 2 shows the average buy-and-hold abnormal stock returns (BHARs) for different debt-rollover-risk quartiles over the sample period. Although the average BHARs significantly decrease in general across all debt-rollover-risk quartiles in February and March, the decline is more pronounced for the top two firm quartiles with the highest rollover risk.

[Please insert Figure 2 here]

Our regression results further confirm that relative to firms in the other quartiles of debt rollover risk, the crisis leads to an economically significant decline of -2% to -3% in stock returns for real-sector firms in the highest rollover-risk quartile over the sample period. Further, the lower stock returns for high rollover-risk firms are confined to real-sector firms and not financial-sector firms, and mainly concentrated in the later sample period when the U.S. becomes heavily impacted by COVID-19. This finding is consistent with the notion that different from the Global Financial Crisis, the COVID-19 crisis is a health crisis that directly hits the real sector and not the financial sector businesses.[1] In addition, we show that the negative stock return reactions are much stronger

[1] The banking and financial industries are much better prepared when the COVID-19 crisis hit possibly also due to the resilience built up through various post-Great Recession regulations.

for high debt-rollover-risk firms when such firms also face tight financial constraints, or have higher stock return volatilities, consistent with the earlier findings from CDS spread changes and the findings from the Global Financial Crisis (e.g., Ivashina and Scharfstein, 2011).

Our evidence that financial constraints amplify the magnitude of the impact of the COVID-19 crisis on stock returns of high debt-rollover-risk firms is consistent with the implications from the literature. For example, previous studies suggest that stock returns of financially constrained firms tend to comove together, and such firms tend to earn higher returns on average (e.g., Whited and Wu 2006). However, during crisis time, such firms tend to suffer more likely due to their corporate liquidity shortfall. For example, Campbello, Graham, and Harvey (2010) find that during the Global Financial Crisis, financially constrained firms planned deeper cuts in tech spending, employment, and capital spending, burned through more cash, drew more heavily on lines of credit, sold more assets to fund their operations, and bypassed attractive investment opportunities. The evidence from our paper indicates that the liquidity shortfall due to the COVID-19 cash flow shock exposes firms, especially those facing tight financial constraints, to debt rollover risk. Moreover, the literature suggests that stock returns are primarily driven by firm's cash flow news (e.g., Vuolteenaho, 2002). Our evidence that firm's cash flow uncertainty amplifies the magnitude of the impact of the COVID-19 crisis on stock returns of high debt-rollover-risk firms is consistent with the implications from the literature. That is, firms with high cash flow uncertainty are likely to be hit particularly hard by the cash flow shock of COVID-19 and thus should earn lower stock returns during the crisis.

To strengthen the identification on the effects of rollover risk, we further zoom in on the timing of firms' debt rollover, and compare the effects of rollover risk on CDS spreads and BHARs for firms with debt maturing immediately and firms with debt due later in the year. The key is to

understand that the actual timing of the COVID-19 strike is what makes it an exogeneous shock to the firms. As the outbreak of the COVID-19 pandemic is entirely unexpected, the percentage of firms' debt that is maturing in the first few months of year 2020 when the COVID-19 shock hit the U.S. is exogenous to firms' choice ex ante. Even if the total amount of debt due in year 2020 is the same for two firms, the actual timing of the debt due is different, causing different levels of rollover risk for firms at the time of the COVID-19 shock. The COVID-19 crisis creates a liquidity shortfall by causing a sudden plunge in firms' cash flow. If debt rollover risk is indeed a driver for the heterogenous reactions in firms' CDS spread and shareholder value, then we should expect a stronger effect for firms that face immediate refinancing needs than for firms that face refinancing needs in the second half of year 2020 (in other words, distant refinancing needs). Indeed, our empirical results show that firms with immediate refinancing needs suffered more than firms with distant refinancing needs during the COVID-19 cash flow shock. The results thus further confirm the finding of our main tests. Finally, we perform various robustness tests including controlling for new debt issuance in the first quarter of 2020, using alternative measures of debt rollover risk, and separating the impact of the COVID-19 shock from that of the U.S. government relief package. The results of these robustness tests are all consistent with our main findings and suggest that firms' debt rollover risk is indeed a key factor that drives the heterogenous reactions to the COVID-19 shock.

This paper contributes to a few strands of literature. First, the paper contributes to the literature on firms' debt rollover risk. The extant literature highlights the importance of carefully managing the risks from maturing debt (e.g. Froot, Scharfstein and Stein, 1993). Earlier research on debt maturity choice discusses the trade-offs between having long-term versus short-term debt. For example, the use of short-term debt overcomes underinvestment problems by mitigating the

conflicts of interest between managers, debt holders and equity holders (Myers 1977; Barclay and Smith 1995), but exposes firms to rollover risks more often and heightens the chance of inefficient liquidation (Diamond, 1991; He and Xiong, 2012). In the presence of credit market imperfections, short-term debt can lower firm value if it has to be refinanced at an overly high interest rate (Froot, Scharfstein and Stein, 1993; Sharpe, 1991; Titman, 1992). Looking at the Global Financial Crisis, Almeida et al. (2012) demonstrate the adverse impact on investment for firms having large proportion of debt maturing right after August 2007. Gopalan, Song and Yerramilli (2013) employ a similar framework and find that firms with a large portion of debt maturing likely experience credit downgrades and face higher spreads in the bond market.[2]

Our paper contributes to the literature on debt rollover risk in two important aspects. First, our study provides fresh empirical evidence on the adverse effects of debt rollover risk on firm default risk as reflected in the CDS spread and abnormal stock returns. Second, our study is the first that looks at the adverse effects of debt rollover risk in a unique setting of the COVID-19 crisis. Differing from the Global Financial Crisis which first affected the financial market and credit supply to firms, the COVID-19 health crisis directly affected firms' cash flows. Stable cash flows are not only essential for covering maturing debt but also crucial for raising new debt. Given the unprecedented COVID-19 shock to cash flows, it is uncertain ex ante whether firms with large amount of debt maturing and little cash reserves can successfully roll over their maturing debt. This study takes advantage of the unique setting of the COVID-19 shock to study the impact of debt rollover risk on corporate default and shareholder value.

[2] A related stream of research looks at the granularity of the entire maturity structure of outstanding debt and provides evidence on the availability and costs of financing (e.g., Norden, Roosenboom, and Wang 2016; Choi, Hackbarth, and Zechner, 2018).

Moreover, the paper is related to the literature on the impact of economic shocks. The literature shows that economic crises are associated with reductions in the aggregate output level (e.g., Reinhart and Rogoff, 2008). Some studies examine the impact of the financial crises on banks and show that there are significant negative effects on banks' capital that reduces the supply of loans to the corporate sector. Further evidence suggests that adverse consequences from increased losses in the banking sector spill over to the corporate sector and negatively affect borrowing firms' performance (Lemmon and Roberts, 2010; Chava and Purnanandam, 2011). This paper contributes to the literature by documenting the heterogeneous effects of the COVID-19 shock on real-sector firms and financial firms from a financial market perspective. Unlike the Global Financial Crisis, the COVID-19 crisis is a health crisis that directly hits the real sector and not the financial sector.

The paper is also related to research on firms' holding of cash reserves. Many empirical papers on corporate liquidity management focus on cash and short-term investment as an important source of liquidity in the presence of market frictions. For example, financially constrained firms may benefit from holding cash that mitigates the underinvestment problem (e.g., Opler et al. 1999; Almeida, Campello and Weisbach, 2004; Faulkender and Wang, 2006; Denis and Sibilkov, 2010; Duchin, Ozbas and Sensoy, 2010). However, in firms with agency problems, holding cash provides the chance for managers to engage in value-destroying investment activities (Jensen, 1986; Harford, 1999). Thus, holding excess cash reserve is regarded as expensive in practice (Holmstrom and Tirole, 2000, 2001). This paper contributes to the literature by emphasizing the importance of holding enough cash reverses to mitigate the rollover risks under the context of the COVID-19 health crisis.

Last but not least, this paper relates to the contemporaneous work on the market reaction to COVID-19 crisis for firms.[3] For instance, Ramelli and Wagner (2020) find that investors were moving away from U.S. firms with exposures to China when the virus was contained in China. Moreover, when the virus spread to Europe and the U.S., leverage ratio and cash holding are important value drivers as they have significant negative and positive effects on stock prices respectively. Ding, Levine, Lin and Xie (2020) investigate the stock market reactions of firms around the world in the early 2020. They find that the drop in stock price was milder for firms with stronger pre-2020 finances, less exposure to COVID-19 through global supply chains and customer locations, more CSR activities, and less entrenched executives. Focusing on non-financial firms during the COVID-19 crisis, Fahlenbrach, Rageth, and Stulz (2020) find a worse decline in stock prices for firms with less cash reserves, and firms with more short-term or long-term debt. The difference between the effects of short-term and long-term debt is insignificant. The authors also find levered firms experienced stronger increase in the CDS premiums but do not find firms with more short-term debt to be affected differently from firms with more long-term debt. In addition, they find that the decline in the stock prices was not affected by firms' ability of accessing financial markets as measured by the financial constraint indices prior to the crisis. Alfaro, Chari, Greenland and Schott (2020) find that an unanticipated doubling (halving) of projected COVID-19 infections forecasts next-day decreases (increases) in aggregate US stock market value of 4 to 11 percent, and firms with higher leverage, lower profitability or higher capital intensity experienced worse COVID-19 related losses. These contemporaneous papers on the market reactions during the COVID-19 crisis do not focus on the effects of debt rollover risk as

[3] There are many contemporaneous papers that are broadly related to the impact of COVID-19 crisis, but not on the effects on the financial markets (e.g., Acharya and Steffen, 2020; Cejnek, Randl and Zechner, 2020; Halling, Yu and Zechner, 2020; Li, Strahan and Zhang, 2020; Bartik, Cullen, Glaeser, Luca and Stanton, 2020; Baker, Farrokhnia, Meyer, Pagel and Yannelis, 2020).

we do. In this paper, we look at both financial and real-sector firms with *immediate financing needs* and *distant financing needs* of rolling over debt at the time of COVID-19 shocks. Facing an immediate liquidity shortfall as implied by the COVID-19 crisis, we document a substantial increase in CDS spread changes and decline in stock returns for firms with higher levels of debt rollover risk. We also find that being financially constrained or having greater firm volatilities makes these firms with higher rollover risks suffered more from the COVID-19 crisis.

The rest of the paper proceeds as follows. Section 2 describes data and explains how we measure debt rollover risk and market reactions. Section 3 investigates the relation between debt rollover risk and CDS spread changes during the COVID-19 crisis. Section 4 examines the relation between debt rollover risk and abnormal stock returns during the crisis. Section 5 investigates whether firms with immediate refinancing needs suffered more during the COVID-19 cash flow shock. Section 6 reports the results from various robustness tests. Section 7 concludes.

2. Background and Data

2.1. COVID-19 Crisis in the United States

The COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing pandemic of coronavirus disease, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak was first identified in Wuhan, China, in December 2019. The virus then quickly spread across the globe, and the U.S. too was hard hit by the COVID-19 crisis in early of 2020. After the first death in the United States was reported in Washington state on February 29, Governor Jay Inslee declared a state of emergency, an action soon followed by other states. President Trump then declared a national emergency on March 13, making federal funds available to respond to the crisis. As of May 17, 2020, more than 4.71 million cases of COVID-19 have been reported in more than 188 countries and territories, resulting in more than 315,000 deaths. The

outbreak of COVID-19 pandemic has far-reaching consequences on the society than the spread of the deadly disease itself. Various levels of mandatory shutdowns and social distancing measures implemented by local and states governments have brought many parts of the U.S. economy to a standstill. In April alone, nearly a quarter of residents (renters and homeowners) did not pay full housing costs. Many workers were furloughed or laid off as a result of business and school closures and the cancellation of public events. According to data released by the U.S. Bureau of Labor Statistics on May 8, the U.S. economy lost a staggering record 20.5 million jobs in April, pushing the unemployment rate to 14.7%—the highest monthly rate since record keeping began in 1948.

2.2. Data and Variables

We measure firms' stock price reactions and CDS spread changes over the entire sample period from 1/30/2020 to 3/26/2020. We also separately examine two subperiods: 1/30/2020-2/28/2020 and 3/2/2020-3/26/2020.[4] The sample period and subperiods are based on three major milestones related to the development of COVID-19 crisis, including 1/30/2020, the date when the World Health Organization (WHO) declared a global public-health emergency, 2/29/2020, the date when the US reports the first death on American soil, and 3/26/2020, the date when the U.S. became the world's most affected country—total confirmed cases in the US reached 82,404 on this date, surpassing China's 81,782 and Italy's 80,589.[5]

To analyze the stock market reactions, we obtain daily stock price data of all common stocks (CRSP share code 10 or 11) listed on NYSE, AMEX, and NASDAQ from the Center for Research in Security Prices (CRSP). We obtain information on firms' CDS spread from Markit

[4] 2/29/2020 and 3/1/2020 are weekends with no trading activities.

[5] The two-trillion-dollar relief package passed the U.S. Senate on March 25th and the House of Representatives on March 27th. It was then immediately signed into law by President Trump on March 27th. News about the rescue package sent the S&P 500 index up by 9.38% on March 24—its best day since Oct 28, 2008. The market has generally been in an upward trend since then. Our results are even stronger if our sample period stops on March 23rd.

database for firms with CDS contracts of various maturities. Only the CDS contracts on public firms for which we have data in CRSP and COMPUSTAT are used in our study. To control for firm characteristics, we obtain one-quarter lagged financial data from Compustat. We then link firms' stock price and CDS reactions to firms' characteristics such as rollover risk in the quarter *prior to* the COVID crisis to study the cross-sectional variation in the market reactions to the shocks. We also include standard firm-level control variables such as firm size (*Size*), profitability (*Roa*), firm market-to-book equity ratio (*MTB*), leverage ratio (*Leverage*), past stock returns of the firm (*Past_Return*) and past volatility of stock returns (*Vol*) as it is well known that these firm characteristics are related to cross-sectional stock returns.

We measure the potential impact of debt rollover risk based on the ratio of firms' debt that matures shortly (due within one year) to cash and short-term investment before the crisis (*DD_One*). Having a larger percent of debt maturing shortly subjects a firm to liquidity risks of creditors' refusing to roll over the debt due to the cash flow shock imposed by the COVID-19 crisis.[6] And having abundant cash reserves help mitigate the adverse effects from potentially not being able to roll over the debt due. If the cash reserve is large enough to pay back the debt due, there is no need to roll the debt over to future periods. The literature also suggests that the negative impact of the Global Financial Crisis on firm investment is more pronounced for firms with lower level of pre-cautionary cash reserves and firms with more short-term debt outstanding (Duchin, Ozbas and Sensoy, 2010). A higher value of this ratio thus indicates higher potential effects from debt rollover risk. In other words, firms with immediate needs of repaying maturing debt and insufficient cash reserves will face significant debt rollover risk. In the robustness tests, we also

[6] Corporate cash flows are one of the key factors considered by banks when they structure terms on new loans and renegotiating existing loans, and cash flow covenants are one of the most widely used types in lines of credit (e.g., Roberts and Sufi, 2009; Sufi, 2009).

construct two alternative debt-rollover-risk measures by scaling the amount of debt due within one year with the amount of total debt outstanding (Friewald, Nagler and Wagner, 2018) and the amount of total long-term debt outstanding (Almeida et al., 2012; Hu, 2010), respectively.

Our dataset consists of 3,047 firm observations with non-missing stock returns and financial data. Then, we create a subsample that contains 234 firms having CDS contracts with non-missing main spread data in Q1 2020. Table A1 provides the detailed definition and data source for each of the variables used in the study and Table 1 provides the summary statistics. All continuous variables are winsorized at the 1st and 99th percentiles to limit the influence of outliers.

[Please insert Tables 1 here]

3. Debt Rollover Risk and CDS Spread during the COVID-19 Crisis

This section investigates how the COVID-19 shock affects the CDS spread of firms with different levels of debt rollover risk. We also examine whether financial constraints and firm volatilities amplify the impact of the COVID-19 shock on the default risk and CDS spread of high debt-rollover-risk firms.

3.1. Debt Rollover Risk and CDS Spread

We sort firms with available CDS spread data (i.e., 234 firms) equally into quartiles according to their debt rollover risk (*DD_One*) and construct an indicator variable, *DD_One_High25*, which equals 1 if the firm falls in the top quartile of debt due within one year scaled by cash and short-term investment (with available CDS data) and equals 0 otherwise. We then employ the following regression model to examine the impact of the COVID-19 shock on CDS spread of firms with different levels of debt rollover risk:

$$Spread_i = \alpha + \beta_1 DD\_One\_High25_i + \beta_2 Controls_i + Industry\_FE + \varepsilon_{i,t}. \quad (1)$$

In Equation (1), the dependent variable, *Spread*, is the change in firm *i*'s 6-month, 1-year, 5-year or 10-year CDS spread over the sample period (*CDS_6M*, *CDS_1Y*, *CDS_5Y* or *CDS_10Y*). The regression coefficient of *DD_One_High25* reflects the incremental impact of the crisis on firms in the highest debt-rollover-risk quartile relative to firms in the other quartiles. Control variables include firm characteristics such as firm size (*Size*), profitability (*Roa*), market-to-book equity ratio (*MTB*), financial leverage (*Leverage*), past stock returns (*Past_Return*), stock return volatility (*Vol*) and stock illiquidity (*Illiquidity*). Industry fixed effects (i.e., 2-digit SIC industry indicators) are included to control for potential heterogeneous responses of firms from different industries.[7] Standard errors are clustered at the 2-digit SIC industry level. The results are reported in Table 2.

[Please insert Table 2 here]

We separately estimate Equation (1) for the first period from 1/30/2020 to 2/28/2020 (i.e., the period from the date when WHO declares a global public-health emergency to the date when the U.S. reports the first death on American soil), the second period from 3/2/2020 to 3/26/2020 (i.e., the period when the U.S. gradually develops into the most COVID-19 affected country in terms of the number of cases identified), and the full sample period from 1/30/2020 to 3/26/2020 and report the results in Panels A, B, and C respectively. Panel A of Table 2 shows that the regression coefficients of *DD_One_High25* are significantly positive at the 1% level across different regression models with *CDS_6M*, *CDS_1Y*, *CDS_5Y* and *CDS_10Y* as the dependent variables respectively. The results indicate that relative to firms in the other quartiles of debt rollover risk, the COVID-19 crisis leads to an economically significant increase in CDS spread of

[7] For example, firms from transportation industries may react very differently from internet or online gaming firms.

104 to 207 basis points across different CDS contract maturities for firms in the highest rollover-risk quartile in the first period when the US reports the first death on American soil.

Panel B shows even more significant results in the second period. Again, the regression coefficients of *DD_One_High25* are significantly positive across different regression models. The results indicate that the crisis leads to a startling increase in CDS spread of 270 to 673 basis points across different CDS contract maturities for firms in the highest rollover-risk quartile relative to firms in the other rollover-risk quartiles. Moreover, the shorter the CDS maturity, the larger is the increase in CDS spread, indicating that investors are more concerned about the short-term default risk for high rollover-risk firms than these firms' long-term default risk.

Panel C shows the impact of the COVID-19 crisis on the CDS spread of firms with different levels of debt rollover risk over the entire sample period from 1/30/2020 to 3/26/2020. Consistent with the earlier results, the results in Panel C suggest that the COVID-19 crisis leads to an increase in CDS spread of 349 to 880 basis points across different CDS contract maturities for firms in the highest rollover-risk quartile relative to firms in the other rollover-risk quartiles—again, the shorter the CDS maturity, the greater is the impact. The regression coefficients of three control variables, *Roa*, *Past_Return* and *Vol*, are also statistically significant, indicating that firms with lower past stock returns, greater stock return volatility or greater profitability experience greater increase in CDS spread during the COVID-19 crisis.

As a robustness test, we use the first (lowest) rollover-risk quartile as the reference group and construct three indicator variables, including *DD_One_Group2*, *DD_One_Group3*, and *DD_One_Group4*, to indicate the other three quartiles and re-estimate Equation (1). The results are reported in Table A2 in the Appendix. We consistently find that only the regression coefficient of the highest rollover-risk quartile (*DD_One_Group4)* is significantly positive across different

regression models with *CDS_6M*, *CDS_1Y*, *CDS_5Y* and *CDS_10Y* as the dependent variables respectively in the first, second and whole periods. The results indicate that relative to firms in the lowest debt-rollover-risk quartile, firms in the highest debt-rollover-risk quartile on average experience a highly significant increase in CDS spread of 353 to 974 basis points over the full sample period. Moreover, the increase in CDS spread is much more pronounced in the second period than in the first period.

To summarize, we find that the COVID-19 shock exerts heterogeneous impact on the default risk and CDS spread change of firms with different levels of debt rollover risk. The crisis leads to a sharp increase in CDS spread for firms in the highest debt-rollover-risk quartile relative to firms in the other quartiles—the shorter the maturity of the CDS contract, the greater is the increase in CDS spread for firms with high debt rollover risk. Furthermore, the impact is much more pronounced in the second period than in the first period.

3.2. Debt Rollover Risk and CDS Spread Conditional on Financial Constraints or Firm Volatilities

Given that the COVID-19 crisis posts a significant hit to firm cash flow, it may be particularly challenging for a financially constrained firm with little cash reserves and large amount of debt due in the near future to meet its payment obligation, resulting in significant default risk. Literature suggests that stock returns of financially constrained firms tend to comove together, and such firms tend to earn higher returns on average (e.g., Whited and Wu 2006). However, during crisis time, such firms tend to suffer more likely due to their corporate liquidity shortfall (e.g. Campbello, Graham, and Harvey, 2010). We expect the negative cash flow shock due to the COVID-19 crisis to increase the default risk for high debt-rollover-risk firms particularly when these firms also face tight financial constraints. In other words, financial constraints can amplify the impact of the COVID-19 shock on the default risk and CDS spread of high debt-rollover-risk firms.

We thus partition the sample firms with available CDS spread data (i.e., 234 firms) into high- and low-constraint groups based on six commonly used financial-constraint measures: 1) the Hadlock and Pierce (2010) index (*HP*), 2) the Whited and Wu (2006) index (*WW*), 3) the Altman's Z score (*Z_Score*), 4) the Kaplan and Zingales (1997) index (*KZ*), 5) whether the firm paid any cash dividend over the past fiscal year (*Non_Div*), and 6) Whether the firm's Standard & Poor's (S&P) long-term debt is rated below investment grade (*Non_Invest_Grade*). For each of the first four financial-constraint measures, the indicator variable, *High_FC*, equals 1 for firms with greater-than-sample-median financial constraints and equals 0 otherwise. For the fifth measure, *High_FC* equals 1 if the *Non_Div* indicator (which takes the value of 1 if the firm did not pay any cash dividend in 2019) equals 1 and equals 0 otherwise. For the sixth measure, *High_FC* equals 1 if the *Non_Invest_Grade* indicator (which takes the value of 1 if the firm's long-term debt is rated below investment grade by S&P) equals 1 and equals 0 otherwise. We then interact *High_FC* with the *DD_One_High25* indicator in CDS spread regressions.[8] Component terms of the interaction terms (i.e., *High_FC* and *DD_One_High25*) are also included in the regressions. Moreover, we include the firm-level control variables and industry fixed effects as in Table 2. The results are reported in Table 3. For brevity concern, we only report the regression results using 6-month CDS spread (*CDS_6M*) as the dependent variable in the full sample period (as the results with other CDS maturities and with the first and second subperiods are qualitatively similar to the reported results) and only report the regression coefficients of the interaction terms (which are our main interest).

[Please insert Table 3 here]

[8] We further check and find that the high- and low-constraint firms are allocated quite evenly into the different debt-rollover-risk quartiles.

Panel A of Table 3 shows that the regression coefficients of the interaction terms *DD_One_High25*High_FC* are significantly positive and large in magnitude across all regressions with different financial-constraint measures. The results suggest that the COVID-19 shock increases the CDS spread for the firms in the top quartile of debt rollover risk relative to firms in the other rollover-risk quartiles by an incremental 1,157 to 3,575 basis points over the full sample period if these high-rollover-risk firms also face tight financial constraints.[9] Thus, our empirical results confirm that the negative cash flow shock occasioned by the COVID-19 crisis significantly increases the default risk and CDS spread for high debt-rollover-risk firms particularly when such firms also face tight financial constraints.

It is known that firms with greater volatilities tend to have greater default risk and CDS spread (Ericsson, Jacobs and Oviedo, 2009). Thus, we further conjecture that the negative cash flow shock occasioned by the COVID-19 crisis should significantly increase the default risk for high debt-rollover-risk firms especially if such firms also have high volatilities prior to the crisis. That is, high volatilities can also amplify the impact of the COVID-19 shock on the CDS spread of firms with high debt rollover risk.

We next partition the sample firms with available CDS spread data equally into high- and low-volatility groups based on their past total stock return volatility (*Vol*), idiosyncratic stock return volatility (*Ivol*), options-implied volatility (*Impl_Vol*),[10] ROA volatility (*Roa_Vol*), and operating cash flow volatility (*Operating_Cash_Vol*) respectively. For each of these volatility measures, we construct an indicator variable *High_Vol*, which equals 1 for firms with greater-than-

[9] In Panel A of Table A3 in the Appendix, instead of interacting *High_FC* only with *DD_One_High25*, we interact *High_FC* with three different debt-rollover-risk indicators (i.e., *DD_One_Group2*, *DD_One_Group3*, and *DD_One_Group4*) in CDS spread regressions. The results are qualitatively similar to those in Panel A of Table 3.

[10] Options-implied volatility is a market-based, forward-looking measure of firm stock return volatility (e.g., Christensen and Prabhala, 1998; Fleming, Kirby and Ostdiek, 1998; Busch, Christensen and Nielsen, 2011; Guo and Qiu, 2014).

sample-median level of volatility and equals 0 otherwise. We then interact *High_Vol* with the *DD_One_High25* indicators in CDS spread regressions.[11] Component terms of the interaction terms, firm-level control variables and industry fixed effects are also included in the regressions. The results are reported in Panel B of Table 3. For brevity concern, again we report only the regression results using 6-month CDS spread (*CDS_6M*) as the dependent variable in the full sample period (the results with other CDS maturities and with the first and second subperiods are qualitatively similar to the reported results) and only report the regression coefficients of the interaction terms.

Consistent with our expectation, Panel B of Table 3 shows that the coefficients of the interaction terms *DD_One_High25*High_Vol* are positive and statistically significant across all five regressions. The results indicate that the COVID-19 shock increases the CDS spread for the firms in the top quartile of debt rollover risk relative to firms in the other rollover-risk quartiles by an incremental 1,443-2,290 basis points over the full sample period if these high-rollover-risk firms also have high volatilities.[12] Therefore, our empirical results strongly support the conjecture that the negative cash flow shock occasioned by the COVID-19 crisis significantly increases the default risk and CDS spread for high debt-rollover-risk firms particularly if such firms also have high stock return or cash flow volatilities.

4. Debt Rollover Risk and Stock Returns during the COVID-19 Crisis

In the last section, we document that the COVID-19 shock significantly increases the default risk and CDS spread of firms with high debt rollover risk. Because a sharp increase in default risk

[11] We check that high- and low-volatility firms are allocated quite equally into different debt-rollover-risk quartiles.
[12] In Panel B of Table A3 in the Appendix, instead of interacting *High_Vol* only with *DD_One_High25*, we interact *High_Vol* with three different debt-rollover-risk indicators (i.e., *DD_One_Group2*, *DD_One_Group3*, and *DD_One_Group4*) in CDS spread regressions. The results are very similar to those in Panel B of Table 3.

should significantly decrease the firm's equity value, we next examine how the COVID-19 shock affects stock returns of firms with different levels of debt rollover risk.

4.1. Debt Rollover Risk and Stock Returns

We first use the event study approach to discern the impact of the COVID-19 shock on stock returns of firms with different levels of debt rollover risk. The sample consists of 3,047 firms with non-missing stock return data from CRSP and financial data from Compustat. We sort the sample firms equally into quartiles according to their levels of debt due within one-year scaled by cash and short-term investment (*DD_One*). For each firm, we then calculate its buy and hold abnormal stock returns (BHARs) and cumulative abnormal returns (CARs) for three periods: 1) 1/30/2020 – 2/28/2020 (the first period); 2) 3/2/2020 – 3/26/2020 (the second period); and 3) 1/30/2020 – 3/26/2020 (the full period) similar to Table 2. We use the S&P 500 stock market index as the market portfolio. We calculate CARs using both the market model and the market-adjusted model. The market-model estimation window is days (-150, -50) before 1/30/2020. The event-study results are reported in Table 4.

[Please insert Table 4 here]

Panel A of Table 4 reports the mean BHARs for firms with different levels of debt rollover risk during the first, second and full sample periods. We expect the COVID-19 shock to disproportionately affect the equity value of high debt-rollover-risk firms. Consistent with our expectation, we find that firms in the high rollover-risk group (i.e., group 4) have the most negative mean BHARs among the four groups of firms in both the second period (-14.62%) and the full sample period (-14.08%), which are statistically significantly at the 1% level. During the first period, firms in group 4 have similar mean BHAR (-1.92%) as those in group 3 and their mean BHARs are lower than the BHARs of groups 1 and 2. We also find that although firms in the high

rollover-risk group generally have the lowest BHARs, the relation between mean BHAR and debt rollover risk is not monotonic in the first three groups—firms in group 2 have higher mean BHARs than firms in the other two groups. The significantly negative average BHARs for all sample firms during the first, second and full sample periods suggest that small firms generally fare worse than large firms during the COVID-19 crisis. Results are qualitatively similar when we examine CARs estimated using the market model (Panel B) and the market-adjusted model (Panel C). In particular, firms with high debt rollover risk (group 4) generally have the lowest CARs among the four debt-rollover-risk groups during the COVID-19 crisis.

Next, we use the following regression specification to examine the impact of the COVID-19 shock on stock returns of firms with different levels of debt rollover risk:

$$Return_i = \alpha + \beta_1 DD\_One\_High25_i + \beta_2 Controls_i + Industry\_FE + \varepsilon_{i,t}. \quad (2)$$

In Equation (2), the dependent variable, *Return*, is the *BHAR* or *CAR* of firm *i* in the first, second or full sample period. *DD_One_High25* equals 1 if firm *i*'s debt rollover risk falls in the highest quartile of 3,047 sample firms with available stock returns and financial data and equals 0 otherwise. Similar to Equation (1), the regression coefficients of *DD_One_High25* reflect the incremental impacts of the crisis on firms in the highest debt-rollover-risk quartile relative to firms in the other quartiles. Control variables include firm size (*Size*), profitability (*Roa*), market-to-book equity ratio (*MTB*), financial leverage (*Leverage*), past stock returns (*Past_Return*), stock return volatility (*Vol*), stock illiquidity (*Illiquidity*), and industry fixed effects (i.e., 2-digit SIC industry indicators). Standard errors are again clustered at the 2-digit SIC industry level. The results are reported in Table 5. For brevity, we report only the results using *BHAR* as the dependent variable (as results using *CAR* as the dependent variable are qualitatively very similar to the reported results).

[Please insert Table 5 here]

We separately report the results of estimating Equation (2) for real-sector firms, banking and financial firms and the full sample in Panels A, B and C of Table 5, respectively.[13] Panel A shows that while the regression coefficients of *DD_One_High25* are insignificantly negative in the first period (Columns 1 and 2), they are significantly negative in the second and the full periods (Columns 3 to 6)—comparing with firms in the other debt-rollover-risk quartiles, high rollover-risk firms on average produce significantly lower BHARs by 2-3% during the COVID-19 crisis (mainly due to their low returns in the second period). This finding is consistent with our earlier findings on the CDS spread changes of firms with high debt rollover risk.

In terms of control variables, the regression coefficients of *Size*, *MTB*, *Past_Return*, and *Illiquidity* are significantly positive, while those of *Leverage* and *Vol* are significantly negative. This finding indicates that larger firms and firms with higher valuation, better past stock performance or lower stock liquidity fare better, while firms with greater leverage or more volatile past stock returns fare worse, during the COVID-19 crisis.

Panel B shows the regression results for banking and financial firms. Interestingly, we find that the regression coefficients of high debt rollover risk are statistically insignificant in general. This finding suggests that the uncovered heterogeneous effect of the COVID-19 shock on firms with different levels of debt rollover risk is mainly concentrated in the main-street firms. Different from the Global Financial Crisis, which is a financial crisis first starting from the banking and financial industries and then spreading to the real sector through the decrease in credit supply, the COVID-19 crisis is a health crisis that directly hits the real sector and not the financial sector.

[13] It is valuable to compare the CDS spread changes between the real-sector and financial firms. However, we are constrained by the limitation of the CDS data—only 20+ financial firms have complete and non-missing data on CDS spreads. Thus, it is challenging to draw general conclusions on the comparison between the financial and real-sector firms when it comes to the effects of the COVID-19 on CDS spread changes.

Moreover, the banking and financial industries are much better prepared when the COVID-19 crisis hit, possibly also due to the resilience built up through various post-global-financial-crisis regulations (e.g., the Dodd-Frank Act, the stress tests, etc.). Thus, the finding that the uncovered effect is mainly concentrated in the real sector is perhaps not too surprising.

Panel C shows the regression results using the full sample of both real-sector and financial-sector firms. The results are qualitatively similar to, but understandably weaker than, those reported in Panel A. We generally find that firms in the highest rollover-risk quartile produce lower stock returns than firms in the other rollover-risk quartiles during the crisis.

To ensure the robustness of the findings, we use the first (lowest) rollover-risk quartile as the reference group and construct three indicator variables, including *DD_One_Group2*, *DD_One_Group3*, and *DD_One_Group4*, to indicate the other three rollover-risk quartiles and reestimate Equation (2). The results are reported in Table A4 in the Appendix. Panel A of Table A4 shows the regression results for real-sector firms, which are qualitatively similar to those reported in Panel A of Table 5. The regression coefficients of *DD_One_Group4* are negative across all the six regressions and significantly so in the latter four regressions. The results indicate that relative to firms in the lowest rollover-risk quartile, firms in the highest debt-rollover-risk quartile on average produce significantly lower BHARs by around 2.5-3% during the full sample period. Moreover, the low stock returns of high rollover-risk firms are mainly concentrated in the second period. Panels B and C of Table A4 also show qualitatively similar results as those reported in Panels B and C of Table 5. In particular, the heterogeneous impact of the COVID-19 shock on firms with different levels of debt rollover risk is mainly confined to the real sector and not the financial sector.[14]

[14] Consistent with the results in Table 4 (that firms in the second rollover-risk quartile have the highest returns during the crisis), Panel C of Table A4 shows that the coefficient of *DD_One_Group2* is positive in all regression models

To summarize, we find that the COVID-19 shock exerts heterogeneous impact on stock returns of firms with different levels of debt rollover risk. Consistent with the patterns depicted in Figure 2, the crisis leads to a significantly lower stock returns for firms with high debt rollover risk than other firms—the finding is mainly driven by real-sector firms and not financial-sector firms and mainly concentrated in the second period (when the U.S. becomes heavily impacted by the health crisis).

4.2. Debt Rollover Risk and Stock Returns Conditional on Financial Constraints or Firm Volatilities

In earlier results, we document that financial constraints amplify the impact of the COVID-19 shock on the default risk and CDS spread of high debt-rollover-risk firms. In this section, we similarly examine whether financial constraints affect the magnitude of the impact of the COVID-19 shock on stock returns of high debt-rollover-risk firms.

We partition the sample firms with available stock returns and financial data (i.e., 3,047 firms) into high- and low-constraint groups based on the following six financial-constraint measures: 1) the Hadlock and Pierce (2010) index (*HP*), 2) the Whited and Wu (2006) index (*WW*), 3) the Altman's Z score (*Z_Score*), 4) the Kaplan and Zingales (1997) index (*KZ*), 5) whether the firm paid any cash dividend over the past fiscal year (*Non_Div*), and 6) Whether the firm's Standard & Poor's (S&P) long-term debt is rated below investment grade (*Non_Invest_Grade*). For each of these measures, we then similarly construct the indicator variable *High_FC* to indicate firms facing tight financial constraints. We then interact *High_FC* with the *DD_One_High25* indicator in stock return regressions. Component terms of the interaction term (i.e., *High_FC* and

and significantly so in five out of six regression models—although firms in both the first and second rollover risk quantiles have low debt rollover risk, firms in the second rollover risk quartile on average have higher BHARs than firms in the first quartile by around 2-2.5% in the whole period.

DD_One_High25), firm-level control variables and industry fixed effects are included in all regressions. The results are reported in Table 6. For brevity concern, we only report the regression results using *BHAR* as the dependent variable in the full sample period and only report the regression coefficient of the interaction term.

[Please insert Table 6 here]

Panel A of Table 6 shows that the regression coefficients of the interaction terms *DD_One_High25*High_FC* are negative in all regressions and significantly so in three out of the six regressions. The results suggest that the COVID-19 shock decreases stock returns for the firms in the top quartile of debt rollover risk relative to firms in the other rollover-risk quartiles by an incremental 2-4% over the full sample period if these high-rollover-risk firms also face tight financial constraints according to the financial-constraint measures of *HP*, *Z-Score*, and *KZ*. Thus, consistent with the earlier CDS spread finding, we find that the COVID-19 shock significantly decreases stock returns for firms with high debt rollover risk particularly when these firms also face tight financial constraints.[15]

As our earlier findings suggest that high firm volatilities amplify the impact of the COVID-19 shock on the default risk and CDS spread of high debt-rollover-risk firms, we further examine whether firm volatilities similarly amplify the impact of the COVID-19 shock on stock returns of such firms. We again partition the sample firms with available stock returns and financial data equally into high- and low-volatility groups based on their past total stock return volatility (*Vol*), idiosyncratic stock return volatility (*Ivol*), options-implied volatility (*Impl_Vol*), ROA volatility (*Roa_Vol*), and operating cash flow volatility (*Operating_Cash_Vol*). For each of these volatility

[15] In Panel A of Table A5 in the Appendix, instead of interacting *High_FC* only with *DD_One_High25*, we interact *High_FC* with three different debt-rollover-risk indicators (i.e., *DD_One_Group2*, *DD_One_Group3*, and *DD_One_Group4*) in stock return regressions. The results are qualitatively similar to those in Panel A of Table 6.

measures, we then construct an indicator variable *High_Vol* to indicate above-sample-median level of volatility. We then interact *High_Vol* with the *DD_One_High25* indicator in stock return regressions, respectively. Component terms of the interaction term, firm-level control variables and industry fixed effects are also included. The results are reported in Panel B of Table 6.

Consistent with our expectation, Panel B of Table 6 shows that the regression coefficients of the interaction term *DD_One_High25*High_Vol* are negative in all regressions and significantly so in three out of the five regressions. The results indicate that the COVID-19 shock decreases BHARs for firms in the top quartile of debt rollover risk relative to firms in the other rollover-risk quartiles by an incremental 3% over the full sample period if these high-rollover-risk firms also have high stock return volatilities according to *Vol*, *Ivol* and *Impl_Vol*. Therefore, our empirical results confirm that the COVID-19 shock significantly decreases abnormal stock returns for high debt-rollover-risk firms particularly if such firms also have high stock return volatilities.[16]

5. Immediate Refinancing Needs versus Distant Refinancing Needs

In this section, we further strengthen the identification on the effects of debt rollover risk. Our identification strategy hinges on the assumption that the COVID-19 shock was entirely unexpected and thus the percentage of firms' debt that was maturing in the first few months of year 2020 when COVID-19 hit the U.S. is largely exogenous to firms' choice.[17] To identify the effect of debt rollover risk on firms' CDS spread and stock return reactions during the COVID-19 crisis, we thus zoom in on the timing of firms' debt rollover, and compare the effects of rollover risk on CDS spread changes and BHARs for firms with debt maturing immediately and firms with debt due

[16] In Panel B of Table A5 in the Appendix, instead of interacting *High_Vol* only with *DD_One_High25*, we interact *High_Vol* with three different debt-rollover-risk indicators (i.e., *DD_One_Group2*, *DD_One_Group3*, and *DD_One_Group4*) in stock return regressions. The results are qualitatively similar to those in Panel B of Table 6.
[17] We are grateful to a referee for suggesting this identification strategy to us.

later in the year. Even if the total amount of debt due in year 2020 were the same for two firms, the actual timing of the debt due would be different, causing different levels of rollover risk for firms at the time of the COVID shock. The COVID-19 crisis creates a liquidity shortfall by causing a sudden plunge in firms' cash flow. If debt rollover risk is indeed a driver for the heterogenous reactions in firms' CDS spread and shareholder value, then we should expect a stronger effect for firms with debt maturing immediately rather than for firms with debt due later in the year (firms with distant refinancing needs).

Thus, we distinguish firms with immediate needs of repaying maturing debt and firms with distant refinancing needs, and test whether firms with immediate refinancing needs suffered more during the COVID-19 cash flow shock. In particular, we collect comprehensive bond and bank loan data from the SDC New Debt Issuance and Thomson Reuters Dealscan Syndicated Loan databases over the past 30 years. We extract the maturity information on firms' outstanding bonds and bank loans, and construct the maturity profiles of firms' debt outstanding. We identify firms in the highest quartile in terms of the immediate refinancing needs with debt maturing in March-June, and firms in the highest quartile in terms of distant refinancing needs with debt maturing in the rest of year 2020 (July-December). We then rerun the baseline regressions of Equation (1) and Equation (2), using the new rollover risk variables constructed. The results are reported in Table 7.

[Please insert Table 7 here]

As shown in Table 7, the regression coefficients of *DD_One_High25 (March-June)* on changes in CDS spread are significantly positive and very large in magnitude (e.g., 751 basis points for 6-month CDS spread changes). Similarly, relative to the other firms, real-sector firms in the highest immediate debt-rollover-risk quartile (debt due in March-June) on average produce

significantly lower BHARs by around 2.3 percent. By contrast, the effect of having a large proportion of debt maturing in July to December is largely muted. These empirical results hence confirm the finding from our main tests, showing that firms' debt rollover risk is a key factor that drives the heterogenous CDS spread and stock return reactions to the COVID-19 shock.

6. Robustness Results

6.1. Controlling for New Debt Issuance in the First Quarter of 2020

The existing evidence shows that firms had substantially borrowed from banks (Acharya and Steffen, 2020) and the public bond market (Halling, Yu and Zechner, 2020) during the COVID-19 crisis period. It is likely that those firms with a larger amount of debt maturing within one year may borrow more. Thus, firms' default risk may increase if there is a surge in firms' leverage ratio during the sample period. In that case, controlling for the leverage ratio measured at the end of 2019 Q4 cannot fully reflect the effects from potential new debt issuance.[18]

To address this valid concern, we collect new data on firms' new debt (including both bonds and bank loans) issuance in the first quarter 2020, from Compustat, SDC New Debt Issuance and Thomson Reuters Dealscan Syndicated Loan databases. The idea is that if it is the potential surge in firm leverage during the sample period that drives up default risks, then controlling for the new debt issuance will likely mute the effect of debt rollover risk (i.e., the coefficient of DD_One_High25 indicator, which indicates firms in the top quartile of debt rollover risk). We include the new debt issuance measures constructed from Compustat and merged SDC/DealScan databases in our baseline regressions, respectively. The results are reported in Table 8.

[18] When controlling for leverage ratio, we use book leverage to be consistent with other accounting variables which also use book value. We also conduct additional robustness check controlling for market leverage instead of book leverage. As shown in Table A6 in the Appendix, the results controlling for market leverage are consistent with the original results.

[Please insert Table 8 here]

Panel A of Table 8 reports the regression results controlling for new debt issuance (*New_Debt_Issuance*) constructed from Compustat database, while Panel B reports the regression results controlling for *New_Debt_Issuance* constructed from merged SDC New Issuance and Dealscan Syndicated Loan databases. Indeed, we find that new debt issuance (scaled by lagged total assets) during the sample period is significantly and positively related to CDS spread changes and significantly and negatively related to BHARs (real sector). Nevertheless, it is clear that the coefficients of *DD_One_High25* remain statistically and economically significant in the regressions of CDS spread changes and BHARs. For example, after controlling for new debt issuance (constructed from merged SDC/Dealscan), Panel B of Table 8 shows that the regression coefficients of *DD_One_High25* on CDS spread changes are significantly positive and very large in magnitude (e.g., 702 basis points for 6-month CDS spread changes). Similarly, relative to the other firms, real-sector firms in the highest debt-rollover-risk quartile on average produce significantly lower BHARs by around 1.7 percent. Empirical results are qualitatively similar after controlling for new debt issuance constructed from Compustat in Panel A of Table 8.

6.2. Alternative Measures of Debt Rollover Risk

To ensure the robustness of our findings, we further construct two alternative measures of firms' debt rollover risk. Instead of using firm's cash and short-term investment, we use the amount of total debt outstanding (Friewald, Nagler, and Wagner, 2018) and the amount of total long-term debt outstanding (Almeida et al., 2012; and Hu, 2010) as the denominators to scale the total amount of debt due within one-year, respectively. Accordingly, we construct two alternative debt-rollover-risk measures for robustness (*DD_One_Alternative1_High25* and *DD_One_Alternative2_High25*)

to reflect whether the firm falls in the top quartile in terms of debt rollover risks or not. The results using these alternative debt-rollover-risk measures are reported in Table 9.

[Please insert Table 9 here]

The results in Table 9 are very similar to the baseline results in Tables 2 and 5. It is clear that the coefficients of both *DD_One_Alternative1_High25* and *DD_One_Alternative2_High25* are significantly positive across the regression models with CDS spread changes as the dependent variables and significantly negative with BHAR (Real Sector) as the dependent variable over the full sample period. The results indicate that relative to the other firms, firms in the highest debt-rollover-risk quartile, as measured using the two alternative debt-rollover-risk variables, on average experience a highly significant increase in CDS spread and a significant decline in stock prices over the full sample period. Moreover, the economic significance of the effects using alternative measures is also comparable to our findings using the original measure of rollover risk. These robustness results suggest that our findings are insensitive to the choice of debt-rollover-risk measures.

6.3. Two-Trillion-Dollar Government Relief Package and Federal Reverse Rate Cut

We conduct additional tests looking at the period leading to the launch of U.S. government's relief package (i.e., Jan 30 to Mar 23, 2020), and the period around the U.S. Senate passing the two-trillion-dollar relief package on March 25th (i.e., Mar 24 to Mar 26, 2020). News about the rescue package sent the S&P 500 index up by 9.38% on March 24—its best day since Oct 28, 2008. The market has generally been in an upward trend since then. We examine how the CDS spreads and stock returns of firms of different levels of debt rollover risk may have reacted differently to the lockdown from the COVID-19 that happened initially, as compared to the two-trillion-dollar government relief package that was launched at the later stage. The results are shown in Table 10.

[Please insert Table 10 here]

We document strong effects of the COVID-19 shock on firms facing high debt rollover risk during the period leading to the launch of the government interventions. The results indicate that relative to firms in the other rollover-risk quartiles, the crisis on average leads to a startling increase in CDS spread of up to 812 basis points for firms in the highest rollover-risk quartile, and significantly lower BHARs by around 1.9% for real sector firms in the highest rollover-risk quartile, during the period leading to the launch of the two-trillion-dollar government relief package. In contrast, we observe opposite (albeit statistically insignificant) effects for firms with the highest rollover risks around the launch of the government relief package, suggesting the potential positive effects of the government relief package on firms' cash flow.

We further investigate how firms' CDS spread changes and stock returns react to the interest rate reduction by the Federal Reserve System on March 15, 2020. As shown in Table A7 in the Appendix, we do not find any significant effect from the changes in Federal Reserve's interest rate. The results make sense given that the interest cut is largely expected by the market. Also, although a reduction in the interest rate may reduce the cost of a firm's rolling over maturing debt if it is able to roll it over, it is not immediately clear that the odds for firms to be able to roll over debt will increase.

7. Conclusion

In this paper, we investigate the heterogeneous impacts of the COVID-19 shock on the default risk and abnormal stock returns of firms with different levels of debt rollover risk. The COVID-19 crisis has caused significant disruptions to economic activities and resulted in a sharp decline in firms' cash flows, leaving those firms with little cash and short-term investment and pressing

financing needs vulnerable to default risk. The health crisis is expected to cause a significant surge in bankruptcies should it persists. In the event of actual bankruptcies, shareholders, who are residual claimers of firms' assets, often suffer a total loss of their shareholder value. Thus, the increased default risk will negatively affect shareholder wealth.

Because both the short-term debt and cash reserve play an important role in determining firms' funding liquidity risk, we construct a measure based on the ratio of firms' short-term debt (debt due within one year) to cash reserve to identify those firms facing significant debt rollover risk in the near future. The idea is that firms that have the immediate needs of repaying maturing debt and do not have enough cash to meet the repayment obligation will face significant debt rollover risk—these firms will have to default their debt-repayment obligation if they cannot roll over the maturing debt to future periods. We then sort US public firms equally into quartiles according to their debt rollover risk right before the crisis.

Using data on firms' CDS spread, we then investigate whether the COVID-19 shock exerts differential impact on the default risk of firms facing different levels of debt rollover risk. We find that the crisis leads to a sharp increase in CDS spread of 349 to 880 basis points for firms in the highest debt-rollover-risk quartile relative to firms in the other quartiles. Moreover, the shorter the maturity of the CDS contract, the greater is the increase in CDS spread for firms with high debt rollover risk, indicating that investors are more concerned about the short-term default risk for high rollover-risk firms than these firms' long-term default risk. Further, we find that the impact of the crisis on CDS spread of high rollover-risk firms is much more pronounced in the later sample period when the U.S. gradually becoming the most COVID-19 affected country than in the first sample period when the crisis mostly affecting Asia and Europe.

Consistent with the evidence on default risk, we find that the COVID-19 shock also exerts heterogeneous negative impact on the stock returns of firms with different levels of debt rollover risk. The crisis leads to significantly lower abnormal stock returns for firms with high debt rollover risk than other firms. The finding of the lower stock returns for high rollover-risk firms is mainly driven by real-sector firms and not financial-sector firms and mainly concentrated in the later sample period when the U.S. becomes heavily impacted by COVID-19. Real-sector firms with high debt rollover risk produced 2-3% lower abnormal stock returns than other firms during the crisis. The finding is consistent with the notion that different from the Global Financial Crisis, the COVID-19 crisis is a health crisis that directly hits the real sector and not the financial sector. In addition, our evidence indicates that the negative cash flow shock occasioned by the COVID-19 crisis significantly increases default risk (CDS spreads) and depresses stock prices for high debt-rollover-risk firms particularly if such firms also face tight financial constraints or have high firm volatilities.

To strengthen the identification on the effects of rollover risk, we zoom in on the timing of firms' debt rollover. We find that firms with immediate refinancing needs (debt due in March-June) suffered more than firms with distant refinancing needs (debt due in July-December) during the COVID-19 cash flow shock, which further confirms that firms' debt rollover risk is indeed a key factor that drives the heterogenous reactions to the COVID-19 shock. This study is the first that investigates the effects of debt rollover risk on firms' default risk and shareholder value using the unique quasi-natural experiment of the COVID-19 health crisis. The study contributes new evidence to the literature on debt rollover risk and economic shocks, and sheds light on the economic impact of the unprecedented COVID-19 health crisis.

References

Acharya, V.V., and Steffen, S, 2020. The risk of being a fallen angel and the corporate dash for cash in the midst of COVID. *CEPR COVID Economics, 10*.

Alfaro, L., Chari, A., Greenland, A.N. and Schott, P.K., 2020. Aggregate and firm-level stock returns during pandemics, in real time. NBER Working Paper No. 26950.

Almeida, H., Campello, M. and Weisbach, M.S., 2004. The cash flow sensitivity of cash. *Journal of Finance*, *59*(4), 1777-1804.

Almeida, H., Campello, M., Laranjeira, B. and Weisbenner, S., 2012. Corporate debt maturity and the real effects of the 2007 credit crisis. *Critical Finance Review*, *1*(1), 3-58.

Altman, E.I., 1968. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance*, *23*(4), 589-609.

Baker, S.R., Farrokhnia, R.A., Meyer, S., Pagel, M. and Yannelis, C., 2020. How does household spending respond to an epidemic? Consumption during the 2020 COVID-19 pandemic. NBER Working Paper No. 26949.

Barclay, M.J. and Smith Jr, C.W., 1995. The maturity structure of corporate debt. *Journal of Finance*, *50*(2), 609-631.

Bartik, A.W., Bertrand, M., Cullen, Z.B., Glaeser, E.L., Luca, M. and Stanton, C.T., 2020. How are small businesses adjusting to COVID-19? Early evidence from a survey. NBER Working Paper No. 26989.

Busch, T., Christensen, B.J. and Nielsen, M.Ø., 2011. The role of implied volatility in forecasting future realized volatility and jumps in foreign exchange, stock, and bond markets. *Journal of Econometrics*, *160*(1), 48-57.

Campello, M., Graham, J.R. and Harvey, C.R., 2010. The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics*, *97*(3), 470-487.

Cejnek, G., Randl, O. and Zechner, J., 2020. The COVID-19 pandemic and corporate dividend policy. CEPR Discussion Papers No. 14571.

Chava, S. and Purnanandam, A., 2011. The effect of banking crisis on bank-dependent borrowers. *Journal of Financial Economics*, *99*(1), 116-135.

Choi, J., Hackbarth, D. and Zechner, J., 2018. Corporate debt maturity profiles. *Journal of Financial Economics*, *130*(3), 484-502.

Christensen, B.J. and Prabhala, N.R., 1998. The relation between implied and realized volatility. *Journal of Financial Economics*, *50*(2), 125-150.

Denis, D.J. and Sibilkov, V., 2010. Financial constraints, investment, and the value of cash holdings. *Review of Financial Studies*, *23*(1), 247-269.

Diamond, D. W., 1991. Debt maturity structure and liquidity risk. *Quarterly Journal of Economics*, *106*(3), 709-737.

Ding, W., Levine, R., Lin, C. and Xie W., 2020. Corporate immunity to the COVID-19 pandemic. NBER Working Paper No. 27055.

Duchin, R., Ozbas, O., Sensoy, B.A., 2010. Costly external finance, corporate investment, and the subprime mortgage credit crisis. *Journal of Financial Economics*, *97*(3), 418-435.

Ericsson, J., Jacobs, K. and Oviedo, R., 2009. The determinants of credit default swap premia. *Journal of Financial and Quantitative Analysis*, *44*(1), 109-132.

Fahlenbrach, R., Rageth, K. and Stulz, R.M., 2020. How valuable is financial flexibility when revenue stops? Evidence from the COVID-19 crisis. NBER Working Paper No. 27106.

Faulkender, M. and Wang, R., 2006. Corporate financial policy and the value of cash. *Journal of Finance*, *61*(4), 1957-1990.

Fleming, J., Kirby, C. and Ostdiek, B., 1998. Information and volatility linkages in the stock, bond, and money markets. *Journal of Financial Economics*, *49*(1), 111-137.

Friewald, N., Nagler, F. and Wagner, C., 2018. Debt refinancing and equity returns. Working Paper, Norwegian School of Economics.

Froot, K.A., Scharfstein, D.S. and Stein, J.C., 1993. Risk management: Coordinating corporate investment and financing policies. *Journal of Finance*, *48*(5), 1629-1658.

Gopalan, R., Song, F. and Yerramilli, V., 2014. Debt maturity structure and credit quality. *Journal of Financial and Quantitative Analysis*, *49*(4), 817-842.

Guo, H. and Qiu, B., 2014. Options-implied variance and future stock returns. *Journal of Banking & Finance, 44*, 93-113.

Hadlock, C.J. and Pierce, J.R., 2010. New evidence on measuring financial constraints: Moving beyond the KZ index. *Review of Financial Studies*, *23*(5), 1909-1940.

Halling, M., Yu, J. and Zechner, J., 2020. How did COVID-19 affect firms' access to public capital markets?. *The Review of Corporate Finance Studies, 9*(3), 501-533.

Harford, J., 1999. Corporate cash reserves and acquisitions. *Journal of Finance*, *54*(6), 1969-1997.

He, Z. and Xiong, W., 2012. Rollover risk and credit risk. *Journal of Finance*, *67*(2), 391-430.

Holmström, B. and Tirole, J., 2000. Liquidity and risk management. *Journal of Money, Credit and Banking*, *32*(3), 295-319.

Holmström, B. and Tirole, J., 2001. LAPM: A liquidity-based asset pricing model. *Journal of Finance*, *56*(5), 1837-1867.

Hu, X., 2010. Rollover risk and credit spreads in the financial crisis of 2008. Working paper, Princeton University.

Ivashina, V., Scharfstein, D.S. and Stein, J.C., 2015. Dollar funding and the lending behavior of global banks. *Quarterly Journal of Economics*, *130*(3), 1241-1281.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review*, *76*(2), 323-329.

Kaplan, S.N. and Zingales, L., 1997. Do investment-cash flow sensitivities provide useful measures of financing constraints?. *Quarterly Journal of Economics*, *112*(1), 169-215.

Li, L., Strahan, P. E. and Zhang, S., 2020. Banks as lenders of first resort: Evidence from the COVID-19 Crisis. NBER Working Paper No. 27256.

Lemmon, M. and Roberts, M.R., 2010. The response of corporate financing and investment to changes in the supply of credit. *Journal of Financial and Quantitative Analysis*, *45*(3), 555-587.

Myers, S.C., 1977. Determinants of corporate borrowing. *Journal of Financial Economics*, *5*(2), 147-175.

Norden, L., Roosenboom, P. and Wang, T., 2016. The effects of corporate bond granularity. *Journal of Banking & Finance*, *63*, 25-34.

Opler, T., Pinkowitz, L., Stulz, R. and Williamson, R., 1999. The determinants and implications of corporate cash holdings. *Journal of Financial Economics*, *52*(1), 3-46.

Ramelli, S. and Wagner, A.F., 2020. Feverish stock price reactions to COVID-19. Swiss Finance Institute Research Paper No. 20-12.

Reinhart, C.M. and Rogoff, K.S., 2008. Is the 2007 US sub-prime financial crisis so different? An international historical comparison. *American Economic Review*, *98*(2), 339-44.

Roberts, M.R. and Sufi, A., 2009. Renegotiation of financial contracts: Evidence from private credit agreements. *Journal of Financial Economics*, *93*(2), 159-184.

Sharpe, S.A., 1991. Credit rationing, concessionary lending, and debt maturity. *Journal of Banking & Finance*, *15*(3), 581-604.

Sufi, A., 2009. Bank lines of credit in corporate finance: An empirical analysis. *Review of Financial Studies*, *22*(3), 1057-1088.

Titman, S., 1992. Interest rate swaps and corporate financing choices. *Journal of Finance*, *47*(4), 1503-1516.

Vuolteenaho, T., 2002. What drives firm-level stock returns? *Journal of Finance*, *57*(1), 233-264.

Whited, T.M. and Wu, G., 2006. Financial constraints risk. *Review of Financial Studies*, *19*(2), 531-559.

Table 1. Summary Statistics

Table 1 reports sample descriptive statistics. The sample consists of 3,047 firm observations with no missing CRSP-Compustat data that covers the period from January 1, 2019 to March 31, 2020. A detailed description of the variables is presented in Table A1 of the Appendix. All dollar values are in 2019 constant dollars. All continuous variables are winsorized at the 1st and 99th percentiles. We report the means, medians, standard deviations, 25th percentiles, 75th percentiles, and numbers of observations for the variables used.

Variable	Mean	Median	Standard	P25	P75	N
BHAR (Period 1)	-1.081	-1.464	11.027	-6.742	4.015	3047
BHAR (Period 2)	-11.365	-10.033	17.29	-21.528	0.509	3047
BHAR (Whole Period)	-10.639	-9.79	18.846	-22.185	1.154	3047
CDS_6M	250.61	3.825	1715.395	0.65	25.31	234
CDS_1Y	246.392	5.317	1548.984	1.145	32.535	234
CDS_5Y	197.519	10.147	940.78	1.014	80.719	234
CDS_10Y	178.055	7.226	789.246	-0.001	90.956	228
DD_One	1.187	0.081	5.223	0.002	0.522	3047
DD_One_High25	0.250	0.000	0.433	0.000	0.000	3047
Size	7.642	7.742	2.177	6.389	9.022	3047
Roa	-4.007	1.842	29.06	-1.537	5.552	3047
MTB	3.263	1.745	9.706	0.254	3.908	3047
Leverage	34.043	28.633	32.17	8.955	48.746	3047
Past_Return	23.627	21.208	43.533	0	42.795	3047
Vol	39.356	32.546	24.095	23.134	48.405	3047
KZ	-19.181	-0.237	87.554	-9.064	0.127	3047
WW	-9.533	-0.353	31.481	-3.116	-0.17	3047
HP	-4.119	-4.045	0.864	-5.119	-3.398	3047
Z_Score	-0.262	0.212	6.117	0	1.438	3047
Non_Div	0.464	0	0.499	0	1	3047
Ivol	36.758	29.041	24.834	19.184	45.809	3047
Impl_Vol	41.803	33.899	27.879	24.546	48.223	3047
Roa_Vol	8.033	2.778	15.767	1.179	7.224	3047
Operating_Cash_Vol	6.378	2.849	11.364	1.272	6.012	3047
Illiquidity	36.533	1.592	177.269	0.522	5.993	3047
New_Debt_Issues (Compustat)	4.902	0.201	9.407	0.000	5.910	3047
New_Debt_Issues (SDC&Dealscan)	4.012	0.351	7.543	0.000	4.864	3047

Table 2. CDS Spread Changes and Debt Due within One Year (DD_One_High25) under the COVID-19 Shock

Table 2 reports the OLS regression results for CDS spread changes. The sample consists of 234 firm observations with CDS spread data from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. Panel A presents the regression results for CDS spread changes in Period 1 (from January 30, 2020 – February 28, 2020). Panel B presents the regression results for CDS spread changes in Period 2 (from March 2, 2020 – March 26, 2020). Panel C presents the regression results for CDS spread changes in the Whole Period (from January 30, 2020 – March 26, 2020). ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. CDS spread change in Period 1

2020-01-30 -- 2020-02-28 (Period 1)				
	(1)	(2)	(3)	(4)
Variables	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y
DD_One_High25	190.596***	206.575***	124.165***	104.084***
	(69.014)	(69.009)	(44.835)	(38.643)
Size	27.301	24.678	19.379	12.824
	(26.177)	(26.175)	(17.006)	(14.693)
Roa	16.565***	16.057***	10.872***	8.884***
	(4.931)	(4.931)	(3.204)	(2.759)
MTB	1.221	1.101	0.782	0.557
	(2.303)	(2.303)	(1.496)	(1.287)
Leverage	0.100	-0.379	-0.106	-0.187
	(1.135)	(1.135)	(0.737)	(0.636)
Past_Return	-3.538***	-2.982***	-2.076***	-1.972***
	(0.979)	(0.979)	(0.636)	(0.561)
Vol	14.812***	13.676***	11.073***	9.742***
	(2.543)	(2.543)	(1.652)	(1.456)
Illiquidity	-0.698	-0.517	-0.324	-0.200
	(2.365)	(2.365)	(1.537)	(1.322)
Industry FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	232
Adj R2	0.211	0.132	0.270	0.243

Panel B. CDS spread change in Period 2

2020-03-02 -- 2020-03-26 (Period 2)				
	(1)	(2)	(3)	(4)
Variables	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y
DD_One_High25	673.498***	568.930***	319.250***	270.181***
	(238.709)	(211.349)	(122.189)	(103.619)
Size	94.141	87.151	47.331	33.984
	(90.542)	(80.164)	(46.346)	(39.202)
Roa	54.117***	46.933***	25.694***	21.910***
	(17.057)	(15.102)	(8.731)	(7.495)
MTB	3.849	3.360	1.668	1.336
	(7.967)	(7.054)	(4.078)	(3.528)
Leverage	0.760	0.701	0.534	0.350
	(3.926)	(3.476)	(2.009)	(1.691)
Past_Return	-11.106***	-10.082***	-5.138***	-4.720***
	(3.386)	(2.998)	(1.733)	(1.488)
Vol	53.058***	49.138***	29.010***	24.711***
	(8.797)	(7.788)	(4.503)	(3.840)
Illiquidity	-2.362	-2.177	-1.122	-0.878
	(8.181)	(7.243)	(4.187)	(3.511)
Industry FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	227
Adj R2	0.264	0.302	0.338	0.343

Panel C. CDS spread change in the Whole Period

2020-01-30 -- 2020-03-26 (Whole Period)				
	(1)	(2)	(3)	(4)
Variables	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y
DD_One_High25	880.088***	762.400***	424.455***	349.181***
	(307.119)	(272.419)	(159.402)	(133.576)
Size	121.062	111.543	65.421	42.471
	(116.490)	(103.328)	(60.461)	(50.369)
Roa	71.123***	62.337***	35.104***	27.753***
	(21.946)	(19.466)	(11.390)	(9.520)
MTB	5.064	4.418	2.324	1.713
	(10.250)	(9.092)	(5.320)	(4.547)
Leverage	0.755	0.284	0.534	0.364
	(5.051)	(4.480)	(2.621)	(2.177)
Past_Return	-14.586***	-13.018***	-6.973***	-6.532***
	(4.356)	(3.864)	(2.261)	(1.918)
Vol	67.731***	62.532***	38.572***	32.570***
	(11.318)	(10.039)	(5.874)	(4.922)
Illiquidity	-3.032	-2.678	-1.405	-1.116
	(10.525)	(9.336)	(5.463)	(4.525)
Industry FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	228
Adj R2	0.250	0.277	0.329	0.345

Table 3. CDS Spread Changes and Debt Due within One Year (DD_One_High25) Conditional on Financial Constraints and Volatilities

Table 3 reports the OLS regression results for CDS spread changes conditional on different measures of financial constraints (i.e., HP; WW; Z_score; KZ; Non_Div; Non_Invest_Grade) and volatilities (i.e., Vol; Impl_Vol; Ivol; Roa_Vol; Operating_Cash_Vol). The sample consists of 234 firm observations with CDS spread data from January 30, 2020 to March 26, 2020. DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. High_FC is a dummy that indicates high financial constraints. High_Vol is a dummy that indicates high firm volatility. Panel A presents the regression results for CDS spread changes on interacting DD_One_High25 and High_FC. Panel B presents the regression results for CDS spread changes on interacting DD_One_High25 and High_Vol. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). Main dummies used to construct the interaction terms are also included in regressions. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. CDS spread change on interacting DD_One_High25 and High_FC

Variables	(1) CDS_6M	(2) CDS_6M	(3) CDS_6M	(4) CDS_6M	(5) CDS_6M	(6) CDS_6M
Financial Constraint Measure	HP	WW	Z_score	KZ	Non_Div	Non_Invest_ Grade
DD_One_High25 *High_FC	2,312.279***	1,210.653**	1,156.686*	1,406.551**	3,575.007***	3,074.667***
	(593.622)	(576.135)	(632.731)	(586.289)	(727.971)	(706.943)
Main Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	234	234	234
Adj R2	0.318	0.266	0.256	0.273	0.344	0.317

Panel B. CDS spread change on interacting DD_One_High25 and High_Vol

Variables	(1) CDS_6M	(2) CDS_6M	(3) CDS_6M	(4) CDS_6M	(5) CDS_6M
Volatility Measure	Vol	Ivol	Impl_Vol	Roa_Vol	Operating_ Cash_Vol
DD_One_High25 *High_Vol	2,290.045***	1,989.492***	2,008.886***	1,443.021***	1,698.569***
	(552.574)	(555.063)	(536.418)	(549.995)	(574.340)
Main Dummies	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	234	234
Adj R2	0.331	0.309	0.325	0.280	0.282

Table 4. Event Study on Stock Returns and Debt Due within One Year under the COVID-19 Shock

Table 4 reports event study results of the impact of COVID-19 on individual stock returns for U.S. listed firms. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One)—group 1 has the lowest DD_One value and group 4 has the highest DD_One value. We report the mean of the buy and hold abnormal returns (BHARs) and cumulative abnormal returns (CARs) for three periods: January 30, 2020 – February 28, 2020 (Period 1); March 2, 2020 – March 26, 2020 (Period 2); and January 30, 2020 – March 26, 2020 (Whole Period). We calculate CARs using both the market model and the market-adjusted model. We use the S&P 500 stock market index as the market portfolio. The market model estimation window is days (-150, -50) before the event date. Panel A demonstrates results in BHARs. Panel B demonstrates results in CARs calculated using the market model. Panel C demonstrates results in CARs calculated using the market-adjusted model. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. BHARs

	Group 1	Group 2	Group 3	Group 4	Total
2020-01-30 -- 2020-02-28 (Period 1)	-0.634*	0.205	-1.975***	-1.924**	-1.081**
	(0.332)	(0.432)	(0.549)	(0.752)	(0.452)
2020-03-02 -- 2020-03-26 (Period 2)	-11.464***	-7.255***	-12.126***	-14.618***	-11.365***
	(2.089)	(1.225)	(1.472)	(1.923)	(1.487)
2020-01-30 -- 2020-03-26 (Whole Period)	-10.516***	-6.041***	-11.926***	-14.079***	-10.639***
	(2.013)	(1.364)	(1.553)	(1.997)	(1.551)
Number of Obs.	762	762	762	761	3,047

Panel B. CARs based on the market model

	Group 1	Group 2	Group 3	Group 4	Total
2020-01-30 -- 2020-02-28 (Period 1)	-1.505*	1.661*	-0.998	-2.016***	-0.714
	(0.859)	(0.831)	(0.705)	(0.690)	(0.739)
2020-03-02 -- 2020-03-26 (Period 2)	-10.886***	-5.826***	-10.242***	-13.776***	-10.181***
	(2.214)	(1.328)	(1.465)	(1.754)	(1.555)
2020-01-30 -- 2020-03-26 (Whole Period)	-12.953***	-3.378	-11.681***	-16.769***	-11.194***
	(3.115)	(2.277)	(2.170)	(2.040)	(2.401)
Number of Obs.	762	762	762	761	3,047

Panel C. CARs based on the market-adjusted model

	Group 1	Group 2	Group 3	Group 4	Total
2020-01-30 -- 2020-02-28 (Period 1)	-0.387	0.531	-2.030***	-1.931**	-0.954*
	(0.380)	(0.496)	(0.596)	(0.819)	(0.508)
2020-03-02 -- 2020-03-26 (Period 2)	-9.466***	-6.064***	-10.756***	-13.221***	-9.876***
	(1.765)	(1.394)	(1.465)	(2.111)	(1.478)
2020-01-30 -- 2020-03-26 (Whole Period)	-9.657***	-5.393***	-12.435***	-14.848***	-10.582***
	(2.075)	(1.796)	(1.951)	(2.641)	(1.912)
Number of Obs.	762	762	762	761	3,047

Table 5. BHARs and Debt Due within One Year (DD_One_High25) under COVID-19 Shock

Table 5 reports the OLS regression results for BHARs. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. Panel A presents the regression results for the real-sector firms. Panel B presents the regression results for the financial-sector firms. Panel C presents the regression results for all firms. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. BHARs for the real-sector firms

Variables	(1) BHAR (Period 1)	(2) BHAR (Period 1)	(3) BHAR (Period 2)	(4) BHAR (Period 2)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
DD_One_High25	-0.703	-0.356	-3.063***	-1.992**	-3.174***	-1.961**
	(0.631)	(0.648)	(0.844)	(0.842)	(0.947)	(0.952)
Size		0.015		0.568***		0.478**
		(0.162)		(0.210)		(0.238)
Roa		0.010		-0.003		-0.004
		(0.010)		(0.013)		(0.014)
MTB		0.024		0.084***		0.092**
		(0.025)		(0.032)		(0.037)
Leverage		-0.011		-0.070***		-0.070***
		(0.009)		(0.011)		(0.013)
Past_Return		0.018***		0.030***		0.039***
		(0.005)		(0.007)		(0.008)
Vol		0.011		-0.092***		-0.075***
		(0.013)		(0.017)		(0.020)
Illiquidity		0.003**		0.003		0.005**
		(0.002)		(0.002)		(0.002)
Industry FE		Yes		Yes		Yes
Constant		Yes		Yes		Yes
Number of Obs.	2,279	2,279	2,279	2,279	2,279	2,279
Adj R2	0.048	0.054	0.224	0.272	0.203	0.240

Panel B. BHARs for the financial firms

Variables	(1) BHAR (Period 1)	(2) BHAR (Period 1)	(3) BHAR (Period 2)	(4) BHAR (Period 2)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
DD_One_High25	0.833	0.517	-1.271	0.462	-0.343	0.995
	(0.615)	(0.607)	(1.276)	(1.276)	(1.322)	(1.327)
Size		-0.545***		-0.541*		-0.864**
		(0.154)		(0.323)		(0.336)
Roa		0.048***		0.055		0.086**
		(0.017)		(0.035)		(0.036)
MTB		-0.048		0.020		-0.028
		(0.037)		(0.077)		(0.080)
Leverage		0.038***		-0.110***		-0.071***
		(0.010)		(0.022)		(0.023)
Past_Return		0.001		0.067***		0.063***
		(0.010)		(0.022)		(0.023)
Vol		-0.060**		0.013		-0.008
		(0.024)		(0.050)		(0.052)
Illiquidity		0.005***		0.001		0.004*
		(0.001)		(0.003)		(0.003)
Industry FE		Yes		Yes		Yes
Constant		Yes		Yes		Yes
Number of Obs.	768	768	768	768	768	768
Adj R2	0.005	0.076	0.118	0.161	0.099	0.136

Panel C. BHARs for all firms

Variables	(1) BHAR (Period 1)	(2) BHAR (Period 1)	(3) BHAR (Period 2)	(4) BHAR (Period 2)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
DD_One_High25	-0.305	-0.075	-2.599***	-1.348*	-2.440***	-1.152
	(0.495)	(0.506)	(0.708)	(0.707)	(0.781)	(0.786)
Size		-0.132		0.227		0.075
		(0.125)		(0.175)		(0.194)
Roa		0.016*		0.009		0.011
		(0.008)		(0.012)		(0.013)
MTB		0.014		0.087***		0.087***
		(0.021)		(0.029)		(0.033)
Leverage		-0.001		-0.077***		-0.069***
		(0.007)		(0.010)		(0.011)
Past_Return		0.018***		0.032***		0.041***
		(0.005)		(0.007)		(0.007)
Vol		0.001		-0.089***		-0.078***
		(0.012)		(0.016)		(0.018)
Illiquidity		0.004***		0.003		0.005***
		(0.001)		(0.002)		(0.002)
Industry FE		Yes		Yes		Yes
Constant		Yes		Yes		Yes
Number of Obs.	3,047	3,047	3,047	3,047	3,047	3,047
Adj R2	0.047	0.056	0.208	0.251	0.188	0.222

Table 6. BHARs and Debt Due within One Year Conditional on Financial Constraints and Volatilities

Table 6 reports the OLS regression results for BHARs conditional on different measures of financial constraints (i.e., HP; WW; Z_score; KZ; Non_Div; Non_Invest_Grade) and volatilities (i.e., Vol; Ivol; Impl_Vol; Roa_Vol; Operating_Cash_Vol). The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. High_FC is a dummy that indicates high financial constraints. High_Vol is a dummy that indicates high firm volatility. Panel A presents the regression results for BHARs on interacting DD_One_High25 and High_FC. Panel B presents the regression results for BHARs on interacting DD_One_High25 and High_Vol. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). Main dummies used to construct the interaction terms are also included in regressions. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. BHARs on interacting DD_One_High25 and High_FC

Variables	(1) BHAR (Whole Period)	(2) BHAR (Whole Period)	(3) BHAR (Whole Period)	(4) BHAR (Whole Period)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
Financial Constraint Measure	HP	WW	Z_score	KZ	Non_Div	Non_Invest_Grade
DD_One_High25*	-3.981***	-0.809	-2.091*	-2.408***	-2.094	-1.442
High_FC	(1.388)	(1.354)	(1.082)	(0.730)	(1.495)	(2.289)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Main Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	3,047	3,047	3,047	3,047	3,047	3,047
Adj R2	0.223	0.223	0.226	0.224	0.222	0.223

Panel B. BHARs on interacting DD_One_High25 and High_Vol

Variables	(1) BHAR (Whole Period)	(2) BHAR (Whole Period)	(3) BHAR (Whole Period)	(4) BHAR (Whole Period)	(5) BHAR (Whole Period)
Volatility Measure	Vol	Ivol	Impl_Vol	Roa_Vol	Operating Cash_Vol
DD_One_High25	-3.030**	-3.169**	-2.754**	-0.611	-1.197
*High_Vol	(1.391)	(1.385)	(1.384)	(1.346)	(1.344)
Controls	Yes	Yes	Yes	Yes	Yes
Main Dummies	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Number of Obs.	3,047	3,047	3,047	3,047	3,047
Adj R2	0.223	0.224	0.225	0.221	0.221

Table 7 CDS Spread Changes, BHARs and Debt Due within One Year by Months (Immediate Refinancing Needs vs Distant Refinancing Needs) under COVID-19 Shock

Table 7 reports the OLS regression results for both CDS spread changes and BHARs under debt due within one-year measures with different maturity months. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We merge and collect relevant debt maturity by months information in the past 30 years from merged SDC New Debt Issuance and Dealscan Syndicated Loan databases. We divide our sample firms into quartiles according to either their immediate debt due amount (debt due from March--June) or their distant debt due amount (debt due from July--December), both scaled by cash and short-term investment, respectively. DD_One_High25 (March--June) is a dummy variable that equals 1 if the firm belongs to the top debt due from March to June scaled by cash and short-term investment quartile and equals 0 otherwise. DD_One_High25 (July--December) is a dummy variable that equals 1 if the firm belongs to the top debt due from July to December scaled by cash and short-term investment quartile and equals 0 otherwise. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

The Influence of Debt Maturity Month (Immediate Refinancing Needs vs Distant Refinancing Needs)								
	CDS Spread Changes				BHARs			
	Immediate Refinancing (March-June)		Distant Refinancing (July-December)		Immediate Refinancing (March-June)		Distant Refinancing (July-December)	
VARIABLES	CDS_6M	CDS_1Y	CDS_6M	CDS_1Y	BHAR (Real Sector)	BHAR (Financial Sector)	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_High25	750.713**	666.566**			-2.299**	0.918		
(March -- June)	(289.186)	(256.226)			(0.926)	(1.314)		
DD_One_High25			218.567	133.312			-1.770*	0.507
(July --December)			(314.426)	(278.813)			(0.927)	(1.334)
Size	149.885	135.992	165.301	152.065	0.464*	-0.860**	0.469**	-0.856**
	(115.857)	(102.652)	(118.174)	(104.789)	(0.237)	(0.336)	(0.237)	(0.336)
Roa	81.350***	71.453***	69.800***	61.112***	-0.003	0.086**	-0.003	0.086**
	(22.495)	(19.932)	(22.420)	(19.881)	(0.014)	(0.036)	(0.014)	(0.036)
MTB	1.479	1.258	4.102	3.559	0.093**	-0.028	0.093**	-0.027
	(10.331)	(9.153)	(10.468)	(9.282)	(0.037)	(0.080)	(0.037)	(0.080)
Leverage	0.198	-0.237	1.650	1.145	-0.069***	-0.071***	-0.070***	-0.069***
	(5.099)	(4.518)	(5.165)	(4.580)	(0.013)	(0.023)	(0.013)	(0.023)
Past_Return	-12.780***	-11.423***	-14.130***	-12.632***	0.039***	0.063***	0.039***	0.062***
	(4.404)	(3.902)	(4.449)	(3.945)	(0.008)	(0.023)	(0.008)	(0.023)
Vol	71.697***	65.961***	71.515***	65.929***	-0.075***	-0.007	-0.076***	-0.008
	(11.266)	(9.982)	(11.484)	(10.183)	(0.020)	(0.052)	(0.020)	(0.052)
Illiquidity	-6.097	-5.368	-3.579	-3.396	0.005**	0.004	0.005**	0.004*
	(10.572)	(9.367)	(10.828)	(9.602)	(0.002)	(0.003)	(0.002)	(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	234	2,279	768	2,279	768
Adj R2	0.244	0.272	0.217	0.245	0.240	0.136	0.240	0.135

Table 8 CDS Spread Changes, BHARs and Debt Due within One Year Controlling for New Debt Issuance under COVID-19 Shock

Table 9 reports the OLS regression results for both CDS spread changes and BHARs with additional controlling for new debt issuances occurred in Q1 2020 for robustness checks. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). Panel A presents the regression results while obtaining New_Debt_Issuance from Compustat database. Panel B presents the regression results while obtaining New_Debt_Issuance from merged SDC New Debt Issuance and Dealscan Syndicated Loan databases. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. Controlling for New_Debt_Issuance Constructed from Compustat database

2020-01-30 -- 2020-03-26 (Whole Period)						
	CDS Spread Changes				BHARs	
VARIABLES	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_High25	721.796**	624.261**	340.838**	275.992**	-1.710*	1.198
	(291.284)	(258.921)	(150.823)	(127.440)	(0.950)	(1.338)
New_Debt_Issue (Compustat)	110.113***	96.094***	58.167***	45.773***	-0.160***	-0.074
	(22.926)	(20.379)	(11.871)	(10.018)	(0.040)	(0.064)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	228	2,279	768
Adjusted R-squared	0.334	0.355	0.407	0.414	0.245	0.136

Panel B. Controlling for New_Debt_Issuance Constructed from SDC New Issuance and Dealscan Syndicated Loan databases

2020-01-30 -- 2020-03-26 (Whole Period)						
	CDS Spread Changes				BHARs	
VARIABLES	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_High25	701.749**	607.194**	330.629**	266.379**	-1.704*	1.136
	(293.150)	(260.626)	(151.893)	(128.361)	(0.951)	(1.335)
New_Debt_Issue (SDC&Dealscan)	126.064***	109.713***	66.324***	52.254***	-0.199***	-0.076
	(27.221)	(24.201)	(14.104)	(11.905)	(0.050)	(0.080)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	228	2,279	768
Adj R2	0.329	0.349	0.401	0.409	0.245	0.136

Table 9 CDS Spread Changes, BHARs and Alternative Debt Due within One Year Measures under COVID-19 Shock

Table 8 reports the OLS regression results for both CDS spread changes and BHARs under two alternative debt due within one-year measures for robustness checks. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by either total debt amount (DD_One_Alternative 1) or total long-term debt amount (DD_One_Alternative 2), respectively. DD_One_Alternative 1_High25 is a dummy variable that equals 1 if the firm belongs to the top debt due within one-year scaled by total debt amount quartile and equals 0 otherwise. DD_One_Alternative 2_High25 is a dummy variable that equals 1 if the firm belongs to the top debt due within one-year scaled by total long-term debt amount quartile and equals 0 otherwise. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). Panel A presents the regression results for the DD_One_Alternative 1 measures. Panel B presents the regression results for the DD_One_Alternative 2 measures. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. DD_One is defined as debt due within one-year divided by total debt amount

2020-01-30 -- 2020-03-26 (Whole Period)						
	CDS Spread Changes				BHARs	
VARIABLES	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_ Alternative 1_High25	815.402***	706.693**	355.366**	260.421*	-3.962**	2.835
	(306.035)	(271.414)	(159.283)	(133.445)	(1.550)	(1.904)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	228	2,279	768
Adj R2	0.246	0.272	0.321	0.334	0.243	0.140

Panel B. DD_One is defined as debt due within one-year divided by long-term debt amount

2020-01-30 -- 2020-03-26 (Whole Period)						
	CDS Spread Changes				BHARs	
VARIABLES	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_ Alternative 2_High25	719.195**	617.337**	298.818*	214.691	-4.340***	3.785*
	(307.012)	(272.304)	(159.740)	(133.648)	(1.479)	(1.810)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	228	2,279	768
Adj R2	0.239	0.266	0.315	0.329	0.244	0.143

Table 10 CDS Spread Changes, BHARs and Debt Due within One Year before vs. around Government's Relief Package

Table 10 reports the OLS regression results for both CDS spread changes and BHARs before vs. around government's relief package. The two-trillion-dollar relief package passed the U.S. Senate on March 25 and the House of Representatives on March 27. It was then immediately signed into law by President Trump on March 27. News about the rescue package sent the S&P 500 index up by 9.38% on March 24, which is the best day since October 28, 2008. The market has generally been in an upward trend since then. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

The Influence of Government Relief Package (Pre-Relief Package vs. Post-Relief Package)								
	CDS Spread Changes				BHARs			
	Before Relief (Jan 30 to Mar 23, 2020)		Around Relief (Mar 24 to Mar 26, 2020)		Before Relief (Jan 30 to Mar 23, 2020)		Around Relief (Mar 24 to Mar 26, 2020)	
VARIABLES	CDS_6M	CDS_1Y	CDS_6M	CDS_1Y	BHAR (Real Sector)	BHAR (Financial Sector)	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_High25	812.182***	672.898***	-23.870	-20.571	-1.911**	1.485	0.566	-1.243
	(288.431)	(248.124)	(22.922)	(26.130)	(0.936)	(1.261)	(0.737)	(1.260)
Size	128.594	113.000	-5.225	-7.512	-0.142	-1.309***	0.965***	1.241***
	(109.401)	(94.113)	(8.694)	(9.911)	(0.234)	(0.319)	(0.184)	(0.319)
Roa	67.389***	55.905***	-1.516	-1.607	0.011	0.074**	-0.024**	-0.004
	(20.610)	(17.730)	(1.638)	(1.867)	(0.014)	(0.034)	(0.011)	(0.034)
MTB	4.986	4.022	-0.228	-0.137	0.094***	-0.083	-0.043	0.103
	(9.627)	(8.281)	(0.765)	(0.872)	(0.036)	(0.076)	(0.028)	(0.076)
Leverage	0.293	0.673	-0.500	-0.624	-0.082***	-0.075***	0.061***	0.047**
	(4.743)	(4.081)	(0.377)	(0.430)	(0.013)	(0.022)	(0.010)	(0.022)
Past_Return	-13.343***	-11.515***	0.162	0.284	0.021***	0.032	0.027***	0.025
	(4.091)	(3.520)	(0.325)	(0.371)	(0.008)	(0.021)	(0.006)	(0.021)
Vol	67.910***	60.790***	-2.064**	-3.154***	-0.063***	0.018	-0.017	-0.067
	(10.629)	(9.144)	(0.845)	(0.963)	(0.019)	(0.049)	(0.015)	(0.049)
Illiquidity	-2.778	-2.496	0.065	0.110	0.006***	0.008***	-0.004*	-0.009***
	(9.885)	(8.503)	(0.786)	(0.895)	(0.002)	(0.003)	(0.002)	(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	234	2,279	768	2,279	768
Adj R2	0.283	0.309	-0.090	-0.030	0.222	0.175	0.135	0.145

Figure 1. CDS Spread Changes (6-Month) and Debt Due within One Year under the COVID-19 Shock

Figure 1 shows the cumulative CDS spread changes (6-month) for various groups. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investments (DD_One)—group 1 has the lowest DD_One value and group 4 has the highest DD_One value).

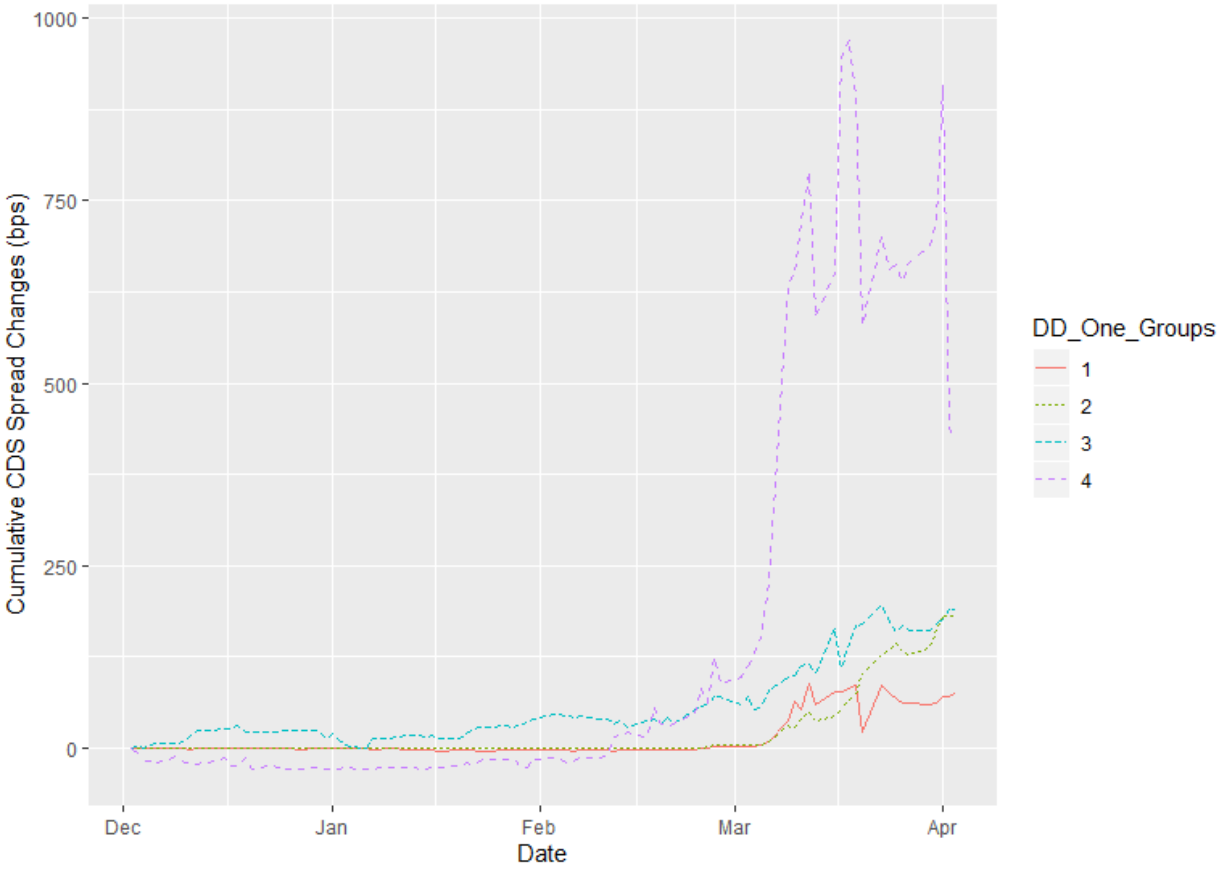
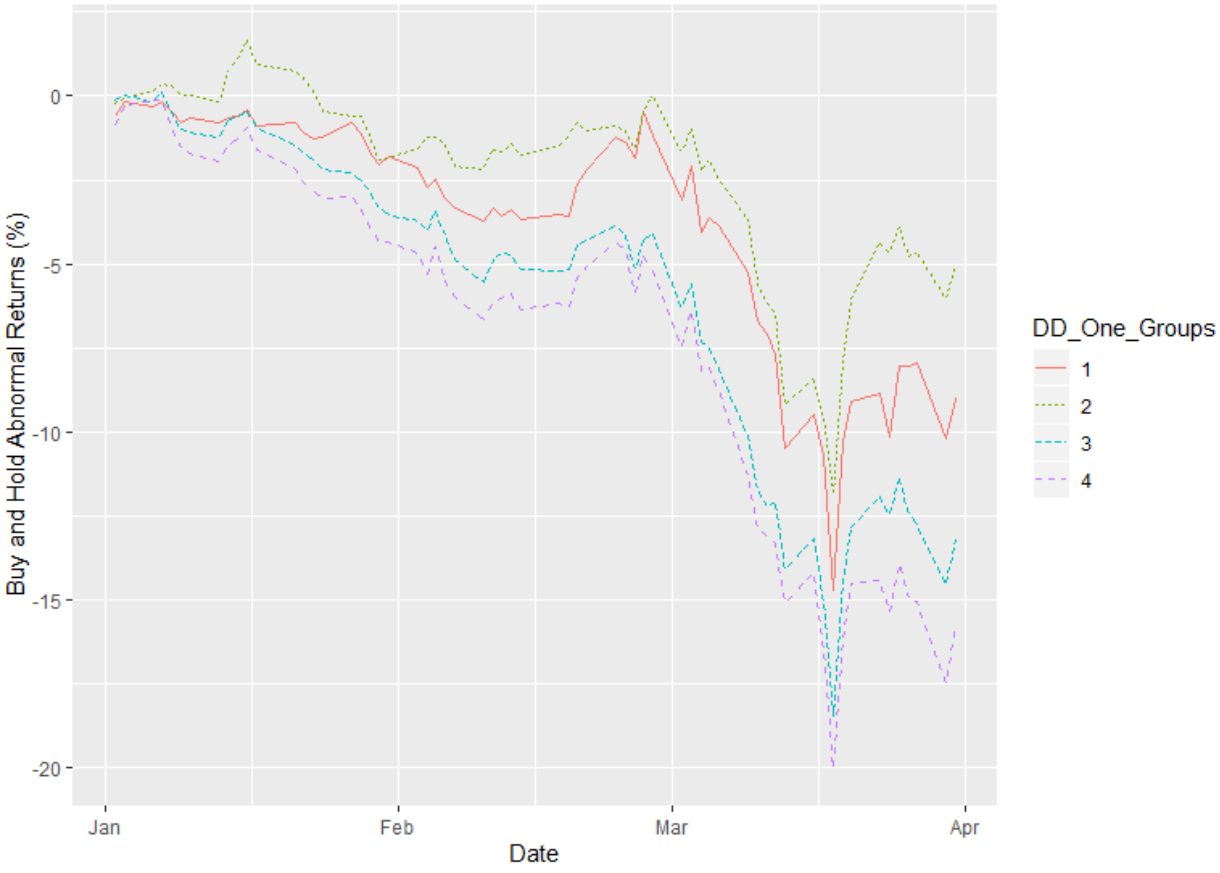


Figure 2. BHARs and Debt Due within One Year under the COVID-19 Shock

Figure 2 shows the cumulative buy and hold abnormal returns (BHARs) for various groups. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investments (DD_One)—group 1 has the lowest DD_One value and group 4 has the highest DD_One value).



Appendix

Table A1. Variables Descriptions

Variable	Descriptions	Source
BHAR (Period 1)	Individual daily compounding returns minus market daily compounding returns from 1/30/2020 to 2/28/2020. We use the S&P 500 index as the market portfolio.	CRSP
BHAR (Period 2)	Individual daily compounding returns minus market daily compounding returns from 3/1/2020 to 3/26/2020. We use the S&P 500 index as the market portfolio.	CRSP
BHAR (Whole Period)	Individual daily compounding returns minus market daily compounding returns from 1/30/2020 to 3/26/2020. We use the S&P 500 index as the market portfolio.	CRSP
CDS_6M	Changes in 6-month CDS spreads measured in basis points.	Markit
CDS_1Y	Changes in 1-year CDS spreads measured in basis points.	Markit
CDS_5Y	Changes in 5-year CDS spreads measured in basis points.	Markit
CDS_10Y	Changes in 10-year CDS spreads measured in basis points.	Markit
DD_One	Total long-term debt falling due within fiscal year 2020 (including all long-term bank, finance lease and other forms of debt) divided by cash and short-term investments.	Compustat
DD_One_High25	A dummy variable that equals 1 if the firm belongs to the top debt due within one year scaled by cash and short-term investment quartile and equals 0 otherwise.	Compustat
DD_One_Alternative 1_High25	A dummy variable that equals 1 if the firm belongs to the top debt due within one year scaled by total debt amount quartile and equals 0 otherwise.	Compustat
DD_One_Alternative 2_High25	A dummy variable that equals 1 if the firm belongs to the top debt due within one year scaled by total long-term debt amount quartile and equals 0 otherwise.	Compustat
Size	The natural logarithm of total assets measured in $ millions.	Compustat
Roa	Income before extraordinary items scaled by total assets.	Compustat
MTB	Market value of equity divide by book value of equity.	Compustat
Leverage	The total of long-term debt and debt in current liabilities divided by total assets.	Compustat
Past_Return	Past stock return in percentage points for the last fiscal year.	CRSP

Vol	Annualized daily stock return volatility in each month (we require at least 17 nonmissing daily returns in a month for the calculation), averaged over the last fiscal year.	CRSP
KZ	As –1.001909[(IB + DP)/lagged PPENT] + 0.2826389[(AT + PRCC_F×CSHO - CEQ - TXDB)/AT] + 3.139193[(DLTT + DLC)/(DLTT + DLC + SEQ)] – 39.3678[(DVC + DVP)/lagged PPENT] – 1.314759[CHE/lagged PPENT].	Compustat
WW	As –0.091 [(IB + DP)/AT] – 0.062[indicator set to one if DVC + DVP is positive, and zero otherwise] + 0.021[DLTT/AT] – 0.044[log(AT)] + 0.102[average industry sales growth, estimated separately for each three-digit SIC industry and each year, with sales growth defined as above] – 0.035[sales growth].	Compustat
HP	As –0.737Size + 0.043Size2 – 0.040Age, where Size equals the log of inflation-adjusted Compustat item AT (in 2019 dollars), and Age is the number of years the firm is listed with a non-missing stock price on Compustat. In calculating the index, we cap Size at (the log of) $5.6 billion and Age at 50 years.	Compustat
Z_Score	As (1.2*WCAP + 1.4*RE + 3.3*PI + 0.999*SALE)/AT.	Compustat
Non_Div	Takes value of 1 if a firm pays no dividends at the end of the last fiscal year, and 0 otherwise.	Compustat
Non_Invest_Grade	Dummy variable equals to 1 if the firm's long-term debt does not belong to an investment grade by Standard & Poor's, otherwise 0.	Compustat
Ivol	Annualized standard deviation of the residuals from regressing daily individual stock returns on the Fama-French three-factors in each month (we require at least 17 nonmissing daily returns in a month for the regression), averaged over the last fiscal year.	CRSP
Impl_Vol	Annualized options-implied volatility of the firm's stock, which is the average options-implied volatility of a call option with non-zero trading volume, (closest to) at the money, and (closest to) 30-day expiration and a put option with non-zero trading volume, (closest to) at the money, and (closest to) 30-day expiration, measured at the end of the last fiscal year.	OptionMetrics
Roa_Vol	Standard deviation of the past five years' returns on assets in percentage points. We require at least three years' numbers to calculate the volatility.	Compustat
Operating_Cash_Vol	Standard deviation of the past five years' cash flow from operations excluding extraordinary items scaled by the beginning total assets in percentage points. We require at least three years' numbers to calculate the volatility.	Compustat
Illiquidity	Following Amihud (2002), illiquidity is measured as the average daily ratio of absolute return to the dollar volume of each stock in percentage for the last fiscal year. Stocks admitted in the last fiscal year have more than 200 days of data for the calculation of the characteristics and their end-of-year price exceeds $5.	Compustat
New_Debt_Issuance	Following Farre_Mensa (2016), debt issues net of debt repurchases in Q1 2020 scaled by lagged total assets in Q4 2019 in percentage.	Compustat, SDC New Issuance & Dealscan

Table A2. CDS Spread Changes and Debt Due within One Year (DD_One_Group4, DD_One_Group3, and DD_One_Group2) under the COVID-19 Shock

Table A2 reports the OLS regression results for CDS spread changes. The sample consists of 234 firm observations with CDS spread data from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_Group4, DD_One_Group 3 and DD_One_Group2 are dummy variables that equal 1 if the firm belongs to the top, second to the top, and third to the top, quartile according to the value of DD_One, respectively, and equal 0 otherwise. Panel A presents the regression results for CDS spread changes in Period 1 (from January 30, 2020 – February 28, 2020). Panel B presents the regression results for CDS spread changes in Period 2 (from March 2, 2020 – March 26, 2020). Panel C presents the regression results for CDS spread changes in the Whole Period (from January 30, 2020 – March 26, 2020). ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. CDS spread change in Period 1

2020-01-30 -- 2020-02-28 (Period 1)				
	(1)	(2)	(3)	(4)
Variables	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y
DD_One_Group4	223.574**	225.216**	142.974**	110.008**
	(87.798)	(88.059)	(57.116)	(49.482)
DD_One_Group3	69.865	38.253	38.736	18.687
	(80.341)	(80.580)	(52.265)	(45.670)
DD_One_Group2	-15.263	-5.895	-6.247	-15.435
	(75.122)	(75.345)	(48.870)	(42.431)
Size	25.756	23.888	18.572	12.203
	(26.259)	(26.337)	(17.082)	(14.773)
Roa	17.085***	16.338***	11.157***	9.046***
	(4.967)	(4.981)	(3.231)	(2.788)
MTB	0.971	0.974	0.652	0.444
	(2.321)	(2.328)	(1.510)	(1.300)
Leverage	0.046	-0.415	-0.141	-0.171
	(1.172)	(1.175)	(0.762)	(0.657)
Past_Return	-3.319***	-2.867***	-1.958***	-1.900***
	(0.998)	(1.001)	(0.649)	(0.573)
Vol	14.973***	13.773***	11.170***	9.764***
	(2.586)	(2.594)	(1.682)	(1.480)
Illiquidity	-0.700	-0.515	-0.323	-0.214
	(2.371)	(2.378)	(1.542)	(1.328)
Industry FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	232
Adj R2	0.209	0.124	0.266	0.238

Panel B. CDS spread change in Period 2

2020-03-02 -- 2020-03-26 (Period 2)				
	(1)	(2)	(3)	(4)
Variables	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y
DD_One_Group4	739.926**	642.418**	349.903**	253.803*
	(304.586)	(269.593)	(155.985)	(133.611)
DD_One_Group3	135.928	143.489	58.765	-14.889
	(278.718)	(246.696)	(142.737)	(123.584)
DD_One_Group2	-20.139	-7.071	-0.546	-35.659
	(260.611)	(230.670)	(133.464)	(114.753)
Size	91.350	84.525	46.308	33.360
	(91.096)	(80.630)	(46.652)	(39.489)
Roa	55.115***	47.967***	26.114***	21.849***
	(17.230)	(15.251)	(8.824)	(7.559)
MTB	3.401	2.945	1.508	1.233
	(8.054)	(7.128)	(4.124)	(3.565)
Leverage	0.630	0.524	0.455	0.464
	(4.065)	(3.598)	(2.082)	(1.749)
Past_Return	-10.696***	-9.673***	-4.974***	-4.715***
	(3.461)	(3.063)	(1.772)	(1.528)
Vol	53.404***	49.552***	29.188***	24.571***
	(8.971)	(7.940)	(4.594)	(3.898)
Illiquidity	-2.355	-2.154	-1.110	-0.918
	(8.225)	(7.280)	(4.212)	(3.533)
Industry FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	227
Adj R2	0.257	0.296	0.331	0.336

Panel C. CDS spread change in the Whole Period

2020-01-30 -- 2020-03-26 (Whole Period)				
	(1)	(2)	(3)	(4)
Variables	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y
DD_One_Group4	974.197**	858.711**	472.998**	352.946**
	(391.747)	(347.464)	(203.394)	(171.659)
DD_One_Group3	194.541	188.796	95.339	28.194
	(358.476)	(317.953)	(186.120)	(157.780)
DD_One_Group2	-32.881	-10.910	-5.901	-45.731
	(335.188)	(297.298)	(174.029)	(147.705)
Size	116.976	108.051	63.649	41.125
	(117.165)	(103.920)	(60.832)	(50.698)
Roa	72.557***	63.699***	35.792***	27.974***
	(22.161)	(19.656)	(11.506)	(9.616)
MTB	4.406	3.866	2.044	1.489
	(10.358)	(9.187)	(5.378)	(4.592)
Leverage	0.580	0.056	0.420	0.454
	(5.229)	(4.638)	(2.715)	(2.252)
Past_Return	-13.993***	-12.477***	-6.699***	-6.384***
	(4.451)	(3.948)	(2.311)	(1.968)
Vol	68.213***	63.072***	38.843***	32.506***
	(11.538)	(10.234)	(5.991)	(5.001)
Illiquidity	-3.026	-2.649	-1.391	-1.160
	(10.578)	(9.382)	(5.492)	(4.552)
Industry FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	228
Adj R2	0.244	0.271	0.322	0.339

Table A3. CDS Spread Changes and Debt Due within One Year (DD_One_Group4, DD_One_Group3 and DD_One_Group2) Conditional on Financial Constraints and Volatilities

Table A3 reports the OLS regression results for CDS spread changes conditional on different measures of financial constraints (i.e., HP; WW; Z_score; KZ; Non_Div; Non_Invest_Grade) and volatilities (i.e., Vol; Impl_Vol; Ivol; Roa_Vol; Operating_Cash_Vol). The sample consists of 234 firm observations with CDS spread data from January 30, 2020 to March 26, 2020. High_FC is a dummy that indicates high financial constraints. High_Vol is a dummy that indicates high firm volatility. Panel A presents the regression results for CDS spread changes on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_FC. Panel B presents the regression results for CDS spread changes on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_Vol. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). Main dummies used to construct the interaction terms are also included. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. CDS spread change on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_FC

Variables	(1) CDS_6M	(2) CDS_6M	(3) CDS_6M	(4) CDS_6M	(5) CDS_6M	(6) CDS_6M
Financial Constraint Measure	HP	WW	Z_score	KZ	Non_Div	Non_Invest_ Grade
DD_One_Group4*	2,068.376***	1,007.194	1,099.353	905.904	3,733.480***	2,720.286***
High_FC	(688.516)	(691.899)	(775.551)	(694.430)	(857.373)	(913.142)
DD_One_Group3*	-561.427	-371.384	-75.908	-843.476	467.741	-381.958
High_FC	(613.152)	(636.804)	(685.165)	(635.372)	(997.822)	(871.202)
DD_One_Group2*	-143.022	-189.731	-213.222	-664.589	214.094	-701.354
High_FC	(614.737)	(637.124)	(668.428)	(638.562)	(897.595)	(954.299)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Main Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	234	234	234
Adj R2	0.307	0.252	0.242	0.267	0.330	0.306

Panel B. CDS spread change on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_Vol

Variables	(1) CDS_6M	(2) CDS_6M	(3) CDS_6M	(4) CDS_6M	(5) CDS_6M
Volatility Measure	Vol	Ivol	Impl_Vol	Roa_Vol	Operating_ Cash_Vol
DD_One_Group4*High_Vol	2,368.742***	2,063.652***	1,954.251***	1,509.180**	1,699.692**
	(654.293)	(660.761)	(638.541)	(668.365)	(696.629)
DD_One_Group3*High_Vol	209.555	138.883	-100.519	156.216	-138.855
	(600.834)	(599.730)	(600.247)	(648.313)	(641.123)
DD_One_Group2*High_Vol	52.464	103.398	-32.928	17.812	147.703
	(608.289)	(601.792)	(609.462)	(654.078)	(636.076)
Controls	Yes	Yes	Yes	Yes	Yes
Main Dummies	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Number of Obs.	234	234	234	234	234
Adj R2	0.317	0.295	0.311	0.267	0.269

Table A4. BHARs and Debt Due within One Year (DD_One_Group4, DD_One_Group3, and DD_One_Group2) under COVID-19 Shock

Table A4 reports the OLS regression results for BHARs. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_Group4, DD_One_Group 3 and DD_One_Group2 are dummy variables that equal 1 if the firm belongs to the top, second to the top, and third to the top, quartile according to the value of DD_One, respectively, and equal 0 otherwise. Panel A presents the regression results for the real-sector firms. Panel B presents the regression results for the financial-sector firms. Panel C presents the regression results for all firms. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. BHARs for the real-sector firms

Variables	(1) BHAR (Period 1)	(2) BHAR (Period 1)	(3) BHAR (Period 2)	(4) BHAR (Period 2)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
DD_One_Group4	-0.580	-0.301	-3.216***	-2.752**	-3.237***	-2.525*
	(0.832)	(0.881)	(1.110)	(1.143)	(1.244)	(1.291)
DD_One_Group3	-0.705	-0.655	-1.634	-2.190**	-1.977*	-2.308*
	(0.775)	(0.813)	(1.035)	(1.055)	(1.159)	(1.192)
DD_One_Group2	1.446*	1.381*	1.947*	1.370	2.748**	2.261**
	(0.772)	(0.780)	(1.030)	(1.012)	(1.154)	(1.143)
Size		0.062		0.685***		0.611**
		(0.165)		(0.214)		(0.241)
Roa		0.010		-0.003		-0.004
		(0.010)		(0.013)		(0.014)
MTB		0.021		0.078**		0.085**
		(0.025)		(0.032)		(0.036)
Leverage		-0.009		-0.064***		-0.063***
		(0.009)		(0.012)		(0.013)
Past_Return		0.018***		0.029***		0.038***
		(0.005)		(0.007)		(0.008)
Vol		0.011		-0.091***		-0.075***
		(0.013)		(0.017)		(0.020)
Illiquidity		0.003**		0.003		0.005**
		(0.002)		(0.002)		(0.002)
Industry FE		Yes		Yes		Yes
Constant		Yes		Yes		Yes
Number of Obs.	2,279	2,279	2,279	2,279	2,279	2,279
Adj R2	0.052	0.057	0.229	0.276	0.210	0.246

Panel B. BHARs for the financial firms

Variables	(1) BHAR (Period 1)	(2) BHAR (Period 1)	(3) BHAR (Period 2)	(4) BHAR (Period 2)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
DD_One_Group4	0.584	0.213	-0.955	1.057	-0.238	1.317
	(0.648)	(0.644)	(1.348)	(1.356)	(1.397)	(1.411)
DD_One_Group3	-0.277	-0.426	0.825	1.639	0.626	1.256
	(0.752)	(0.731)	(1.563)	(1.539)	(1.620)	(1.601)
DD_One_Group2	-1.337*	-1.388*	1.030	1.544	-0.153	0.298
	(0.758)	(0.734)	(1.576)	(1.545)	(1.633)	(1.608)
Size		-0.526***		-0.577*		-0.883***
		(0.154)		(0.324)		(0.337)
Roa		0.049***		0.055		0.086**
		(0.016)		(0.035)		(0.036)
MTB		-0.050		0.021		-0.028
		(0.037)		(0.077)		(0.080)
Leverage		0.038***		-0.112***		-0.073***
		(0.010)		(0.022)		(0.023)
Past_Return		0.002		0.066***		0.062***
		(0.010)		(0.022)		(0.023)
Vol		-0.061**		0.013		-0.008
		(0.024)		(0.050)		(0.052)
Illiquidity		0.005***		0.001		0.004
		(0.001)		(0.003)		(0.003)
Industry FE		Yes		Yes		Yes
Constant		Yes		Yes		Yes
Number of Obs.	768	768	768	768	768	768
Adj R2	0.006	0.078	0.117	0.160	0.097	0.134

Panel C. BHARs for all firms

Variables	(1) BHAR (Period 1)	(2) BHAR (Period 1)	(3) BHAR (Period 2)	(4) BHAR (Period 2)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
DD_One_Group4	-0.309	-0.134	-2.421***	-1.246	-2.285**	-1.047
	(0.603)	(0.629)	(0.860)	(0.879)	(0.949)	(0.976)
DD_One_Group3	-0.671	-0.665	-0.962	-0.813	-1.323	-1.090
	(0.588)	(0.607)	(0.840)	(0.848)	(0.927)	(0.941)
DD_One_Group2	0.978*	0.935	2.087**	1.826**	2.537***	2.325**
	(0.589)	(0.592)	(0.841)	(0.826)	(0.928)	(0.917)
Size		-0.103		0.266		0.126
		(0.127)		(0.177)		(0.197)
Roa		0.016*		0.009		0.011
		(0.008)		(0.012)		(0.013)
MTB		0.013		0.084***		0.083**
		(0.021)		(0.029)		(0.033)
Leverage		0.001		-0.074***		-0.065***
		(0.007)		(0.010)		(0.011)
Past_Return		0.017***		0.031***		0.040***
		(0.005)		(0.007)		(0.007)
Vol		0.001		-0.089***		-0.078***
		(0.012)		(0.016)		(0.018)
Illiquidity		0.004***		0.003*		0.006***
		(0.001)		(0.002)		(0.002)
Industry FE		Yes		Yes		Yes
Constant		Yes		Yes		Yes
Number of Obs.	3,047	3,047	3,047	3,047	3,047	3,047
Adj R2	0.049	0.058	0.212	0.253	0.192	0.225

Table A5. BHARs and Debt Due within One Year (DD_One_Group4, DD_One_Group3 and DD_One_Group2) Conditional on Financial Constraints and Volatilities

Table A5 reports the OLS regression results for BHARs conditional on different measures of financial constraints (i.e., HP; WW; Z_score; KZ; Non_Div; Non_Invest_Grade) and volatilities (i.e., Vol; Impl_Vol; Ivol; Roa_Vol; Operating_Cash_Vol). The sample consists of 234 firm observations with BHARs data from January 30, 2020 to March 26, 2020. High_FC is a dummy that indicates high financial constraints. High_Vol is a dummy that indicates high firm volatility. Panel A presents the regression results for BHARs on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_FC. Panel B presents the regression results for BHARs on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_Vol. Regressions include the same set of controls appeared in the baseline results (e.g. Table 2). Main dummies used to construct the interaction terms are also included. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

Panel A. BHARs on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_FC

Variables	(1) BHAR (Whole Period)	(2) BHAR (Whole Period)	(3) BHAR (Whole Period)	(4) BHAR (Whole Period)	(5) BHAR (Whole Period)	(6) BHAR (Whole Period)
Financial Constraint Measure	HP	WW	Z_score	KZ	Non_Div	Non_Invest_Grade
DD_One_Group4*	-3.851***	-0.719	-3.383**	-3.498***	-1.577	-3.165
High_FC	(1.473)	(1.363)	(1.324)	(1.344)	(1.831)	(3.418)
DD_One_Group3*	-0.443	-0.449	-2.127	-2.932**	-1.905	-3.156
High_FC	(1.454)	(1.308)	(1.390)	(1.258)	(1.794)	(3.158)
DD_One_Group2*	0.437	0.309	-1.423	-1.290	2.748	-1.357
High_FC	(1.478)	(1.340)	(1.363)	(1.337)	(1.796)	(3.148)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Main Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	3,047	3,047	3,047	3,047	3,047	3,047
Adj R2	0.226	0.226	0.226	0.227	0.226	0.226

Panel B. BHARs on interacting DD_One_Group4, DD_One_Group3, DD_One_Group2 and High_Vol

Variables	(1) BHAR (Whole Period)	(2) BHAR (Whole Period)	(3) BHAR (Whole Period)	(4) BHAR (Whole Period)	(5) BHAR (Whole Period)
Volatility Measure	Vol	Ivol	Impl_Vol	Roa_Vol	Operating_Cash_Vol
DD_One_Group4*	-3.574**	-3.836***	-2.610*	-0.486	-1.120
High_Vol	(1.421)	(1.417)	(1.412)	(1.355)	(1.353)
DD_One_Group3*	-3.226**	-2.804**	-0.660	-0.017	-0.489
High_Vol	(1.320)	(1.332)	(1.322)	(1.277)	(1.276)
DD_One_Group2*	-0.483	-1.971	1.163	0.502	0.400
High_Vol	(1.385)	(1.371)	(1.330)	(1.365)	(1.362)
Controls	Yes	Yes	Yes	Yes	Yes
Main Dummies	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Number of Obs.	3,047	3,047	3,047	3,047	3,047
Adj R2	0.227	0.228	0.229	0.224	0.224

Table A6 CDS Spread Changes, BHARs and Debt Due within One Year Controlling for Market Leverage under the COVID-19 Shock

Table A6 reports the OLS regression results for both CDS spread changes and BHARs further controlling for market leverage ratio for robustness checks. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. We replace book leverage ratio in the baseline regression with market leverage ratio for robustness check. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

2020-01-30 -- 2020-03-26 (Whole Period)						
	CDS Spread Changes				BHARs	
VARIABLES	CDS_6M	CDS_1Y	CDS_5Y	CDS_10Y	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_High25	771.547***	654.699***	365.201**	299.230**	-2.840***	0.264
	(287.294)	(251.213)	(147.750)	(123.705)	(0.945)	(1.300)
Size	151.586	139.253	82.761	56.797	0.242	-0.977***
	(107.263)	(93.792)	(55.163)	(45.992)	(0.235)	(0.333)
Roa	76.340***	67.275***	38.014***	30.105***	-0.001	0.106***
	(20.520)	(17.943)	(10.553)	(8.812)	(0.015)	(0.036)
MTB	5.826	5.181	2.738	2.011	0.084**	-0.015
	(9.592)	(8.387)	(4.933)	(4.213)	(0.037)	(0.079)
Market_Leverage	10.067***	9.775***	5.552***	4.569***	-0.002	-0.090***
	(2.021)	(1.767)	(1.040)	(0.861)	(0.007)	(0.025)
Past_Return	-10.896***	-9.453***	-4.933**	-4.837***	0.039***	0.048**
	(4.139)	(3.619)	(2.129)	(1.804)	(0.008)	(0.023)
Vol	70.726***	65.190***	40.289***	33.890***	-0.088***	0.018
	(10.274)	(8.984)	(5.284)	(4.415)	(0.020)	(0.052)
Illiquidity	-4.429	-4.127	-2.152	-1.749	0.005**	0.004
	(9.808)	(8.576)	(5.044)	(4.175)	(0.002)	(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	228	2,279	768
Adj R2	0.343	0.384	0.422	0.438	0.230	0.139

Table A7 CDS Spread Changes, BHARs and Debt Due within One Year Reacting to Interest Rate Reduction

Table A7 reports the OLS regression results for both CDS spread changes and BHARs reacting to the interest rate reduction by Federal Reserve announced on March 15, 2020. The sample consists of 3,047 firm observations from January 30, 2020 to March 26, 2020. We investigate both the one-day (March 16) and two-day (March 16 and March 17) market reactions to the interest rate reduction announcement made by Federal Reserve. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investment (DD_One). DD_One_High25 is a dummy variable that equals 1 if the firm belongs to the top DD_One quartile and equals 0 otherwise. ∗ indicates significance at the 10% level; ∗∗ significance at 5%; ∗∗∗ significance at 1%. Variable definitions are provided in Table A1 in the Appendix.

The Influence of Cutting Interest Rate on March 15, 2020 by Federal Reserve								
	CDS Spread Changes				BHARs			
	One-Day Reactions		Two-Day Reactions		One-Day Reactions		Two-Day Reactions	
VARIABLES	CDS_6M	CDS_1Y	CDS_6M	CDS_1Y	BHAR (Real Sector)	BHAR (Financial Sector)	BHAR (Real Sector)	BHAR (Financial Sector)
DD_One_High25	18.811	54.097**	6.615	12.956	0.449	0.214	-0.264	1.007
	(38.705)	(26.742)	(13.907)	(14.806)	(0.420)	(0.635)	(0.654)	(0.980)
Size	12.137	13.612	3.193	6.058	-0.282***	-0.804***	-0.456***	-1.470***
	(14.681)	(10.143)	(5.275)	(5.616)	(0.105)	(0.161)	(0.163)	(0.248)
Roa	3.929	5.174***	0.471	1.925*	-0.004	0.012	0.003	0.021
	(2.766)	(1.911)	(0.994)	(1.058)	(0.006)	(0.017)	(0.010)	(0.027)
MTB	0.484	0.480	-0.017	0.100	-0.021	0.005	-0.006	-0.103*
	(1.292)	(0.893)	(0.464)	(0.494)	(0.016)	(0.038)	(0.025)	(0.059)
Leverage	0.481	-0.002	0.229	0.209	-0.031***	-0.023**	-0.039***	-0.067***
	(0.637)	(0.440)	(0.229)	(0.244)	(0.006)	(0.011)	(0.009)	(0.017)
Past_Return	-1.055*	-1.162***	0.199	0.005	-0.017***	-0.015	-0.012**	-0.002
	(0.549)	(0.379)	(0.197)	(0.210)	(0.004)	(0.011)	(0.005)	(0.017)
Vol	6.071***	6.970***	1.589***	3.412***	-0.011	0.007	-0.014	-0.002
	(1.426)	(0.985)	(0.512)	(0.546)	(0.009)	(0.025)	(0.014)	(0.038)
Illiquidity	-0.272	-0.149	-0.112	-0.172	0.005***	0.005***	0.003*	-0.002
	(1.326)	(0.916)	(0.477)	(0.507)	(0.001)	(0.001)	(0.002)	(0.002)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234	234	234	234	2,279	768	2,279	768
Adj R2	0.059	0.312	0.002	0.292	0.184	0.196	0.214	0.285

Figure A1. CDS Spread Changes (1-Year) and Debt Due within One Year under the COVID-19 Shock

Figure A1 shows the cumulative CDS spread changes (1-year) for various groups. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investments (DD_One)—group 1 has the lowest DD_One value and group 4 has the highest DD_One value).

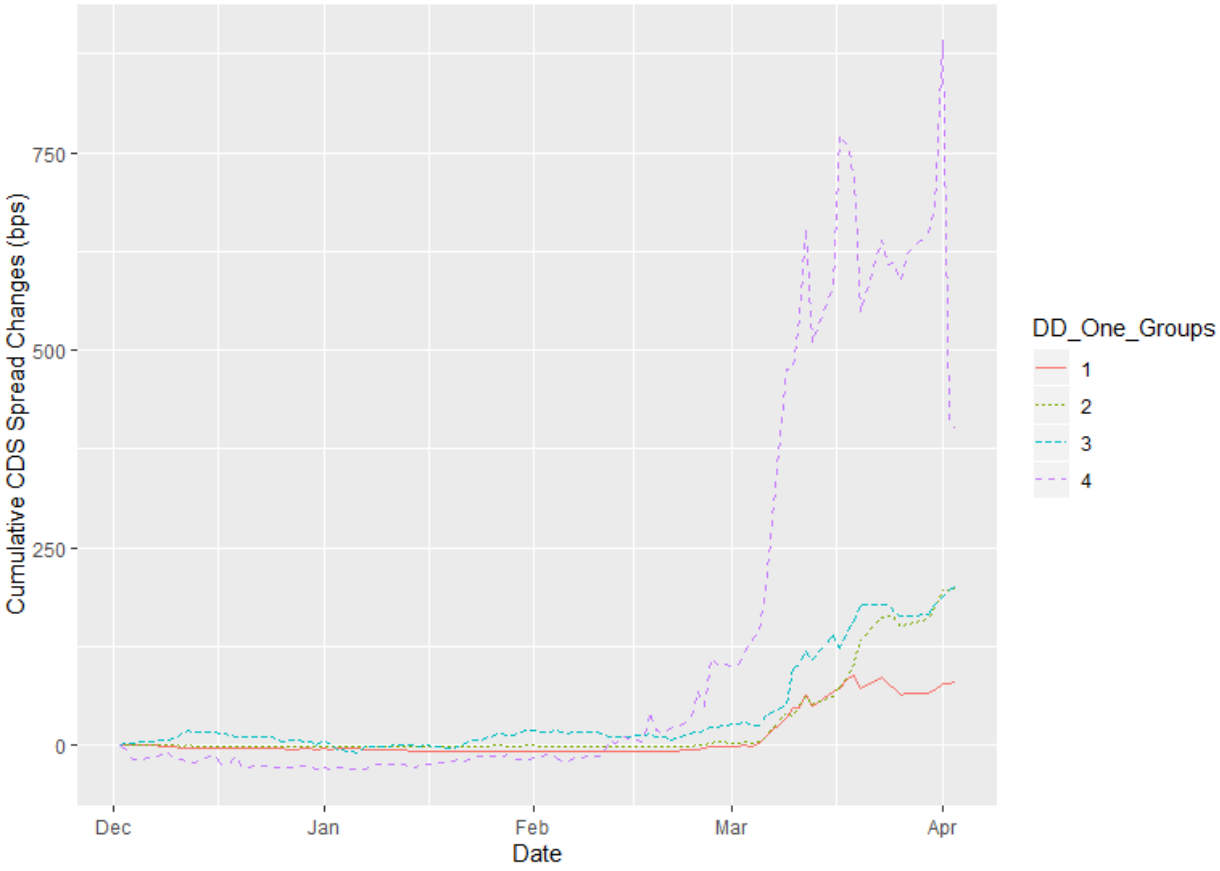


Figure A2. CDS Spread Changes (5-Year) and Debt Due within One Year under the COVID-19 Shock

Figure A2 shows the cumulative CDS spread changes (5-year) for various groups. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investments (DD_One)—group 1 has the lowest DD_One value and group 4 has the highest DD_One value).

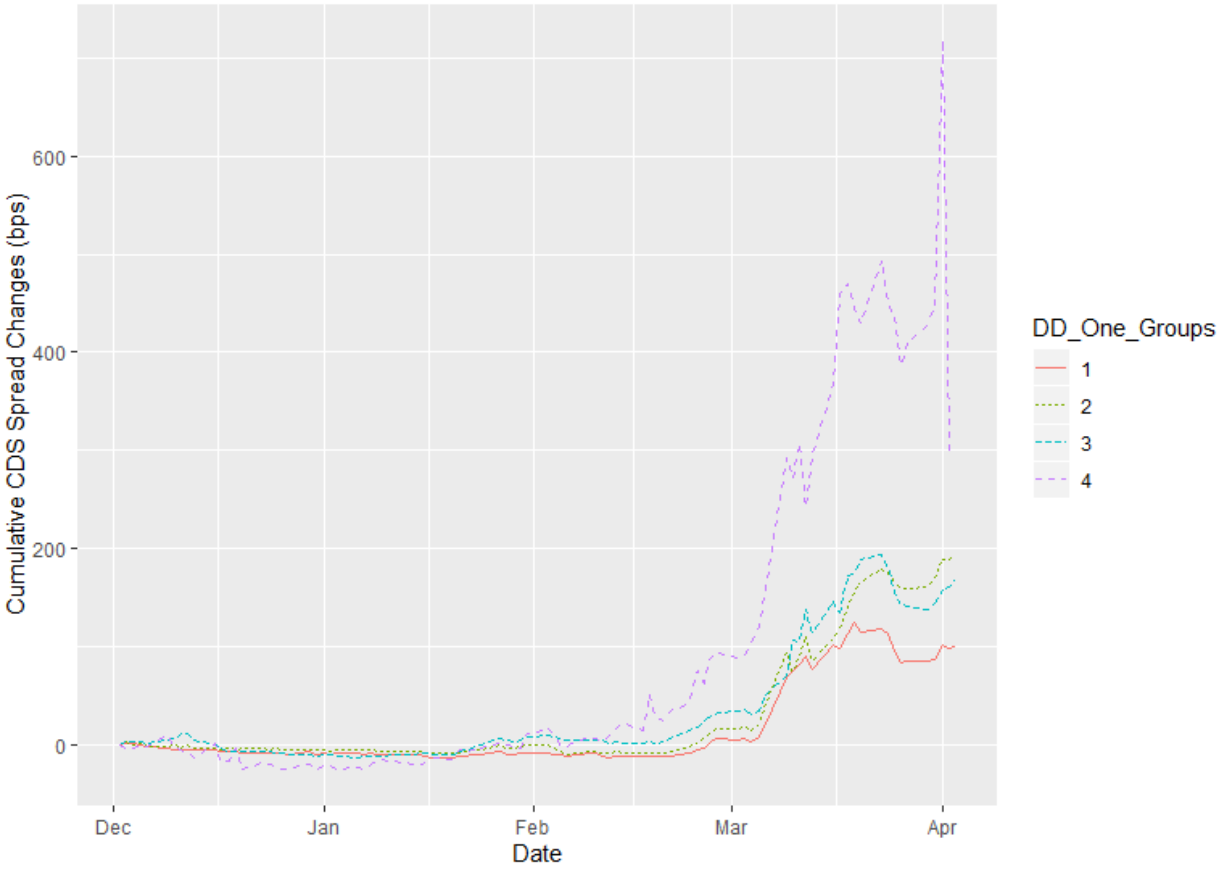


Figure A3. CDS Spread Changes (10-Year) and Debt Due within One Year under the COVID-19 Shock

Figure A3 shows the cumulative CDS spread changes (10-year) for various groups. We divide our sample firms into quartiles according to their debt due within one-year scaled by cash and short-term investments (DD_One)—group 1 has the lowest DD_One value and group 4 has the highest DD_One value).