The Costs of Corporate Debt Overhang

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Abstract

We propose extending the measurement of debt overhang by liabilities to cash flow. Firms with this type of overhang experience 4% (5.5%) slower asset growth (during recessions) – even after controlling for traditional leverage, highlighting the importance of a firm's debt servicing capacity. Our findings extend to employment and capital expenditure growth; are more pronounced for firms with greater funding needs; and appear to be the result of "excessive" reliance on debt financing. We show that the rise in debt overhang during the Covid-19 outbreak may lead to a 15% slower growth for firms most affected by the lock-down.

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1 Introduction

How do high levels of "debt to cash flow" in U.S. firms affect their growth and investment, especially during periods of tight lending conditions? Corporate debt rose substantially in the years leading up to the Covid-19 outbreak and continued to grow in 2020, as firms borrowed against falling revenues. Given the shuttering of the economy during the pandemic, an unprecedented number of firms found themselves constrained and operating with historically high levels of borrowing relative to EBITDA at the beginning of 2021. This made it difficult for firms to service their debt, but perhaps more importantly, it will likely limit their ability to raise new funding going forward.

In this paper, we use the Great Recession and the Covid-19 crises to showcase that high debt to cash flow represents an important measure of debt overhang, which affects firm growth above and beyond the traditional measures of leverage that are prevalent in studies of debt overhang. Debt to cash flow fits well with the theoretical literature on debt overhang because it captures the firm's capacity to service debt, a key driver of its ability to raise additional funding. Further, debt to cash flow likely constitutes a more exogenous component of overhang because part of the volatility in a firm's cash flow is beyond its control.

After reaching a record-high level in 2020, debt owed by the U.S. business sector have begun to fall as revenues have picked up over the course of 2021. However, this reversal does not extend to all firms. In fact, firms that entered the Covid-19 crisis with high levels of liabilities relative to their cash flow as well as firms whose liabilities to cash flow rose sharply during the outbreak have not been able to reduce their debt burden in 2021 (Figure 1). These firms continue to struggle with high overhang in terms of both pure leverage and high liabilities to EBITDA – which threatens to significantly curtail future growth of a substantial share of the U.S. corporate sector.

[Figure 1 about here]

We exploit a number of data sets, including Compustat, DealScan, the Shared National Credit (SNC) program, and the Y14 database, to identify the ways in which high debt overhang – as measured by liabilities to EBITDA – can affect firm growth. We use both historical data as well as data from the ongoing Covid-crisis. We capitalize on past crises, in particular the Great Recession, to gauge how firms with high debt overhang are affected by tighter lending conditions, while also making use of unique events to showcase exogenous tests of the cost of overhang. For example, we exploit the bank failures that occurred during the Great Recession, together with the granularity of our loan-level data,

to account for some of the endogeneity issues inherent to a firm's funding structure choices. Finally, we combine the insights from past crises with data from the Covid era to gauge how the large segment of corporate America, currently exposed to debt overhang, may be affected as lending conditions begin to tighten following historically generous levels.

We report a large array of results related to the costs of debt overhang in firms. They can broadly be broken up into three groups covering; the effect of overhang during ordinary times, the effects during an unanticipated financial crisis similar to the Great Recession, and in the context of the Covid-19 lockdown, which saw an unprecedented rise in the number of firms affected with high debt overhang burden.

We find that, during times of generous lending conditions, firms with a one standard deviation higher overhang, measured as total borrowing to cash flow, experience 4% lower asset growth than comparable firms. This is a sizeable effect as it represents a decline of almost 50% relative to unconditional firm growth in our sample. Importantly, that effect accounts for the implications of operating with high leverage (liabilities to assets) and represents the component of reduced growth attributable specifically to sustaining high debt with little cash flow. We find similar patterns when we consider a firm's growth of capital expenditures and employment. Furthermore, we find that – all else held equal – firms with high debt overhang take out almost 4% smaller loans while paying higher interest rates and receiving shorter maturity loans.

Secondly, and consistent with expectations, we find that the costs of debt overhang increase during periods of tight lending conditions. Firms with high overhang grow their assets over 5.5% more slowly during periods of tight bank lending standards. We further show that the effects of debt overhang during a crisis, like the Great Recession, are significantly more pronounced for firms with greater needs for external funding (as was shown in Benmelech et al. (2019)). We measure firms' needs for external funding through several different approaches, including (i) short maturity left in their debt at the onset of the crisis, (ii) reduced amount of undrawn funds in their credit lines, and (iii) reductions in the size of credit lines available to them.

While credit line reductions in a crisis might originate from the borrower, we show that the failure of individual banks in a loan syndicate is more likely to lead to a credit line reduction if the borrowing firm suffers from high debt overhang. In these instances, no other lender appears willing to take up the failed bank's loan share. Given that bank failures are independent of the performance of individual borrowers in a syndicate, this test is exogenous to the credit demand of a firm and highlights a very

direct cost of debt overhang.

Finally, we make use of early data to analyze the effects of the Covid-19 lockdown. The Covid-19 crisis has seen an unprecedented number of firms fall into a category of "historically high" debt overhang. By 2020 over 50% of all publicly listed firms operated with overhang at or above levels that would have been considered "the top quartile" (or negative EBITDA) in 2018. In the past, overhang of this magnitude was associated with an up to 7%-pt drop in firm asset growth. With lending standards similar to the last Great Recession, affected firms would experience 15% slower asset growth and 26% (8%) slower growth in CAPEX (employment). These are large magnitudes and would undoubtedly have a negative effect on the U.S. economy.

The effects of debt overhang have been explored theoretically as well as empirically. In early theoretical work, Myers (1977) and Myers and Majluf (1984) highlight the conflict that arises between various existing and potential new stakeholders of a company with extremely high levels of debt. Once the face value of a firm's debt exceeds its payoff, the firm cannot raise additional funds to finance projects with a positive NPV. Potential debtors cannot accurately evaluate a company's investment opportunities (Fazzari et al., 1988), while equity holders are averse to financing projects whose benefits accrue only to existing debt holders. This theoretical work was expanded upon by Lamont (1995), Hennessey (2005), Hennessy et al. (2007), and Occhino (2010). Hennessey et al. show that debt overhang can limit and distort investment, with long-term assets/projects experiencing the most pronounced reduction. Lamont points out that debt overhang should not bind during economic booms, as returns on investment are high and corporate debt is less risky. However, downturns will significantly reduce a firm's ability to invest as existing projects become less profitable and debt overhang grows.[1]

Early empirical work by Lang et al. (1996) shows a negative relationship between leverage and future firm growth. Sharpe (1994) shows that firms with high debt to assets are more sensitive to macroeconomic changes in consumer demand, a finding corroborated by Giroud and Mueller (2016). Empirical work on the effects of debt overhang have become more numerous since the Great Recession. Kalemli-Ozcan et al. (2020), using European micro data, show that debt overhang reduced firm investment after the recession particularly for firms borrowing from banks more exposed to

[1] A rich literature models firm values in the face of debt-agency issues. Parrino and Weisbach (1999) model stock-holder and bond-holder conflicts using monte-carlo simulations. They show that wealth transfers from equity claimants to debt claimants arise from the adoption of low-risk positive NPV projects and vis-versa. Mello and Parsons (1992) model the value of a firm reflecting on the agency consequences of debt, using a real-options framework. Mella-Barral and Perraudin (1997) highlight that firms can extract concessions from debt holders by acting strategically and that strategic debt service may account for a portion of the premium on corporate debt.

sovereign risk. Using another large data-set of European firms, Popov et al. (2018) document a positive correlation between investment efficiency and debt overhang, which reverses during banking crises and when corporate debt levels are extremely high. Giroud and Mueller (2020), in turn, show – using U.S. data – that an increase in firm leverage results in a subsequent reduction in firm-growth and employment.[2]

There is also a set of studies that have investigated the effects of debt overhang from a macroeconomic perspective. For example, Mian et al. (2017) show that higher household debt-to-GDP predicts slower economic growth, and Mian et al. (2020) document that large debt burdens by corporations have a drag effect on the economy. Jorda et al. (2014a) and Jorda et al. (2014b), in turn, show that mortgage credit growth can predict financial crises while Jorda et al. (2013) highlight that recessions, which follow credit expansions, are deeper and persist longer.[3]

Our paper is closer to existing studies of debt overhang that rely on firm level data, but it differs from them in at least three important ways, allowing us to contribute to the existing literature in a meaningful way. First, in contrast to the bulk of the existing literature on debt overhang, which focuses on the ratio of a firm's total debt to assets, following Lawless et al. (2015), we make use of liabilities/EBITDA (or debt/EBITDA) as our primary criteria for measuring debt overhang, while also controlling for measures of traditional leverage and firm size.[4] We thereby highlight that a purely leveraged based view of overhang is incomplete given the strong impact of cash flow constraints on a firm's ability to obtain future funding. Another advantage of relying on cash flow based measures is that they are less endogenous to firm funding choices and are still vital for firm growth. Additionally, these measures are well suited to ascertain the impact of debt overhang on firm growth in the wake of the Covid-19 crisis, given that large parts of the economy were shuttered in 2020 and EBITDA contracted significantly.

Second, we make use of supervisory information to explore the heterogeneity of the effects of debt overhang for firms of differing sizes (including privately held firms) and with different funding needs (by virtue of having access to unused credit lines or having strategically refinanced early). Supervisory data also gives us the opportunity to investigate the effect of debt overhang when firms lose funding (in connection with the failure of syndicate member banks) and thus circumvent some of the issues

[2] Campello et al. (2010) find, based on interviews of C-suite executives from around the world, that credit constrained firms are more likely to cut investment and employment as obtaining new credit becomes more difficult in crisis periods.

[3] An older literature, including Krugman (1988), Borensztein (1990) and Manzano and Rigobon (2001), has documented an adverse relationships between overhang and investment at the country level.

[4] Lawless et al. (2015), who show that Irish SME's with overhang were particularly affected during the crisis, point out that **debt-turnover** may be more apt. This is similar to how the problem is viewed in the context of household finance, see: Mian and Sufi (2010); Mian and Sufi (2011); Dynan et al. (2012).

surrounding the endogenous funding choices of firms.

Lastly, we explore the economic effects of debt overhang following the shutdown triggered by the Covid-19 outbreak. This period is unique in the extent to which it has shaped debt overhang, especially for the highly indebted firms in the sectors affected by the shutdown. These firms experienced a disproportional increase in their liabilities to EBITDA and many of them have been unable to reduce their overhang burden since the outbreak. This helps us identify the costs of debt overhang and, perhaps more importantly, it gives us an opportunity to deepen our understanding of the costs of "excessive" reliance on debt financing.

The rest of the paper is organized as follows. The next section presents our data sources, characterizes our sample, and describes our methodology. Section 3 presents our findings on the effects of debt overhang on firm growth in normal times as well as during periods of tighter lending conditions, including the Great Recession. Section 4 presents the results of a series of tests we carry out to address concerns with the endogeneity of firms' indebtedness. Section 5 offers a first attempt to estimate the effects of debt overhang following the Covid-19 outbreak building on the evidence we uncover during the Great Recession. Section 6 concludes with some final remarks.

2 Data, Sample Selection and Methodology

2.1 Data

The data for this project comes from Compustat, the Shared National Credit (SNC) program, Dealscan, the Senior Loan Officer Opinion Survey (SLOOS), the Federal Reserve's Y14 Q database, and the FDIC bank failure list. We rely on Compustat to gather firm-level data. We make use of annual data, as it most accurately tracks those variables that are of interest to this study and does not require seasonal adjustments. We exclude finance and insurance firms, firms that do not report EBITDA, revenue, assets, and liabilities as well as firms whose liabilities exceed their assets by more than 20%. We exclude this last category of firms because firms whose liabilities exceed their assets by a significant amount are the result of some data error or otherwise will likely default and leave the sample within a short period of time. This leaves us with a sample of approximately 3,700 firms per year over our sample period from 2000 to 2020.

We merge Compustat data with syndicated loan level data from the SNC program, and the Dealscan and Y14 databases. The SNC program, run by the Federal Deposit Insurance Corporation, the Federal

Reserve, and the Office of the Comptroller of the Currency, tracks – at the end of each year – confidential information on all syndicated credits – new as well as credits originated in previous years – that exceeded $20 million and are held by three or more federally supervised institutions.[5] For each loan, the program reports the identity of the borrower, the credit type, its purpose, origination amount, origination date, maturity date, and amount drawn-down on credit lines. The program also reports complete information about the syndicate, including investors' loan shares.[6] Given that SNC does not gather information on loan spreads, we use Dealscan to obtain that information. Dealscan gathers information on all syndicated credits but only at the time of their origination.[7] We also rely on Dealscan to gather information on loan credit spreads.

We use the Federal Reserve Y14 Q database to gather information on loans (and their borrowers) originated after the Great Recession. Y14 data is used in the stress testing of major financial institutions. As such, it includes a variety of details on the loans of every bank that has ever been subject to the stress tests. We make use of the sub-database "H.1", which contains detailed quarterly information on the C&I loans of reporting banks. Reporting institutions must file all loans with a total balance sheet commitment of more than 1 million USD each quarter. Also, the data tracks a number of important facts about the borrower, including EBITDA and other balance sheet components. In contrast to SNC and Dealscan, Y14 gathers information on all loans, not just syndicated loans. However, in contrast to those datasets which go back to the late 1980s, Y14 data started to be collected only in 2012 and therefore is available only for a period of relatively loose credit conditions.

We use the SLOOS data to capture banks' lending standards over time. Finally, we merge FDIC data on bank failures with SNC information on loan syndicates to investigate the impact of a syndicate member's failure on borrowers' access to bank funding. We restrict this exercise to bank failures (including Bear Sterns and Lehman Brothers) because we do not have comprehensive information on the failures of nonbank financial institutions that participate in the syndicated loan market.

2.2 Sample Characterization

Table 1 depicts summary statistics for the key firm-level dependent variables we consider in this study (growth of assets, capital expenditures, and employment). Growth rates and debt overhang measures

[5] In January of 2018 this cutoff was raised from $20 to $100 million. This reduced the volume of loans supervised by the SNC by 2%. However, this change lies outside the period for which we make use of SNC data.

[6] The confidential data was processed solely within the Federal Reserve System for the analysis presented in this paper.

[7] See Bord and Santos (2012) for a comparison between the SNC and Dealscan databases.

are winsorized at the 2 and 98 percent thresholds. Firm growth in the sample is nevertheless driven in part by survivorship bias and could constitute an upper-estimate of total firm growth. Panel A of the table reports statistics for the entire sample period that we consider in the first part of our analysis: 2000-20. Average annual asset growth during the entire sample period is nearly 7% while employees and capital expenditures at the average firm grow by around 3% and 2%, respectively.

[Table 1 about here]

Our key independent variable is debt overhang. We define debt overhang as firm borrowing relative to cash flow, which we proxy with *liabilities/EBITDA*. Liabilities are a broad measure of "indebtedness". They reflect all of the borrowing (including trade credit) a firm may have undertaken to support its operations.[8] EBITDA, in turn, can be considered a proxy of cash flow. As discussed in the introduction, cash flow can be more volatile than a firm's balance sheet structure as it depends on macroeconomic conditions, unrelated to the firm's business model. Using a debt overhang measure that relates borrowing to a proxy for cash flow removes some of the endogeneity associated with the financing decisions of the firm because overhang can arise when a firm is less profitable than investors and lenders expected. This is particularly relevant in the current situation because EBITDA was negatively affected in many sectors of the economy following the Covid-19 outbreak.

For these reasons we focus on liabilities/EBITDA, which is equal to 3.43 for the average firm in our sample, with the 10th and 90th percentiles being -2.59 and 10.37, respectively. We also consider two alternative measures of debt overhang: Debt/EBITDA and EBITDA/Interest payments to highlight the stability of our results. Debt/EBITDA does not include trade credit and is a narrow measure of the debt a company has taken on from borrowers to finance its operations. It is equal to 0.87 for the average firm, with the 10th and 90th percentiles being -0.09 and 3.22, respectively. With regards to EBITDA relative to interest payments, it is equal to 23.6 for the average firm, with the 10th and 90th percentiles being -26 and 89, respectively.

Panel B of Table 1 focuses on the sample period (2004-10), which we consider to investigate the effects of debt overhang during the Great Recession. Panel C reports statistics for that same period but after restricting the sample of Compustat firms that also appear in the SNC program. Not all firms in Compustat appear in the SNC program either because they do not borrow in the syndicated loan

[8] Any lender considering the financing of a firm will have to reflect upon the chances of receiving a payout in bankruptcy. This is made less likely if the firm has a large number of outstanding creditors, relative to its earnings. This is compounded if the trade credit has been secured with a company's assets or inventory, as is a common case in SMEs.

market or because their loans do not meet the requirements to be included in that program (minimum size of $20 million and held by at least three federally regulated financial institutions). As a result, our sample of matched firms is smaller than our full sample and, by virtue of the firms that borrow large loans, skewed towards larger firms, with slower growth. For this reason, we control for some firm characteristics, which differentiate the samples, in all our regressions below.[9]

2.3 Methodology

Our baseline specification correlates debt overhang in firm "c", lagged by one year, with that firm's subsequent asset, investment, and employment growth. Our dependent variables of interest are therefore annual log change in assets, investment, and employees. We control for a number of factors, in addition to debt overhang, which may impact firm growth. These include lagged revenue, total liabilities to assets (i.e. traditional leverage), and lagged assets (which accounts for firm size). Given that some potentially important factors, including trade credit and leverage, are industry specific, we make use of industry*year or firm fixed effects in our specifications. Our baseline specification, for firm "c" at time "t" in industry "i" therefore takes the following form:

$$\begin{aligned} \Delta Y_{c,t} =& \beta_0 + \beta_l DebtOverhang_{c,t-1} + \\ & \theta_{c,t-1} + I * t_c + \epsilon_{c,t} \end{aligned} \tag{1}$$

Here θ captures lagged firm-specific controls, and $I*t$ are industry-year fixed effects (or firm fixed effects). Given that our baseline specification makes use of log-changes as dependent variables, which remove time in-varying firm characteristics, adding firm fixed effects makes our specification rather restrictive (nonetheless, we include this as a robustness test below, to showcase result validity).

Since tighter lending conditions (or crises more generally) exacerbate the issue of debt overhang, we expand our baseline regression to include the interaction term between our measure of debt overhang and banks' lending standards. In this case, we consider the following model:

[9] We also showcase that our results are strongest among the small firms in our sample, i.e firms most opaque to lenders. Accordingly, results obtained with our SNC sample are most likely lower bound estimates of the total effect. We discuss this below.

$$\begin{aligned}\Delta Y_{c,t} =& \beta_0 + \beta_1 DebtOverhang_{c,t-1} + \beta_2 DebtOverhang_{c,t-1} * LendStandards_t \\ &+ \theta_{c,t-1} + I * t_c + \epsilon_{c,t},\end{aligned} \tag{2}$$

where *LendStandards* are banks' lending standards according to SLOOS or a dummy variable equal to one for the period that coincides with the Great Recession (2008-09).

Additionally, we investigate the heterogeneity of our baseline debt overhang effect across firms that are likely to have more financial needs and/or be more financially constrained. This helps address some of the endogeneity concerns around the structure of debt – a firm specific choice discussed below – and also allows us to identify those firms most likely to be affected during periods of tighter lending constraints.

We capitalize on our access to loan level data from the SNC program to construct some alternative measures of firms' needs for external funding. Our first measure compares firms that refinanced their loans early to extend their maturity prior to the Great Recession, with firms that did not refinance strategically. We expect firms that refinanced early prior to the crisis to have lesser needs for external funding during the crisis.[10]

Our second measure builds on this same idea but focuses on firms with debt maturing during the crisis. These firms are more likely to be credit constrained because they will experience significant hurdles refinancing their debt during the crisis.

Our third measure is the level of the borrower credit line utilization. High credit line utilization prior to a crisis may imply that a firm is financially constrained and has more limited financing options during the crisis.[11] Given that average credit line utilization in SNC data is below 20% and the fact that additional loan covenants take effect at a credit line utilization above 33%, we make use of 33% as a cutoff to define relatively "high" credit line utilization.

We estimate regression (2) for sub-samples of our data based on these three metrics. We are particularly interested in understanding the compounding effect of external financing needs during the Great Recession. This allows us to ascertain whether the effects of debt overhang during a financial crisis are more pronounced in firms facing financial constraints/renegotiation pressure. Given that the onset of the recession was likely unexpected, it is possible that renegotiation, at the margin, was

[10] Mian and Santos (2018) who show that firms, particularly those with higher credit quality, systematically renegotiate their loans to extend their maturity in good times to reduce the risk of having to refinance them during crises periods.

[11] Santos and Viswanathan (2020) document that firms tend to increase drawdowns on their credit during recessions.

exogenous to financing and debt structure decisions themselves.

Finally, we expand our analyses along two dimensions to further reduce concerns that our measures of financially constrained firms, as well as firms financing choices as a whole, are endogenous. First, we analyze whether the propensity of banks to reduce existing credit lines during a crisis correlates with debt overhang. Given that borrowers usually do not reduce their credit lines during crises periods, these cuts are likely bank-driven and represent tangible costs of overhang.

Second, we make use of the failure of syndicate member banks as exogenous events that affect the supply of credit. Following Santos and Viswanathan (2020) finding that lead banks can frequently step in and take over a failing syndicate member's loan share, we investigate the propensity that syndicates, in which at least one member bank fails, reduce outstanding credit commitments/loans to firms based on the level of debt overhang. Given that banks usually hold small investments in each credit syndicate, the failure of a bank is likely independent of its participation in any one syndicate and from the demand for credit by any particular borrower. As a result, this constitutes our most direct test of the impact of debt overhang on the ability of firms to finance themselves.

We build on the following model to investigate the impact of bank failures:

$$\begin{aligned}\Delta Y_{c,t} =& \beta_0 + \beta_l DebtOverhang_{c,t-1} + \beta_2 DebtOverhang_{c,t-1} * Syndicate_Failures_{c,t-1} + \\ & \beta_3 SyndicateFailures_{c,t-1} + \theta_{c,t-1} + I * t_c + \epsilon_{c,t}\end{aligned} \tag{3}$$

This regression takes the same form as those above. The key variable of interest is the interaction between whether a syndicate member failed in the previous year and a firm's level of debt overhang. Given that the ultimate goal of our investigation is to understand whether debt overhang adversely affects firms, we investigate whether a reduction in credit following the failure adversely affects log growth in assets, investment or employees.

3 The Cost of Debt Overhang

In this section we report our findings on the effects of debt overhang on firm growth of assets, investment and employment. We also report results on the effects of overhang when banks tighten their lending standards and during the Great Recession as a case study.

3.1 Effects of Debt Overhang: Univariate Analysis

Figure 2 depicts the annual log growth of assets for firms in Compustat for the period 2004-2013. We focus on this period, around the Great Recession, because the effects of debt overhang are likely to be more salient during financial crises.

In 3 (a) we index growth to 2007 for ease of viewing the time series of changes during the crisis. In both above Figures, we split the sample of firms into five groups, of which we show three. The first group includes firms in the highest quartile of liabilities/EBITDA in 2007; the second group includes firms in the lowest quartile of liabilities/EBITDA in the same year. The final group captures firms with negative EBITDA in 2007. Firms with high liabilities to EBITDA, i.e. firms with high total borrowing relative to their cash flow, are more likely to experience the debt overhang problem. These firms may find refinancing difficult, especially during times of tighter credit conditions or during periods of cash-flow contractions. New investors may chose not to invest in these firms because any new profits would finance existing debt holders. Firms with negative EBITDA are either firms with a unique growth proposition or on the verge of bankruptcy; in either case these firms ostensibly have very high levels of overhang and require lenders' willingness to shoulder the risk. We can see in Figure 2 and 3 panel (a) that while firms with high liabilities/EBITDA grow somewhat more slowly during normal times, this is exacerbated during the crisis. Firms with negative EBITDA experience the most pronounced contraction in growth, likely because they are unable to raise additional funding. Panels (b) and (c) of 3 make use of changes in capital expenditure (capex) and changes in employment, respectively. A clear pattern emerges across the three panels: firms with high liabilities/EBITDA experienced the largest relative contraction in growth during the last financial crisis.

We next seek to determine whether the effect brought about by debt overhang is more salient for firms that need to raise funding during the Great Recession. We identify these firms using the maturity of their outstanding loans at the outset of the crisis. In panel (d) we again plot indexed asset growth for firms in our sample. We exclude firms with negative EBITDA, as these are a unique type of firms and our matched sample includes only a few of these firms. Instead, we split firms that are in the highest and lowest quartiles of debt overhang, i.e. high or low ratios of liabilities to EBITDA, by whether the firm had loans maturing in 2008 or 2009 or not. Firms which have both high liabilities/EBITDA and loans maturing in the crisis are affected most severely, experiencing the most pronounced contraction in asset growth. This evidence adds support to the idea that debt overhang is costly.

[Figures 2, 3, and 4 about here]

To reduce concerns that the relationship between liabilities/EBITDA and firm growth is driven by outliers or concentrated in one part of the distribution, we plot, in Figure 4, the relationship between a firm's asset growth and its ratio of lagged liabilities/EBITDA. We limit this exercise to the Great Recession. The relationship is clearly negative across the entire distribution. The scatterplot shows residuals after accounting for industry*year fixed effects, implying that the relationship is also independent of any one industry.

The evidence we presented thus far is consistent with the idea that debt overhang is costly to borrowers, particularly during crises periods when they will likely find it more difficult to access external finance. The evidence, however, is based on univariate analyses and consequently suffers from the corresponding limitations. For that reason, we investigate next the effects of debt overhang using a multivariate analysis.

3.2 Effects of Debt Overhang: Multivariate Analysis

The observations from Figures 2, 3, and 4 are confirmed in a series of regressions. We start by regressing the log change in assets, capex, and employees in a given year on our proxy for debt overhang (liabilities/EBITDA) in the previous year as well as a number of controls. We control for industry*year fixed effects in all regressions to account for industry-specific factors. We further account for lagged firm size, EBITDA, and traditional leverage. We exclude firms with negative liabilities/EBITDA. Approximately 12% of all firms have a negative EBITDA in at least one year of the sample. As discussed above, these firms may represent a specific type of investment/growth firm. They can also be considered as having extremely high debt overhang. Additionally, the measure of overhang that we employ is inverted for these firms, which makes it more difficult to interpret the regression coefficients. Nonetheless, we consider these firms in a robustness test we discuss below.

[Table 2 and 3 about here]

Table 2 makes use of data for the period between 2001 and 2019.[12] Our results show that, throughout this period, liabilities/EBITDA was negatively correlated with firm growth in both assets and employees, as well as capital expenditures. Scaling our coefficients by the standard deviation of liabilities/EBITDA,

[12]For some companies, the fiscal year 2019 ended in early 2020. We purposely do not include the most recent crisis. This is discussed explicitly below.

which was about 4 percentage points for the entire sample, we find that a 1 std. dev. increase in debt overhang would result in a 4% lower growth rate in the following year.[13] Using the long-term unconditional standard deviation – which includes negative EBITDA firms – this reduction rises to 6%. This represents roughly half of the unconditional firm growth during the key crisis period, and therefore constitutes both a statistically and economically meaningful effect. It is worth highlighting that this effect is observable even though we control for the traditional measure of leverage (liabilities to total assets) in our regressions. As such, the effect of cash-flow constraint-based overhang is an additional factor worth considering when evaluating the costs and effects of overhang.

Given that the adverse effects of debt overhang are likely to be exacerbated when there is a decline in the availability of external funding, in Table 3, we extend our baseline analysis to include the interaction of debt overhang with a dummy variable that indicates whether credit conditions are tightening, according to the SLOOS.[14] We see that, consistent with our priors, throughout our sample period tightening credit conditions increase the negative correlation between debt overhang and firm growth. A one standard deviation increase in overhang would reduce total asset growth by 5.5% during times of tighter lending conditions. The effect is most pronounced when looking at CAPEX. Investment appears to fall by about 6% during times of tighter lending conditions. This represents the entirety of the unconditional mean of the variable.

Our results are not functional form dependent. In Appendix Table A.1, we make use of log levels of our dependent and explanatory variables as well as firm and industry*time fixed effects. Our results hold in this specification, indicating that operating in changes does not impact our results. We also look consider firms with negative EBITDA in Appendix Table A.2. Here we make use of quantiles of debt overhang as well as a separate category for any firm with negative EBITDA. The effect of additional debt overhang is linearly increasing in each quantile with the most significant and pronounced effect among firms with negative EBITDA as well as firms in the highest quartile – the effect magnitudes are ultimately highly similar.

[Table 4 about here]

Finally, we focus on the Great Recession. Given that bank lending conditions tightened considerably during the crisis this provides us with an opportunity to investigate whether firms experiencing a debt overhang problem were relatively more affected during such a period of extremes. We focus on the

[13] It is worth noting that the std. deviation was much higher in volatile times, such as in 2007, when it reached 6.
[14] We consider credit conditions to be tight if the survey of senior loan officers indicates a 10% or more increase.

years between 2004 and 2010 (inclusive) and regress annual changes in assets, capex, and employees on the firm's overhang in the previous year – just as in the analyses above. The results of this exercise are reported in Table 4. Our interaction of interest is a firm's debt overhang * the dummy for the years 2008 and 2009, which we refer to as the "crisis". We see that the effect of debt overhang on firm growth is more pronounced during the crisis. This holds across our three measures of firm performance although the effect retains its statistical significance in only two of the three measures (assets and capex growth). A one standard deviation increase in the 2007 level of liabilities/EBITDA would result in an additional 0.8% slower growth in assets, 1.2% lower growth in capex, and 0.4% slower growth in employees during a great recession-like period.

3.3 Alternative measures of debt overhang

The evidence we presented thus far builds on our liabilities/EBITDA measure of debt overhang. As we discussed in Section (2.2), we focus on this measure because it is a broad measure of "indebtedness". Further, scaling a firm's indebtedness by a proxy for cash flow removes some of the endogeneity associated with the financing decisions of a firm.

Nonetheless, we want to confirm that our key results are robust to alternative measures of debt overhang. To that end, we rerun our analysis of the effect of debt overhang during the Great Recession but this time proxying debt overhang by debt/EBITDA. The results of this exercise, which are reported in columns 4-6 of Table 4, are similar to those we unveil when we use liabilities/EBITDA. Again we find that firms with high debt overhang at the onset of the crisis experience relatively lower growth in assets, capex, and employees in the subsequent years. In contrast to our previous measure of debt overhang where we find a statistically significant effect for assets and capex, with the current measure we find a significant effect for capex and employees. To showcase the validity of our results, however, we control for firm fixed effects and year in the specification.

In the Appendix, we additionally make use of EBITDA relative to interest payments. This measure sets a firm's cash flow in relation to the costs of its capital structure. Here, a high ratio would imply that the firm has a large cash flow relative to the costs of its debt. Conversely, a small ratio would imply that a large share of a firms cash flow is absorbed by interest payments. This would likely increase the reluctance of prospective financiers to grant additional funding - especially equity holders who would see all profits accrue to debt holders. In Appendix Table A.4 we show a positive and significant effect for both the baseline and interaction terms implying that high cash flow to interest payments is

associated with stronger growth in all three variables of interest during ordinary and crisis periods.

3.4 Leverage and Liabilities to EBITDA

We focus our investigation on the costs of debt overhang on the importance of liabilities to EBITDA because a firm's ability to service its debt likely drives its ability to raise additional funding. Nonetheless, we have included leverage – measured as liabilities to assets – as a control in our regressions above. Naturally, firms with high leverage will find it difficult to attract new funding – especially in times of tighter lending standards. Therefore, it is useful to analyse the compounding effect of the cash-flow constraint for firms with high and low leverage. In Table 5, we split our sample by whether a firm has above or bellow mean leverage in the preceding year. As can be seen, high liabilities relative to cash flow exert a negative influence on growth in assets, investment, and employees for both types of firms. Importantly, the effect is more pronounced in firms with high leverage. This holds especially in times of tighter lending conditions. This highlights most clearly the degree to which our cash-flow based measure of overhang should be seen as an important complement to traditional measures of leveraged-based overhang – especially during times of tighter lending conditions.

3.5 Additional evidence on the costs of debt overhang

3.5.1 Loan Terms

Thus far we attempted to infer the costs of debt overhang by investigating three measures of firm performance that are linked to their ability to raise external funding: growth of assets, capex, and employees. We focus on these metrics because we do not have a comprehensive data source on U.S. firms' access to external funding. Recall that according to theory, debt overhang is costly because firms may not be able to raise additional funding even though they have good alternative investment opportunities. Nonetheless, we consider two data sources – the Federal Reserve Y14 data and the Dealscan database – to investigate whether liabilities relative to EBITDA are associated with worse or otherwise more restrictive credit access conditions.

[Table 6 about here]

As we can see from Table 6, higher liabilities to EBITDA are associated with smaller loans, at higher interest rates, and shorter maturity even during a period of relatively easy credit conditions (2012-2020).

As we noted above, Y14 data is only available during this period. These regressions account for bank, firm, loan type, loan purpose, bank internal ratings, and time fixed effects. As such, any effect is identified within firm and bank, with any firm-specific time-invariant characteristics absorbed. A one standard deviation increase in debt overhang is still associated with a 3.5% reduction in loan amount, all else equal. This is a statistically and economically meaningful effect.

As we noted above, a limitation of the Y14 data is that it is only available after 2012 and therefore does not cover periods of tight financial conditions, arguably when the costs of debt overhang are higher. To address this question, we merge information on new loans from Dealscan with Compustat data. Dealscan is available going back to the late 1980s. A limitation of this database is that it is dominated by large corporations. Despite this, it gives us the opportunity to investigate whether firms with high debt overhang pay higher credit spreads on their loans and whether this effect was more pronounced for those firms that took out loans during the Great Recession.

We compute two measures of the credit spread paid by firms. The first measure is the average all-in-drawn spread paid by firms on loans originated at a certain time.[15] We then relate the average firm spread to a firm's debt overhang at that time. For the second measure, we begin by regressing the all-in-drawn loan spread on loan-type, loan purpose, loan size, and a number of other loan and company characteristics in the first stage. We then take the average unexplained residual spread for a given firm at the time of the loan origination and regress this measure on a firm's debt overhang at that time.

The results of this investigation are reported in Appendix Table A.5. They confirm that firms with high debt overhang, which are able to take new loans, pay higher all-in-drawn spreads on their loans. More important for our purposes, our results show that this effect increases during the financial crisis and is independent of firm fixed effects and time varying firm characteristics, as well as loan-type, loan size, or loan-purpose for which we are able to account. It is worth noting that this estimate represents a lower bound because many firms, particularly those suffering from high levels of debt overhang, were likely unable to take on new debt in the crisis (more on this issue below).

[15]The all-in-drawn spread, which is defined over Libor and equals the annual cost to a borrower, accounts for the credit spread and also reflects other fees borrowers pay on their loans.

3.5.2 Cross-section sample splits

We can show that the effects of debt overhang are compounded for different types of firms. We have documented above the cross section effect depending on firm leverage. We focus here on the effect of debt overhang across firms depending on their opacity. Firms that are young and/or small are likely more opaque from the vantage point of lenders. These firms, therefore, will likely have a harder time raising funds (Banerjee and Blickle, 2021). All firms in our sample are inherently large and old because they are publicly listed. However, even within these firms, a difference can be observed when comparing the very large to the somewhat smaller. In Appendix Table A.6, we split our sample by size. As can be seen, the effects of high debt overhang are indeed more concentrated in "smaller" firms.

3.5.3 Role of private equity investors

One potential concern with the evidence we presented thus far relates to the role of private equity investors. This is important because these investors are known to increase leverage in order to maximize their returns. To ensure that firms held by private equity companies are not affecting our results, we make use of Dealscan, given that it reports whether a firm has a private equity sponsor. We are able to confirm that the majority of firms in the syndicated loan market, which have private equity sponsors, are privately held firms, as opposed to the publicly listed firms we use in the regressions above.[16] We are nevertheless able to identify a small set of COMPUSTAT firms with PE sponsors.

Our measure of debt overhang is indeed higher for these firms, but the difference vis-á-vis non-sponsored firms becomes statistically insignificant in the face of the controls we use in our analysis i.e. year, industry, size, and basic leverage controls. We confirm that our results are unaffected by (i) removing PE sponsored firms from our sample or (ii) including a dummy variable in our regressions that denotes whether a firm has a PE sponsor. Results not reported for brevity.

4 Accounting for Endogeneity

The results we report in the previous section show that firms with higher levels of indebtedness relative to cash flow experience slower growth, particularly during periods of tight credit conditions. These findings are consistent with the insight from the theoretical literature that debt overhang hinders a firm's ability to raise external funding. However, since firm indebtedness is endogeneous to a firm's

[16] 35% of private firms and around 10% of public firms have a PE-sponsored facility in Dealscan

unobservable strategic business model, our findings could also be the result of other factors.

In this section, we attempt to alleviate the concerns with this issue by investigating whether the adverse effects of firms' high indebtedness are exacerbated among firms with greater needs of external funding. We capitalize on SNC data to identify firms with greater potential needs for external funding (because their loans are due to be refinanced or they have fully utilized their credit lines) and firms with effective needs for external funding (because they experienced a cut on their credit lines, due to the failure of a syndicate member bank).

4.1 Proxying funding needs by refinancing requirements

We start by identifying firms' funding needs based on possible pressure to refinance their existing debt during a financial crisis. Firms have to continually renegotiate, or refinance, the maturity of their outstanding loans with their lending institutions. The inability of the banking system to guarantee funding at the same conditions over time keeps firms susceptible to a sense of fragility: What if banks refuse to rollover their loans or demand a high spread the next time they seek an extension? Firms attempt to hedge these risks by refinancing early and extending the maturity of their debt when credit conditions are easy. Bodnar et al. (2012) document based on survey of Chief Financial Officers (CFOs) data that CFOs worry about managing their maturity structure to avoid refinancing in bad times. Mian and Santos (2018), discussed above, show that firms, in particular better quality ones, actively refinance and extend the maturity of their debt in good times to hedge against the cost of refinancing in bad times.

Building on this evidence, we examine the impact of debt overhang on firms with refinancing needs during the Great Recession. In Table 7, we split our sample into firms that refinanced one or more of their loans early, just prior to the onset of the Great Recession, and those that did not. We define a refinancing as being early if (i) a loan is renegotiated 364 or more days prior to the loan's due date, (ii) the loan maturity is extended and (iii) the loan amount remains within +/-20% of the original loan amount. We expect firms that extended the maturity of their loans prior to the crisis to be more insulated from the effects of debt overhang. Columns (1)-(3) capture the effect of debt overhang for firms that refinanced early prior to the onset of the Great Recession. Firms which failed to refinance early are captured in columns (4)-(6). We include a longer – full sample – version of the table in the Appendix of the paper (see A.3). The results are even more pronounced in this longer sample.

As we can see from that table there is a remarkable difference between the two sets of firms: Firms

that failed to refinance early experience a contraction in the growth of assets, investment, and employees as a consequence of high debt overhang. In contrast, none of the additionally adverse effects of debt overhang that manifest during a financial crisis are present among firms that refinanced early. The aggregate reduction in asset growth due to a one standard deviation increase in debt overhang – for firms that failed to refinance early – stands at 8%. This is twice as large as the total effect for firms that refinance early and highlights the difference in the degree to which unprepared firms with overhang were more adversely affected.

[Table 7 about here]

An alternative way to identify those firms that are more likely to have to refinance during the crisis is through the maturity left on their loan portfolio prior to the onset of the Great Recession. We assume that the average maturity of firms' loan portfolios in 2007 was largely unrelated to the tightening of credit conditions during the financial crisis. The outlook of most macro-economists in the first half of 2007, according to blue-chip data compiled by the Federal Reserve, still held the expectation of at least 3% GDP growth for 2007 and 2008. This implies that firms did not have a particular incentive, beyond ordinary firm-specific hedging, to seek to renegotiate their entire loan portfolio prior to the crisis. Similar to the findings from the previous test, our results show that debt overhang exacerbated the effect of the crisis in firms with loans that needed to be renegotiated (results not reported for brevity). For example, a one standard deviation increase in debt overhang during the crisis (i.e. 8.5 percentage points), for firms with short debt maturity would lead to 7% lower growth in assets and an 11.5% reduction in the growth of CAPEX (i.e. investment). While we do find that debt overhang also matters for firms whose loans mature after the crisis, the added effect of the crisis is significantly less pronounced.

4.2 Proxying funding needs by credit line utilization

Our next test identifies firms with larger funding needs based on their credit line utilization. Firms value credit lines for several reasons, including the protection they offer them against shocks to their cash needs (Campbell (1978), Holmstrom and Tirole (1997)) and against changes in interest rates (Thakor and Udell (1987)). Several empirical studies have uncovered supporting evidence for the liquidity role of credit lines. For example, Chen et al. (2017) find that firms are more likely to draw down credit lines than obtaining new loans during times of greater short-term financing needs. Santos and Viswanathan (2020), in turn, document that firms increase their drawdowns during recessions. This was particularly

evident during the Great Recession.[17] Borrowers are able to capitalize on credit lines' liquidity insurance role only to the extent they have funds unused in their lines of credit. In other words, borrowers that have already drawn down large portions of their credit lines are more likely to have to seek additional external funding. To the extent that borrowers are not able to fully hedge against financial crises, those that have limited unused funds in their credit lines are more likely to experience the typical difficulties in raising funding during the crisis.[18]

To ascertain if these challenges interact with debt overhang, we split our sample of firms into two groups based on their credit line utilization at the end of 2007. As mentioned above, the average credit line utilization for all firms in the SNC is below 33%. This is likely the result of additional loan covenants that trigger at a utilization of above 33%. We therefore use this threshold to separate our firms. The results of this exercise are reported in Appendix Table A.7. Columns (1)-(3) report results for firms with "low" utilized credit lines while Columns (4)-6) report the results for firms with "high" utilized credit lines as of 2007 year end. Our results show that the negative correlation between debt overhang and firm growth during the crisis is concentrated in firms with high ex-ante credit line utilization. Among the firms with low ex-ante credit line utilization, debt overhang is not negatively correlated with any of the three measures of firm growth that we consider (assets, capex, and employment). This supports the notion that firms facing financing constraints are more affected by debt overhang, especially during times of aggregate financial distress.

A potential concern with the previous test is that firms with low credit line utilization also make use of less debt, in aggregate, than their more credit line preferring counterparts. As a consequence the two groups may not be sufficiently comparable in terms of their debt overhang. However, the average liabilities to EBITDA, during the crisis, of firms with high credit line utilization is insignificantly different from those with low credit line utilization. This implies that the two groups are comparable in terms of debt overhang, but different in available credit during a time of tighter lending conditions.

[17] See Jiménez et al. (2009), Norden and Weber (2010) and Kizilaslan and Mathers (2014) for further evidence in support of the liquidity role of credit lines.

[18] Moreover, high credit line utilization may be the result of a firm receiving a smaller credit line than desired, making it credit constrained at the outset of the crisis.

4.3 Proxying funding needs by cuts on credit lines

4.3.1 Effects of credit line cuts

Another way of identifying firms' needs for external funding is to analyze outright reductions in the credit available to them. We proxy these reductions by cuts in existing credit lines. Credit line reductions may be firm driven, for example, to save on costs.[19] They may also be reduced by banks for a number of reasons, though the reduction is often associated with uncertainty about the solvency of the firm and a desire by banks to limit their exposure. Roberts and Sufi (2009) and Sufi (2009) find that covenant violations lead to substantial reductions in credit line commitments. Santos and Viswanathan (2020), in turn, document that credit line cuts often coincide with lead banks downgrading the credit rating of the borrower. Our data source does not contain information on the driver of a credit line reductions. To reduce concerns with reductions that are firm driven, we first focus specifically on cuts that occurred during the Great Recession.[20] In the next subsection, we take a look at a subset of cuts that are likely entirely bank driven because they follow the failure of a syndicate member bank.

[Table 8 about here]

We start by investigating whether firms are more likely to experience a reduction in an existing credit line during the crisis and whether their indebtedness at the onset of the crisis further increases the odds of that reduction. To that end, we estimate a model where the dependent variable takes the value 1 if the firm experiences a reduction in its credit line over the year. We again consider the sample period 2004 to 2010 and control for industry*year fixed effects, lagged leverage and lagged firm size, as in regressions above.

The results of this exercise are reported in Table 8. Column (1) shows that, over the sample period, firms with high levels of debt overhang are more likely to experience a credit line reduction in a given year. A one standard deviation increase in overhang would lead to an almost 5% higher likelihood of a credit line reduction. Column (2) makes use of the same sample but includes an interaction term of debt overhang and "crisis period" – a dummy that takes the value of 1 in the years 2008 and 2009. Importantly, Column (2) shows that the effect of indebtedness on the likelihood that the firm experiences

[19] The pricing structure of a credit line includes an undrawn fee and a credit spread. The undrawn fee compensates the bank for the liquidity risk it incurs by guaranteeing the firm access to funding at its discretion over the life of the credit line and it is paid on funds not yet utilized. In contrast, the credit spread compensates the bank for the credit risk it incurs when the borrower draws down on its credit line.

[20] Chodorow-Reich and Falato (2018) argue that credit lines were cut in the financial crisis of 2008-2009 for firms that had covenant violations.

a credit line reduction only holds during the crisis. This suggests that debt overhang can lead to credit rationing, but only in times of aggregate tighter credit conditions. Consistent with this insight, we find that firms with high debt overhang, which draw on their credit lines during the crisis, are more likely to experience a reduction in their credit lines (results not reported for brevity).

Having established the link between debt overhang and credit line reductions, we investigate next whether those reductions negatively impact a firm's growth during the crisis. The results of this investigation are reported in Table A.8. The table takes the same structure as tables above, but makes use of credit line reductions as the key explanatory variable. Columns (1)-(3) show the effect of any credit line reductions on firm growth during the Great Recession. Here, we make use of one observation per firm and relate whether a firm ever experiences a credit line cut between 2007 and 2010 (dummy which takes the value of 1 if at least one cut ever occurred) to its growth over the same period. Finally, columns (4)-(6) use the full sample from 2004 to 2010 and relate whether a credit line was cut in the year before to a firm's growth. We additionally include an interaction term for the crisis period – a dummy variable that takes the value of 1 in 2008 and 2009. As above, the dependent variables are a firm's growth in assets, growth in capex, and growth in employees. An examination of the results reported in Table A.8 shows that credit line reductions negatively impact firm growth and this effect is concentrated in the crisis period. A credit line reduction is associated with a 2% reduction in asset growth during the crisis periods (column 1).

4.3.2 Cuts driven by syndicate member failures

A potential concern with relying on credit line cuts is that some of them may be driven by firms as opposed to the providing banks (discussed above). In this section, we address this concern by relying on cuts that follow the failure of a syndicate member bank. We focus on the failure of syndicate member banks during the Great Recession. The failure of these banks is likely independent of the performance (or loan demand) of any one firm. Perhaps the biggest risk to the liquidity insurance provided by credit lines is the risk of failure of a syndicate member. Credit lines are legal arrangements whereby each syndicate member commits only to its loan investment. As a result, the failure of a syndicate member will lead to the reduction of the credit line and limit the borrower's drawdown ability, unless other banks step in and take on the investment of the failed bank. As such, these failure-induced cuts allow us to make a statement about the effects of debt overhang that are unrelated to the demand of the firms facing debt overhang.

We manually merge failed banks to the syndicate in which they participate. We then make use of the crisis period, 2007 to 2010, and analyze whether firms borrowing from these syndicates experience (i) credit line reductions on existing credit lines (ii) slower growth as credit is constrained and these firms face the difficulties associated with financing themselves from syndicates in which a member has failed[21]. The results of this exercise are reported in Table 9.

[Table 9 about here]

We find that the failure of a syndicate member is correlated with a rise (16% increase) in the probability that a credit line is reduced (column (1)). This probability is concentrated in those firms that have higher debt overhang (column (2)). This suggests that other syndicate members may be unwilling to step in and absorb the share of the failed member if the company in question represents a greater risk due to its high debt overhang. Similar to the insights from our previous analyses on the costs of limited access to funding, we see that the failure of a syndicate member correlates with reduced firm growth (columns (3)-(5)). Importantly, this relationship holds almost exclusively for firms with high debt overhang (columns (6)-(8)). These findings suggest that the fact that no other lender is willing to fill the position of the failed syndicate member, because the firm suffers from high debt overhang, has consequences for the growth of the firm. The firm faces a constraint and associated reduction in growth brought about by an exogenous event in combination with its debt overhang.

5 Is this time different? Debt Overhang after Covid-19

5.1 Overhang in Covid-19

The Covid-19 outbreak has the potential to substantially impact the economy through the channel of debt overhang. Corporate sector indebtedness stood at record-high levels at the time of the outbreak, and the crisis likely increased the problems that are associated with high levels of debt. Firstly, the shuttering of large parts of the economy resulted in a rapid drop in EBITDA for many firms. Secondly, this shortfall triggered an aggressive rise in firm borrowing. As such, corporate debt levels have reached new record highs and overhang, as measured by liabilities to EBITDA, is greater than at any point in the recent past. Lastly, debt ownership has become more dispersed, which will make it harder to renegotiate.

[21] Bank failures, especially syndicate member bank failures, are exceedingly rare outside the financial crisis.

Figure 5 shows indexed levels of average debt overhang for firms with positive EBITDA as well as for firms with negative EBITDA (inverted for convenience). Both are indexed to 2018 and show a strong rise in overhang during 2019 and 2020. We index to 2018 because the fiscal year 2019 ends in 2020 calendar year for many firms, meaning some of the Covid-effect may already be captured in the 2019 data. Operating with such extreme levels of overhang will likely slow growth and investment in the coming years.

[Figure 5 about here]

We define firms as having historically high debt overhang if – at any point in time – they would have been in the top quartile of liabilities to EBITDA for 2018. Given that 2018 already saw elevated levels of debt overhang, this constitutes a high watermark for our measure. For example, a firm with a high level of overhang in 2007 may not fall into the top quartile of firms with high overhang in 2018, given overall lower levels of overhang in 2007.

Firms with negative EBITDA constitute a separate fifth group. In Figure 5, panel (b), we show the share of firms in Compustat that fall into three of these groups. We exclude firms with medium-low overhang as well as firms with negative EBITDA. One can see that the share of firms with historically high debt overhang has risen sharply during Covid-19. A quarter of all firms now have historically high levels of debt overhang. If we include firms with negative EBITDA in this category, assuming that supporting any level of debt with negative cash flow is akin to high debt overhang, then just over 55% of all firms are operating with very high overhang.

Critically, that rise is driven by an increase in debt as opposed to a drop in EBITDA. This follows from the fact that the number of firms reporting data for 2020 has fallen sharply. Firms which suffered a significant drop in EBITDA appear to have stopped – or delayed – reporting data. The share of firms with extremely high overhang looks almost identical if we assume firms earned the same EBITDA in 2020 as in 2019 (results not reported for brevity). As such, the share of firms with extremely high debt overhang is likely higher than indicated by our measure. Perhaps more crucially, this also implies that the situation will not be reversed even if firms return immediately to pre-pandemic profitability in 2022.

Operating with historically high levels of debt overhang significantly slows firm growth. In Table 10, we relate a firm being in the bracket of "historically high" debt overhang to its growth in assets, capital expenditures, and employees. Having historically high overhang is defined as a dummy, which takes the value of 1 if a firm in any given year *would* fall into the highest quartile of debt overhang (or have

negative EBITDA) in 2018. In our full sample from 2001 to 2020, historically high debt overhang at the firm-level is associated with over 7%-pts slower growth in assets, 15%-pts slower growth in capex, and 3%-pts slower growth in employees. These effects are statistically and economically meaningful. The regressions depicted include Industry*Year fixed effects as well as controls for firm size, profitability, and mechanical leverage (as in regressions described above).

[Table 10 and 11 about here]

Of course, the effect is significantly higher in times identified by the SLOOS as having tighter credit conditions. In total, growth in assets is 15%-pts slower in times of tighter credit conditions. This implies that aggregate firm growth is negative for over indebted firms. This holds for both capital expenditures as well as employee growth.

Despite lending conditions remaining generous, partly due to government support throughout the Covid crisis, one can observe a slightly more pronounced impact of high debt overhang in 2020. Although firms with very high debt overhang enjoyed positive growth on average in the past few years, the onset of the Covid crisis has reversed this effect. The issue is likely to be exacerbated considerably if lending standards tighten - possibly as a result of slowing government support. For example, if lending standards tighten similar to the level of the Great Recession, firms in high overhang brackets could expect a 15%-pt slower asset growth and 26%-pt (8%) slower growth in CAPEX (employment). Given that, by some definitions, one half of all firms fall into the category of very high overhang, this issue may affect large swaths of the economy for several years to come.

The sharp rise in debt overhang following the Covid-19 outbreak provides us with an additional way to ascertain the costs of debt overhang. To that end, we replicate in Table 11 the results reported in Table 10 but using the initial jump of a firm into the 'historically high" debt overhang bracket as the key independent variable. Specifically, this variable takes the value of 1 if a firm moves into the highest overhang bracket and 0 otherwise. This is an important exercise because it isolates those firms that move into the historically high debt overhang-bracket, many of which probably for the very first time, which is likely to trigger an evaluation of their credit worthiness. We see that the effect observed above is primarily driven by this set of firms that jump into the high debt overhang bracket. This jump is associated with a reassessment of the borrowers quality and associated with significantly slower growth in the short term – an effect that may be exacerbated in the future. While the effect of moving into the highest debt overhang bracket is negative, particularly in times of tighter lending conditions, the effect

is most pronounced in 2020. Looking at 2012 to 2020, we see that firms moving into the highest bracket of overhang in 2020 have already experienced 12%-pt slower growth in assets and around a 10%-pt slower growth in investment and employment. This effect is present despite the fact that we exclude negative EBITDA firms here, allowing for the fact that these may return to profitability shortly.

The costs of moving into the highest level of debt overhang are also visible in the terms borrowers are able to obtain when they raise additional funding. As can be seen in Table 12, loans are more likely to become more expensive and to have shorter maturity in the year a firm moves into the category of having historically high levels of debt overhang. There is no positive correlation in a loan becoming smaller. However, when firms move into the historically high debt overhang group, this jump is associated with it either dropping from the data entirely (not reported for brevity) or having to seek new lenders as we observe the final bank-firm observation in the data.

[Table 12 about here]

Focusing on the Covid period, we find that loans are likely to become smaller, more expensive, and to have shorter maturity for firms that experience a jump into the highest debt overhang category. The effects are pronounced, despite the short amount of data available. They will likely be exacerbated in the future if lending conditions tighten. As of now, we still do not have enough data to determine whether firms are dropped by their bank by the end of 2020, though if past evidence is a guide, this wil likely hold true.

5.2 Additional complications of the Covid crisis

There are a number of additional complications that may exacerbate the costs of debt overhang in the Covid crisis relative to the Great Recession. Average credit line utilization of firms in 2019, after spiking during the Great Recession, was approximately 32%, similar to the high utilization observed in 2007, when it stood just above 30%. However, firms in the transportation and retail sectors entered 2020 with above average credit line utilization (in some instances as high as 40%). Also, the average loan maturity of all outstanding loans in the SNC was similar in 2019 to 2007. However, retail and transportation firms, again, showed statistically shorter average loan maturities by several months. These differences may compound the issue of debt overhang in these industries. There is at least one additional factor that is likely to increase the costs of debt overhang in the current crisis for all affected firms: the ownership structure of debt. There is limited evidence on the optimal mechanisms to resolve the issue of debt

overhang. But, Kurtzman and Zeke (2015) show, theoretically, that debt forgiveness can lead to large aggregate gains in times of aggregate distress. Giroud et al. (2012) use a natural experiment to show that debt forgiveness can lead to renewed healthy growth in firms previously affected by debt overhang. However, renegotiation is complicated, in practice, by the ownership structure of debt. Debt forgiveness by any one party presents a free rider problem if no other debt holders follow suit (see Corden (2006) or Krugman (1988)). This problem is compounded when loan ownership is dominated by many investors owning small loan shares as in the leveraged loan market. For example, at the end of 2019, the average number of CLOs in Ba and B rated loans was 203 and 160, respectively. Their average loan share was 0.24% and 0.42% respectively. Further, CLO managers will likely be reluctant to agree to any concessions involving the conversion of debt into equity because the latter carry little to no value in CLO tests.

Of course in instances when voluntary debt forgiveness is not feasible, the Chapter 11 bankruptcy process may be a viable option. Bankruptcy courts can help enforce a debt renegotiation and debtor-in-possession (DIP) loans can help a firm circumvent some of the aforementioned challenges of out-of-court reorganizations. This may be an option for large firms provided that the bankruptcy courts are not overburdened and DIP financing is still available.[22].

However, small private firms may not be able to reorganize in bankruptcy. Brunnermeier and Krishnamurthy (2020) compare small firms to the over-indebted households of 2007-2009. These firms are opaque to potential lenders and, in many cases, have relied heavily on non-bank intermediaries. Due to the aggregate slowdown in economic activity, these firms are now likely to be facing a significant debt overhang problem and limited ability to renegotiate.

Indeed, we show in the Appendix, that during the Great Recession "small" firms were more adversely affected by debt overhang. This is observable even within the sample of large publicly traded Compustat firms. The effects are likely to be even more pronounced among very small, privately held, firms. Smaller firms are less likely to be rated and more likely to be opaque from the perspective of lenders. Very small firms with high levels of debt overhang may find refinancing themselves difficult. The liquidation or simply reduced long-term growth prospects of small firms represents a sizeable risk for the economy because this segment of the economy collectively account for a large portion of employment and economic growth.

[22]See Brunnermeier and Krishnamurthy (2020) for a theoretical discussion of this issue

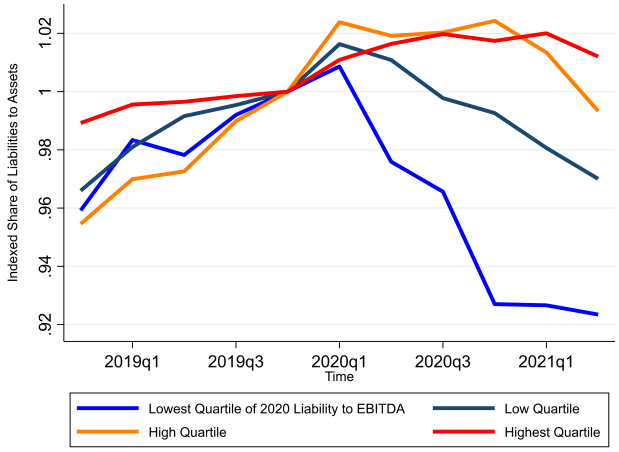
6 Conclusion

We combine public firm level data and supervisory loan level data to show that debt overhang, as measured by total borrowing to cash flow, limits firm growth as measured by assets, capital expenditures, or employees. The effects are more pronounced during times of tighter lending conditions, including financial crises. In a crisis, like the Great Recession, a one standard deviation higher debt overhang is associated with about 5% slower growth in assets per year. The effects of debt overhang during a crisis are concentrated in firms with greater needs for external funding, including firms needing to refinance their existing debt during the crisis, firms with less available funds in their credit lines, and firms experiencing outright reductions in the size of their credit lines.

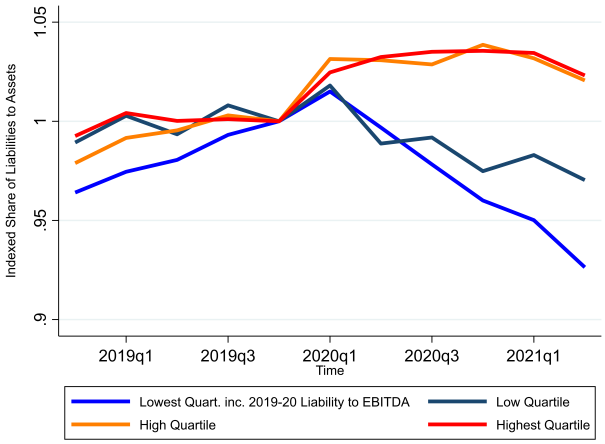
We make use of the exogenous failures of banks in a syndicate to disentangle the issue of credit demand from loan supply. The failure of syndicate members is associated with a decrease in available credit to firms with high debt overhang, but not otherwise.

We use our findings together with estimates on the impact of the Covid-19 outbreak on firms' cash flow to ascertain the effects of debt overhang in the Covid crisis. By some accounts, the contraction in asset growth due to debt overhang can be as high as 13%. The contraction is most pronounced in firms that entered the Covid crisis with high levels of debt overhang and firms in industries (such as real estate, retail, or transportation) that are most strongly affected by the Covid-19 related lock-downs.

7 Figures and Tables



(a) *Indexed Leverage - Firms sorted by Overhang in 2019*



(b) *Indexed Leverage - Firms sorted by Growth in Overhang 2018-2020*

Figure 1: *This figure depicts indexed leverage (liabilities to assets) between 2019 and 2021 Q2. Panel (a) sorts firms into quartiles based on levels of liabilities to EBITDA in 2019 Q4. Panel (b) sorts firms based on the increase in overhang (liabilities to EBITDA) between 2018 and 2020.*

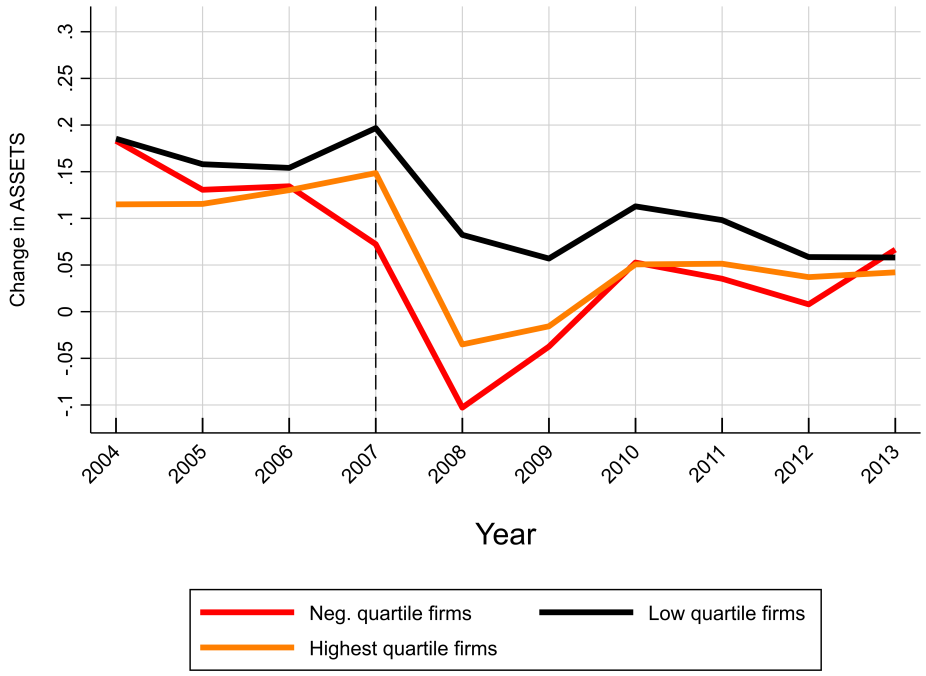
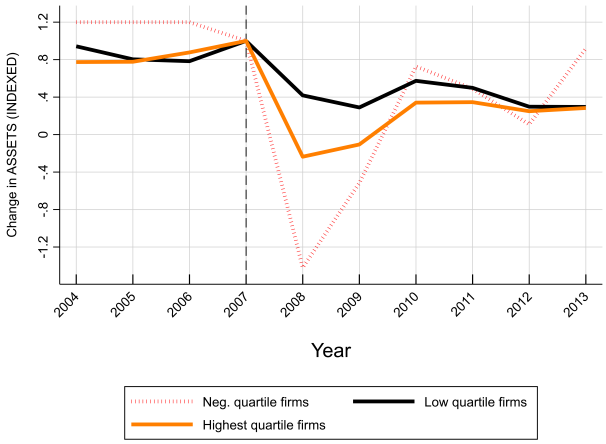
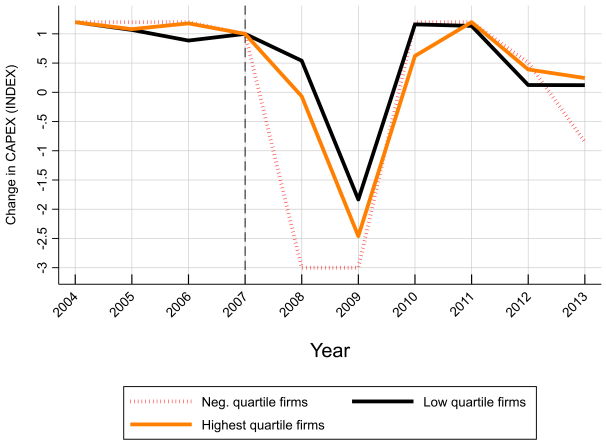


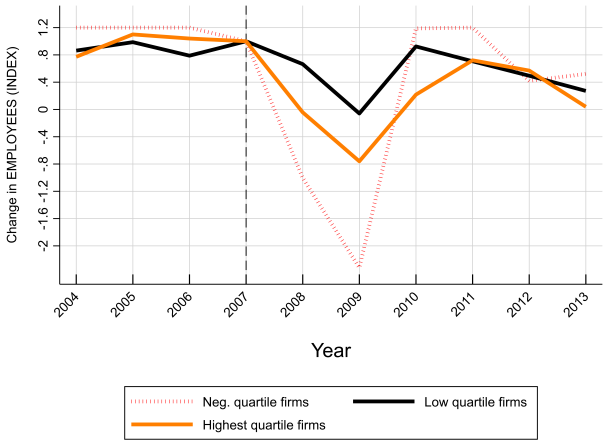
Figure 2: *This figure depicts level of changes in assets for firms in the highest quartile of overhang, the lowest quartile of overhang, as well as firms with negative EBITDA in 2007.*



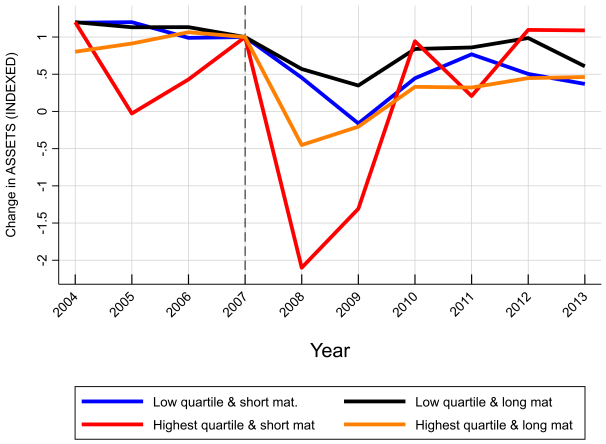
(a) *Change in Assets (indexed to 2007)*



(b) *Change in CAPEX (indexed to 2007)*



(c) *Change in Employees (indexed to 2007)*



(d) *Change in Assets (indexed to 2007 and split by loan maturity)*

Figure 3: *In this figure, panels, (a), (b), and (c) plot annual log-changes in assets, capital expenditures (capex) and employees indexed to 2007. We distinguish three groups of firms: firms in the lowest quartile of liabilities/EBITDA in 2007, firms in the highest quartile of liabilities/EBITDA in 2007, and firms with negative EBITDA in 2007. We index the annual changes to 2007 for ease of comparative viewing. The graphs thereby reflect the relative change in growth within each of the categories, relative to 2007. Panel (d) drops firms with negative EBITDA and focuses only on firms in the highest quartile and lowest quartile of liabilities/EBITDA in 2007. We additionally sub-divide these into firms with loans maturing in 2008/09 and loans maturing later.*

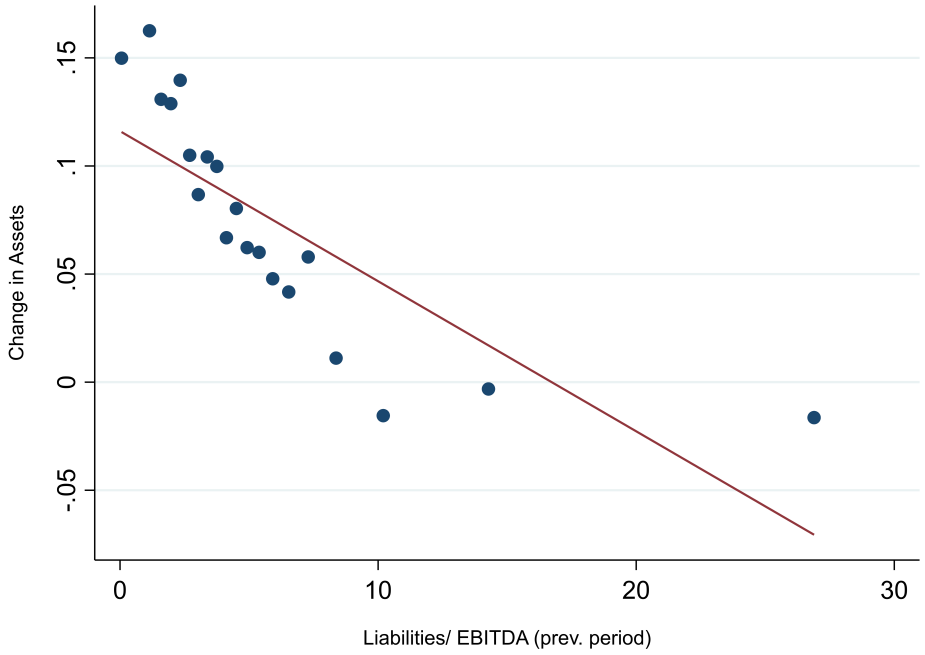
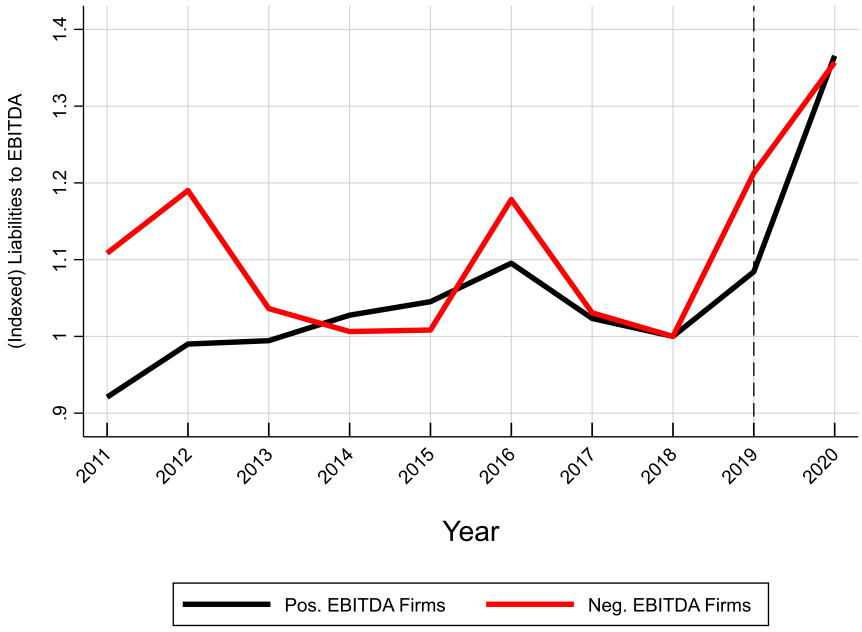
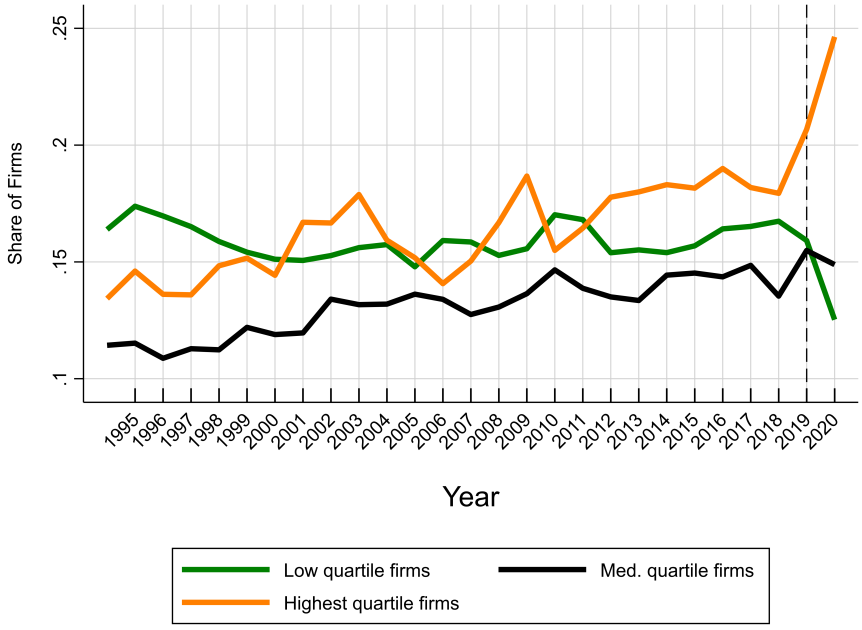


Figure 4: *This figure depicts the correlation between log-changes in assets and a firm's debt overhang, as measured by liabilities/EBITDA, in the previous year. The plot shows residuals, when controlling for industry*year fixed effects.*



(a) *Change in Overhang (indexed to 2018)*



(b) *Share of Firms in Overhang-Tranches using 2018 thresholds*

Figure 5: *Panel (a) depicts the indexed change in overhang for firms with positive and negative EBITDA in recent years. It is indexed to 2018. Panel (b) depicts the share of all firms that fall into a buckets/tranches of overhang relative to 2018 thresholds. We depict 3 out of a total of 5 buckets of overhang, leaving out negative EBITDA firms and the second quartile of low overhang firms for convenience.*

Panel A - Full sample

	N	Mean	StDev.	10th Pctile	90th Pctile
$\Delta Assets$	59805	0.083	0.242	-0.117	0.316
$\Delta CAPEX$	59805	0.065	0.633	-0.624	0.741
$\Delta EMPL$	59805	0.041	0.196	-0.123	0.234
Liabilities/EBITDA$_{t-1}$	59805	5.62	4.19	1.33	12.08
Debt/EBITDA$_{t-1}$	55117	1.24	1.55	0.10	3.92
EBITDA/Interest$_{t-1}$	51897	73.08	221	2.25	137
Leverage$_{t-1}$	59805	0.541	0.264	0.206	0.846
Assets$_{t-1}$	59805	5367	20209	45	10629
Revenue$_{t-1}$	59805	7526	27666	44	15546

Panel B- Crisis Sample

	N	Mean	StDev.	10th Pctile	90th Pctile
$\Delta Assets$	27974	0.085	0.319	-0.220	0.413
$\Delta CAPEX$	27974	0.036	0.795	-0.900	0.908
$\Delta EMPL$	27974	0.041	0.242	-0.180	0.287
Liabilities/EBITDA$_{t-1}$	27974	3.35	8.594	-2.48	10.182
Debt/EBITDA$_{t-1}$	26263	0.768	2.018	-.068	2.89
EBITDA/Interest$_{t-1}$	22803	42	86	-22	115
Revenue$_{t-1}$	27974	3639	15667	8	6744
Assets$_{t-1}$	27974	4744	21030	16	8932
Leverage$_{t-1}$	27974	0.523	0.300	0.168	0.865

Panel C - Crisis sample in SNC data

	N	Mean	StDev.	10th Pctile	90th Pctile
$\Delta Assets$	6000	.081	0.213	-0.097	0.281
$\Delta CAPEX$	6000	.067	0.487	-0.48	0.596
$\Delta EMPL$	6000	.031	0.172	-.123	0.194
Liabilities/EBITDA$_{t-1}$	6000	5.21	3.51	1.74	9.71
Debt/EBITDA$_{t-1}$	5436	1.12	1.31	0	2.96
EBITDA/Interest$_{t-1}$	5759	43	153	2.82	62
Revenue$_{t-1}$	6000	6348	20865	272	13400
Assets$_{t-1}$	6000	6708	17274	288	16369
Leverage$_{t-1}$	6000	.58	0.218	.317	0.825

Table 1: *Summary Statistics*

Note: This table depicts summary statistics for some of the key variables in our sample for the period between 2001 and 2019. We make use of the full baseline regression sample in Panel A, which excludes 13140 firm-years with negative liabilities to EBITDA. The period between 2004 and 2010 is depicted in Panel B, and the combination of SNC and Compustat data for the period between 2004 and 2010 in Panel C.

	(1) Change in assets	(2) Change in capex	(3) Change in employees
Liabilities/EBITDA$_{t-1}$	-0.967***	-0.827***	-0.398***
	[0.0412]	[0.0948]	[0.0298]
Industry * Year FE	Yes	Yes	Yes
Mean	0.082	0.057	0.039
R^2	0.085	0.068	0.066
N	59805	59805	59805

Table 2: *Debt overhang*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA, and log-growth in assets, capex, and employees. Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry*year fixed effects. Sample period: 2001 to 2019. Coefficients are scaled by 100 for convenience. We exclude any firm with negative liabilities/EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Change in assets	(2) Change in capex	(3) Change in employees
Liabilities/EBITDA$_{t-1}$ * Tighter lending	-0.916***	-0.716***	-0.371***
	[0.0436]	[0.104]	[0.0315]
Liabilities/EBITDA$_{t-1}$	-0.344***	-0.741***	-0.195***
	[0.0655]	[0.237]	[0.0652]
Industry*Year Fe	Yes	Yes	Yes
Mean	0.082	0.057	0.039
R^2	0.085	0.064	0.063
N	59805	59805	59805

Table 3: *Credit conditions * debt overhang*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA, and log-growth in assets, capex, and employees. The coefficient of interest is the interaction between debt overhang and tightening lending conditions, as measured by SLOOS statements. Credit tightening is a dummy that takes the value of 1 if loan officers indicate a 10 percent increase in tighter lending standards and remains a 1 until credit standards are relaxed. Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period: 2001 to 2019. Coefficients are scaled by 100 for convenience. We exclude any firm with negative liabilities/EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Change in assets	(2) Change in capex	(3) Change in employees	(4) Change in assets	(5) Change in capex	(6) Change in employees
Liabilities/EBITDA$_{t-1} * Crisis$	-0.259***	-0.732***	-0.0723			
	[0.0799]	[0.269]	[0.0799]			
Liabilities/EBITDA$_{t-1}$	-0.952***	-0.775***	-0.400***			
	[0.0425]	[0.100]	[0.0317]			
Debt/EBITDA$_{t-1} * Crisis$				0.187	-1.928**	-0.349*
				[0.207]	[0.798]	[0.183]
Debt/EBITDA$_{t-1}$				-2.689***	-3.453***	-1.200***
				[0.142]	[0.344]	[0.100]
Fixed Effects	Industry* Year	Industry*Year	Industry * Year	Firm	Firm	Firm
Mean	0.083	0.065	0.041	0.085	0.058	0.043
R^2	0.085	0.064	0.063	0.261	0.115	0.243
N	59805	59805	59805	56181	56181	56181

Table 4: *Crisis (i.e. Great Recession) * debt overhang*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA (columns (1)-(3)) or debt/EBITDA (columns (4)-(6)), and log-growth in assets, capex, and employees for the period just before and just after the Great Recession. The coefficient of interest is the interaction between debt overhang and the crisis-period dummy, which takes the value of 1 in the years 2008 and 2009. Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year (columns (1)-(3)) or firm fixed effects (columns (4) - (6)). Sample period: 2001 to 2019. Coefficients are scaled by 100 for convenience. We exclude any firm with negative liabilities/EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Sample:	Low Leverage			High Leverage		
	(1)	(2)	(3)	(4)	(5)	(6)
	Change in assets	Change in CAPEX	Change in employees	Change in assets	Change in CAPEX	Change in employees
Liabilities/EBITDA$_{t-1}$ * *Tighterlending*	-0.366***	-0.397	-0.155	-0.392***	-1.263***	-0.152
	[0.118]	[0.324]	[0.0972]	[0.111]	[0.265]	[0.0861]
Liabilities/EBITDA$_{t-1}$	-0.777***	-0.540***	-0.337***	-0.938***	-0.780***	-0.376***
	[0.0648]	[0.159]	[0.0511]	[0.0525]	[0.135]	[0.0423]
Industry * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.100	0.073	0.051	0.059	0.023	0.021
R^2	0.074	0.064	0.064	0.123	0.095	0.087
N	31457	31457	31457	34733	34733	34733

Table 5: *High leverage firms*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA, and log-growth in assets, capex, and employees. The coefficient of interest is the interaction between debt overhang and tightening credit conditions. The sample is split into two groups: firms with relatively higher (>mean) leverage (assets/liabilities) in a given industry/year (columns (1), (2), and (3)) vs. less leveraged firms within the same group (columns (4), (5), and (6)). Other controls (lag revenue and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period: 2001 to 2019. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Loan Amount	(2) Interest Rate	(3) Maturity
Liabilities to EBITDA	-0.035***	0.003***	-1.246***
	[0.008]	[0.000]	[0.356]
Loan and Bank Fixed Effects	Yes	Ye	Yes
R^2	0.74	0.37	0.74
N	1420748	1420748	1446011

Table 6: *Loan Conditions and Overhang*

Note: This table shows coefficients of interest that relate loan conditions such as interest rates, loan maturity, and loan size to debt overhang, measured as liabilities relative to cash flow (EBITDA). We exclude firms with negative EBITDA for simplicity, as the coefficients would be inverted. Controls include bank, firm, loan purpose, bank internal risk based on loan rating, loan type, and year*quarter fixed effects as well as firm size controls. Sample period is 2012 to 2020. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Sample:	Loans Renegotiated pre-Crisis			Loans Not Renegotiated		
	(1)	(2)	(3)	(4)	(5)	(6)
	Change in assets	Change in CAPEX	Change in employees	Change in assets	Change in CAPEX	Change in employees
Liabilities/EBITDA$_{t-1} * Crisis$	-1.202***	-4.133***	-0.925***	-1.492***	-4.468***	-1.254***
	[0.265]	[0.916]	[0.169]	[0.199]	[0.814]	[0.175]
Liabilities/EBITDA$_{t-1}$	-0.612**	0.200	-0.0870	-1.165***	-0.826	-0.164
	[0.245]	[0.734]	[0.210]	[0.267]	[0.716]	[0.206]
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.084	0.067	0.029	0.081	0.069	0.033
R^2	0.334	0.160	0.342	0.339	0.177	0.300
N	1915	1915	1915	4068	4068	4068

Table 7: *Renegotiated pre-crisis*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA, and log-growth in assets, capex, and employees. The coefficient of interest is the interaction between debt overhang and a crisis dummy for the the last Great Recession; "crisis", which takes the value of 1 in the years 2008 and 2009. The sample is split into two groups: firms that renegotiated their loans in 2006 or 2007 *early* (i.e. before the loans were within 364 days of coming due) (columns (1), (2), and (3)) vs. firms that did not (columns (4), (5), and (6)). Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period: 2004 to 2010. Coefficients are scaled by 100 for convenience. We exclude any firm with negative liabilities/EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
	Credit line reduced	Credit line reduced
Liabilities/EBITDA$_{t-1}$	0.608***	-0.335***
	[0.177]	[0.0634]
Liabilities/EBITDA$_{t-1} * Crisis$		1.219***
		[0.210]
Fixed Effects	Industry * Yea	Industry * Year
Mean	0.444	0.444
R^2	0.111	0.122
N	4589	4589
Sample period	2004-2010	2004-2010

Table 8: *Credit rationing during the crisis*

Note: This table depicts the relationship between whether a firm sees its credit line reduced (especially during the financial crisis) and debt overhang, as measured by liabilities/EBITDA. Column (1) makes use of the sample period between 2004 and 2010 and lagged liabilities/EBITDA as the key variable. The dependent variable is a dummy that denotes whether the firm experiences a reduction in its credit line in a given year. Column (2) includes the interaction between lagged liabilities/EBITDA and a dummy denoting the crisis period, which takes the value of 1 in the years 2008 and 2009. Other controls (lag revenue and lag assets) are hidden for ease of viewing. Coefficients are scaled by 100 for convenience. We exclude any firm with negative liabilities/EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CL is red.	CL is red.	Change in assets	Change in CAPEX	Change in empl	Change in assets	Change in CAPEX	Change in empl
Bank failure	0.160***	0.131***	-0.0133	-0.0217	-0.0261***	0.0388	0.183	0.0173
	[0.0234]	[0.0260]	[0.00809]	[0.0190]	[0.00476]	[0.0380]	[0.111]	[0.0183]
Liab/EBITDA$_{t-1}$		0.922*				-0.678***	-0.735**	-0.279***
		[0.376]				[0.117]	[0.188]	[0.0455]
Interaction: Bank fail* Liab/EBITDA$_{t-1}$		0.430*				-0.523*	-2.333*	-0.515**
		[0.250]				[0.231]	[1.056]	[0.162]
Industry * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.443	0.444	0.072	0.072	0.072	0.074	0.074	0.074
R^2	0.062	0.069	0.136	0.194	0.142	0.147	0.197	0.149
N	4643	4589	5278	5278	5278	5278	5278	5278

Table 9: *The failure of syndicate members*

Note: This table analyzes the impact of one or more members of a firm's loan syndicate failing during the recession. Column (1) and (2) depicts the relationship between a syndicate member's failure in the previous year and whether a firm experiences a credit line reduction. Columns (3)-(5) correlate log change in assets, capex, and employees to the failure of a bank's syndicate member in the previous year. In columns (6)-(8) we additionally interact the dummy denoting the failure of a syndicate member in the previous year with debt overhang in the previous year. Overhang coefficients are scaled by 100 for convenience. Standard errors are clustered at the firm and year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	2001 to 2020			2001 to 2020			2012 to 2020; EBITDA>0		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Change in assets	Change in capex	Change in employees	Change in assets	Change in capex	Change in employees	Change in assets	Change in capex	Change in employees
High Overhang relative to 2018	-0.074***	-0.153***	-0.033***	-0.046***	-0.109***	-0.015***	0.020***	-0.044***	0.012***
	[0.008]	[0.013]	[0.005]	[0.007]	[0.012]	[0.005]	[0.006]	[0.012]	[0.004]
High Overhang relative to 2018 x Tighter lending				-0.101***	-0.157***	-0.065***			
				[0.018]	[0.031]	[0.011]			
High Overhang relative to 2018 x 2020							-0.037**	-0.039	-0.052***
							[0.016]	[0.033]	[0.014]
Industry*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.069	0.010	0.032	0.069	0.010	0.032	0.082	0.043	0.039
R^2	0.065	0.065	0.057	0.070	0.066	0.060	0.048	0.037	0.049
N	87141	87141	87141	87141	87141	87141	25459	25459	25459

Table 10: *Highest Category of Overhang*

Note: This table analyzes the impact of a firm having historically high levels of debt overhang (i.e. having negative EBITDA or having higher levels of liabilities to EBITDA than firms in the top quartile of overhang in 2018) at any time in the sample on firm growth, measured by changes in assets, capex, and employment. We make use of industry*time fixed effects as well as controls for firm size, mechanical leverage, and EBITDA. Columns (4), (5), and (6) include interactions of high overhang and tighter lending standards. Columns (7), (8), and (9) include interactions of a firm having high debt overhang and the year 2020, and includes only observations between 2012 and 2020 as well as only firms with positive EBITDA. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	2001 to 2020			2001 to 2020			2012 to 2020; EBITDA>0		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Change in assets	Change in capex	Change in employees	Change in assets	Change in capex	Change in employees	Change in assets	Change in capex	Change in employees
Increase to High Overhang relative to 2018	-0.011	-0.057***	-0.016***	0.014	-0.039***	0.002	0.083***	-0.009	0.032***
	[0.007]	[0.012]	[0.005]	[0.009]	[0.013]	[0.005]	[0.012]	[0.020]	[0.008]
Increase to High Overhang relative to 2018 x tighter lending				-0.071***	-0.052**	-0.053***			
				[0.013]	[0.025]	[0.009]			
Increase to High Overhang relative to 2018 x 2020							-0.118***	-0.087*	-0.095***
							[0.018]	[0.049]	[0.016]
Industry*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.069	0.010	0.032	0.069	0.010	0.032	0.082	0.043	0.039
R^2	0.053	0.057	0.053	0.054	0.057	0.054	0.055	0.036	0.051
N	87141	87141	87141	87141	87141	87141	25459	25459	25459

Table 11: *Highest Category of Overhang*

Note: This table analyzes the impact of a firm moving into a historically high levels of debt overhang category (i.e. first transitioning to having levels of liabilities to EBITDA at or above the level of firms that constituted the top quartile of overhang in 2018) on firm growth, measured by changes in assets, capex, and employment. We make use of industry*time fixed effects as well as controls for firm size, leverage, and EBITDA. Columns (4), (5), and (6) include interactions of high overhang and tighter lending standards. Columns (7), (8), and (9) include interactions of a firm having high debt overhang and the year 2020, and includes only observations between 2012 and 2020 as well as only firms with positive EBITDA. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Loan Reduced	(2) Maturity Reduced	(3) Interest Rate Increased	(4) Rating dropped	(5) Borrower dropped by bank	(6) Loan Reduced	(7) Maturity Reduced	(8) Interest Rate Increased	(9) Rating Dropped
Increase to High Overhang relative to 2018	-0.006***	0.017***	0.009***	0.026***	0.121***	-0.007***	0.007***	0.004***	0.119***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Increase to High Overhang relative to 2018 x 2020						0.004	0.085***	0.036***	0.013***
						[0.004]	[0.003]	[0.003]	[0.003]
R^2	0.47	0.22	0.48	0.36	0.49	0.47	0.23	0.48	.49
N	1,420,769	1,446,011	1,446,011	1,446,011	1,446,011	1,420,769	1,446,011	1,446,011	1,44,6011

Table 12: *Credit Rationing to Firms with Rising Overhang*

Note: This table analyzes the impact of a firm moving into the category of having "historically high" levels of debt overhang (i.e. having negative EBITDA or having higher levels of liabilities to EBITDA than firms in the top quartile of overhang in 2018) at any time in the sample on measures of credit rationing immediately afterwards. Measures of credit rationing include whether a loan is reduced, maturity is reduced, the interest rate is increased, the loans bank internal rating is reduced, or the borrower disappears from the sample entirely (because they could not find another stress tested lender to borrow from). Columns (6) to (9) include an interaction with a dummy, denoting whether the year in question is 2020. We are unable to estimate whether a borrower is dropped from the sample, given that 2020 is the final year for which we have data. Standard errors are clustered at the industry*year level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

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Internet Appendix for "The Costs of Corporate Debt Overhang"

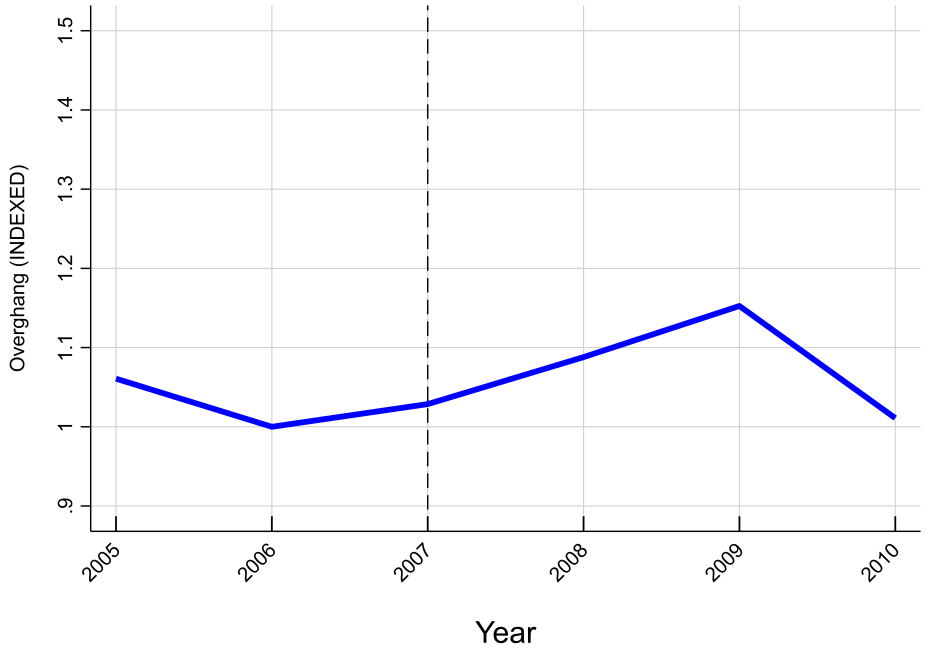

Figure A.1: *This shows the indexed growth in overhang, as measured by liabilities to EBITDA, during the previouscrisis.*

	(1) Log Assets	(2) Log Capex	(3) Log Employees
Log(Liabilities/EBITDA$_{t-1}$)	-0.0799***	-0.242***	-0.0822***
	[0.00533]	[0.0146]	[0.00655]
Log(Liabilities/EBITDA$_{t-1}$) *Tighter Lending Conditions	-0.0187*	-0.0557**	-0.0407***
	[0.0104]	[0.0234]	[0.0100]
Industry * Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Mean	0.085	0.061	0.037
R^2	0.074	0.062	0.062
N	65924	65924	65924

Table A.1: *Debt overhang - Log Levels*

Note: This table depicts the relationship between a firm's debt overhang, as measured by logged liabilities/ebitda, and log assets, capex and employees. Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year and firm fixed effects. Sample period: 2001 to 2019. We exclude any firm with negative Liabilities to EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Change in assets	(2) Change in CAPEX	(3) Change in employees	(4) Change in assets	(5) Change in CAPEX	(6) Change in employees
Negtive EBITDA Firms	-0.110***	-0.195***	-0.0555***	-0.0768***	-0.146***	-0.0387***
	[0.0119]	[0.0206]	[0.00720]	[0.0112]	[0.0183]	[0.00708]
Very High Liabilities to EBITDA	-0.0611***	-0.0827***	-0.00340	-0.0466***	-0.0681***	0.00437
	[0.00700]	[0.0122]	[0.00463]	[0.00738]	[0.0126]	[0.00474]
High Liabilities to EBITDA	-0.0620***	-0.0290***	-0.00103	-0.0549***	-0.0193*	0.00230
	[0.00551]	[0.0108]	[0.00353]	[0.00601]	[0.0111]	[0.00380]
Medium Liabilities to EBITDA	-0.0462***	-0.0150*	-0.000949	-0.0446***	-0.0161*	0.000648
	[0.00432]	[0.00816]	[0.00289]	[0.00469]	[0.00880]	[0.00311]
Negative EBITDA Firms x Tighter Lending				-0.176***	-0.252***	-0.0861***
				[0.0188]	[0.0486]	[0.0137]
Very High Liabilities to EBITDA x Tighter Lending				-0.0786***	-0.0764***	-0.0414***
				[0.0120]	[0.0291]	[0.00823]
High Liabilities to EBITDA x Tighter Lending				-0.0344***	-0.0455*	-0.0158**
				[0.00968]	[0.0270]	[0.00673]
Medium Liabilities to EBITDA x Tighter Lending				-0.00619	0.0130	-0.00733
				[0.00863]	[0.0209]	[0.00694]
Industry * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.100	0.073	0.051	0.059	0.023	0.021
R^2	0.074	0.064	0.064	0.123	0.095	0.087
N	31457	31457	31457	34733	34733	34733

Table A.2: *Stepwise EBITDA to Liabilities*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA, and log-growth in assets, capex and employees. Liabilities to EBITDA are grouped into 4 quartiles for firms with positive liabilities to EBITDA and a separate category for firms with negative liabilities to EBITDA. The coefficient of interest is the interaction between debt overhang and tightening credit conditions. The sample is split into two groups: firms with relatively higher (>mean) leverage (assets/liabilities) in a given industry/year (columns (1), (2), and (3)) vs. less leveraged firms within the same group (columns (4), (5), and (6)). Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period:2001 to 2019. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Sample:	Loans Renegotiated pre-Crisis			Loans Not Renegotiated		
	(1)	(2)	(3)	(4)	(5)	(6)
	Change in assets	Change in CAPEX	Change in employees	Change in assets	Change in CAPEX	Change in employees
Liabilities/EBITDA$_{t-1}$ x Tighter Lending	-0.797***	-3.475***	-0.643***	-1.025***	-3.381***	-0.804***
	[0.178]	[0.585]	[0.147]	[0.142]	[0.555]	[0.130]
Liabilities/EBITDA$_{t-1}$	-0.847***	-0.270	-0.302**	-1.298***	-1.050***	-0.358***
	[0.140]	[0.399]	[0.121]	[0.133]	[0.394]	[0.110]
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.071	0.059	0.025	0.068	0.054	0.028
R^2	0.188	0.081	0.182	0.210	0.085	0.181
N	4402	4402	4402	9008	9008	9008

Table A.3: *Renegotiated pre-crisis*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/ebitda, and log-growth in assets, capex and employees. The coefficient of interest is the interaction between debt overhang and a dummy denoting tighter lending conditions. The sample is split into two groups: Firms that renegotiated their loans *early* i.e. (before the loans were within 364 days of coming due) (columns (1), (2), and (3)) vs. firms that did not (columns (4), (5), and (6).) Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period: 2001 to 2020. Coefficients are scaled by 100 for convenience. We exclude any firm with negative Liabilities to EBITDA as these would invert the interpretation of the coefficient. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Change in assets	(2) Change in CAPEX	(3) Change in employees
EBITDA/Interest	0.00624***	0.00563***	0.00390***
	[0.000584]	[0.00133]	[0.000445]
Fixed Effects	Ind*Year	Ind*Year	Ind*Year
Mean	0.080	0.056	0.033
R^2	0.068	0.064	0.061
N	57062	57062	57062

Table A.4: *EBITDA relative to interest payments*

Note: This table depicts the relationship between a firm's debt overhang, as measured by ebitda relative to interest, and log-growth in assets, capex and employees. Other controls (lag revenue, lag leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period: 2001 to 2019. Coefficients scaled by 100 for convenience. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Av. Spread	(2) Av. Residual Spread
Interaction: liabilities/EBITDA * crisis	6.103***	5.139***
	[1.035]	[0.914]
Liabilities/EBITDA	4.102***	3.268***
	[0.666]	[0.588]
Fixed Effects	Firm	Firm
Mean	168.742	-28.889
R^2	0.754	0.672
N	2639	2637

Table A.5: *All-in-drawn spread*

Note: This table relates the all-in-drawn spread paid by firms on new loans to the firm's lagged debt overhang as well as lagged debt overhang interacted with "crisis period". Crisis period takes the value of 1 for the period between 2007 and 2009 (inclusive). Sample period 2004 - 2009. Only coefficients of interest are depicted for ease of viewing. Hidden controls include revenue, assets, and year effects. Column (1) makes use of average all-in-drawn spread for a firm while column (2) averages a firm's residual all-in-drawn spread after controlling for loan size, loan-type, loan purpose. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively

	(1) Change in assets	(2) Change in CAPEX	(3) Change in employees	(4) Change in assets	(5) Change in CAPEX	(6) Change in employees
Liabilities/EBITDA * Tighter lending	-0.113***	-0.303***	-0.0619	-0.128**	-0.397**	-0.113**
	[0.0424]	[0.115]	[0.0389]	[0.0535]	[0.168]	[0.0488]
Liabilities/EBITDA	-0.448***	-0.371***	-0.168***	-0.503***	-0.558***	-0.223***
	[0.0272]	[0.0701]	[0.0246]	[0.0357]	[0.103]	[0.0294]
Industry * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.067	0.043	0.031	0.116	0.093	0.048
R^2	0.089	0.091	0.074	0.088	0.059	0.066
N	43184	43184	43184	22734	22734	22734

Table A.6: *Debt overhang and Firm Size*

Note: Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/EBITDA, and log-growth in assets, capex and employees. The coefficient of interest is the interaction between debt overhang and tightening credit conditions. The sample is split into two groups: relatively larger firms (>mean) in a given industry/year (columns (1), (2), and (3)) vs. smaller firms within the same group (columns (4), (5), and (6).) Other controls (lag revenue and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period:2001 to 2019. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Change in assets	(2) Change in CAPEX	(3) Change in employees	(4) Change in assets	(5) Change in CAPEX	(6) Change in employees
Liabilities/EBITDA$_{t-1}$ $*$ *Crisis*	-0.0475	-0.688**	-0.00786	-0.444*	-1.066*	-0.0725
	[0.156]	[0.339]	[0.126]	[0.255]	[0.595]	[0.202]
Liabilities/EBITDA$_{t-1}$	-0.701***	-0.466**	-0.300***	-0.448***	-0.305	-0.307***
	[0.0896]	[0.194]	[0.0717]	[0.128]	[0.298]	[0.106]
Industry * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.082	0.075	0.027	0.096	0.079	0.038
R^2	0.150	0.176	0.156	0.216	0.206	0.210
N	4052	4052	4052	1829	1829	1829

Table A.7: *Sample Split: High credit line utilization*

Note: This table depicts the relationship between a firm's debt overhang, as measured by liabilities/ebitda, and log-growth in assets, capex and employees. The coefficient of interest is the interaction between debt overhang and the the last great recession (2008-2009). The sample is split into two groups: Firms with lower (<33%) credit line utilization in 2007 (columns (1), (2), and (3)) vs. firms with higher credit line utilization (columns (4), (5), and (6).) Other controls (lag revenue, lage leverage, and lag assets) are hidden for ease of viewing. The regressions use industry* year fixed effects. Sample period: 2004 to 2010. Coefficients are scaled by 100 for convenience. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Change in assets 07 to 10	(2) Change in CAPEX 07 to 10	(3) Change in Employees 07 to 10	(4) Change in Assets	(5) Change in CAPEX	(6) Change in Employees
Reduced Credit Line 07 to 10	-0.0223***	-0.0320***	-0.00937***			
	[0.00416]	[0.00833]	[0.00329]			
Reduced Credit Line$_{t-1} * crisis$				-0.0399***	-0.0229	-0.0161***
				[0.00752]	[0.0172]	[0.00593]
Reduced Credit Line$_{t-1}$				0.0363***	0.0120	0.0192***
				[0.00532]	[0.0122]	[0.00418]
Fixed Effects	Ind	Ind	Ind	Ind*Year	Ind*Year	Ind*Year
Mean	0.123	0.125	0.117	0.072	0.073	0.067
R^2	0.096	0.093	0.091	0.139	0.185	0.150
N	815	815	815	4441	4441	4441

Table A.8: *The effect of Credit rationing*

Note: This table depicts the relationship between whether a firm sees its credit line reduced (especially during the financial crisis) and growth in the following year(s). Columns (1)-(3) look at the impact of a credit line reduction during and around the crisis period (2007-2010). We make use of one observation per firm. The regressions correlate whether a firm experiences a credit line reduction during the crisis to growth over the same period. Columns (4) -(6) make use of the period between 2004 and 2010 to highlight the difference between the crisis and non-crisis periods. Crisis represents a dummy that takes the value of 1 in the years 2008 and 2009. We relate whether a credit line was reduced in the previous year to changes in our key dependent variables (growth in assets, Capex, and employees). Other controls (lag revenue, lag assets, and lag leverage) are hidden for convenience. Standard errors are clustered at the industry*year level, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.