Does High Leverage Render Businesses Vulnerable to the COVID-19 Shock?*

Falk Bräuning, José L. Fillat, and J. Christina Wang†
Federal Reserve Bank of Boston

November 8, 2021

Abstract

Using supervisory data on bank borrowers, we study how leverage has affected nonfinancial firms' access to bank credit as well as their investment behavior since the COVID-19 outbreak in spring 2020. For small and mid-sized firms (SMEs), high pre-crisis leverage was associated with statistically significant reductions in loan volume from the largest banks after the shock. As importantly, higher pre-crisis leverage lowered the probability during the COVID period that SMEs received the loan from a bank with which they had no prior commercial loans. Likely because bank loans constitute the primary source of debt funding for SMEs, bank lending contraction during COVID coincided with a modest decline in investment for highly levered SMEs, in particular mid-sized firms. In contrast, there is no evidence that high leverage impaired access to bank loans or affected the loan terms for large firms, or deterred their investment, since the COVID outbreak. Our analysis suggests that unprecedented supply of public funding has likely mitigated the impact of high leverage on small firms, while the Federal Reserve's bond purchase programs has done likewise for large firms. By comparison, mid-sized firms may have received less policy support and were thus more adversely affected by higher pre-COVID leverage.

*Prepared for the Federal Reserve Bank of Boston's 65th Economic Conference, "The Implications of High Leverage", November 8-10, 2021. We thank Joe Peek for valuable discussions and comments. Kelly Jackson provided outstanding research assistance. The views expressed here are solely those of the authors and do not reflect the opinions of the Federal Reserve Bank of Boston, or the Federal Reserve System.
†Falk.Brauning@bos.frb.org, Jose.Fillat@bos.frb.org, Christina.Wang@bos.frb.org

Introduction

The COVID-19 outbreak in March 2020 and the drastic containment measures imposed by governments across the globe led to abrupt and severe disruptions of economic activity, as well as considerable uncertainty in credit markets. Firms in some industries, especially those supplying services involving personal proximity, had to substantially curtail operations or even shut down. The survival of those firms, especially the small ones with limited liquidity buffers, was called into question. Firms in many other industries also lost revenue, jeopardizing their solvency. Even prior to the COVID-induced abrupt plummet of income, the nonfinancial business sector already carried a high level of debt relative to earnings by historical standards. The debt accumulation was in large part supported by a period of steady growth and historically low interest rates so that the debt-service burden for nonfinancial businesses appeared quite manageable, at least on average for the sector as a whole.[1]

The COVID-induced precipitous loss of income naturally caused widespread concern that the high leverage would likely amplify the adverse impact of the COVID shock, especially among those firms that entered the crisis with high leverage and were hard hit by the pandemic.[2] The risk of excessive liquidation following bankruptcies is particularly acute for firms that are privately owned, which are mostly small or mid-sized (often referred to as small and medium-sized enterprises, or SMEs), if they defaulted on debt because of the temporary loss of revenue, even if they remain viable over the long run. The well-documented constraints faced by SMEs in accessing external liquidity exacerbates this risk. The resulting deadweight loss could be considerable. Even large firms could suffer from inefficient bankruptcy resolution if the court system became overwhelmed by an influx of cases.[3] Largely owing to the extraordinary government direct support and loan modification programs under the Coronavirus Aid, Relief, and Economic Security (CARES) Act, the anticipated surge in distressed firms has not materialized so far. Nevertheless, short of outright failures, there is still the well-known distortionary effect on real spending from debt overhang. This distortion could render the accommodation from monetary and fiscal policy less effective. Since the onset of the pandemic, many firms, perhaps especially large public firms, have taken on even more debt. It is therefore no surprise that the worry remains that

[1] Figure 1 plots three indicators of leverage for the entire nonfinancial business sector, using data from the Financial Accounts of the United States through 2021:Q1. Although the pre-COVID ratios of debt to capital income and debt to assets were both high by historical standards, nonfinancial businesses' ability to cover interest payments on a flow basis was in fact excellent before the COVID shock, largely due to the historically low level of interest rates.

[2] Throughout the paper, our primary measure of leverage is total debt over EBITDA. We have also explored other measures of indebtedness, such as the interest coverage ratio (ICR), for robustness.

[3] These are the concerns expressed by Greenwood et al. (2020) and Brunnermeier and Krishnamurthy (2020).

the high (or higher) leverage may yet hinder the pace of the recovery.

Though the role of corporate leverage in the transmission of shocks has substantial policy implications, empirical findings about this role are relatively scarce, in part due to the lack of firm-level data for SMEs, which constitute a large fraction of businesses.[4] This paper uses confidential supervisory financial data on nonfinancial business borrowers, most of which are such SMEs, to study if and how pre-COVID leverage has affected firms ability to access credit since the COVID outbreak, potentially exacerbating the adverse impact of the shock.[5] Furthermore, we analyze the effect, if any, of pre-COVID leverage on firms' real activity, investment in particular. We further explore the extent to which the influence of leverage on investment is mediated through its effect on firms' access to additional credit. The quantity and terms of bank loans presumably matter more for SMEs' real activity because they are largely dependent on banks for external financing.

A large body of research, including early seminal work by Gertler and Gilchrist (1994), has shown that small firms face greater financial frictions, which hamper their ability to access the credit needed to smooth cash flow shortfalls. Recent studies (Chodorow-Reich et al. (2021) in particular) show that, when compared with large firms, SMEs are more subject to bank discretion in accessing liquidity, as they are less likely to have lines of credit, face shorter maturities, and routinely utilize higher fractions of such lines. Consistent with the notion that SMEs are effectively constrained in their access to liquidity when facing adverse events, they were less likely to draw on credit lines during the initial COVID outbreak even when lines were available. We complement the analysis of existing credit lines in Chodorow-Reich et al. (2021) by focusing on how the attributes of the SMEs' *new* loan contracts after the COVID outbreak differ from the attributes of their larger peers' COVID-period loan contracts, and the role of leverage in particular.

In contrast, apart from being able to tap into existing credit lines for liquidity upon the COVID-induced abrupt pause of economic activity, large firms were soon able to issue bonds at low interest rates, benefiting from the rapid normalization of the bond market following the Federal Reserve's announcement of two credit facilities authorized to purchase corporate bonds in the primary and the secondary markets. At the same time, survey data indicate that banks tightened their lending standards and terms noticeably. For instance, large banks raised the interest rate spread charged, especially on risky loans. So it appears that the credit market may have bifurcated, with credit conditions quickly easing back to a normal level for large firms but tightening over much of 2020 for the smaller, bank-dependent

[4]Note, however, that there is no standard cross-industry definition of a small or medium-sized enterprise. As we describe below, we mostly identify SMEs as those with revenues of up to $50 million.

[5]These data cover every corporate loan and lease with a committed balance greater than or equal to $1 million.

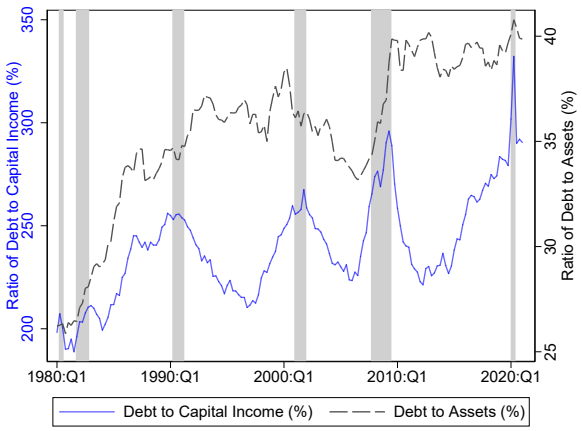
firms. When all these factors are considered, it seems quite likely that leverage may have acted as a greater hindrance to credit access for small firms compared with large firms in the wake of COVID-19. And this detrimental effect may have been more pronounced for those firms in industries that were hit harder by COVID. A focus of our analysis will be to estimate these effects.

Greater difficulty in accessing credit can manifest in more expensive loan rates and non-price terms, tighter lending standards, or both. We thus first examine if higher pre-pandemic leverage reduced the loan amount or increased the spreads on the loans available to a firm after the pandemic shock, or made the requirement for (more) collateral more likely. We also search for evidence that banks tightened lending standards, one important effect of which is to shrink the extensive margins of lending, meaning certain types of borrowers (such as small or risky firms) may have seen their loan share decline or even disappear. This means that among the loans *actually made*, we may observe little or no tightening of terms (such as an increase in spreads), because the borrowers that would have been charged higher prices were no longer receiving any credit.

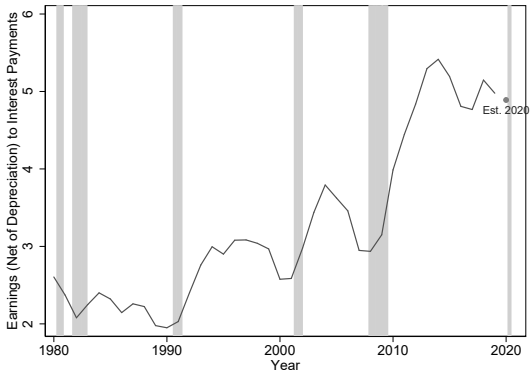
Compared with past downturns, this one is unique in that the short-lived but extremely deep crisis caused by COVID also generated extraordinary public policy responses by both fiscal and monetary policymakers. Recognizing the particular vulnerability of small businesses, policymakers enacted the Paycheck Protection Program (PPP), which issued loans-*cum*-grants to businesses with up to 500 employees. Federal Reserve purchased participations in low-cost loans targeted at small and medium-sized firms through the Main Street Lending Program (MSLP) and purchased corporate bonds through the Primary and the Secondary Market Corporate Credit Facility, which mostly benefited the largest firms. Unlike in previous crises, the public sector directly supported bank lending to a broad swath of nonfinancial businesses, through the PPP and the MSLP.

Firms taking advantage of these programs were severely impacted by the COVID-19 outbreak, as well as by the non-pharmaceutical policy interventions (such as lockdowns and closures) introduced to promote public health. With little to no revenue for weeks, and facing a higher degree of uncertainty regarding the duration and severity of the pandemic, these affected businesses were unlikely to obtain new bank loans to meet their liquidity needs. Thus, public intervention in the credit markets most likely did not crowd out private credit provision, especially during the height of the crisis in spring 2020, and among those SMEs or even large firms deemed more risky (such as due to high pre-COVID leverage). Receiving public funding assistance, particularly if it was a PPP loan that was most likely to be forgiven, should enhance a business' financial health and thus survival probability. And the marginal benefit may be particularly pronounced for small and risky firms. Thus, to the

Figure 1: Indicators of Leverage for Nonfinancial Businesses



(a) Left Scale: Ratio (%) of debt to gross surplus (which approximates earnings before interest and depreciation). Right Scale: Ratio (%) of debt to assets.



(b) Ratio of gross surplus to interest payment, equivalent to interest coverage ratio (ICR); interest payment not yet available for 2020 and estimated using the highest value over the period from 2016 to 2019.

Note: This figure presents three measures of leverage for nonfinancial businesses using data through 2021:Q1 from the Financial Accounts of the United States. Source: Federal Reserve and Haver Analytics.

extent that the firm still had unmet funding needs afterward, such as funding to invest in capital or personnel that would adapt its production process to the COVID environment, it might be able to obtain bank loans again, and possibly at a lower price or more favorable terms than would be implied by its pre-COVID conditions.

The ultimate goal of the public credit support is presumably to minimize the pandemic's deleterious effects on the productive capacity of the economy by enabling firms to not only avoid bankruptcy, but also to retain workers, to invest in new capital, or to take other actions to preserve their long-term enterprise value. It is thus important for us to analyze whether a higher pre-COVID leverage, or credit risk more generally, hampered the recovery of a firm's real activity (specifically investment) after the strict containment policies of the initial intense phase were removed. We also explore the extent to which the recovery of real activity was influenced by a firm's access to bank credit, whether it tapped into any of the public funding programs, and how the two factors interacted. Controlling for the disparate impact of COVID-19 on product demand across industries, we estimate the real effects of the crisis on firms' investment as a function of differences in pre-crisis credit characteristics such as loan type, collateralization, loan-to-value ratio, interest coverage and other covenants, and participation in public funding programs.

To the extent that we find evidence for tighter lending standards and terms for smaller, riskier (but viable before the pandemic) firms, it bolsters the value of the Main Street

Lending Program, which was intended to provide a credit backstop for bank-dependent, middle-market, nonfinancial firms so that they had access to affordable credit in order to weather the pandemic-induced downturn. Such evidence would also provide support for the revisions in the MSLP terms that lowered the minimum loan size to make it feasible or easier for small businesses to access the program.

The remainder of the paper proceeds as follows. Section 1 reviews the related strands of literature to which we contribute. Section 2 uses a simple model to illustrate the likely effect of leverage on firms' access to credit and their incentive to invest in labor and capital in the wake of adverse shocks to firm value, paying special attention to the likely differential impact on SMEs. Section 3 describes the data sets used in this study. The next two sections present results from our empirical analysis. First, Section 4 reports how much leverage affected SMEs' access to bank loans and, among the SME borrowers, the impact of leverage on loan quantity and terms. It also assesses the effect of public credit support programs (the PPP and MSLP specifically) along these dimensions. Next, Section 5 provides estimates of the impact of leverage on firms' capital investment, and the extent to which that impact was exacerbated by the constrained access to bank loans, particularly for SMEs. Section 6 summarizes our findings and discusses the policy implications.

1 Related Literature

There is an extensive body of research studying the impact of debt and the associated financial frictions for businesses' growth prospects, cyclical fluctuations, sensitivity to shocks, and survival. In this section, we review some selected studies that are most closely related to our analysis; this is not meant to be a comprehensive survey of the literature. Early studies (see Myers 1977, in particular) recognized that firms choice of debt versus equity affects incentives for real activity, and too high a stock of debt relative to equity would lead to a "debt overhang" problem whereupon equityholders become less inclined to take any action, such as investing or retaining workers, when the resulting benefits would accrue mainly to debt holders. This distortion arises as a result of shareholder optimization, even in the absence of financing constraints.[6] Hennessy et al. (2007) develop and estimate a model of investment under debt overhang when financing frictions are present, showing that the partial effect of expectations of future constraints is, in fact, to induce firms to accumulate more capital now.

In a recent study, Brunnermeier and Krishnamurthy (2020) use a simple model to illustrate how debt overhang could distort firm behavior in the aftermath of the COVID shock,

[6]The logic is further illuminated and tested in Hennessy (2004).

leading firms to cut back on spending that maintains franchise value (such as maintaining employment and capital) and to postpone filing for bankruptcy longer than is socially optimal. Blickle and Santos (2021) estimate that firms with high total liabilities relative to cash flow experience slower growth of assets, capital expenditures and employment, especially when a firm faces credit supply constraints.[7] We contribute new empirical evidence for understanding how firm investment after an adverse shock depends on their existing leverage.

Apart from directly distorting a nonfinancial firm's operating decisions, high leverage, and hence the heavy reliance on external finance, also renders firms more vulnerable to disruptions to credit supply. Credit conditions can tighten following a negative shock that impairs financial intermediaries' equity capital. The 2008 global financial crisis (GFC) was just such an episode, characterized by severe damage to intermediaries' capital due to declines in house prices and in turn the collapse of the subprime mortgage market. The resulting contraction in credit supply caused even some large public firms to curtail employment and investment if they had to seek debt funding. Almeida et al. (2012) show that firms with long-term bonds maturing at the peak of the GFC in late 2008 cut investment significantly more than those with bonds maturing afterward. Furthermore, Duchin et al. (2010) find that, following the onset of the GFC, investment declined more for firms that had low cash reserves or high net short-term debt, were financially constrained, or operated in industries dependent on external finance. Kalemli-Özcan et al. (2018) quantify how much of the sluggish post-crisis investment by European firms can be attributed to high leverage, versus the credit constraints due to banks weakened by the sovereign default risk, versus weak aggregate demand. They find debt overhang responsible for 40 percent of the cumulative decline over four years. Chodorow-Reich (2013) presents evidence that supply-side credit constraints can also curb employment: firms with prior relationships with banks that were more damaged by Lehman's bankruptcy reduced employment more than firms with relationships with healthier banks. Focusing more specifically on SMEs, Bord et al. (2021) find that the supply shock to bank small business loans crimped the birth of new firms and hurt the growth of firms with fewer than 20 employees.[8]

It has long been established that borrowing constraints are more likely to be binding for small firms, most of which rely on bank loans for external financing. The debt-based propagation mechanism, partly intermediated through banks, thus operates more prominently on small firms. Gertler and Gilchrist (1994) show that small firms account for a dispropor-

[7]This paper studies only public firms, in part because financial statements and data on loans were available for these firms through the financial crisis and Great Recession.

[8]Greenstone et al. (2020), on the other hand, find that contraction in banks' small business lending exerted no significant negative impact on employment at local small businesses.

tionate share of the manufacturing decline and inventory slowdown that follows monetary policy tightening. More recently, using Y-14Q data, Chodorow-Reich et al. (2021) find that, compared with large firms, small firms are less likely to have committed lines of credit, face shorter maturities on such lines, post more collateral, have higher utilization rates, and pay higher spreads. Consistent with the hypothesis that SMEs are subject to greater lender discretion, SMEs are found to be less likely to draw down on available lines when they faced the same abrupt disruption of revenues as large firms when COVID-induced lockdown measures were put in place. PPP recipients reduced non-PPP loan balances, indicating the program alleviated SME recipients' liquidity shortfall. Similarly, Greenwald et al. (2021) use Y-14Q data to document that bank loan volume rises following adverse shocks (COVID and monetary tightening) because large firms are able to tap into their existing credit lines. This liquidity to large firms, however, seems to come at a cost to small firms as their access to bank term loans became somewhat constrained when a bank experienced large drawdowns on its credit lines.

Our subsequent analysis will complement the analysis in these two studies, which mostly examine the behavior of pre-existing credit lines to large versus small firms, as we focus on the *new* loan contracts after the aggregate adverse shock of COVID-19. Given the evidence provided by Chodorow-Reich et al. (2021) that SMEs were more constrained in accessing liquidity through existing credit lines when COVID hit, and that over 80 percent of loans outstanding in 2019:Q4 to firms with up to $50 million in assets were immediately callable or maturing sometime in 2020, our prior is that the refinancing need in 2020 would be more relevant for SMEs, should the PPP funding prove inadequate. Absent the PPP, intuition suggests that SMEs would also face more constraints in seeking new bank loans. However, the subsidy from a most likely to be forgiven PPP loan should improve a firm's prospects and reduce its credit risk than otherwise. The net outcome of new bank loans to SMEs therefore becomes more an empirical question. Moreover, we pay close attention to the role of borrower leverage, including how the effect of leverage may differ for large versus small firms. Ultimately, our interest lies in understanding the effect, if any, of credit constraints on real activity, specifically investment. The quantity and terms of bank loans presumably matter more for SMEs' real activity because they are much more dependent on banks for external financing.

In addition, we examine if and how the pattern of collateral has changed, especially for SMEs, after the COVID outbreak. The importance of collateral in facilitating SME borrowing is highlighted by Caglio et al. (2021), who use Y-14Q data to document that essentially all bank loans to private firms, most of which are SMEs, are secured by some form of collateral, the most important types being accounts receivable & inventory, and

blanket liens. The common property uniting these types of collateral is that they are all created intrinsically as a result of a firm's operations, that is, embedded in its value as a going concern instead of tied to an asset (such as equipment or real estate) with independent value even without the firm's operations. Given the unusual nature of the COVID shock, which disrupted many firms' operations and their ability to create cash flows, it should be particularly informative to examine if and how the requirement for these continuation-value-based collateral changed after the COVID outbreak, and in turn how it has affected the quantity and price of bank loans made to SMEs.

The nature of this downturn induced by COVID-19 is noticeably different from the Great Recession following the GFC. The collapse of economic activity in March and April 2020 was largely the result of policy mandates for the sake of public health, causing a brief but drastic pause in an otherwise sound economy. Banks, especially the systemically important ones, were generally in fine health, well capitalized and holding adequate liquidity prior to the viral outbreak, in part owing to enhanced regulation after the GFC. As we will show, there is indeed little evidence of credit market disturbances due to COVID-19 being further propagated through the banking sector. We therefore focus more on analyzing how the degree of leverage on nonfinancial firms' balance sheets has affected their reaction thus far to the COVID shock. Specifically, we study the investment behavior of small businesses after the initial COVID shock, accounting for the cross-industry heterogeneity of the intrinsic severity of the shock, and how the investment outcome may have been influenced by new originations of small business loans. Our analysis thus should further help understand if, and how, leverage renders small firms more vulnerable to real and financial shocks jointly.

Several studies are closely related to our analysis in that they also recognize the potential threat posed by high leverage and seek to estimate the magnitude of the hazard. Ding et al. (2021) and Alfaro et al. (2020), for instance, find that higher leverage was associated with steeper stock price declines early on in the COVID outbreak. This suggests that investors expected leverage to hamper a firm's ability to weather the shock. Similarly, Fahlenbrach et al. (2020) find that firms with greater financial flexibility (chiefly less debt or more cash) experienced milder stock price declines. Kovner et al. (2020) project that highly levered firms face a higher risk of becoming insolvent than their less-levered peers because their debt repayment obligations constitute additional fixed costs that their COVID-induced diminished income might not be able to cover. Data for public firms through 2020 show that highly levered sectors experienced much greater decline in cash flows than the reduction in interest expenses. By relying on stock prices and public filings, these studies can analyze only large firms. Our study, in contrast, seeks to estimate the impact of COVID on the numerous private and small firms, by utilizing a data source that covers a large share of such firms.

Our study also joins a growing body of research, in addition to the papers referenced above, that uses the Y-14Q data to answer a range of questions concerning bank behavior, including bank lending and its broader impact on the economy. For example, Luck and Santos (2019) show that collateral lowers the interest rate spread paid by borrowers, especially for the riskier and smaller firms. Caglio et al. (2019) find that banks generally do not use credit default swaps (CDS) to lay off credit exposure to corporate borrowers, nor do they find evidence that banks' use of CDS interferes with their incentive to monitor the borrowers. Luck and Zimmermann (2020) estimate that the Federal Reserve's quantitative easing raised employment and investment via a bank lending channel. Bidder et al. (2017) examine how banks adjust their portfolio of loans and securities after an adverse shock—the oil price collapse in 2014. Niepmann and Schmidt-Eisenlohr (2018) document that banks reduce loan supply to nonfinancial firms when the US dollar appreciates because of outflows from bank loan mutual funds, which have become an important source of funding for corporate loans after the financial crisis. Ivanov and Whited (2021) estimate that tax cuts in fact lead to an increase in leverage because the decline in default probability outweighs the loss of tax shield.

Even though in this study we focus on analyzing the effect of high leverage on individual firms, especially small and private firms, it is worth noting that such firm-level impacts would be expected to aggregate up to the economy level.[9] Lamont (1995) shows that debt overhang bites more in downturns, possibly creating multiple expectational equilibria. A number of important macroeconomic studies further develop a framework for understanding the implications of corporate leverage for aggregate growth and stability. Kiyotaki and Moore (1997) show that more indebted firms are likely to invest less after a negative shock causes collateral to lose value, which tightens the constraint on how much credit firms can access. This lowers firm output next period, further reducing their net worth and overall investment. This feedback loop through borrowing secured by assets can amplify the initial impact of temporary negative shocks. A series of papers, from Bernanke and Gertler (1989) to Bernanke et al. (1999), demonstrate that such a feedback dynamic due to the agency cost of debt can amplify business-cycle fluctuations considerably.

[9]There are likely further general equilibrium effects, such as the multiplier of income loss due to layoffs reducing aggregate demand.

2 A Simple Model of Debt Overhang, Credit Access and Investment

This section adapts the model in Brunnermeier and Krishnamurthy (2020) to serve as the framework for organizing our analysis. This model highlights the problem of debt overhang—how it can lead to inefficient spending (such as capital investment and worker retention) when a firm is too heavily indebted, even when it faces no credit constraints. We pay special attention to the distinction between large and small firms, with firm size serving as a proxy for firms' access to external funding markets since firms that can readily access the corporate bond or stock markets tend to be much larger than firms that have access only to bank loans. The model will make clear that higher leverage is more likely to adversely affect small firms' real activity in the wake of a negative shock by impairing their ability to obtain additional credit from private lenders. If government intervention alleviates this constraint, then higher leverage does not necessarily distort investment in small firms more than in large firms, even if small firms receive less new private credit than large firms.

To focus on studying the impact of a likely temporary shock, we include two dates in the model, $t = 1$ and $t = 2$. A firm needs additional funding, beyond its available cash holdings, to maintain operations that will generate surplus in the future, $t = 2$. The firm has cash holdings of a, and a gross expenditure need, e, to produce its output. The net funding need is $e - a$ if the firm chooses to use internal funds first. If the firm decides to spend and produce, the future surplus is eR, with R denoting the gross rate of return of the new expenditure. For simplicity, we assume that the return R is certain, and $R > r$, with r denoting the gross risk-free interest rate.[10]

The firm's existing assets will have a stochastic value of $\tilde{A}$ at $t = 2$, with cumulative distribution function $F(\tilde{A})$. If the shock is structural and changes the value of the firm's existing assets, then $\tilde{A}$ can be construed as the post-shock value. For example, COVID raised the value of e-commerce-centric Amazon while devastating brick-and-mortar retailers. We assume that the firm's outstanding debt requires a gross payment of D in $t = 2$. The probability that $\tilde{A} < D$ is denoted δ; δ is the default probability in the absence of additional borrowing, or approximates it if only a sufficiently small amount of debt is added.[11] This implies that, for given D, a negative (positive) structural shock to $\tilde{A}$ increases (decreases) the firm's default probability, and thus is equivalent to raising (lowering) its leverage. In

[10] We will briefly discuss later in a simple extension where the return on e is risky, and the firm has a choice among multiple new projects. Then a highly levered firm would prefer more risky projects to safer ones, even when a safer project yields a higher certainty-equivalent return if more of that return accrues to bondholders.

[11] By the same logic, cash holding a is assumed to be sufficiently small and thus has negligible effect on δ.

a realistic setting where corporate bonds on average have a remaining time to maturity of five years or more, δ over a short duration relevant for a temporary shock is more likely to depend on the firm's cash flow generated by $\tilde{A}$ versus the contractual interest payment on D, assuming the debt does not need to be rolled over during that time frame.[12]

Our setup so far means the firm is subject to a classic debt overhang problem, as illuminated in Myers (1977). High leverage leads firms to under-spend on value-enhancing projects. Some concrete examples of such spending are compensation needed to retain workers, worker training needed to keep up with technical advances, and outlays to maintain production facilities open. It also covers investment needed to replace old capital that is rendered obsolete when a negative shock impairs a firm's ability to produce using the existing technology and capital. For example, in the wake of COVID, many firms had to install better air filtration systems, or equip workers with additional hardware and software to effectively work from home, or develop e-commerce capabilities to continue fulfilling customer orders. It is conceivable that such transformational investment is more necessary for those firms whose mode of operation is disrupted structurally by the pandemic.

Note that, if some components of such spending affect a firm's productivity in a post-COVID world for several years or more, then the payoff R can at least partially offset the impairment to $\tilde{A}$ from the shock. In other words, a negative structural shock to a firm can generates two countervailing effects: it depresses $\tilde{A}$ while at the same time probably boosts R. The essence of the assumption $R > r$ is that at the margin, the spending e carries a positive net present value. A higher R can be construed as a simple way in our setup to represent the idea that new investment e will have a longer-lasting boost to the firm's post-shock productivity. As noted above, it is possible that R is especially high (relative to $\tilde{A}$) for firms severely impacted by COVID. Then the trade-off becomes whether R is sufficiently large to overcome the debt overhang (inclusive of the effective increase in leverage stemming from the damage to $\tilde{A}$).

2.1 A Large Firm's Optimization Problem

Now assume this firm is a large public firm that can issue a corporate bond to fund the expenditure e. Investors charge the firm a gross interest rate of $\gamma \geq r$ to purchase the bond. If the firm issues the bond and spends the funds, the value of the firms equity becomes:

$$V_E = \frac{1}{r}(1-\delta)(\bar{A} - D + eR - (e-a')\gamma + (a-a')r), \tag{1}$$

[12]In other words, metrics such as the interest coverage ratio, which measures a firm's ability to service its debt on a flow basis, may be more relevant than a stock-based measure of indebtedness over a brief period.

where a' is the amount of cash used to fund the expenditure, with $a' \leq a$; $\bar{A} = \mathbb{E}[\tilde{A}|\tilde{A} \geq D]$ denotes the mean value of existing assets $\tilde{A}$ conditional on the firm staying solvent.[13] Note that here we abstract from the pricing of default risk by risk-averse bond investors; alternatively, δ and $\bar{A}$ can be thought of as the default probability and mean asset value of a solvent firm defined under the risk-neutral measure instead of the natural measure.

Implicitly embedded in Equation 1 is the assumption that the opportunity cost of cash is simply r in this two-period model. In a dynamic setting, the shadow value of cash may exceed r if the firm expects borrowing constraints to bind in the future. Furthermore, if we allow shareholders to pay out the cash as dividend, then too much D relative to $\underline{A}$ will induce shareholders to pay out internal funds instead of using it to finance the expenditure, as will be made clear.

If we assume the firm's compensation scheme fully aligns managers' incentives with those of the shareholders so that managers maximize the value of equity, several observations follow readily. As long as $\gamma > r$, the firm should use up all the internal funds first, that is, $a' = a$.[14] Then the net payoff from the investment e becomes $eR - (e-a)\gamma$, and it is undertaken so long as $eR \geq (e-a)\gamma$. This is clearly satisfied if $R > \gamma$ since $a \geq 0$.

γ is determined by bond investors' breakeven condition. Assuming the new bond is pari passu with the existing bond, and the amount of new borrowing is sufficiently small, then the zero-profit condition implies:

$$(1-\delta)\gamma e_N + \delta \frac{\gamma e_N}{D + \gamma e_N}(\underline{A} + eR) = re_N, \tag{2}$$

where $e_N \equiv e - a$ denotes the net funding that needs to be raised through the bond issue, and we substitute in the result that the firm first uses all available intern funds; $\underline{A} = \mathbb{E}[\tilde{A}|\tilde{A} < D]$ is the mean value of existing assets conditional on the firm being in default.[15]

If we further simplify and take e_N, already assumed to be small, to the limit of zero, then the interest rate on the new bond can be expressed as:

$$\gamma = \frac{r}{(1-\delta) + \delta \underline{A}/D} \tag{3}$$

$\gamma - r$ is the credit spread on the firm's new bond. A firm with no default risk (that is, $\delta = 0$,

[13] $(1-\delta)\bar{A} = \int_D^\infty \tilde{A} dF(\tilde{A})$.

[14] This is in keeping with the pecking order theory of capital structure. It holds even if the firm uses the natural measure, instead of the risk-neutral measure, of default probability to compute the expected payoff because it is the same probability used for the cost-benefit comparison.

[15] The implicit rate of return on existing assets $\tilde{A}$ implied by $\delta\underline{A} + (1-\delta)\bar{A}$ here is allowed to be uncorrelated with the marginal return R on the new investment, which is a reasonable assumption in the event of a major aggregate shock. Otherwise, R is likely to be correlated with the average return on $\tilde{A}$.

equivalent to $min(\tilde{A}) >= D$ in the setup so far) has a zero credit spread.

It follows that the higher a firm's probability of default, the higher the rate γ the firm has to pay on the new debt, since $\frac{\partial \gamma}{\partial \delta} \geq 0$. For any given distribution of $\tilde{A}$, the higher the existing debt D, the higher the probability of default δ. More generally, lower profitability (lower EBITDA) relative to interest payments (that is, a lower interest coverage ratio) also raises the firm's δ. This can encompass the case where the firm's cash flow is structurally impaired because its old mode of operation is no longer feasible due to COVID. A higher δ then leads to a higher rate γ. Since the condition for the firm to undertake the investment is $R \geq (e-a)\gamma/e$, the higher the γ, the less likely the firm is to carry out the value-enhancing spending. This is the debt overhang problem à la Myers (1977), as firms with higher existing debt face a higher probability of default, higher costs of new funds, and less likely to invest in new, profitable projects.

As discussed above, following a structural shock, the effective γ can become elevated even with moderate pre-shock D if a firm's existing assets' earning power is impaired by the shock. Obviously, a higher existing debt D exacerbates the problem, raising the odds of $R < \gamma$ so that the firm foregoes the positive-net-value investment. If the amount of spending needed is nontrivial, which may be more likely in response to a structural shock, it also aggravates the overhang problem. This is because then the default probability δ will depend on not only $\underline{A}$, but also the new debt. For given R on the new spending, the more the firm borrows, the higher the default probability and thus the higher γ. On the other hand, R is also more likely to be high following an adverse structural shock since the investment e will tend to enhance the firm's post-shock long-term productivity. The outcome thus depends on the shock's relative impact on R versus γ. This logic reveals an additional channel through which the Federal Reserve's bond purchase programs, or even better direct funding, can be extremely valuable to the real economy following a structural shock that damages some businesses' productivity and raises their default probability: by lowering the risk premium and thus the cost of debt (γ), the government reduces the expected deadweight loss due to debt overhang.[16]

High existing debt D also makes it more tempting for shareholders to pay out cash as dividends today instead of using it to fund the new investment. For any amount o that can be paid out today, investing it will raise the equity value by $\frac{oR(1-\delta)}{r}$. So shareholders will choose to pay out o as long as $1-\delta < r/R$, or $\delta > 1 - r/R$.[17] This will make the firm more

[16]The more precise such public funding can be targeted, the better its ability to counter debt overhang. Otherwise, firms may hoard too much of the injected funds in liquid assets or even pay out to shareholders.

[17]Compared with the condition above determining whether the firm will invest, it is clear that if the firm chooses not to pay out the internal funds today, it will definitely invest. If $\frac{r}{(1-\delta)} > R > \gamma e^N/e$, the firm will rather pay dividend than invest.

risky than otherwise, which is another effect of debt overhang.

2.2 A Small Firm's Optimization Problem

Now consider the same spending problem for a small firm. We model the key distinction between a large and a small firm to be whether it faces a borrowing constraint. As described in the above literature review section, it has long been recognized that small firms face more frictions in accessing external finance. The cause is generally modeled as lenders having to overcome greater information asymmetry (adverse selection or moral hazard, or both), or a worse agency problem (misaligned incentive between outside debtholders and the owner/manager) when lending to small firms. One consequence is that small firms can borrow only from intermediaries, chiefly banks, which conduct screening and monitoring of the borrowers, to minimize the asymmetric information problem. Mechanisms such as borrowing constraints, which limit the amount a small firm can borrow to no more than a certain multiple of its owner's net worth (or equivalently a fraction of the firm's asset value, with the assets serving as collateral), are employed to mitigate the agency problem.

Several forms of loan covenants can be viewed through this lens. According to Greenwald (2019), interest coverage covenants are prevalent in loan contracts, along with a ceiling on debt balance over earnings. As would be expected, Greenwald (2019) shows that, during periods of low interest rate, debt-over-earnings covenants are more likely to be binding than the interest coverage covenants. This may help explain our findings using different indicators of indebtedness: debt-over-earnings seems to exhibit a more consistent pattern than the interest coverage ratio (ICR) measure. More generally, the presence of earnings-based covenants is likely to trigger widespread technical defaults on loan contracts in the wake of a shock, such as COVID-19, that hinders some firms' ability to generate sales or even halts revenue inflow entirely. If not alleviated through temporary suspension of the enforcement of covenants by lenders on a large scale, the covenants per se could have a significantly disruptive impact on the operations of borrower firms.

We follow the above structure and model the borrowing constraint on a small firm as based on asset value. Specifically, we assume a small firm's owner is endowed with starting wealth (net worth) N and can borrow D from banks to buy capital K, which serves as collateral for D. The liquidation value of K is θK, and the borrowing constraint is thus set as $D \leq \theta K$, and the firm pays a gross interest rate of γ on the loan. Assume the gross rate of return on K is R in steady state, and $R > \gamma$, then the firm will borrow as much as possible, and its balance-sheet identity implies:

$$K = N + D, D = \theta K \quad \Longrightarrow \quad K = N/(1-\theta) \tag{4}$$

If the firm expects to run at this scale forever, then the (private) value of the firm to the owner is

$$V_E = N\frac{R-\gamma\theta}{r(1-\theta)} \tag{5}$$

Now assume a negative shock, such as the pandemic shock causes the cash flow process to become $\tilde{R}_1$ with CDF $F(\tilde{R}_1)$, so that the default probability becomes $F(\gamma D)$. Once the firm defaults, the bank will take over, sell the capital and receive θK. So the deadweight loss to society is $V_E - \theta K$, since the firm is more efficiently operated by the owner/manager. Now further assume that the liquidation value is also reduced by the shock, and that the shock especially elevates downside risk so that in the worst case scenario the bank receives only $\underline{\theta}K$ from selling the capital, with $\underline{\theta} < \theta$. This can lead to a credit constraint on the firm even without it defaulting on the existing loan contract if its loan comes due and has to be renewed, because the bank will want to tighten the borrowing limit down to $\underline{\theta}K$. This probability is higher for small firms because they tend to have loan contracts with shorter maturities (Chodorow-Reich et al. (2021)). This constraint can be mitigated to some extent if the firm has unpledged assets that can be tapped as collateral to minimize the reduction in loan balance, despite the lower limit $\underline{\theta}K$. A policy measure of granting loan extension upon borrower request can also alleviate the problem.

Even if the adverse shock does not directly diminish the fundamental value of firm i, it can still be subject to credit constraints if defaults by other firms impair the bank's capital and hence its risk-bearing capacity, or if the resale value of assets serving as collateral deviates from the fundamentals because the secondary market suffers from a fire sale or excess supply. These factors were the main culprits during and after the 2008 financial crisis, but have been largely absent during the COVID-19 episode because banks were well capitalized prior to the outbreak.

If the credit tightening is sufficiently severe, it could in fact precipitate default if the firm cannot find enough internal liquidity to cover the gap between the smaller new loan and the larger repayment needed on the old loan. Sources of internal funds include cash flow from operations (net income, non-cash expenses, and change in working capital), additional cost cutting, or cash reserves. Given that most small firms have little cash on hand, they most likely have to resort to diverting depreciation, cutting back on working capital, or even employment.[18] This implies that, even if the firm can scrounge enough internal funds to cover the shortfall, the credit constraint will likely damage the firm's long-term value because the funds diverted to loan repayment would have had more productive uses, such as to maintain capital or retain workers.

[18] According to Bartik et al. (2020), among firms in the survey, the median of cash on hand covers 5.3 months of expenses.

Even if the firm has no loans maturing in the near term after the adverse shock hits, the owner/manager's desire to preserve enterprise value by lowering the default risk will likely still lead to value-destroying resource allocations, because the value of liquidity is high for a typical small firm in the wake of a negative shock. Suppose the firm cuts back on necessary (but not critical) maintenance, suspends worker training, or even lays off some employees, so that it raises $\tilde{R}_1$ by e, but at the cost of lowering revenue at $t = 2$ by e. This reduction in today's default probability raises the enterprise value by $V_E f(\gamma D)e$, compared with a present value of future revenue loss equal to $(1 - F(\gamma D)e)/r$. It is clear that the gain is proportional to the stock of enterprise value, whereas the loss is proportional to the flow of revenue, and this suggests that many small firms would be willing to cut expenses today by a nontrivial margin to preserve V_E.[19]

The high market value of liquidity for small businesses provides a clear rationale for policy measures that help preserve borrower liquidity. For example, lender forbearance in the form of temporary postponement of partial or all loan repayment can alleviate the liquidity demand. Supply of funding by the public sector at low or no cost, such as through the Paycheck Protection Program, to cover at least part of the small businesses' credit demand should also mitigate, or even eliminate, the deadweight loss if some small firms were to go bankrupt, or the damage to their enterprise values that would have been inflicted by credit constraints had these firms needed to seek credit with private lenders.

Public funding support becomes even more important if the revenue loss due to the adverse shock turns out to persist for a period, since the more substantial cumulative loss of income means that the borrowers need debt relief beyond the temporary delay of private debt repayment. This argument applies to COVID-19, as the pandemic has lingered much longer than initially anticipated, especially for firms in some industries and regions.

3 Data Description

3.1 Data Sources

The primary data source for this study is the financial information on borrowers reported in the supervisory FR Y-14Q (henceforth Y-14) Commercial and Industrial Loan (C&I) dataset, because it enables us to analyze not only public firms but also a large number of private, and often small, firms. Banks with more than $100 billion in total consolidated assets are subject to the mandated Dodd-Frank Act Stress Tests (DFAST), and are required

[19] Here, the assumption is that today's cost cutting is by and large marginal and thus will only lower future revenue temporarily. If the cost cutting is too deep, it can inflict longer lasting damage on the enterprise value.

to report facility-level information on corporate loans and leases on a quarterly basis to the Federal Reserve.[20] Specifically, reporting of the Y-14 C&I schedule started in 2012:Q2, covering corporate loans and leases with a committed balance greater than or equal to $1 million. These data include detailed facility-level information such as type of loan, interest rate, and maturity, among others. More importantly, they also cover balance sheet and income statement information for the borrowers, irrespective of borrower size or ownership status.[21]

Borrowers covered in the Y-14 data span a wide range of the firm-size distribution, and most are small and mid-sized private businesses. In contrast, most previous studies of firm financing and investment relied largely on Compustat data of financial statements of public firms filed with the Securities and Exchange Commission (SEC), along with Dealscan data of individual loan attributes. These data thus cover only public firms, and their borrowing from banks is dominated by the largest loans. While they represent most of the bank credit volume, the sample of firms in Compustat leaves out an important segment of the firm-size distribution, and thus cannot be used to study small or even mid-sized firms, many of which rely on bank loans as a primary source of external funding. The Y-14 dataset thus is necessary for the purpose of this study: to understand the effects of leverage on the access to credit and real activity for firms across the size distribution, especially those small- to mid-sized private businesses, which generally do not have access to market finance.

For our analysis, we further restrict our sample to only nonfinancial firms (that is, excluding firms with 2-digit NAICS industry code of 52), in order to focus on investigating how a high pre-COVID leverage ratio has affected credit access and real activity of nonfinancial firms since the pandemic started.

4 Bank Lending since COVID-19 Outbreak: The Role of Firm Leverage

4.1 Intensive and Extensive Margins of Bank Lending during COVID

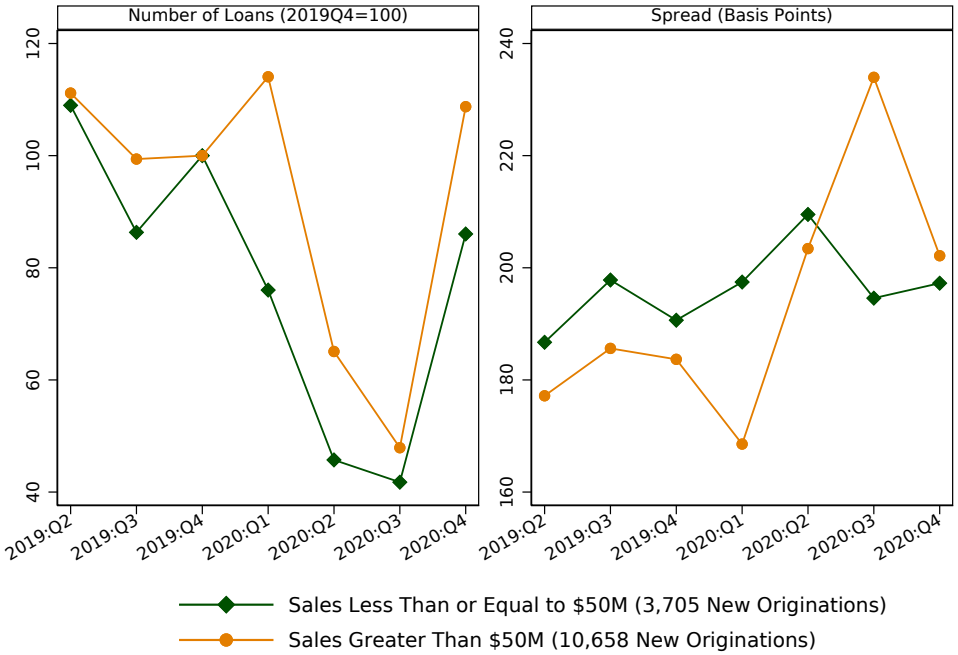
As noted above, the COVID-19 outbreak and the drastic containment measures in response caused an abrupt plummet in sales and income for many firms. A given degree of income loss

[20] "Banks" here is a shorthand for large bank holding companies (BHCs) domiciled in the US and foreign-owned intermediate holding companies (IHCs) with substantial presence in the US that are subject to the DFAST.

[21] The reported data are confidential supervisory information, but the Y-14 reporting form and instructions, including the list of variables collected by the Federal Reserve, are publicly available at `https://www.federalreserve.gov/apps/reportforms/Default.aspx`.

may be mostly an inconvenience for a lightly levered firm, especially if it had a pre-existing credit line to tap into, but can spell disaster for a firm already highly levered. Ordinarily, credit conditions would be expected to tighten more for firms that entered the COVID crisis with relatively high leverage ratios, even accounting for the damage to their fundamentals inflicted by COVID. Moreover, previous studies have found that small firms, which rely predominantly on bank loans for funding, are more likely to face greater constraints on credit availability and credit terms following a downturn.

Figure 2: All New Originations, 2019:Q2—2020:Q4



We thus start our analysis with an empirical examination of the behavior of bank lending since the onset of COVID to address the following questions: 1) Did lending conditions evolve differently for firms with different "pre-conditions," especially their pre-pandemic leverage, controlling for the damage to a firm's fundamentals brought on by COVID? 2) Did higher pre-existing leverage lead to more severe tightening of bank lending standards and terms for SMEs than for large firms?

Figure 2 depicts the number (indexed to 100 in 2019:Q4) of newly originated bank loans to small versus large firms by Y-14 banks, along with the respective average spread (over LIBOR) of those loans. It shows a clear decline in new originations over the first three quarters in 2020, bottoming in 2020:Q3 by nearly 40 percent. The reduction is more pronounced for small firms (those with sales up to $50 million) than the larger firms. The contrast was

especially stark in 2020:Q1: new loan originations in fact rose by over 10 percent for the large firms, but fell by a little over 20 percent for the small firms. New originations rebounded in 2020:Q4 (the latest data point in our analysis), more for large than for small firms. We observe the opposite pattern for interest rate spreads in 2020:Q1: the average spread fell by close to 20 basis points for large firms but rose (albeit only by close to 10 basis points) for small firms. Spreads then rose by a sizable margin (cumulatively by close to 50 basis points, or nearly 30 percent) for large firms over the next two quarters, before retreating in 2020:Q4. Spreads for small firms returned to pre-pandemic levels a quarter earlier than large firms' spreads. Taken together, the disparate patterns of quantity and spread for large versus small firms suggest there might have been (more) supply constraints on small firms as well as a selection in the group of small firms that were able to obtain new credit in the second half of 2020.

We next explore if and how credit conditions over the pandemic have evolved differently for firms depending on their leverage. Figure 3 depicts the range of leverage among Y-14 borrowers since 2012:Q4, along with the more detailed distribution of leverage at the end of last two years.[22] The range of leverage had been fairly stable until 2019, with a median hovering around 2, with the 75th and 90th percentiles reaching above 5 and 10, respectively. A noticeable increase in the entire range, especially the upper quantiles, is only observed for 2020:Q4. This is confirmed in the histograms in the bottom two panels, comparing the distributions in 2019:Q4 versus 2020:Q4 among small and large firms, respectively. The histograms also reveal that the entire distribution of leverage is shifted toward the higher end for large firms when compared with small firms.

Figure 4 then presents the evolution of the number of new loan originations and the interest rate spread of these new loans among the small firms, distinguished by leverage ratio below versus above the median. Unconditionally, loan volume fell about equally between the two subgroups in 2020:Q2 and Q3, but rebounded a little more noticeably among firms with below-median leverage in 2020:Q4. But this group of firms also experienced somewhat higher, and more volatile, spreads over 2020. This may indicate, once again, that the sample of firms with high leverage that were able to obtain new credit during the second half of 2020 may have been of better quality. To better understand this feature of the data, our regression analysis below will condition on firm and bank characteristics. By comparison, Figure 5 presents the corresponding time series for the larger firms. The pattern is to some degree opposite to that observed for the small firms. Unconditionally, large firms with *above*-median leverage experienced a much *higher* growth of loan counts in 2020:Q1, and did not fall more over the subsequent two quarters. Note that the increase in 2020:Q1 were newly originated

[22]The time series plots only the Q4 value in each year because of the much better data coverage in Q4.

loans, not drawdowns on existing loans. These more levered large firms also generally paid lower rate spreads. This combined pattern indicates that the endogeneity of leverage is more pronounced among the large firms: those among the large firms deemed sufficiently safe are allowed to take on more leverage, and can still enjoy lower spreads despite the higher leverage. We will show that this is driven heavily by the largest firms, many of which are public.

We now proceed to regression analysis of the amount and interest rate spread of newly originated loans to estimate the impact of pre-crisis leverage while controlling for a number of other relevant characteristics. We primarily consider newly originated loans instead of outstanding loans because loan terms (such as the total committed amount of a credit line and the interest rate spread) are set at the time of the origination, and new originations are much more likely to be subject to supply constraints as lenders have much greater discretion than with drawdowns under existing credit lines, which are largely determined by demand.[23] Extant evidence suggests that small firms, which are bank dependent and subject to greater information frictions, are likely to be hit particularly hard by the pandemic. In fact, just because small firms tend either not to have credit lines or face short maturities on lines, often below one year for credit lines (as shown Chodorow-Reich et al. (2021)), they have to refinance their loans more frequently and thus are more likely to be subject to supply constraints. For these reasons, our core analysis focuses on firms with annual sales of $50 million or less (measured at the year-end prior to the loan origination). This size threshold maps approximately to the bottom quintile of firms covered in the FR Y-14, and it is the definition of small businesses used in the Senior Loan Officer Opinion Survey. Our sample period covers all the loans originated from 2019:Q4 through 2020:Q4.

Specifically, we estimate the following regression:

$$\text{Credit Margin} = \beta \cdot \text{Leverage} \times \text{COVID-Crisis} + X'\gamma + \epsilon, \tag{6}$$

where Credit Margin refers to (log) loan volume, or interest rate spread (in basis points over LIBOR) of new loan originations, or extensive margins of lending such as whether a firm is a new borrower or able to refinance a loan that comes due for repayment of principle. Leverage is the debt-to-income ratio, measured using data from financial statements as of the year-end prior to the loan origination, and income equals earnings before interest, depreciation and amortization (EBITDA). COVID-crisis is a dummy variable that equals 1 after March 15, 2020, and 0 otherwise. Our key coefficient of interest is β, which measures the change in credit conditions since the COVID outbreak depending on a firm's pre-COVID

[23] Chodorow-Reich et al. (2021) show banks still have some discretion over drawdowns, but most likely not as much as their influence over new originations.

leverage.[24]

The vector X collects the control variables, along with leverage and COVID-Crisis individually. First of all, our specification estimates the effect of firm leverage on credit conditions *within* a given industry as firms in different industries tend to have different average levels of leverage. Such differences are related to, among other factors, the degree of asset pledgability or the cyclicality of revenues. Hence, we include in our first set of regressions 2-digit NAICS industry*quarter fixed effects, which account for any systematic difference across industries over time. We also include state*quarter fixed effects to account for potentially time-varying effects of state heterogeneity in economic conditions during the pandemic (such as related to differences in mobility restrictions) that may influence credit demand. Moreover, we include bank*quarter fixed effects to absorb heterogeneous supply effects across banks, which encompass, but are not limited to, the impact of a high volume of drawdowns on credit lines to large firms (as documented in Greenwald et al. (2021)) and the capital buffer constraint analyzed in Berrospide et al. (2021), which we also explore in Section 4.1.1 below.

Furthermore, we control for the type of collateral pledged (such as fixed assets versus blanket lien). Interestingly, the share of each type of collateral in originated loans remains roughly the same during the COVID period versus before for small firms as well as large private firms (see Figure A.2), even though one might have expected the share of accounts receivable and inventory as collateral to decline given the COVID-induced damage to firm revenue.[25] The only exception is the noticeable increase in the share of unsecured loans (mostly offset by the lower share of loans secured with blanket liens) to large public firms. This hints at the possibility of a change in the extensive margin of bank lending in that more loans were shifted toward large public firms that could borrow without posting collateral. Finally, we also control for the type of base rate (such as LIBOR or prime rate, since they correspond to noticeably different average levels of the rate spread) by quarter, and loan maturity range.

Because the dependent variables as well as several explanatory variables (including leverage) contain extreme outlier values, we trim the sample to remove observations with values in the top and the bottom 1 percentile. See Table 1 for the summary statistics of the new-loans-only sample underlying the regressions for loan volume and interest rate spread. Summary statistics of the utilization-rate regression sample are reported in Table A.2 in the Appendix. We omit coefficients on all the fixed-effects control variables from all the output

[24]Since the COVID indicator equals 1 since March 15, 2020, its own coefficient is identified with only loans originated between March 15 and April 1, 2020 when quarter fixed effects are included.

[25]One likely explanation is the anecdotal evidence that, after the COVID shock, banks lengthened the period over which accounts receivable value would be assessed, effectively making it easier for firms to satisfy this requirement.

Table 1: Sample Statistics for New Loan Origination Regressions

(a) Firms with Sales Less Than or Equal to $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Loan Volume	2,128	4.43	5.48	1.00	1.50	2.39	4.88	16.64
Spread (BPS)	2,128	194.75	111.94	0.00	137.35	200.00	256.85	375.00
New Borrower	2,128	0.50	0.50	0.00	0.00	1.00	1.00	1.00
Leverage	2,128	3.07	4.85	0.00	0.44	1.52	3.53	11.48
Sales	2,128	22.42	13.69	2.33	11.09	20.56	33.53	46.20
Profit Margin	2,128	0.18	0.23	-0.01	0.05	0.12	0.23	0.60
Tangibility	2,128	0.30	0.28	0.00	0.05	0.21	0.51	0.88
Liquidity	2,128	0.12	0.15	0.00	0.02	0.06	0.16	0.45

(b) Firms with Sales Greater Than $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Loan Volume	6,459	28.07	39.29	1.47	4.08	12.77	35.00	104.93
Spread (BPS)	6,459	190.73	103.03	0.00	125.00	175.00	250.00	400.00
New Borrower	6,459	0.26	0.44	0.00	0.00	0.00	1.00	1.00
Leverage	6,459	3.75	3.88	0.13	1.51	2.87	4.87	9.98
Sales	6,459	3,616.2	9,299.9	66.9	184.9	640.2	2,571.7	17,129.0
Profit Margin	6,459	0.10	0.09	-0.00	0.04	0.07	0.12	0.25
Tangibility	6,459	0.35	0.28	0.02	0.10	0.27	0.55	0.88
Liquidity	6,459	0.05	0.07	0.00	0.01	0.03	0.07	0.21

Note: Loan volume and Sales are in million dollars. Spread is in basis points (BPS). New borrower is an indicator equal to one if a newly originated loan is the first between a bank-firm pair, zero otherwise. Leverage is the ratio of total debt over EBITDA. Utilized Exposure is the utilized amount of Y-14 bank loans. Profit margin equals operating income over total assets. Tangibility equals PPE over total assets. Liquidity equals cash plus marketable securities over total assets.

tables for brevity in order to focus on the main coefficients of interest—those measuring the effects of leverage and the change, if any, during COVID. All standard errors are multi-way clustered at the industry, state, and bank level (bank level clustering is dropped for data at the firm-level).

Table 2 presents the results for dependent variables we refer to as intensive margins: the loan volume and interest rate spread of newly originated loans, as wells as the utilization rate of existing credit lines. The coefficient on the leverage and COVID interaction term in column (2), which is estimated using new loans to firms in COVID damaged industries, suggests the more levered among these small firms indeed saw a statistically significant reduction in their

loan size since the onset of COVID, and the decline is economically meaningful, amounting to nearly the same magnitude as the effect of leverage during normal times prior to the COVID outbreak (2.17% versus 2.42%). In fact, during normal times, higher leverage is associated with larger loans. This is in addition to the massive 20% decline in loan size upon the outbreak of COVID-19.[26] By comparison, the extra impact of leverage on loan size during COVID for all the industries remains negative but no longer significant, as shown in column (1), although the magnitude is non-negligible—close to one-third of the (positive) effect of leverage prior to COVID. (Table A.1 reports the severity of the COVID impact by 2-digit NAICS codes.[27])

By comparison, Columns (3) and (4) in Table 2 show that leverage by and large does not exert significant influence on the credit risk spread paid on new loans.[28] Higher leverage is in fact associated with a slightly lower spread on average in normal times, albeit only marginally significant for the full new-loan sample. The association between leverage and spread did not rise significantly during COVID. In addition, loans made during the initial outbreak (in late March 2020) carried significantly lower spreads (by 16 basis points on average).

For comparison with new loans, we also examine how leverage may have affected small firms' utilization of their existing credit lines during the pandemic. Columns (5) and (6) report the coefficient estimates.[29] Higher leverage was associated with higher utilization of lines prior to the COVID outbreak, and leverage did not exert further influence on utilization during the COVID period.[30] The pattern is about the same regardless of an industry's vulnerability to COVID. This result is perhaps not surprising, given the finding by Chodorow-Reich et al. (2021) that small firms did not really draw on their credit lines during the COVID outbreak, even when it was available.

[26]Given its definition, the COVID indicator's own coefficient is identified with only loans originated between March 15 and April 1, 2020, when quarter fixed effects are included.

[27]Assessment of the severity of the COVID-19 shock by industry is produced by the Federal Reserve Bank of Chicago. We refer to all the industries that are classified to have suffered a severe or substantially adverse impact by COVID as the "impacted industries," and only firms in those industries enter the regressions reported in column (2).

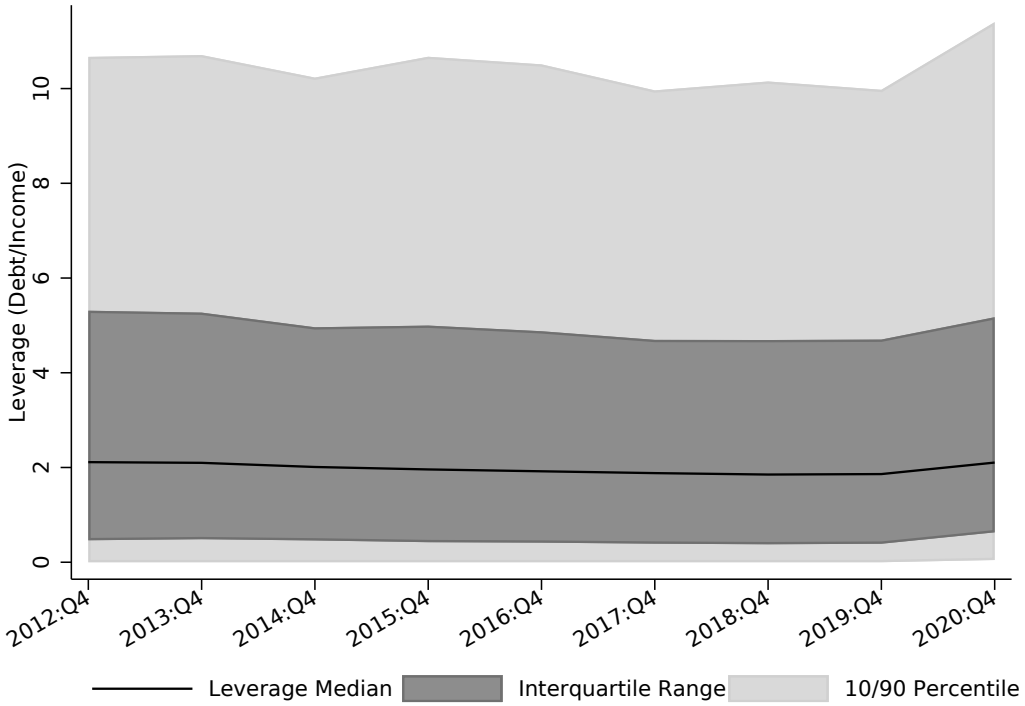
[28]Similar regressions of loan maturity also reveal that its relationship with leverage is generally weak, and did not change significantly during COVID. Results are omitted for brevity.

[29]See Table A.2 for the summary statistics for this estimation sample.

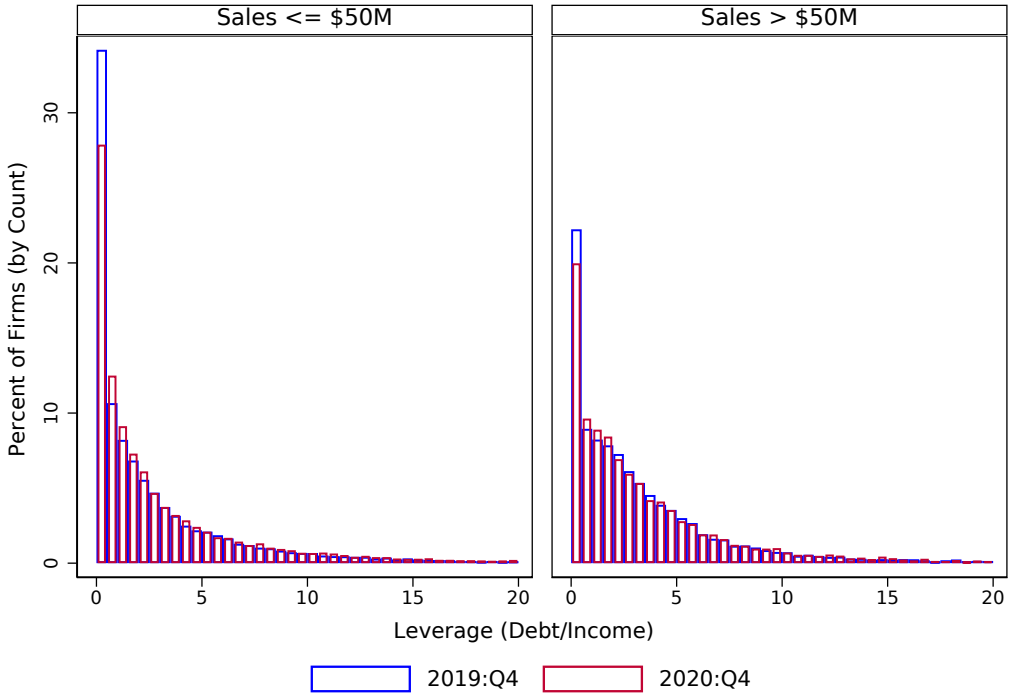
[30]The COVID indicator is omitted because we can only observe utilization rate at the end of each quarter, not variations within a quarter, and the regressions include 2-digit NAICS industry*quarter and state*quarter fixed effects.

Figure 3: Distribution of Leverage

(a) Range of Leverage among Y-14 Borrowers over Time, 2012-2020



(b) Distribution of Leverage, Small versus Large Firms in 2019:Q4 and 2020:Q4



Note: Excludes firms with Debt/Income greater than 20 (approximately 5.8% of firms).

Figure 4: New Originations to Firms with Sales Up to $50M, 2019:Q2—2020:Q4

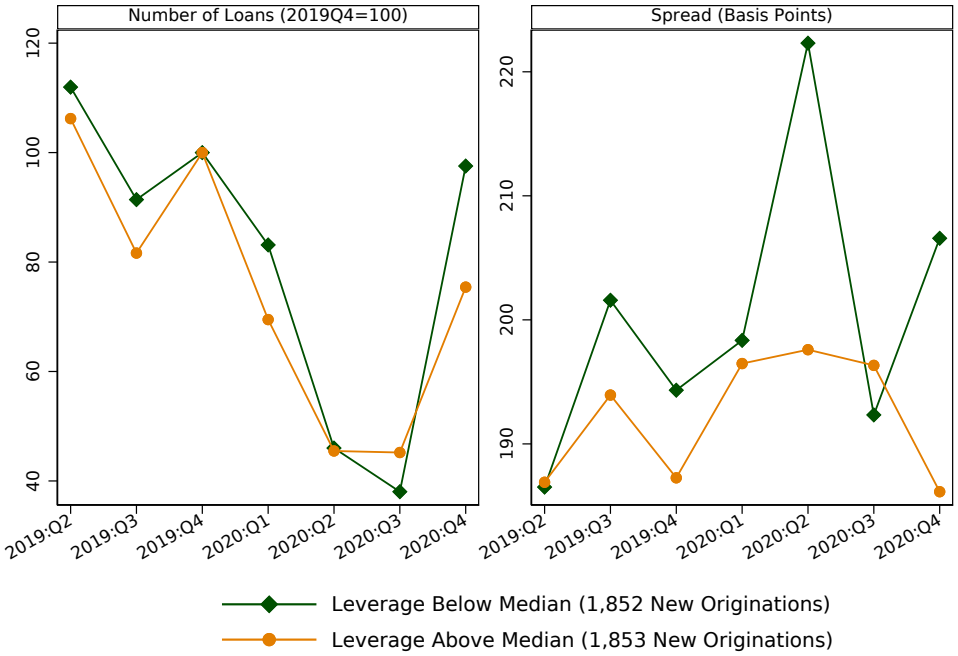


Figure 5: New Originations from Firms with Sales Greater Than $50M, 2019:Q2—2020:Q4

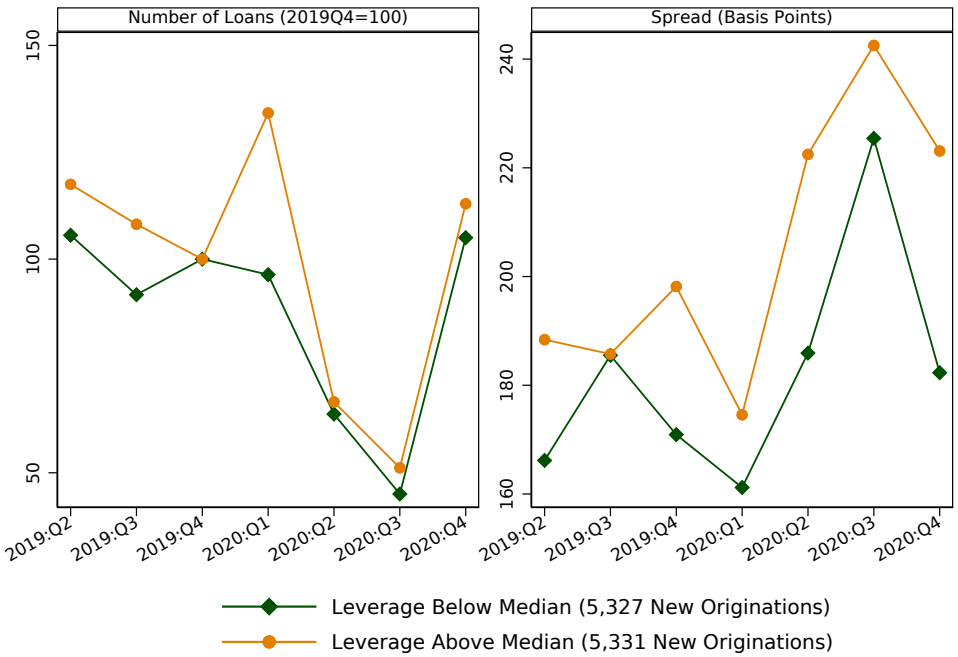


Table 2: Effects of Leverage during COVID along Intensive Margins of Bank Lending; Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) Log(Volume)	(2) Log(Volume)	(3) Spread (BPS)	(4) Spread (BPS)	(5) Utilization Rate	(6) Utilization Rate
Leverage*COVID Crisis	-1.25**	-2.15*	1.82	-0.32	0.00	-0.02
	(0.52)	(1.06)	(1.27)	(1.23)	(0.03)	(0.02)
Leverage (Demeaned)	3.97***	2.42**	-1.45	-1.10	0.11**	0.09***
	(0.67)	(1.06)	(0.85)	(0.87)	(0.04)	(0.03)
COVID Crisis	-0.46	-19.38	-16.23	-7.73		
	(8.31)	(17.85)	(10.74)	(15.45)		
Observations	2,128	746	2,128	746	43,467	16,279
R-squared	0.347	0.517	0.617	0.720	0.637	0.578
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Base-Rate-Type*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Impacted Industries Only	No	Yes	No	Yes	No	Yes

Note: Coefficient estimates for Log(Volume) regressions are multiplied by 100. Spread is in basis points (BPS). Utilization rate equals utilized loan amount as percent of committed loan amount. See Table A.2 for statistics of utilization rate. Leverage is the ratio of total debt over EBITDA. COVID-Crisis is an indicator that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

The volume, risk spread, and maturity of newly originated loans only inform about the condition of loans *actually made*, that is, the intensive margin of credit. These measures alone do not inform us of potential changes in the extensive margin of credit—whether credit became less available to a subset of prospective borrowers. In fact, they can even be misleading. During crises, banks may choose not to lend at all to borrowers that they deem most risky. This selection effect, if sufficiently severe, can show up as no change or even easing of terms among the loans actually made, that is, to the safe borrowers only. As we have shown above, the number of new loan originations indeed declined sharply (unconditionally) after the onset of the pandemic, which could mean certain types of borrowers exited, or were pushed out of, the market. Hence, we next analyze the extensive margin of bank lending.

Because we do not observe loan applications in Y-14 data, we measure changes in the access to bank credit using two alternative approaches. In the first approach, we compute an indicator variable that identifies a new relationship between a bank and a borrowing firm: it equals one if a loan among all the new originations during our sample period is between a bank-firm pair that did not have any previous loans in all the past Y-14 data, and zero otherwise. This new-borrower indicator enables us to gauge the extent to which the likelihood of forming new lending relationships changed during the pandemic depending on firm leverage.[31] Table 3, column (1), shows that, since the onset of COVID, highly levered firms are significantly less likely to obtain credit from a bank from which it did not borrow previously.[32] The coefficient estimate indicates that the probability that a bank lends to a new borrower declines by about 2.2 percentage points if the borrower's leverage ratio rises by 1x. Leverage's negative impact on the probability of a new lending relationship is about the same (1.8 percentage points lower) when estimated only on the firms in industries hardest hit by the pandemic during COVID period (column (2) of Table 3). By comparison, the impact of COVID itself is only about half, and insignificant. These results indicate that the composition of new originations changed during the COVID crisis, as the share of newly originated loans reached more existing highly levered customers than those with which the bank did not have an established credit relationship.

[31] A potential caveat of the extensive-margin interpretation is that only loans of balances $1 million or more are reported in Y-14. So some small firms among the new borrowers could have previously borrowed from one of the Y-14 banks at balances lower than $1 million. In our sample, around 60% of the small firms among the new firm-bank pairs are new borrowers to the Y-14 dataset. In such cases, observing fewer such borrowers is perhaps more accurately interpreted as an intensive margin contraction: some firms that would have borrowed more and become visible in the Y-14 data continued to take out loans smaller than $1 million.

[32] In contrast, leverage had no significant effect on new borrower probability prior to COVID.

Table 3: Effects of Leverage during COVID along Extensive Margins of Bank Lending; Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) New Borrower	(2) New Borrower	(3) Refinancing Flag	(4) Refinancing Flag	(5) Refinancing Flag (Lines Only)	(6) Refinancing Flag (Lines Only)
Leverage*COVID Crisis	-2.26***	-1.92*	-0.07*	-0.05	-0.01	-0.03
	(0.37)	(0.90)	(0.04)	(0.05)	(0.03)	(0.06)
Leverage (Demeaned)	0.63	0.76	-0.01	-0.08	0.00	-0.03
	(0.42)	(0.88)	(0.02)	(0.07)	(0.02)	(0.03)
COVID Crisis	-0.77	-3.12				
	(6.89)	(12.69)				
Observations	2,128	746	20,648	5,965	18,413	5,117
R-squared	0.336	0.502	0.032	0.062	0.023	0.059
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	No	No	No	No
Base-Rate-Type*Quarter FE	Yes	Yes	No	No	No	No
Impacted Industries Only	No	Yes	No	Yes	No	Yes

Note: Coefficient estimates are multiplied by 100. New borrower is an indicator equal to one if a newly originated loan is the first between a bank-firm pair, and zero otherwise. Refinancing Flag is an indicator equal to one if a new loan is originated in a quarter when a firm has one or more loans maturing in that quarter, and zero otherwise. Refinancing (lines only) is defined analogously, but only for new originations of credit lines. See Tables A.3 and A.4 for statistics of the refinancing and refinancing lines only estimation samples, respectively. Leverage is the ratio of total debt over EBITDA. COVID-crisis is an indicator that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses (bank clustering is dropped when data are at the borrower level); ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Our second measure of the extensive margin of bank credit tries to capture the extent to which firms' ability to refinance changed during the pandemic depending on their leverage. The results of the estimation are shown in Columns (3) through (6) of Table 3. The sample consists of all the borrowers that had one or more loans maturing during our sample period. Among these borrowers, we construct a dummy variable that equals one if a new loan is originated to a borrower, and zero otherwise. Using this refinancing indicator as the dependent variable enables us to estimate if leverage lowered a firm's chance of refinancing if it had one or more loans maturing since the COVID outbreak. This margin is likely to be particularly relevant for small firms, according to findings by Chodorow-Reich et al. (2021) that SMEs tend to have credit lines with short maturities (often below one year), necessitating relatively more frequent refinancing.[33]

Columns (3) and (4) of Table 3 consider all types of C&I loans reported in the FR Y-14Q data, while columns (5) and (6) show the results for only credit lines. Columns (4) and (6) zoom in to only those hard hit industries for each respective set of loan refinancing. Note that these regressions can only be defined at the firm-quarter level, not at the loan-date level, because some firms did not refinance their loans.[34] The coefficient estimates indicate that firm leverage exerted slightly negative but insignificant influence on the probability of a firm refinancing a maturing loan during the pandemic period as compared to before. Nor did leverage affect the odds of refinancing before the pandemic. Consistent with what we find in Table 2, banks were still willing to refinance loans to existing, known customers, even though they were reluctant to take on new customers, especially those that appear to have been more risky due to higher leverage.

We next extend the same analysis to larger firms based on net sales. For each dependent variable analyzed above, we estimate a separate set of regressions with the same specifications as those in Tables 2 and 3 for firms in a given size bin, based on net sales. Figure 6 reports the coefficients on the leverage and COVID interaction term estimated from these regressions using the sample of firms in each of the listed size bins (with the first size bin corresponding to the firms whose coefficients are reported in Tables 2 and 3).[35] The blue diamonds and the

[33]On the other hand, their finding that large firms engage in active maturity management, by refinancing loans long (often up to 4 years) before loan maturity, suggests that during the pandemic large firms could delay refinancing that they might have intended previously. Potential advance refinancing of loans that would mature in the next year are not included in our sample for the refinancing regressions.

[34]Accordingly, we drop fixed effects (such as for collateral type and base-rate type) and clustering of standard errors that refer to loan or bank characteristics. Also for this reason, the COVID period indicator is omitted since industry*quarter and state*quarter fixed effects are included.

[35]For robustness, we run an alternative set of regressions by size, with firms grouped into quintile of sales. The corresponding coefficients (on the interaction of leverage and COVID indicator) are reported in Table A.3. The bottom quintile by and large consists of firms with sales up to $30 to $40 million, the second quintile with sales up to $100 to $200 million, and the top quintile with sales greater than $1 billion. Along each

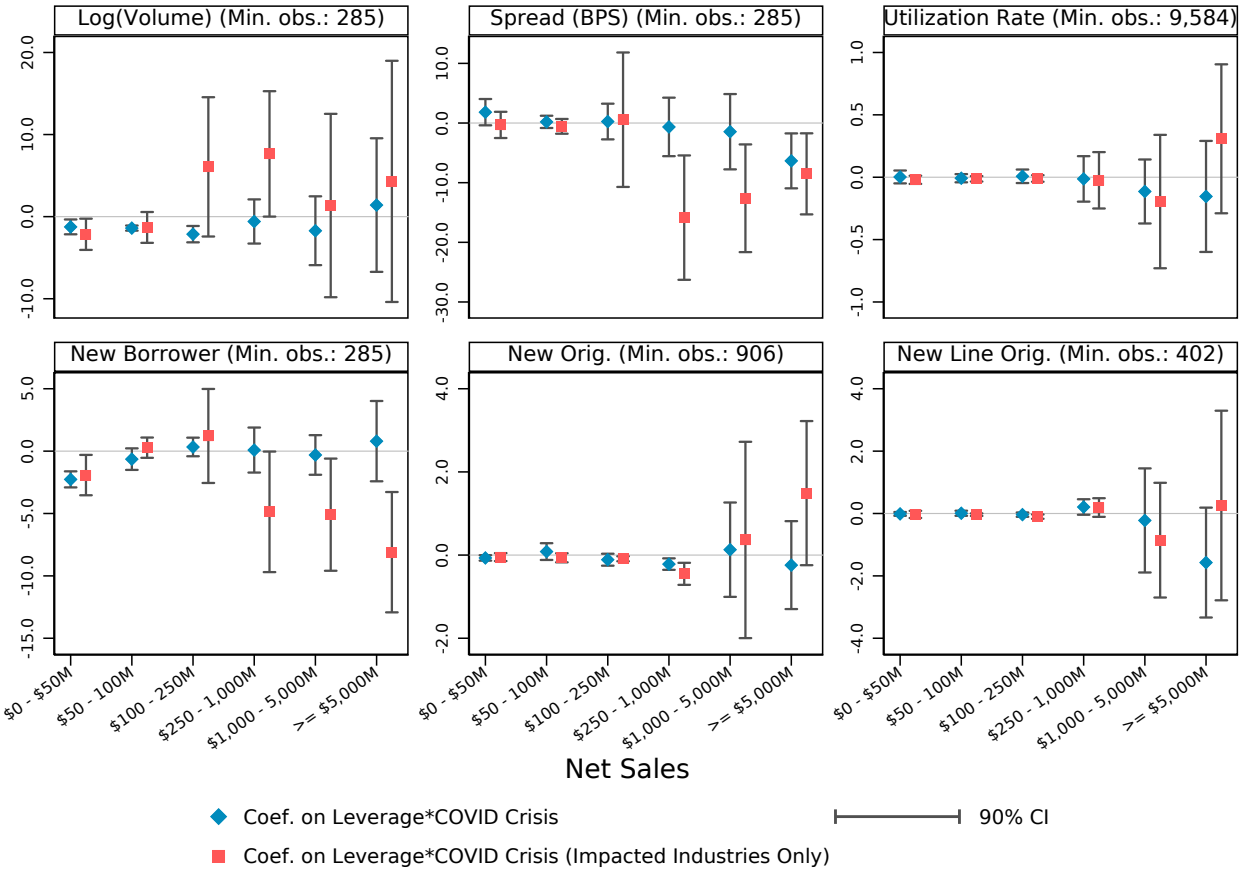
red squares denote estimates based on new loans to all the firms and only firms in severely impacted industries, respectively, in a given size bin. The coefficients depicted in the top left panel indicate that, for all the firms with sales up to $250 million, the higher their leverage, the lower their loan volume during COVID. Interestingly, loan volume in fact rose for the largest firms (with sales of $5 billion or above) in the severely impacted industries, possibly because these firms found it cheaper to turn to banks for liquidity instead of paying wider spreads on a longer-term bond. This would be consistent with the result that interest rate spreads fell for COVID impacted firms in the top three size bins (that is, with sales over $250 million).

We also explore the likely nonlinear effect of leverage on the terms of and access to bank loans, in particular that lenders may model borrower default risk as a step function of leverage—making little distinction across leverage ratios within an interval or up to a certain level, while singling out those with sufficiently high leverage ratios. A debt-to-income ratio of four is considered as such a threshold according to anecdotal evidence, and it is fairly high among the Y-14 borrowers, as can be seen in Figure 3 and summary statistics tables. We thus define an alternative measure of leverage that equals one for firms with a debt-to-income ratio of four or higher, and zero otherwise. Estimates of the effect of this high leverage indicator are reported in Tables A.7 and A.8, which are the counterparts to Tables 2 and 3, respectively. The coefficients on the high leverage indicator and COVID interaction term reveal that the effect of being highly levered on the multiple margins of bank lending during COVID is by and large qualitatively the same as the effect of increasing leverage (reported earlier in Tables). The impact is most noticeable on loan size and the probability of borrowing the first time from a specific bank. The one notable feature is that the negative impact on loan size exerted by having a leverage ratio of four or above is more statistically significant than the marginal impact of having a higher leverage ratio.

Overall, the above analyses indicate that bank credit became more constrained along several dimensions for those small firms that entered the COVID period with higher leverage. They were less likely to obtain a loan from a new lender, and conditional on receiving a loan, the loan size was smaller. All the regressions include a rich set of controls, in particular of bank health by quarter, so that the estimated effects of leverage are more likely due to factors pertaining to the borrowers. It is natural to question the mechanism through which credit conditions would deteriorate more for highly levered firms following a sizable

dimension of the lending outcome, the pattern of the key coefficient across size groups is for the most part highly similar to that using dollar-amount-based size bins. The most robust finding is that the probability of a loan being between a newly formed bank-firm pair is lower during COVID for firms in the lowest size bin. In addition, it appears that the chance of refinancing is also lower during COVID for firms in the bottom size quintile.

Figure 6: Effects of Leverage during COVID: Extensive and Intensive Margins of Bank Lending



Note: Coefficient estimates are multiplied by 100 except for Spread and Utilization Rate regressions. Interest rate spreads are in basis points (BPS). Utilization rate is defined as utilized exposure as percent of committed exposure. Leverage is the ratio of total debt over EBITDA. New borrower equals one if a newly originated loan is the first between a bank-firm pair, and zero otherwise. Refinancing Flag equals one if a new loan is originated in a quarter when a firm has one or more loans maturing in that quarter, and zero otherwise. Refinancing (lines only) is defined analogously, but for new originations of credit lines only. COVID-crisis is an indicator that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise.

aggregate negative shock. As illustrated in the simple model, all else being equal, higher leverage means greater default risk. Thus, to the extent that the price of default risk rises following an aggregate adverse shock, more risky firms will see credit become more expensive or more restricted, especially for SMEs, because they tend to be perceived as more risky even in normal times. In other words, the impact of leverage mostly stems from it being a proxy for default risk. To explore this interpretation, we extend the specifications that underlie the estimates reported in Tables 2 and 3 to account for several borrower characteristics (log

sales, profitability, balance-sheet liquidity, and tangibility), as well as credit ratings of the loans, which should in principle be the sufficient statistic of a loan's credit risk.[36] All of these additional controls are further interacted with the COVID indicator to allow the coefficients to vary during the pandemic period.

The coefficient estimates from these extended specifications of the intensive margins of bank loans are reported in Table A.5. Columns (1) and (2) indicate that the negative effect of leverage on loan size during COVID is indeed weakened slightly with the additional controls, which include bank internal risk ratings. On the other hand, higher leverage continues to be robustly associated with larger loans prior to the pandemic. Taking credit ratings as the sufficient statistic of credit risk, there is the broad pattern that loan size declines more for loans with a worse rating (except for C-rated loans) during the pandemic, although none of the coefficients are significant. Columns (3) and (4) show that leverage remains unrelated to interest rate spread, whereas loans with worse ratings generally pay higher spreads, even though the relationship is not strictly monotonic. Interestingly, BBB-rated loans in fact pay 43 basis points lower spreads than A-rated loans (the omitted category), while the spreads paid on BB-rated and B-rated loans are not statistically higher than that on A-rated loans.[37] In terms of utilization rate, it remains increasing in leverage before the pandemic, even after controlling for credit rating. Likewise, high-yield loans (that is, of rating BB or worse, especially the worst—of rating D) are generally associated with a higher utilization rate prior to COVID. The relationships between line utilization and leverage or rating by and large do not experience significant changes during COVID.

Table A.6 reports results from the extended specifications of the extensive margins of bank lending. The earlier finding that higher leverage lowers the share of new originations reaching new borrowers during the COVID period compared with before proves highly robust (columns (1) and (2)). This is likely because banks screen borrowers using pre-COVID leverage and, absent prior knowledge, exhibit greater reluctance to lend to a non-customer that appears more risky. Loans between banks and firms without a prior lending relationship in fact become less likely across all rating classes during COVID, although most reductions are insignificant. In contrast, columns (3) and (4) confirm that leverage appears not to

[36]See Figure A.1 for the distribution of ratings for the loan sample underlying the regressions over the pre-COVID versus COVID period, respectively. The entire distribution shifts slightly toward the more risky end after COVID-19 hit, visible in the increased share of B-rated loans, offset by a decreased share in BB- and BBB-rated loans.

[37]The monotonic relationship between average spread and credit rating is more prominent without the other firm attributes included in the regressions. Not surprisingly, spreads overlap substantially between two adjacent ratings. Different risk premia on loans within a given rating is likely a major factor. This pattern can also be partly due to unobserved loan attributes that mitigate credit risk and thus lower spreads but without shifting the loan into a higher rating class. For example, although these regressions include fixed effects by the type of collateral, there are no sufficient data to control for the loan-to-value ratio.

influence the odds of refinancing (or credit lines or other C&I loans), either before or during COVID, especially once ratings are controlled for. For credit lines only (columns (5) and (6)), in the quarter when a previous line was maturing, the odds of refinancing into a demand loan, which is immediately callable by the lender, is a near certainty (98 percent) for these small firms. This suggests that they cannot practice active maturity management and simply passively roll over the credit line contracts.

In summary, the collective evidence from all of the above analyses points to a strongly detrimental effect of high pre-COVID leverage on small firms' ability to obtain loans from banks with which they did not already have a relationship. To a lesser extent, high pre-COVID leverage also tends to reduce the size of the newly originated loans during COVID, although this effect loses its significance once other firm attributes and credit ratings are included, suggesting that leverage serves more as a proxy for credit risk for loans that are actually made. These effects of pre-COVID leverage on loans to small firms during the pandemic most likely represent the greater credit risk on the part of borrowers acting as an amplifier of aggregate negative shocks, given the rich set of controls behind these estimates, especially the time-varying bank fixed effects.

4.1.1 The Role of Bank Capital

Our previous exploration of the relationship between (potential) borrowers' leverage and various margins of bank lending is carried out within each bank in any given quarter. Now we consider whether lender characteristics, in particular the banks' capital position at the onset of COVID-19 interacts with borrowers' leverage. We find that the lender's level of common equity tier 1 capital, the most loss-absorbing form of capital, above and beyond the regulatory requirements makes a difference in which borrowers obtained credit during the worst period of the COVID crisis in 2020, and also in the quantity and cost of the credit obtained by those borrowers.

We define the management—or excess—capital buffer as the common equity tier 1 capital ratio minus the capital conservation buffer determined by the US implementation of the Basel III capital accord, minus the minimum regulatory capital ratio of 4.5 percent, and minus the G-SIB surcharge if applicable.

Our findings indicate that banks with a larger excess capital buffer take advantage of their healthy balance sheet and capital position during the crisis to provide loans to their riskier customers in affected industries, as can be inferred from Table 4, which shows the effects of bank excess capital and borrower leverage on the intensive margins of bank loans for existing borrowers during the COVID period. Column (2) shows that, in COVID-impacted industries, borrowers with higher leverage were able to obtain significantly larger loans from

Table 4: Effect of Bank Capital Constraint: Intensive Margins Regressions for Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) Log(Volume)	(2) Log(Volume)	(3) Spread (BPS)	(4) Spread (BPS)	(5) Utilization Rate	(6) Utilization Rate
Leverage*COVID Crisis	-1.88*	-2.34**	2.57	-0.46	-0.00	-0.03
	(1.00)	(0.93)	(1.60)	(1.44)	(0.05)	(0.02)
Leverage (Demeaned)	4.07***	1.67	-2.31*	-0.83	0.11***	0.10***
	(0.61)	(1.03)	(1.31)	(1.13)	(0.02)	(0.02)
Leverage*High Capital Buffer*COVID Crisis	3.40	12.32***	-0.95	-1.57	0.14***	0.00
	(2.17)	(2.11)	(2.73)	(4.53)	(0.02)	(0.05)
Leverage*High Capital Buffer	-0.25	2.02	1.84	-0.74	0.02	-0.07
	(1.11)	(1.64)	(1.93)	(2.16)	(0.10)	(0.06)
High Capital Buffer*COVID Crisis	27.28	-3.72	-87.74*	-72.66		
	(48.32)	(55.23)	(45.35)	(70.48)		
COVID Crisis	-6.16	-36.69	-19.56	-9.42		
	(9.85)	(20.88)	(13.77)	(20.26)		
Observations	2,128	746	2,128	746	43,465	16,279
R-squared	0.349	0.529	0.620	0.721	0.637	0.578
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Base-Rate-Type*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Impacted Industries Only	No	Yes	No	Yes	No	Yes

Note: Coefficient estimates for Log(Volume) regressions are multiplied by 100. Interest rate spreads are in basis points (BPS). Utilization rate is defined as utilized exposure as percent of committed exposure. Leverage is the ratio of total debt over EBITDA. COVID-crisis is an indicator that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

those well-capitalized banks after COVID hit. Moreover, during the height of the COVID crisis (in the second half of March 2020), these well-capitalized banks charged borrowers lower spreads than banks with less capital buffer, as shown in columns (3) and (4) of Table 4, although the difference is insignificant for those hard hit industries.[38] Finally, column (5) indicates that higher-leverage firms borrowing from well-capitalized banks utilized more of their lines of credit (0.14 percent) during COVID when compared to lower-leverage borrowers from less-capitalized banks before the crisis. But this pattern is not present for highly levered borrowers in the hard hit industries (column 6). In other words, riskier firms borrowers (in terms of leverage) in COVID-impacted industries did not access more liquidity through their existing lines.

On the other hand, these well-capitalized banks also seem to exhibit a certain degree of uncertainty aversion in that they showed no more willingness during COVID to lend to new customers. As shown in Table 5 (the coefficient on the capital-buffer-COVID interaction term), these banks are associated with lower likelihood of lending to new borrowers after COVID struck, in particular to those firms in the hard hit industries. On the whole, however, extra capital buffer does not appear to have played an important role in credit provision during the pandemic to those firms with higher leverage. It is worth noting again that our finding of limited interactive effect between borrower leverage and bank capital buffer is in large part the results of the full set of Bank*Quarter fixed effects, which absorb most of the variation.

4.1.2 The Role of the Fed Emergency Facilities

A distinguishing feature of this pandemic-induced downturn is the unprecedented scale and speed of support provided by the public sector. On the fiscal front, Congress enacted the CARES Act on March 25, 2020, an important provision of which is the Paycheck Protection Program, which offered essentially grants to small businesses. Around the same time, the Federal Reserve quickly established a number of liquidity and debt purchase facilities to restore the normal functioning of the credit markets. Several studies found that conditions in the corporate bond market normalized rapidly after the announcement of the primary and the secondary corporate credit facilities (PMCCF and SMCCF, respectively) on March 23, 2020. Subsequently, conditions in the corporate bond market improved so much that the overall volume of new issuance in 2020 surpassed that in 2019. During the same period, however, survey evidence suggests that banks tightened their lending standards and terms noticeably over 2020:Q2 and 2020:Q3. Our analysis of bank loans thus also helps reveal to

[38]Note that, with the bank*quarter fixed effects, coefficients on the COVID indicator and its interaction with capital buffer are identified with only loans made in the second half of March 2020.

Table 5: Effect of Bank Capital Constraint: Extensive Margins Regressions for Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) New Borrower	(2) New Borrower
Leverage*COVID Crisis	-2.62***	-2.03**
	(0.57)	(0.86)
Leverage (Demeaned)	0.89	0.74
	(0.66)	(0.81)
Leverage*High Capital Buffer*COVID Crisis	1.17	1.54
	(0.97)	(2.48)
Leverage*High Capital Buffer	-0.56	0.05
	(0.91)	(0.99)
High Capital Buffer*COVID Crisis	-11.88	-125.80***
	(16.94)	(18.28)
COVID Crisis	-8.34	-6.35
	(8.68)	(12.61)
Observations	2,128	746
R-squared	0.338	0.508
State*Quarter FE	Yes	Yes
Industry*Quarter FE	Yes	Yes
Bank*Quarter FE	Yes	Yes
Base-Rate-Type*Quarter FE	Yes	Yes
Impacted Industries Only	No	Yes

Note: Coefficient estimates are multiplied by 100. New borrower is an indicator equal to one if a newly originated loan is the first between a bank-firm pair, and zero otherwise. Refinancing is an indicator equal to one if a new loan is originated in a quarter when a firm has one or more loans maturing in that quarter, and zero otherwise. Refinancing (lines only) is defined analogously, but for new originations of credit lines only. COVID-crisis is a dummy variable that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

what extent the credit market may have bifurcated, with credit conditions easing back to normal for those large firms that are able to access the bond market but tightening for the firms that have to borrow primarily from banks. One aspect we examine is what role, if any, the lending bank's health played. For example, did banks with capital ratios closer to the minimum requirement tighten standards and terms more than other banks? Did banks that experienced more drawdowns at the onset of COVID-19 of pre-committed credit lines relative to their capital cut back on lending later relative to other banks?

These novel and massive public policy support programs may have affected private credit

markets, especially bank lending through various channels. First, firms with access to either of the programs may substitute away from private bank debt toward funding through the public programs. Thus, demand for bank loans may have shifted inward for eligible firms. Second, banks may be more willing to lend to firms knowing that firms could get additional funding through the programs, thereby potentially lowering the risk of default. This is a supply effect.

We test how the public policy programs interact with bank lending, by exploiting eligibility criteria for access to public funding. More specifically, we study how the leverage eligibility criterion of the Main Street Lending Program—firms with leverage more than 4x were excluded from the New Loans program—affected private credit market conditions.[39] As mentioned above, the MSLP was targeted at small and mid-sized firms with up to 15,000 employees or $5 billion in revenue, and its total uptake of more than $17 billion, while well below its maximum capacity, was similar to the total loan volumes originated to comparable firms by Y-14 banks during the same period (see Bräuning and Paligorova, 2021).

To study the impact of eligibility to the MSLP, we employ a regression discontinuity design and compare the volume and interest rate spread as well as the new borrower indicator of size-eligible firms just below and just above the 4x leverage threshold, while controlling for other key firm characteristics, market conditions, and bank supply factors.[40] Firms just around the leverage threshold presumably just differ in their eligibility to the MSLP program, allowing us to isolate the impact of the public policy program on private debt markets.

Formally, we estimate the following regression equation on the sample of all size-eligible firms, while constraining the set of firms to those with 2019 leverage between 3.5x and 4.5x:

$$\text{Credit Margin} = \beta \cdot \mathbf{I}(\text{Leverage} \geq 4) + X'\gamma + \epsilon, \tag{7}$$

where Credit Margin refers to (log) loan volume, or interest rate spread (in basis points over LIBOR), and the extensive margins of lending such as whether a firm is a new borrower or able to refinance. Leverage is the debt-to-income ratio, measured using data from financial statements as of the year-end prior to the loan origination, and income equals earnings before interest, depreciation and amortization (EBITDA).

[39]The Main Street Lending Program had three facilities: the new loan facility, the extended loan facility, and the priority loan facility. The new loan facility was limited to borrowers with less than 4x leverage. The priority and expanded facilities accepted borrowers up to 6x leverage. The sample of firms just above 6x leverage in the 14Q data is too small.

[40]The threshold for the Main Street programs was a function of adjusted leverage, which we do not have data on. Therefore, the threshold that we use is not very precise, which may justify some of the results, or lack thereof.

Table 6: Effect of Main Street Lending Program: Leverage Threshold 4

VARIABLES	(1) Pre-COVID Log(Volume)	(2) Pre-COVID Spread (BPS)	(3) Pre-COVID New Borrower	(4) COVID Log(Volume)	(5) COVID Spread (BPS)	(6) COVID New Borrower
Leverage (4 to 4.5 Dummy)	-34.16	-34.83***	23.73**	48.77*	19.31*	13.13
	(30.97)	(6.33)	(10.46)	(23.28)	(10.94)	(7.95)
Leverage (Demeaned)	-6.31	5.86	10.06	-158.95	-138.64**	-19.59
	(5.18)	(15.43)	(6.38)	(114.21)	(53.41)	(33.94)
Leverage (4 to 4.5 Dummy)*Leverage	96.55	36.47	-76.27**	135.15	122.04**	8.33
	(92.41)	(38.36)	(31.48)	(113.38)	(56.14)	(33.47)
Log(Sales) (Demeaned)	28.80***	-2.95	-8.56***	32.16***	-4.49	-3.11
	(4.70)	(3.70)	(2.11)	(6.07)	(7.45)	(1.94)
Profit Margin (Demeaned)	-92.87	-391.89*	23.27	-72.65	-37.40	-134.75*
	(71.27)	(189.46)	(30.24)	(171.00)	(250.62)	(72.67)
Tangibility (Demeaned)	-0.54	21.21	-17.59**	86.64***	-7.95	-5.31
	(21.03)	(28.63)	(6.89)	(26.32)	(26.49)	(10.89)
Liquidity (Demeaned)	-89.00	84.89	5.76	100.12	-204.02***	52.79
	(56.33)	(154.39)	(33.85)	(86.36)	(62.07)	(61.17)
Observations	301	301	301	474	474	474
R-squared	0.417	0.356	0.265	0.389	0.295	0.176
Base-Rate-Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Security Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes
MSLP Size Eligible Only	Yes	Yes	Yes	Yes	Yes	Yes

Note: Coefficient estimates are multiplied by 100. Leverage is the ratio of total debt over EBITDA. Sample includes only observations where leverage is between 3.5 and 4.5. Leverage between 3.5 and 4 is the omitted category. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Because our interest is in the impact of MSLP eligibility we restrict the sample to new loan originations during the COVID period, but estimate the sample model during the pre-COVID period as a placebo test. Our key coefficient of interest is β, which measures the impact of MSLP ineligibility on credit conditions since the COVID outbreak.

Tables 6 shows the estimation results for the regression discontinuity analysis. Column (4) shows that, during the COVID crisis when MSLP was supporting the flow of credit to eligible firms, firms with leverage just above the 4x leverage threshold (those with leverage larger than 4x, but smaller than 4.5x) did not obtain a significantly different amount of credit. However, leverage had a positive and significant effect during the crisis for those borrowers that were just above the threshold. Column (5) shows that, while borrowers with higher leverage paid lower spreads on average, for those borrowers just above the threshold, the spread increased significantly with leverage. We do not find evidence that ineligible borrowers were able to substitute access to public credit for private credit. However, we find some evidence that those with leverage just above the threshold had to pay steeper prices the higher the leverage when compared with those borrowers just below the threshold.

5 Firm Investment since COVID-19 Outbreak

Ultimately, we care about leverage because of the potentially deleterious effect of high leverage on firms' optimal decision regarding real activity, particularly in response to a negative shock. As noted above, debt overhang can lead to underinvestment, and small firms' investment decisions may be further constrained because they rely on bank loans for external financing and face greater frictions in borrowing. Therefore, we analyze firms' investment behavior in the aftermath of the pandemic shock, using capital expenditures of the borrowers (over the last 12 months) reported in the Y-14Q data. For a large fraction of borrowers (especially, SMEs), financial data are not updated every quarter, with the reporting rate being the highest in the fourth quarter of each year. Therefore, to maximize the sample size, we use capital expenditures reported in borrowing firms' financial statements for 2019:Q4 and 2020:Q4, which represent 12-month investment in the pre-COVID versus the COVID period, respectively.[41]

Specifically, we estimate the following linear equation of the investment rate I_t/K_{t-1} using firm-level data (with the firm subscript omitted for clarity):

$$\mathrm{I}_t/\mathrm{K}_{t-1} = \beta \cdot \text{Leverage} \times \text{COVID-Crisis} + X'\gamma + \nu, \tag{8}$$

[41]Investment reported in 2020:Q4, includes capital expenditures incurred from January 1, 2020, through March 14, 2020, which falls in our pre-COVID period.

where I denotes capital expenditures, and K is the end-of-period stock of plant, property, and equipment (PPE). The key coefficient of interest is again on the leverage-COVID interaction term. All the regressions include state and 2-digit NAICS industry fixed effects (implicit in the vector X). Some specifications further control for firm characteristics (added to X) that have been found to influence the investment rate. The logarithm of sales measures firm size, while sales growth serves as a proxy for the firm's growth prospects. Profit margin (equal to operating income normalized by total assets) measures the profitability of a firm's operations. Tangibility (equal to the fraction of total assets accounted for by property, plant and equipment) captures the degree to which a firm's assets are tangible assets that can more easily serve as collateral. Liquidity (equal to the ratio of cash plus marketable securities over total assets) measures how much internal liquidity is available to a firm. All of the above firm-level controls are lagged by one year. Unutilized exposure (normalized by the lagged stock of PPE) accounts for the extent of external liquidity, in the form of the undrawn amount of available credit lines, that a firm can tap into quickly should the need arise. For the COVID period, the amount of PPP loans (normalized by lagged PPE) is included as an additional control, since it can substitute for funds that might have been diverted from investment to other expenses.

Table 8 presents the estimated effect of leverage on small firms' investment rates before versus during the COVID period. (See Panel (a) of Table 7 for summary statistics of the estimation sample.) Odd numbered columns in the table correspond to firms in all the industries, while even numbered columns cover only firms in those industries severely impacted by COVID-19. To examine the potential amplification of bank lending on the impact of leverage, we restrict the sample to those firms that had one or more loans maturing during the year in which investment is measured. Columns (1) through (4), which correspond to the pre-COVID period, show that the negative effect of leverage on the investment rate disappears once the additional firm-level controls are included. The influence of every explanatory variable is broadly similar for the industries more adversely affected by COVID compared with the rest of the industries over the pre-COVID period.[42] Large firms tend to have lower investment rates, as do firms with a high ratio of PPE to total assets. Greater profitability and faster sales growth tend to be associated with higher investment rates, but not always significantly. Firms with more unutilized bank liquidity exhibit higher investment rates, suggesting that firms carrying out more investment (relative to the existing capital stock) may take out larger credit lines than the amount routinely utilized to serve as extra liquidity insurance. In other words, liquidity through credit lines can comove with investment even

[42]Note that the slope coefficients from each regression are conditioned on a separate set of 2-digit NAICS industry fixed effects.

Table 7: Summary Statistics for Investment Regressions Estimation Sample

(a) Firms with Sales Less Than or Equal to $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Capital Expenditures	11,526	0.72	3.03	0.00	0.00	0.09	0.47	3.03
Investment Rate	11,526	0.38	0.98	0.00	0.00	0.09	0.35	1.56
Leverage	11,526	2.79	5.03	0.00	0.23	1.17	3.16	10.67
Net Sales	11,526	23.30	11.97	5.95	13.56	21.72	32.22	45.02
Sales Growth	11,526	0.08	0.22	-0.21	-0.03	0.06	0.17	0.47
Profit Margin	11,526	0.15	0.16	-0.00	0.05	0.10	0.20	0.46
Tangibility	11,526	0.22	0.22	0.01	0.04	0.14	0.34	0.71
Liquidity	11,526	0.12	0.14	0.00	0.01	0.06	0.17	0.43
Unutilized Exposure/PPE	11,526	4.10	14.75	0.00	0.00	0.25	1.89	19.05
PPP Loan/PPE	4,191	1.32	2.98	0.00	0.00	0.27	1.17	6.37

(b) Firms with Sales Greater Than $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Capital Expenditures	13,742	126.52	781.37	0.00	0.03	1.70	17.32	434.83
Investment Rate	13,742	0.22	0.37	0.00	0.01	0.12	0.26	0.80
Leverage	13,742	3.36	5.01	0.00	0.63	2.06	4.11	10.62
Net Sales	13,742	1,778.1	5,179.6	57.1	93.1	216.2	881.0	9,666.3
Sales Growth	13,742	0.15	0.75	-0.14	0.00	0.06	0.15	0.48
Profit Margin	13,742	0.11	0.13	0.00	0.04	0.08	0.14	0.32
Tangibility	13,742	0.28	0.25	0.02	0.07	0.21	0.43	0.79
Liquidity	13,742	0.09	0.11	0.00	0.01	0.04	0.13	0.34
Unutilized Exposure/PPE	13,742	1.33	4.05	0.00	0.00	0.17	0.84	6.00
PPP Loan/PPE	5,962	0.23	0.61	0.00	0.00	0.00	0.11	1.41

Note: Capital Expenditures and Sales are in million dollars. Investment Rate is defined as 12-month trailing capital expenditures reported in Q4 of year $t, t = 2019, 2020$ normalized by prior year Q4 capital stock of property, plant and equipment (PPE). Leverage is the ratio of total debt over EBITDA. Sales growth is change in 12-month net sales over prior year net sales. Profit margin is operating income over assets. Tangibility is PPE over total assets. Liquidity is cash plus marketable securities over total assets. Unutilized exposure is the amount of credit lines not yet drawn (utilized). PPP Loan amount is from December 1, 2020 data release by the SBA, matched to Y-14 data by firm name and zip code. Leverage, net sales, sales growth, profit margin, tangibility, liquidity, and unutilized exposure/PPE are all lagged by one year vis-á-vis investment.

though they are generally not the main source of direct funding for investment.

Table 8: Investment Rate by Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) Pre-COVID Investment Rate	(2) Pre-COVID Investment Rate	(3) Pre-COVID Investment Rate	(4) Pre-COVID Investment Rate	(5) COVID Investment Rate	(6) COVID Investment Rate	(7) COVID Investment Rate	(8) COVID Investment Rate
Leverage	-0.50**	-0.38	0.06	-0.21	-0.79**	-0.37	-0.67*	-0.16
	(0.21)	(0.57)	(0.17)	(0.42)	(0.30)	(0.36)	(0.36)	(0.27)
Log(Sales)			-3.31	-4.13			-9.77	-16.79**
			(2.43)	(3.96)			(6.50)	(7.44)
Sales Growth			8.79	12.06			29.51***	22.77*
			(6.10)	(11.39)			(9.90)	(11.20)
Profit Margin			28.19***	23.03			-10.02	22.01
			(9.06)	(20.99)			(6.19)	(19.01)
Tangibility			-77.59***	-69.67***			-68.28***	-66.97**
			(8.11)	(9.11)			(17.78)	(21.98)
Liquidity			-1.09	-15.57			6.97	-10.90
			(10.57)	(15.58)			(14.66)	(15.02)
Unutilized Exposure/PPE			0.73***	0.98**			0.19	0.15
			(0.15)	(0.35)			(0.23)	(0.20)
PPP Loan/PPE							2.05	1.56
							(1.38)	(1.34)
Observations	7,335	2,151	7,335	2,151	4,191	1,272	4,191	1,272
R-squared	0.026	0.038	0.070	0.092	0.036	0.069	0.075	0.106
Impacted Industries Only	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leverage*COVID Crisis Coef.	-	-	-	-	-0.28	0.01	-0.73	0.04
Leverage*COVID Crisis Std. Err.	-	-	-	-	0.47	0.79	0.43	0.58

Note: Dependent variable investment rate I_t/K_{t-1} is defined as 12-month trailing capital expenditures reported in Q4 of year t (I_t) normalized by prior year Q4 capital stock of PPE (K_{t-1}). Coefficients are estimated from linear models. See Table 7 for definition of the independent variables. Only firms with loans maturing in the year of investment are included. Coefficient estimates are multiplied by 100. Pre-COVID period uses annual investment reported as of 2019:Q4 and COVID period uses annual investment as of 2020:Q4. All independent variables are lagged by one year. Robust standard errors multi-way clustered at the state and industry level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table 9: Investment Rate by Firms with Sales Greater Than $50M

VARIABLES	(1) Pre-COVID Investment Rate	(2) Pre-COVID Investment Rate	(3) Pre-COVID Investment Rate	(4) Pre-COVID Investment Rate	(5) COVID Investment Rate	(6) COVID Investment Rate	(7) COVID Investment Rate	(8) COVID Investment Rate
Leverage	-0.27	-0.02	-0.26	-0.09	-0.42***	-0.34***	-0.52***	-0.56***
	(0.19)	(0.17)	(0.17)	(0.19)	(0.08)	(0.10)	(0.14)	(0.10)
Log(Sales)			-1.16***	-1.39			-0.97***	-0.44
			(0.36)	(0.87)			(0.25)	(0.41)
Sales Growth			-0.02	-0.64			0.43	-0.52
			(0.53)	(0.58)			(0.53)	(0.66)
Profit Margin			9.43	9.43			-0.89	-5.33
			(6.83)	(10.54)			(5.34)	(6.07)
Tangibility			-32.19***	-32.22***			-28.72***	-30.06***
			(4.39)	(6.84)			(4.18)	(3.15)
Liquidity			-2.43	-9.13			-5.00	-0.06
			(5.03)	(7.50)			(4.60)	(8.80)
Unutilized Exposure/PPE			0.52***	0.39**			0.42**	0.39
			(0.17)	(0.18)			(0.19)	(0.25)
PPP Loan/PPE							2.34	2.92
							(2.24)	(2.96)
Observations	7,780	3,062	7,780	3,062	5,962	2,298	5,962	2,298
R-squared	0.039	0.051	0.076	0.087	0.042	0.068	0.078	0.111
Impacted Industries Only	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leverage*COVID Crisis Coef.	-	-	-	-	-0.15	-0.33	-0.26	-0.47*
Leverage*COVID Crisis Std. Err.	-	-	-	-	0.23	0.20	0.29	0.22

Note: Dependent variable investment rate I_t/K_{t-1} is defined as 12-month trailing capital expenditures reported in Q4 of year t (I_t) normalized by prior year Q4 capital stock of PPE (K_{t-1}). Coefficients are estimated from linear models. See Table 7 for definition of the independent variables. Only firms with loans maturing in the year of investment are included. Coefficient estimates are multiplied by 100. Pre-COVID period uses annual investment reported as of 2019:Q4 and COVID period uses annual investment as of 2020:Q4. All independent variables are lagged by one year. Robust standard errors multi-way clustered at the state and industry level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Columns (5) through (8) of Table 8 report the corresponding estimates for small firms during the COVID period. Unlike before the pandemic, investment rate during COVID for the all-firm sample declines with higher leverage even when all the firm characteristics are accounted for. Nevertheless, the coefficient on leverage during COVID is not statistically significantly different from its pre-COVID counterpart (see the last row in columns (5) to (8) for the standard error of the difference in the leverage coefficient between the two periods). By comparison, leverage continues to have no effect on investment during COVID for firms in industries more severely impacted by COVID. It may be because the much worse COVID impact on many of these firms' cash flow, along with the enormous uncertainty as a result, overwhelms the influence from financial variables. This may be also why available bank liquidity loses its significance.

Note that the firm-level explanatory variables are lagged by one year, meaning these controls for investment during COVID are measured using *pre-COVID* characteristics, which, for the industries hit hard by COVID, may have particularly poor correlation with the forward-looking component of these variables that firms presumably used to assess the expected returns on investment. Another contributing factor may be that small firms in these hard hit industries were more in need than large firms for investment to adapt their operations to the COVID environment (such as developing e-commerce capabilities), and this necessity overrode the drag from high leverage, as shown in the model.[43] Interestingly, investment during the pandemic is more strongly related to (lagged) sales growth than before, with the relationship marginally significant even for the COVID impacted industries. The amount of PPP loans received by a firm (relative to lagged PPE) is positively but insignificantly correlated with investment rate.

Table 9 presents the large-firm counterpart to Table 8. (See Panel (b) of Table 7 for summary statistics of the estimation sample.) Columns (1) through (4) reveal that leverage does not affect investment among all firms with sales greater than \$50M in 2019, regardless of their vulnerability to COVID. In contrast, leverage exerts a statistically significant negative influence on the investment rate over 2020 across all the industries, even when the other firm attributes are accounted for. In particular, for those COVID impacted industries, the decline in the coefficient on leverage in 2020 relative to 2019 is statistically significant (column (8)).[44] In terms of the other firm attributes, their coefficients exhibit qualitatively the same pattern as for the small firms analyzed above. Firms with larger sales volume generally have a lower investment rate, slightly more so in 2019. Firms whose capital stock accounts for a higher

[43]Recall that this corresponds to a case where return on the investment R is sufficiently high to overcome the defaultable debt cost γ.

[44]The share of COVID-vulnerable firms is about 9 percentage points higher among large firms than among small firms (39% versus 30%) in our Y-14 borrower sample.

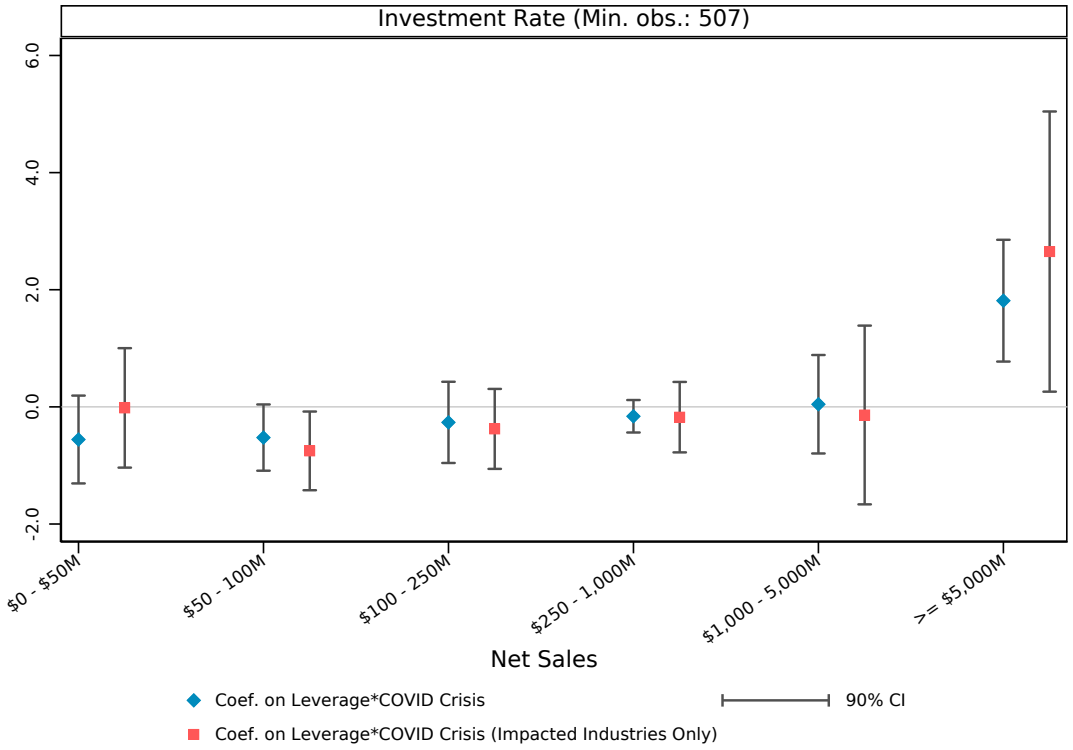
share of total assets show a robustly lower investment rate in both years. Likewise, having more unutilized bank loans is associated with a higher investment rate in 2019, but less so in 2020. Firms receiving larger PPP loans (relative to lagged PPE) tend to have a higher investment rate during COVID, albeit insignificantly so.

To explore in greater detail how the effect of leverage on investment varies across firms of different sizes, we estimate Equation (8) separately for each subgroup of firms within a given range of sales, and compute the change in the coefficient during versus before COVID. These coefficient changes are plotted in Figure 7. When all the coefficients are allowed to vary by firm size, it appears that the *more* negative effect of higher leverage on firm investment found among firms with above $50 million sales (in Table 9) is driven by those firms with sales up to $100 million. The effect of leverage on investment remained statistically the same during COVID relative to before for firms with higher sales, except for those in the largest sales bin ($5 billion or more), whose investment in fact depended less negatively on leverage during COVID. This overall pattern of somewhat more evidence of worsening debt overhang among mid-sized firms during COVID hints at the possibility that, at least for this downturn, these firms may have fallen through the cracks of policy support to some degree.[45] The PPP provided more meaningful assistance to the smallest firms, while the large firms received support from the bond purchase programs, and both sets of programs were able to benefit the target audience broadly. By comparison, the MSLP, which is a loan program intended chiefly to help mid-sized firms, proved much more challenging to administer and seemed to have difficulty reaching mid-sized firms broadly.

To check the robustness of the above estimates, and more accurately account for the fact that around a quarter of the firms report zero investment in a year, we also model the investment rate using Tobit regressions. Tables A.9 and A.10 report the Tobit estimates of the average marginal effect (AME) of leverage and the control variables, corresponding to the linear coefficients presented in Tables 8 and 9, respectively. As would be expected, the magnitudes of the Tobit AMEs are smaller than the linear coefficients, but all the patterns remain qualitatively the same. There is evidence of debt overhang during the pandemic among all the small firms and large firms, as well as those large firms that were severely impacted. However, the effect of leverage on investment is not significantly more negative in 2020 than in 2019. Figure A.4 then reports the Tobit AME estimates by firm size bin, which are the counterparts to the linear coefficients depicted in Figure 7. These Tobit estimates

[45]This contrast is roughly present also in the earlier findings about bank loan margins. During the pandemic, the largest firms (to some extent especially those in the more impacted industries) experienced some easing along several dimensions of bank lending (specifically, loan volume, interest rate spread and the odds of refinancing) whereas mid-sized firms (with sales from $50 to $250 million) experienced slight tightening of loan volume and probability of new origination (see Figure 6).

Figure 7: Changes in Effect of Leverage on Investment Rate across Firm Size Bins: COVID versus Pre-COVID Period



Note: Dependent variable investment rate I_t/K_{t-1} is defined as 12-month trailing capital expenditures reported in Q4 of year t (I_t) normalized by prior year Q4 capital stock of PPE (K_{t-1}). Coefficients are estimated from linear models. See Table 7 for definition of the independent variables. Only firms with loans maturing in the year of investment are included. Coefficient estimates are multiplied by 100. Pre-COVID period uses annual investment reported as of 2019:Q4 and COVID period uses annual investment as of 2020:Q4. All independent variables are lagged by one year.

again verify the overall pattern of the linear coefficients of leverage on investment across firms of different sizes: some evidence of greater overhang among mid-sized firms versus the opposite among the largest firms.

Our earlier finding that small firms with higher leverage experienced a decline in loan volume during COVID relative to the period before seems at odds with the estimate that higher leverage exhibits no additional negative effect on firm investment. One plausible reason is that these firms' investment was supported (indirectly) by funding from the PPP. Another potential reason why C&I loan supply from Y-14 banks may have played a rather limited role in amplifying the impact of high borrower leverage on investment is that these loans are not the main source of external debt financing (especially for investment) for some borrowers. To explore whether Y-14 bank C&I loans matter more for those firms that rely

predominantly on these banks for debt financing, we further restrict the sample to those firms for which 90% or more of total debt is accounted for by the utilized amount of C&I loans from Y-14 banks. Moreover, we examine to what extent the effect of leverage on investment is nonlinear in that only leverage beyond a certain threshold causes problems. The coefficient estimates accounting for these factors are reported in Tables 10 and 11 for large and small firms, respectively.

In our sample, close to 30% (20%) of small firms depend primarily on Y-14 banks for credit before (during) the COVID period. Among these firms, having high leverage exerts a negative effect on investment prior to the onset of COVID, especially among firms that will prove vulnerable to COVID. The magnitude is nontrivial, close to a half of the unconditional sample mean (see columns (2) and (4) in row 1 of Table 10). High leverage, however, has an insignificant effect on investment during the COVID period. By comparison, larger firms are less dependent on Y-14 banks for overall debt funding (about 22% and 15% in the pre-COVID and COVID samples, respectively), as would be expected.[46] Among these large firms, high leverage had an insignificant effect on investment prior to COVID, but exerts a negative effect on investment during the COVID period among firms severely impacted by COVID. Nonetheless, this negative effect is insignificantly different from the pre-COVID estimate (see bottom row of column (8) in Table 11 for the standard error of the coefficient difference).

To sum up, our investigation of the effect of leverage on the investment behavior of nonfinancial firms suggests that higher or high leverage has for the most part not led to a significantly lower investment rate since the COVID outbreak relative to the pre-COVID baseline. In particular, leverage has not become a more serious drag on investment for small firms than for large firms, even among those firms that rely heavily on Y-14 banks for their overall debt funding. One likely reason for these patterns is the unique nature of the pandemic shock along with the unprecedented scale of the public sector support, especially to small businesses. We find some suggestive evidence that the PPP loans helped support investment.

[46] And these are mostly firms with sales below $1 billion, meaning the sample underlying Table 11 is closer to small firms than that underlying Table 9.

Table 10: Investment Rate by Y-14 Bank Reliant Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) Pre-COVID Investment Rate	(2) Pre-COVID Investment Rate	(3) Pre-COVID Investment Rate	(4) Pre-COVID Investment Rate	(5) COVID Investment Rate	(6) COVID Investment Rate	(7) COVID Investment Rate	(8) COVID Investment Rate
Leverage >= 4	-16.85**	-31.34***	-7.99	-19.80***	-9.86	25.06	-5.05	29.25
	(6.14)	(7.90)	(5.04)	(6.01)	(13.89)	(31.34)	(11.97)	(31.50)
Log(Sales)			-5.78	-7.11			-19.16	-37.24
			(4.43)	(7.64)			(11.48)	(30.13)
Sales Growth			12.64	2.50			48.75	-7.77
			(10.73)	(6.68)			(29.63)	(36.22)
Profit Margin			72.86**	81.66*			22.85	139.48
			(30.69)	(40.58)			(42.49)	(91.09)
Tangibility			-109.38***	-106.20***			-116.95***	-141.12*
			(16.61)	(22.36)			(34.96)	(74.96)
Liquidity			21.79	-17.17			7.27	122.00
			(45.56)	(91.19)			(20.06)	(96.63)
Unutilized Exposure/PPE			1.16*	-0.09			0.31	0.33
			(0.66)	(0.29)			(0.27)	(0.31)
PPP Loan/PPE							1.15	-21.93**
							(3.90)	(8.11)
Observations	2,198	688	2,198	688	853	260	853	260
R-squared	0.066	0.056	0.114	0.086	0.113	0.165	0.150	0.232
Impacted Industries Only	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leverage*COVID Crisis Coef.	-	-	-	-	6.99	56.40	2.94	49.05
Leverage*COVID Crisis Std. Err.	-	-	-	-	12.40	32.21	12.42	37.72

Note: Investment rate is defined as 12-month trailing capital expenditures reported in Q4 of year t normalized by prior year Q4 capital stock of PPE. Coefficients are estimated from linear models. See Table 7 for definition of the independent variables. Only includes small firms 1) with loans maturing in the year of investment, and 2) reliant on Y-14 banks for external debt financing, defined as firms whose utilized amount of Y-14 bank loans exceeds 90% of total debt. Coefficient estimates are multiplied by 100. Pre-COVID period uses annual investment reported as of 2019:Q4 and COVID period uses annual investment as of 2020:Q4. All independent variables are lagged by one year. Robust standard errors multi-way clustered at the state and industry level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table 11: Investment Rate by Y-14 Bank Reliant Firms with Sales Greater Than $50M

VARIABLES	(1) Pre-COVID Investment Rate	(2) Pre-COVID Investment Rate	(3) Pre-COVID Investment Rate	(4) Pre-COVID Investment Rate	(5) COVID Investment Rate	(6) COVID Investment Rate	(7) COVID Investment Rate	(8) COVID Investment Rate
Leverage >= 4	4.12	-0.71	3.35	-6.11	1.56	-7.63**	-0.59	-13.13***
	(4.09)	(7.29)	(3.18)	(3.78)	(10.49)	(3.01)	(10.14)	(3.20)
Log(Sales)			-2.89***	-5.49**			-2.63	-6.30
			(0.90)	(2.04)			(2.62)	(4.75)
Sales Growth			2.27	0.47			22.62*	1.96
			(5.62)	(4.68)			(12.47)	(13.97)
Profit Margin			35.35***	33.22**			2.57	-6.06
			(12.17)	(11.26)			(5.37)	(17.32)
Tangibility			-32.26***	-37.99**			-49.80**	-59.49**
			(6.03)	(13.90)			(20.19)	(24.47)
Liquidity			-6.68	-20.02			-20.28	-8.35
			(18.31)	(19.81)			(13.29)	(19.13)
Unutilized Exposure/PPE			0.56***	0.91			0.15	-0.11
			(0.18)	(0.80)			(0.15)	(0.22)
PPP Loan/PPE							-1.84	0.93
							(5.23)	(5.17)
Observations	1,682	697	1,682	697	891	335	891	335
R-squared	0.060	0.111	0.094	0.171	0.072	0.192	0.112	0.245
Impacted Industries Only	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leverage*COVID Crisis Coef.	-	-	-	-	-2.55	-6.92	-3.94	-7.02
Leverage*COVID Crisis Std. Err.	-	-	-	-	11.82	7.04	10.52	5.15

Note: Investment rate is defined as 12-month trailing capital expenditures reported in Q4 of year t normalized by prior year Q4 capital stock of PPE. Coefficients are estimated from linear models. See Table 7 for definition of the independent variables. Only includes large firms 1) with loans maturing in the year of investment, and 2) reliant on Y-14 banks for external debt financing, defined as firms whose utilized amount of Y-14 bank loans exceeds 90% of total debt. Coefficient estimates are multiplied by 100. Pre-COVID period uses annual investment reported as of 2019:Q4 and COVID period uses annual investment as of 2020:Q4. All independent variables are lagged by one year. Robust standard errors multi-way clustered at the state and industry level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

6 Conclusion

The COVID-19 pandemic that precipitated turmoil in financial markets in March and April 2020 wreaked havoc on the operations of most US businesses and disrupted the lives of households. Many firms had to scale back their operations substantially or even shut down altogether. With the heavy income loss, the survival of these firms, especially the small ones, was called into question, in particular because many firms had built up considerable debt relative to income even during the calmer times of low interest rates before the pandemic hit. For these firms, the loss of income thus could spell disaster. Even if widespread failures could be avoided, high leverage may still amplify COVID's damage to the real economy and depress the economic recovery afterward in terms of employment, investment, and growth.

Using a loan-level supervisory data set (FR-Y14Q) containing information about the majority of C&I loans issued by US banks with more than $100 billion in assets, we analyze the impact of pre-pandemic corporate leverage on the credit conditions faced by the borrower firms during the pandemic. We find that credit conditions of small firms with high leverage were negatively affected during the pandemic. They received smaller loans and faced a lower probability of being granted new loans by a bank from which they had not borrowed previously. Large borrowers, either existing or new customers of a Y14 bank, were more able to obtain bank loans after the COVID outbreak compared with small firms, regardless of their leverage levels.

The unprecedented public support provided by the US government and the Federal Reserve ameliorated the credit conditions for the most affected firms, especially those small firms that would have otherwise had difficulty accessing liquidity. We find some evidence that those firms with leverage ratios just above the eligibility threshold (of 4x) set for the Main Street New Loan Facilities appear to have switched toward more credit from the largest banks compared with those firms with leverage ratios just below the threshold. This suggests that the public credit support programs likely substituted for private lending by providing credit assistance to the most needy firms, which then conserved valuable balance sheet capacity for private lenders.

Banks entered the COVID crisis with healthy ratios of high-quality capital to weather potentially sizeable losses, thanks largely to the stricter regulatory requirements implemented in the aftermath of the financial crisis. Our analysis finds that banks with larger excess capital cushions at the onset of the pandemic were able to provide more credit to their existing SME customers, in particular those with high leverage and operating in industries severely affected by COVID. However, these better capitalized banks seemed to become less willing to lend to new customers during COVID, perhaps due to greater uncertainty

aversion, which may have been one of the factors motivating them to accumulate a thicker capital buffer in the first place.

In terms of the impact on real activity, higher or high leverage by and large exerted little negative influence on small firms' investment during the pandemic, despite the negative impact of leverage on the amount of bank loans they received, and on their chances of borrowing from a bank with which they did not have a previous relationship. By comparison, there is slightly more evidence that leverage deterred investment by mid-sized firms. This pattern is consistent with the understanding that the extraordinary funding and lending support from the fiscal and the monetary authorities in response to the COVID shock meaningfully improved the credit conditions faced by small firms. These firms were able to substitute public funding for private bank loans and continue to make the necessary investment. By comparison, mid-sized firms may not have received as much support and thus exhibited more evidence of debt overhang. The special nature of this shock—due to a pandemic—may also have played a role in our finding that debt overhang discouraged investment being relatively weak: Many firms needed to make investment in order to operate effectively and safely in a new environment (such as to enable remote work and implement health safety measures) and meet new consumer demand (such as to build or expand e-commerce).

Overall, our findings highlight the importance of policy measures that support the flow of credit or even grants to small businesses, including those with relatively high leverage but nevertheless viable in the long run, following a severe exogenous adverse shock. In this regard, our results suggest that mid-sized firms may have received less assistance than the rest, and thus have suffered more from higher pre-COVID leverage. Adequate policy support helps preserve valuable human and relationship capital that is vital for effecting the structural adaptations needed in response to a public health shock such as COVID-19 and for enabling a speedy economic recovery afterward. To this end, our analysis also suggests that a well-capitalized banking sector through rigorous capital regulation during normal times can provide further aid to bank-dependent SMEs to supplement public liquidity facilities directly targeted at more constrained small businesses.

Going forward, several challenges associated with corporate leverage remain. Nearly half of the private firms and more than half of the public firms in the Y-14 data experienced an increase in their total debt balance in 2020:Q4 relative to 2019:Q4, and the magnitude of the increase is especially pronounced among the largest firms. If the recovery in revenue and profit proves less vigorous than anticipated, then, for some of these firms at least, the greater debt burden can still impede their long-run growth, especially as the effect of policy support wanes. Efficient debt modification or resolution thus will likely yet be necessary in order to avoid any nontrivial increase in the share of zombie firms, which have been found

to cast negative spillover effects on their more viable competitors or deter the entry of more efficient new firms. At the same time, the marked increase in the share of nonbank financial institutions participating in loan supply to nonfinancial firms, including SMEs, can render the renegotiation process more complex and costly, potentially raising the risk of either inefficient liquidation or insufficient debt modification. Continued research of these issues should prove fruitful.

References

Alfaro, L., A. Chari, A. N. Greenland, and P. Schott (2020): "Aggregate and Firm-Level Stock Returns During Pandemics, in Real Time," NBER Working Paper 26950.

Almeida, H., M. Campello, B. Laranjeira, and S. Weisbenner (2012): "Corporate Debt Maturity and the Real Effects of the 2007 Credit Crisis," *Critical Finance Review*, 1, 3–58.

Bartik, A. W., Z. B. Cullen, E. L. Glaeser, M. Luca, C. T. Stanton, and A. Sunderam (2020): "The Targeting and Impact of Paycheck Protection Program Loans to Small Businesses," Working Paper 27623, National Bureau of Economic Research.

Bernanke, B. and M. Gertler (1989): "Agency costs, net worth and business fluctuations," *American Economic Review*, 79, 14–31.

Bernanke, B. S., M. Gertler, and S. Gilchrist (1999): "The financial accelerator in a quantitative business cycle framework," in *Handbook of Macroeconomics*, Elsevier, vol. 1, chap. 21, 1341–1393.

Berrospide, J., A. Gupta, and M. P. Seay (2021): "Un-used Bank Capital Buffers and Credit Supply Shocks at SMEs during the Pandemic," FEDS Working Paper No. 2021-43.

Bidder, R., J. Krainer, and A. Shapiro (2017): "De-leveraging or De-risking? How Do Banks Cope with Loss?" Federal Reserve Bank of San Francisco working paper 2017-03.

Blickle, K. and J. a. Santos (2021): "The Costs of Corporate Debt Overhang," SSRN Working Paper.

Bord, V. M., V. Ivashina, and R. D. Taliaferro (2021): "Large banks and small firm lending," *Journal of Financial Intermediation*, 48, 100924.

Bräuning, F. and T. Paligorova (2021): "Uptake of the Main Street Lending Program," Current Policy Perspectives 90326, Federal Reserve Bank of Boston.

Brunnermeier, M. and A. Krishnamurthy (2020): "Corporate Debt Overhand and Credit Policy ," *Brookings Papers on Economic Activity*, Summer, 447–488.

Caglio, C., R. M. Darst, and E. Parolin (2019): "Half-full or half-empty? Financial institutions, CDS use, and corporate credit risk," *Journal of Financial Intermediation*, 40, 100812.

Caglio, C. R., R. M. Darst, and S. Kalemli-Özcan (2021): "Risk-Taking and Monetary Policy Transmission: Evidence from Loans to SMEs and Large Firms," Working Paper.

Chodorow-Reich, G. (2013): "The Employment Effects of Credit Market Disruptions: Firm-level Evidence from the 20089 Financial Crisis," *The Quarterly Journal of Economics*, 129, 1–59.

Chodorow-Reich, G., O. Darmouni, S. Luck, and M. Plosser (2021): "Bank liquidity provision across the firm size distribution," *Journal of Financial Economics*.

Ding, W., R. Levine, C. Lin, and W. Xie (2021): "Corporate immunity to the COVID-19 pandemic," *Journal of Financial Economics*, 141, 802–830.

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

Fahlenbrach, R., K. Rageth, and R. M. Stulz (2020): "How Valuable is Financial Flexibility when Revenue Stops? Evidence from the COVID-19 Crisis," NBER Working Paper 27106.

Gertler, M. and S. Gilchrist (1994): "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms*," *The Quarterly Journal of Economics*, 109, 309–340.

Greenstone, M., A. Mas, and H.-L. Nguyen (2020): "Do Credit Market Shocks Affect the Real Economy? Quasi-experimental Evidence from the Great Recession and "Normal" Economic Times," *American Economic Journal: Economic Policy*, 12, 200–225.

Greenwald, D. L. (2019): "Firm Debt Covenants and the Macroeconomy: The Interest Coverage Channel," SSRN Working Paper 3535221.

Greenwald, D. L., J. Krainer, and P. Paul (2021): "The Credit Line Channel," Working Paper.

Greenwood, R., B. Iverson, and D. Thesmar (2020): "Sizing up Corporate Restructuring in the COVID Crisis," NBER Working Paper.

Hennessy, C. A. (2004): "Tobin's Q, Debt Overhang, and Investment," *The Journal of Finance*, 59, 1717–1742.

Hennessy, C. A., A. Levy, and T. M. Whited (2007): "Testing Q theory with financing frictions," *Journal of Financial Economics*, 83, 691–717.

Ivanov, Ivan, P. L. and T. Whited (2021): "Taxes depress corporate borrowing: Evidence from private firms," IHS Working Paper No. 32.

Kalemli-Özcan, S., L. Laeven, and D. Moreno (2018): "Debt Overhang, Rollover Risk, and Corporate Investment: Evidence from the European Crisis," Working Paper 24555, National Bureau of Economic Research.

Kiyotaki, N. and J. Moore (1997): "Credit Cycles," *Journal of Political Economy*, 105, 211–248.

Kovner, A., S. Luck, and S. An (2020): "Implications of the COVID-19 Disruption for Corporate Leverage," Federal Reserve Bank of New York Liberty Street Economics.

Lamont, O. (1995): "Corporate-Debt Overhang and Macroeconomic Expectations," *The American Economic Review*, 85, 1106–1117.

Luck, S. and J. a. Santos (2019): "The Valuation of Collateral in Bank Lending," SSRN Working Paper No. 32.

Luck, S. and T. Zimmermann (2020): "Employment effects of unconventional monetary policy: Evidence from QE," *Journal of Financial Economics*, 135, 678–703.

Myers, S. C. (1977): "Determinants of corporate borrowing," *Journal of Financial Economics*, 5, 147–175.

Niepmann, F. and T. Schmidt-Eisenlohr (2018): "Global Investors, the Dollar, and U.S. Credit Conditions," .

Appendix

A Data Cleaning

For observations in the regressions for new loan originations (with dependent variables Log(Volume), Spread (BPS), Maturity, or New Borrower): We begin with the full Y-14 data with 13,753,768 observations/loans from 2011:Q3 to 2020:Q4. There is a total of 1,598,612 loans in the period from 2019:Q4 to 2020:Q4, of which 74,107 are new originations. The numbers of loans that remain after each cleaning step are as follows:

1. 55,075 new originations remain after dropping records missing obligor TIN.
2. 37,642 new originations remain after dropping records missing interest rate spread.
3. 18,005 new originations remain after dropping records missing prior year Q4 financial data (any among leverage, sales, profit margin, tangibility, or liquidity), or missing state or industry.
4. 10,641 new originations remain after dropping records with fully undrawn commitments (because these do not report interest rate spread).
5. 10,302 new originations remain after keeping only records with valid maturity dates.
6. 9,930 new originations remain after dropping firms in NAICS Sector 52 (Finance and Insurance).
7. 9,563 new originations remain after dropping records with negative leverage.
8. 2,377 new originations remain after keeping only loans to small firms (with net sales less than or equal to $50M).
9. 2,128 new originations remain after trimming RHS variables Leverage, Log(Sales), Profit Margin, Tangibility, and Liquidity (excluding values that are below the 1st percentile or above the 99th percentile for each variable), as well as dropping singleton observations.

For records in the refinancing regressions (with dependent variables Refinancing Flag and Refinancing Flag (Lines Only)): There is a total of 1,622,141 firm-quarters with loans maturing in the raw Y-14 data, of which 121,684 are in the period from 2019:Q4 to 2020:Q4. The numbers of records that remain after each cleaning step are as follows:

1. 49,747 firm-quarters remain after dropping records missing prior year Q4 financial data (any among leverage, sales, profit margin, tangibility, or liquidity), or missing state or industry.
2. 49,272 firm-quarters remain after dropping firms in NAICS Sector 52 (Finance and Insurance).
3. 45,523 firm-quarters remain after dropping records with negative leverage.
4. 22,035 firm-quarters remain after keeping only small firms (firms with net sales less

than or equal to $50M).

For regressions with dependent variable Refinancing Flag, in addition to 1-4 above:

1. 20,648 firm-quarters remain after trimming RHS variables Leverage, Log(Sales), Profit Margin, Tangibility, and Liquidity (excluding values that are below the 1st percentile or above the 99th percentile for each variable), as well as dropping singleton observations.

For regressions with dependent variable Refinancing Flag (Lines Only), in addition to 1-4 above:

1. 19,469 firm-quarters remain after keeping only firms who have a maturing credit line in a quarter.
2. 18,413 firm-quarters remain after trimming RHS variables Leverage, Log(Sales), Profit Margin, Tangibility, and Liquidity (excluding values that are below the 1st percentile or above the 99th percentile for each variable), as well as dropping singleton observations.

For observations in the regressions for all loans (with dependent variables Utilization Rate): We begin with the full Y-14 data with 13,753,768 observations/loans from 2011:Q3 to 2020:Q4. There are a total of 1,598,612 loans in the period from 2019:Q4 to 2020:Q4, of which 703,809 are lines of credit. The number of loans that remain after each cleaning step are as follows:

1. 648,114 loans remain after keeping only those loans originating before COVID period (prior to March 15, 2020).
2. 508,064 loans remain after keeping only those loans maturing after the end of 2020.
3. 414,413 loans remain after dropping records missing obligor TIN.
4. 246,509 loans remain after dropping records missing prior year Q4 financial data (any among leverage, sales, profit margin, tangibility, or liquidity), or missing state or industry.
5. 245,621 loans remain after dropping records with missing or negative utilized exposure.
6. 240,397 loans remain after dropping firms in NAICS Sector 52 (Finance and Insurance).
7. 220,402 loans remain after dropping records with negative leverage.
8. 47,423 loans remain after keeping only loans to small firms (with net sales less than or equal to $50M).
9. 43,467 loans remain after trimming RHS variables Leverage, Log(Sales), Profit Margin, Tangibility, and Liquidity (excluding values that are below the 1st percentile or above the 99th percentile for each variable), as well as dropping singleton observations.

B Additional Tables and Figures

Table A.1: Severity of COVID Impact by Industry (2-Digit NAICS)

Sector	Percent of 6-Digit Industries
Agriculture	0.0%
Mining, Oil and Gas Extraction	31.0%
Utilities	6.7%
Construction	3.2%
Manufacturing	12.6%
Wholesale Trade	15.5%
Retail Trade	89.9%
Transportation and Warehousing	78.9%
Information	46.9%
Finance and Insurance	2.4%
Real Estate	29.2%
Professional Services	75.0%
Management	0.0%
Administrative Support Services	100.0%
Educational Services	0.0%
Health Care and Social Assistance	0.0%
Arts, Entertainment, and Recreation	80.0%
Accommodation and Food Services	86.7%
Other Services	39.6%
Public Administration	3.4%

Note: This table reports the severity of COVID-19 impact by industry at the 2-digit NAICS level, measured as the share of employment in firms assessed to be subject to Severe or Substantial adverse impact by the pandemic.

Table A.2: Sample Summary Statistics for Regressions of Utilization Rate; Firms with Sales Less Than or Equal to $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Utilization Rate	43,467	46.89	41.43	0.00	0.00	43.00	99.85	100.00
Leverage	43,467	6.36	15.30	0.00	0.35	1.83	5.24	28.23
Sales (USD Million)	43,467	22.80	13.30	2.53	11.89	21.48	33.44	45.65
Profit Margin	43,467	0.14	0.20	-0.01	0.04	0.09	0.18	0.48
Tangibility	43,467	0.25	0.27	0.00	0.04	0.14	0.39	0.86
Liquidity	43,467	0.13	0.15	0.00	0.02	0.07	0.18	0.46

Note: Utilization rate is defined as utilized exposure as percent of committed exposure. Sales is in million dollars. Leverage is calculated as short- and long-term debt over EBITDA. Profit margin is calculated as operating income over assets. Tangibility is calculated as Property, Plants and Equipment over total assets. Liquidity is calculated as current assets minus current liabilities over total assets.

Table A.3: Summary Statistics for Refinancing Regressions Estimation Sample; Firms with Sales Less Than or Equal to $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Refinancing Flag	20,648	0.05	0.21	0.00	0.00	0.00	0.00	0.00
Leverage	20,648	2.96	5.11	0.00	0.21	1.20	3.44	11.80
Sales	20,648	21.84	12.18	4.88	11.88	19.83	30.95	44.48
Profit Margin	20,648	0.15	0.19	-0.01	0.04	0.10	0.19	0.47
Tangibility	20,648	0.21	0.23	0.00	0.03	0.12	0.33	0.72
Liquidity	20,648	0.12	0.15	0.00	0.01	0.06	0.16	0.45

Note: Refinancing flag is a binary variable equal to 1 if a new loan (credit lines or term loans) was originated in a quarter when the firm had at least one loan maturing, and 0 otherwise. All the other variables are defined the same as in Table A.2.

Table A.4: Summary Statistics for Refinancing Regressions (Lines Only) Estimation Sample; Firms with Sales Less Than or Equal to $50M

	Count	Mean	Std. Dev.	p5	p25	p50	p75	p95
Refinancing Flag (Lines Only)	18,413	0.02	0.13	0.00	0.00	0.00	0.00	0.00
Leverage	18,413	2.90	5.09	0.00	0.18	1.13	3.37	11.74
Sales	18,413	21.74	12.01	5.26	12.00	19.67	30.57	44.39
Profit Margin	18,413	0.15	0.18	-0.01	0.04	0.10	0.19	0.47
Tangibility	18,413	0.19	0.22	0.00	0.03	0.10	0.29	0.67
Liquidity	18,413	0.12	0.15	0.00	0.01	0.06	0.16	0.45

Note: Refinancing flag (lines only) is a binary variable equal to 1 if a new credit lines was originated in a quarter when the firm had at least one credit line maturing, and 0 otherwise. Sales is in million dollars. Leverage is calculated as short- and long-term debt over EBITDA. Profit margin is calculated as operating income over assets. Tangibility is calculated as Property, Plants and Equipment over total assets. Liquidity is calculated as current assets minus current liabilities over total assets.

Figure A.1: Rating Distribution of New Originations, Pre-COVID versus COVID Periods

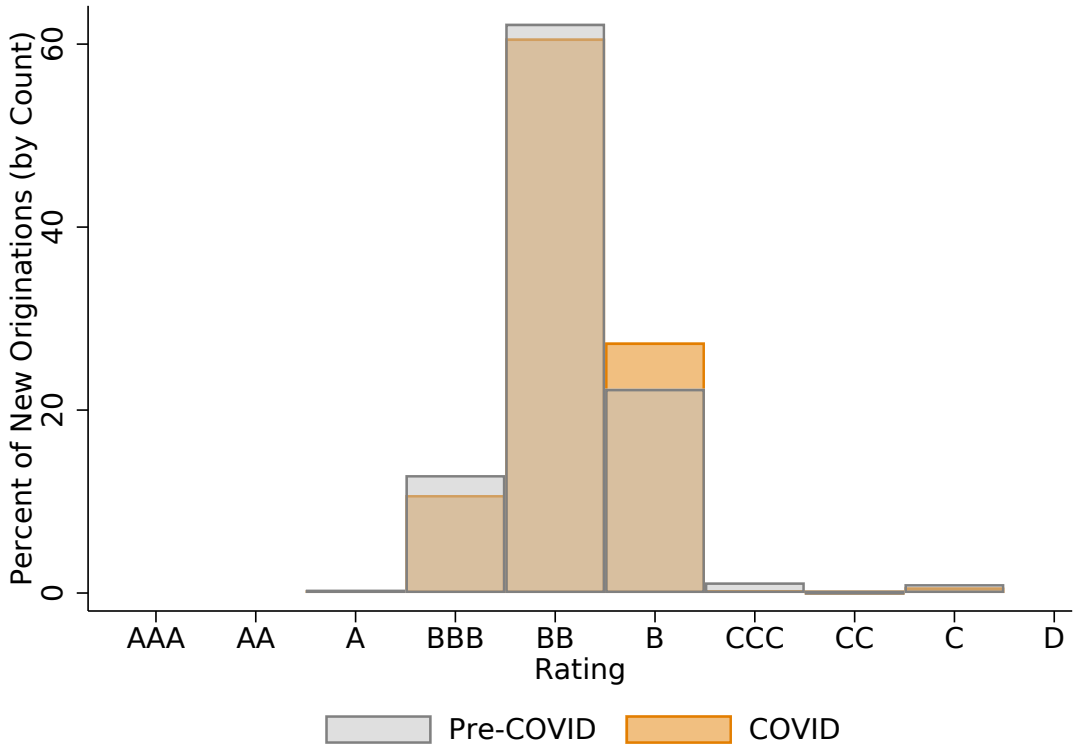
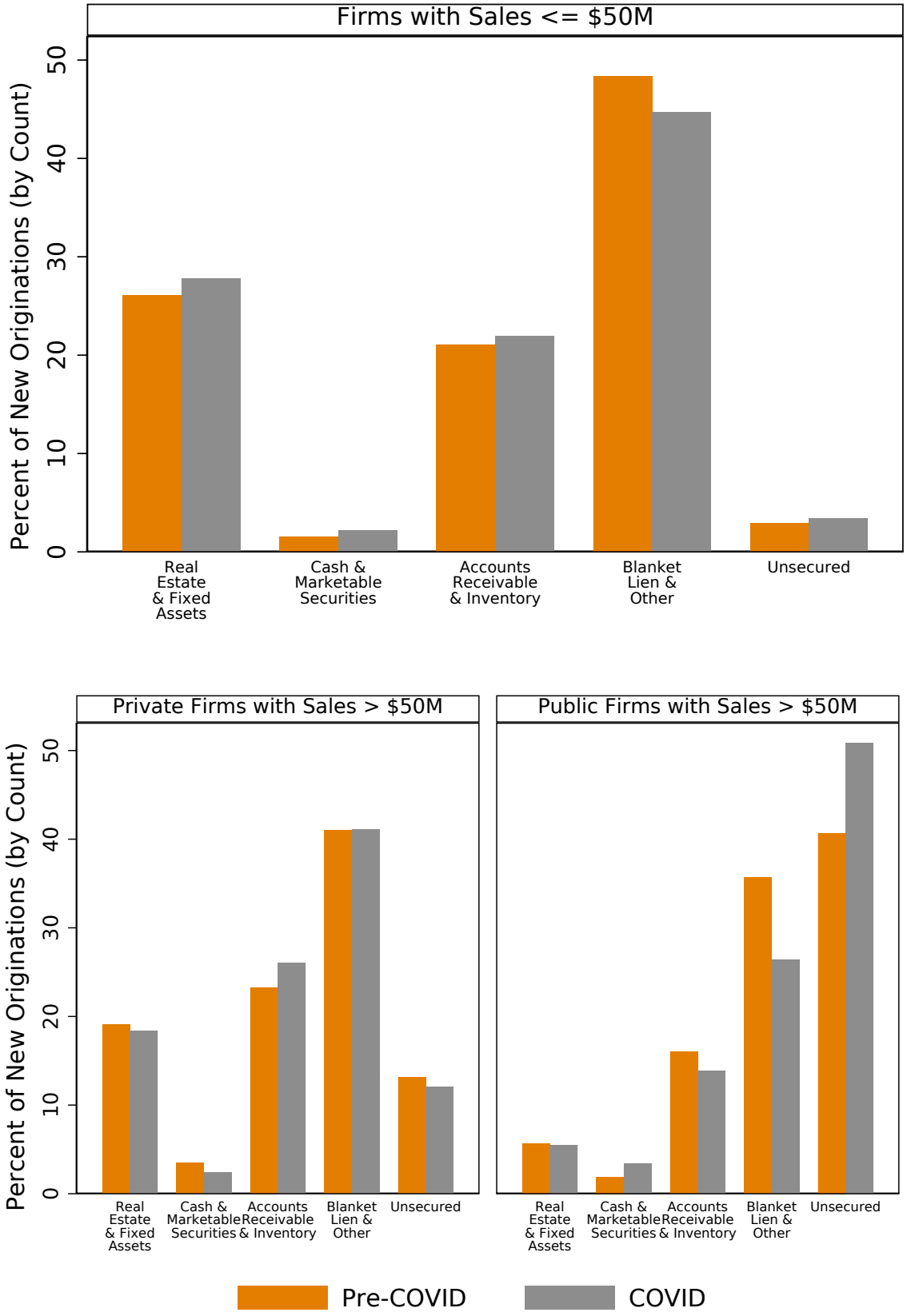


Figure A.2: Collateral Type Bar Chart, by Pre-COVID and COVID Periods



C Additional Regression Estimates

Figure A.3: Extensive and Intensive Margins Regressions: Coefficient on Leverage*COVID Crisis

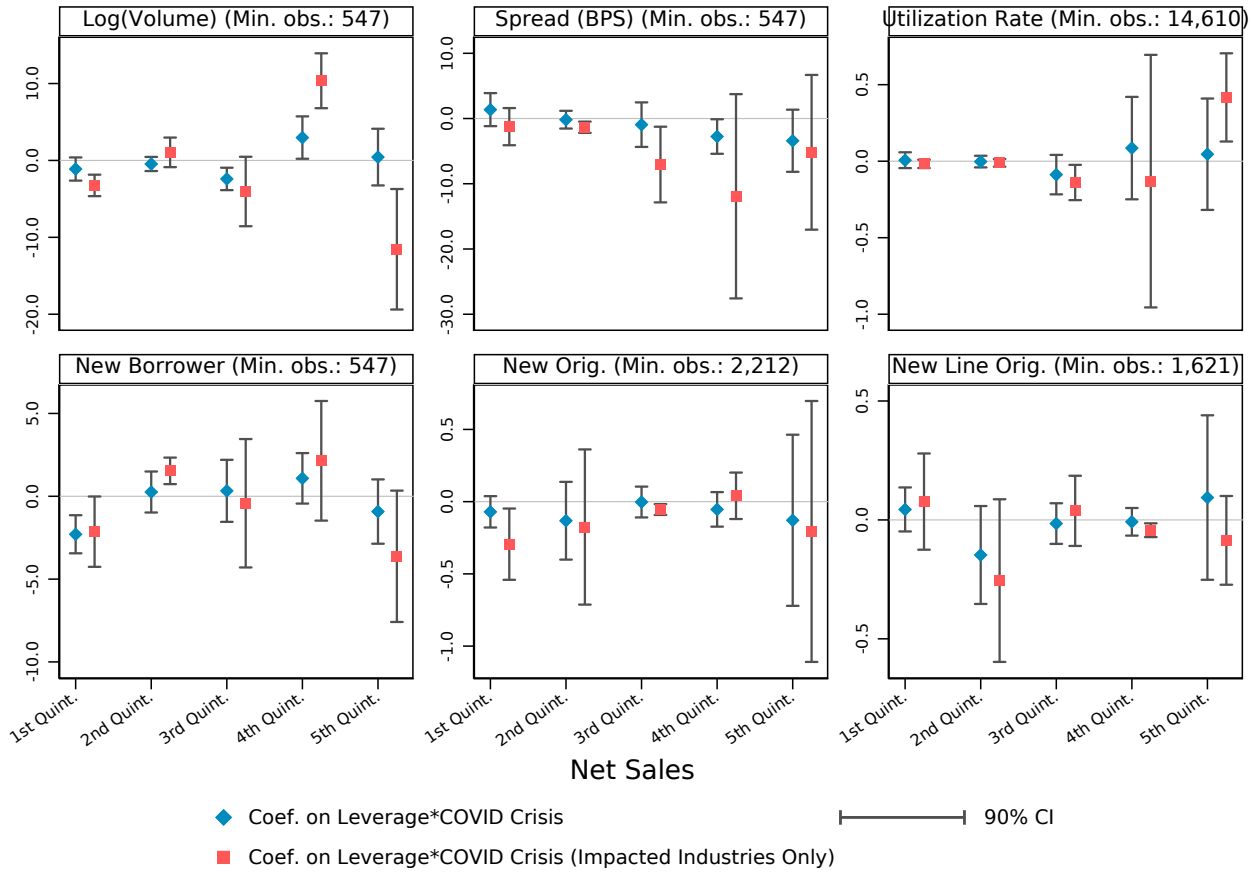


Table A.5: Effects of Leverage along Intensive Margins of Bank Lending with Additional Controls; Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) Log(Volume)	(2) Log(Volume)	(3) Spread (BPS)	(4) Spread (BPS)	(5) Utilization Rate	(6) Utilization Rate
Leverage*COVID Crisis	-1.07	-1.03	1.34	1.00	-0.00	-0.00
	(0.82)	(0.93)	(1.31)	(1.10)	(0.02)	(0.03)
Leverage (Demeaned)	3.47***	3.47***	-1.00	-1.09	0.09***	0.06**
	(0.79)	(0.85)	(0.80)	(0.87)	(0.03)	(0.03)
Log(Sales)*COVID Crisis	-1.18	-1.36	-5.94*	-5.59	-0.47	-0.39
	(3.27)	(3.56)	(3.18)	(4.24)	(0.63)	(0.58)
Log(Sales) (Demeaned)	20.28***	20.69***	-8.32	-8.59	-2.14***	-2.01***
	(3.46)	(3.58)	(5.99)	(5.88)	(0.59)	(0.57)
Profit Margin*COVID Crisis	-8.11	-8.03	-17.20	-18.80	1.46	1.95
	(18.49)	(21.03)	(20.99)	(26.73)	(1.28)	(1.47)
Profit Margin (Demeaned)	-12.02	-13.75	24.81	32.56	-4.05	-2.46
	(9.50)	(14.44)	(17.15)	(20.19)	(2.88)	(2.54)
Tangibility*COVID Crisis	3.60	4.23	-18.69	-14.61	5.54***	5.19**
	(17.67)	(19.27)	(16.06)	(19.89)	(1.84)	(1.98)
Tangibility (Demeaned)	8.93	9.87	-18.70*	-18.16	3.21	4.02
	(14.35)	(14.88)	(10.19)	(12.38)	(2.19)	(2.36)
Liquidity*COVID Crisis	9.88	8.46	-37.63	-24.64	-4.13**	-3.63*
	(49.63)	(51.01)	(34.74)	(36.42)	(1.84)	(2.01)
Liquidity (Demeaned)	-28.26	-26.87	-6.09	-2.41	-4.42	-0.39
	(24.34)	(27.03)	(25.10)	(24.71)	(3.54)	(3.56)
Demand Loan Flag*COVID Crisis					1.35	1.36
					(1.62)	(1.55)
Demand Loan Flag					1.49	1.95
					(4.52)	(4.36)
AAA Rating*COVID Crisis						8.75**
						(3.90)
AAA Rating						20.57***
						(2.41)
AA Rating*COVID Crisis						-6.83
						(4.81)
AA Rating						0.28
						(4.13)
BBB Rating*COVID Crisis		45.50		24.99		-1.03
		(55.97)		(46.47)		(1.62)
BBB Rating		3.41		-38.63		3.78***
		(25.43)		(23.95)		(1.27)
BB Rating*COVID Crisis		44.73		-4.49		-2.10
		(53.71)		(52.14)		(1.29)
BB Rating		11.41		0.44		9.34***
		(24.70)		(22.50)		(1.14)
B Rating*COVID Crisis		36.69		-2.09		-1.45
		(58.96)		(50.75)		(1.67)
B Rating		10.32		24.42		14.15***
		(32.15)		(25.19)		(1.20)
CCC Rating*COVID Crisis		10.60		-70.71		7.91**
		(66.03)		(67.50)		(3.67)
CCC Rating		27.63		94.90		14.31***
		(42.93)		(73.40)		(1.94)
CC Rating*COVID Crisis		8.52		-108.78*		3.80
		(63.86)		(53.34)		(5.55)
CC Rating		-96.75**		193.69***		18.54***
		(35.32)		(35.97)		(5.93)
C Rating*COVID Crisis		68.21		-14.67		0.32
		(75.61)		(76.82)		(3.06)
C Rating		-39.62		85.96**		13.37***
		(60.33)		(38.91)		(1.88)
D Rating*COVID Crisis						-7.18
						(4.16)
D Rating						32.32***
						(3.70)
COVID Crisis	-3.76	-46.18	-14.94	-13.08		
	(7.75)	(52.03)	(9.52)	(55.41)		
Observations	2,128	2,115	2,128	2,115	43,467	43,379
R-squared	0.383	0.388	0.626	0.639	0.643	0.650
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Base-Rate-Type*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Impacted Industries Only	No	No	No	No	No	No

Note: Coefficient estimates for Log(Volume) regressions are multiplied by 100. Interest rate Spread is in basis points (BPS). Utilization Rate is defined as utilized exposure as percent of committed exposure. Leverage is the ratio of total debt over EBITDA. Leverage is the ratio of total debt over EBITDA. COVID-crisis is an indicator that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. A Rating is the omitted category. Demand Loan Flag equals one for credit lines that are immediately callable by lender. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table A.6: Effects of Leverage along Extensive Margins of Bank Lending; Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) New Borrower	(2) New Borrower	(3) Refinancing Flag	(4) Refinancing Flag	(5) Refinancing Flag (Lines Only)	(6) Refinancing Flag (Lines Only)
Leverage*COVID Crisis	-2.21***	-2.07***	-0.06	-0.08*	0.01	-0.01
	(0.43)	(0.54)	(0.04)	(0.04)	(0.04)	(0.04)
Leverage (Demeaned)	0.83	0.79	-0.03	-0.00	-0.03	-0.02
	(0.53)	(0.54)	(0.02)	(0.03)	(0.02)	(0.03)
Log(Sales)*COVID Crisis	0.92	0.92	0.17	0.21	-0.10	0.01
	(2.41)	(2.54)	(0.26)	(0.43)	(0.40)	(0.42)
Log(Sales) (Demeaned)	-7.07**	-7.01**	0.88*	0.90	0.41	0.39
	(2.71)	(3.01)	(0.45)	(0.55)	(0.40)	(0.39)
Profit Margin*COVID Crisis	10.20	9.58	-0.69	-2.24	-0.16	-1.14
	(7.06)	(8.18)	(1.45)	(1.52)	(0.32)	(0.73)
Profit Margin (Demeaned)	-2.13	-2.53	1.63	2.69*	0.10	0.70
	(7.74)	(8.94)	(1.12)	(1.35)	(0.44)	(0.71)
Tangibility*COVID Crisis	5.01	5.06	-2.36	-2.09	0.42	0.61
	(10.74)	(10.80)	(1.54)	(1.64)	(0.78)	(0.88)
Tangibility (Demeaned)	-30.27***	-30.89***	8.29***	7.98***	1.38***	1.07*
	(6.91)	(6.87)	(1.14)	(1.26)	(0.44)	(0.54)
Liquidity*COVID Crisis	-11.95	-13.40	0.89	1.01	0.10	-0.24
	(13.05)	(16.10)	(1.86)	(1.37)	(0.95)	(0.99)
Liquidity (Demeaned)	18.20**	19.11	-3.09*	-3.00**	-2.41*	-1.91
	(8.56)	(11.22)	(1.61)	(1.24)	(1.23)	(1.18)
Refinancing Demand Flag (Lines Only)*COVID Crisis					0.76	0.56
					(0.82)	(0.86)
Refinancing Demand Flag (Lines Only)					98.25***	98.46***
					(0.70)	(0.73)
AAA Rating*COVID Crisis				6.09		0.00
				(5.78)		(0.00)
AAA Rating				-6.64		1.18
				(4.90)		(0.83)
AA Rating*COVID Crisis				0.18		1.18
				(5.50)		(3.25)
AA Rating				-3.26		-1.85
				(5.52)		(3.05)
BBB Rating*COVID Crisis		-73.55		-2.24		1.91
		(52.26)		(2.55)		(2.26)
BBB Rating		25.71		2.60		-1.54
		(38.72)		(1.97)		(2.32)
BB Rating*COVID Crisis		-74.19		-2.83		1.64
		(54.20)		(2.91)		(2.68)
BB Rating		31.17		3.97*		-1.33
		(39.71)		(2.28)		(2.46)
B Rating*COVID Crisis		-82.12		-2.26		1.73
		(51.94)		(2.74)		(2.99)
B Rating		34.64		2.34		-1.17
		(37.75)		(2.24)		(2.87)
CCC Rating*COVID Crisis		-109.82		1.05		4.98
		(64.27)		(4.62)		(3.00)
CCC Rating		21.42		1.46		-3.10
		(62.30)		(3.43)		(2.35)
CC Rating*COVID Crisis		-67.15		-10.25*		1.69
		(64.80)		(5.56)		(4.39)
CC Rating		-18.98		7.59		-1.08
		(52.98)		(5.05)		(3.09)
C Rating*COVID Crisis		-98.25		-1.58		-0.19
		(75.61)		(4.07)		(3.12)
C Rating		35.46		2.22		-0.56
		(61.31)		(3.55)		(2.87)
D Rating*COVID Crisis				-7.87		-7.21
				(7.82)		(7.49)
D Rating				3.77		5.42
				(6.74)		(7.73)
COVID Crisis	1.61	78.77				
	(7.25)	(49.09)				
Observations	2,128	2,115	20,648	19,423	18,413	17,430
R-squared	0.359	0.368	0.037	0.041	0.115	0.122
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	No	No	No	No
Base-Rate-Type*Quarter FE	Yes	Yes	No	No	No	No
Impacted Industries Only	No	No	No	No	No	No

Note: Coefficient estimates are multiplied by 100. New borrower equals one if a newly originated loan is the first between a bank-firm pair, and zero otherwise. Refinancing equals one if a new loan is originated in a quarter when a firm has one or more loans maturing in that quarter, and zero otherwise. Refinancing (lines only) is defined analogously, but for new originations of credit lines only. Leverage is the ratio of total debt over EBITDA. COVID-crisis is a dummy variable that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. A Rating is the omitted category. Refinancing Demand Flag (Lines Only) equals one if a refinanced credit lines is flagged as a demand loan (immediately callable by lender). Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses (bank clustering is dropped when data are at the borrower level); ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table A.7: Effects of High Leverage along Intensive Margins of Bank Lending; Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) Log(Volume)	(2) Log(Volume)	(3) Spread (BPS)	(4) Spread (BPS)	(5) Utilization Rate	(6) Utilization Rate
Leverage >= 4*COVID Crisis	-28.28***	-28.41**	15.80	-13.32	-0.09	-0.20
	(8.18)	(12.67)	(11.16)	(16.48)	(0.96)	(1.04)
Leverage >= 4	55.34***	54.46***	-11.68	-6.55	8.31***	9.28***
	(7.16)	(8.01)	(7.50)	(14.64)	(2.10)	(2.32)
COVID Crisis	7.13	-20.82	-21.81	-2.02		
	(8.64)	(20.57)	(13.45)	(13.27)		
Observations	2,150	756	2,150	756	43,908	16,618
R-squared	0.351	0.527	0.617	0.720	0.640	0.583
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Base-Rate-Type*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Impacted Industries Only	No	Yes	No	Yes	No	Yes

Note: Coefficient estimates for Log(Volume) regressions are multiplied by 100. Interest rate spreads are in basis points (BPS). Utilization rate is defined as utilized exposure as percent of committed exposure. Leverage is the ratio of total debt over EBITDA. COVID-crisis is an indicator that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table A.8: Effects of High Leverage along Extensive Margins of Bank Lending; Firms with Sales Less Than or Equal to $50M

VARIABLES	(1) New Borrower	(2) New Borrower	(3) Refinancing Flag	(4) Refinancing Flag	(5) Refinancing Flag (Lines Only)	(6) Refinancing Flag (Lines Only)
Leverage >= 4*COVID Crisis	-16.55**	-18.99	-0.58	-1.97*	-0.13	-0.57
	(6.65)	(15.27)	(0.56)	(0.92)	(0.49)	(1.15)
Leverage >= 4	5.68	8.91	-0.08	-0.27	0.08	-0.48
	(4.67)	(9.43)	(0.45)	(0.91)	(0.37)	(0.72)
COVID Crisis	3.08	-1.05				
	(6.93)	(14.76)				
Observations	2,150	756	20,853	6,074	18,591	5,208
R-squared	0.330	0.497	0.032	0.061	0.023	0.059
State*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank*Quarter FE	Yes	Yes	No	No	No	No
Base-Rate-Type*Quarter FE	Yes	Yes	No	No	No	No
Impacted Industries Only	No	Yes	No	Yes	No	Yes

Note: Coefficient estimates are multiplied by 100. New borrower is an indicator equal to one if a newly originated loan is the first between a bank-firm pair, and zero otherwise. Refinancing is an indicator equal to one if a new loan is originated in a quarter when a firm has one or more loans maturing in that quarter, and zero otherwise. Refinancing (lines only) is defined analogously, but for new originations of credit lines only. COVID-crisis is a dummy variable that equals 1 from March 15, 2020, to the end of 2020, and zero otherwise. Robust standard errors multi-way clustered at the state, industry, and bank level are in parentheses (bank clustering is dropped when data are at the borrower level); ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table A.9: Investment Rate by Firms with Sales Less Than or Equal to $50M; Tobit Model

VARIABLES	(1) Pre-COVID Investment Rate	(2) Pre-COVID Investment Rate	(3) Pre-COVID Investment Rate	(4) Pre-COVID Investment Rate	(5) COVID Investment Rate	(6) COVID Investment Rate	(7) COVID Investment Rate	(8) COVID Investment Rate
Leverage	-0.45**	-0.19	-0.14	-0.18	-0.42***	-0.01	-0.35**	0.09
	(0.21)	(0.47)	(0.14)	(0.29)	(0.12)	(0.19)	(0.16)	(0.08)
Log(Sales)			-0.45	0.16			-2.97	-5.49
			(1.71)	(1.75)			(3.27)	(3.79)
Sales Growth			5.64	3.29			17.39***	10.32
			(4.09)	(7.06)			(6.32)	(7.92)
Profit Margin			13.78*	9.82			-5.69	15.22
			(7.46)	(13.94)			(5.16)	(11.37)
Tangibility			-44.48***	-44.31***			-36.36***	-38.98***
			(5.57)	(7.10)			(10.48)	(14.24)
Liquidity			3.16	-11.44			8.34	-1.91
			(6.42)	(9.56)			(11.88)	(11.15)
Unutilized Exposure/PPE			0.41***	0.57**			0.08	0.06
			(0.11)	(0.24)			(0.15)	(0.13)
PPP Loan/PPE							1.11	0.92
							(0.94)	(0.92)
Observations	7,335	2,152	7,335	2,152	4,191	1,275	4,191	1,275
Impacted Industries Only	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Compare Leverage AMEs: Chi-squared	-	-	-	-	0.02	0.13	0.83	0.75
P-value	-	-	-	-	0.8844	0.7204	0.3610	0.3878

Note: Average marginal effects are multiplied by 100. Pre-COVID period includes 2019Q4 and COVID period includes 2020Q4. All independent variables are lagged one year. Investment Rate is calculated as current year Q4 capital expenditures divided by prior year Q4 PPE. Robust standard errors multi-way clustered at the industry level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Table A.10: Investment Rate by Firms with Sales Greater Than $50M; Tobit Model

VARIABLES	(1) Pre-COVID Investment Rate	(2) Pre-COVID Investment Rate	(3) Pre-COVID Investment Rate	(4) Pre-COVID Investment Rate	(5) COVID Investment Rate	(6) COVID Investment Rate	(7) COVID Investment Rate	(8) COVID Investment Rate
Leverage	-0.14	0.11	-0.11	0.08	-0.24***	-0.15***	-0.31***	-0.29***
	(0.16)	(0.11)	(0.15)	(0.12)	(0.04)	(0.05)	(0.08)	(0.05)
Log(Sales)			-1.06**	-1.45			-0.52***	0.04
			(0.45)	(1.07)			(0.17)	(0.27)
Sales Growth			-0.41	-1.35*			0.18	-0.57
			(0.62)	(0.72)			(0.35)	(0.35)
Profit Margin			8.58	11.77			-1.05	-3.02
			(7.77)	(13.31)			(3.71)	(3.89)
Tangibility			-19.86***	-19.03***			-18.41***	-21.19***
			(2.55)	(4.67)			(2.90)	(3.58)
Liquidity			-3.78	-9.96			-3.00	0.26
			(4.12)	(7.31)			(2.66)	(5.68)
Unutilized Exposure/PPE			0.35***	0.27*			0.28**	0.25
			(0.10)	(0.14)			(0.13)	(0.18)
PPP Loan/PPE							1.79	2.31
							(1.50)	(1.95)
Observations	7,780	3,062	7,780	3,062	5,963	2,298	5,963	2,298
Impacted Industries Only	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Compare Leverage AMEs: Chi-squared	-	-	-	-	0.33	4.51	0.82	1.09
P-value	-	-	-	-	0.5672	0.0336	0.3660	0.2972

Note: Average marginal effects are multiplied by 100. Pre-COVID period includes 2019Q4 and COVID period includes 2020Q4. All independent variables are lagged one year. Investment Rate is calculated as current year Q4 capital expenditures divided by prior year Q4 PPE. Robust standard errors multi-way clustered at the industry level are in parentheses; ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Figure A.4: Average Marginal Effect of Leverage on Investment Rate: Coefficient Difference, Pre-COVID minus COVID Period