The Usability of Bank Capital Buffers and Credit Supply Shocks at SMEs during the Pandemic*

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Were banks reluctant to use Basel III regulatory capital buffers to support lending to creditworthy SMEs during the COVID-19 pandemic? Confidential U.S. loan-level data show that banks starting the pandemic with "low capital headroom" above the Basel III regulatory buffers (i) reduced SME loan commitments by 10 percent more and (ii) were 11 percent more likely to result in borrower exits, controlling for a host of demand factors. We find credit effects across a variety of industries (comprising up to 21 percent of aggregate SME credit) as well as suggestive evidence of real effects on local employment growth during the pandemic (2 percent slower annually). This study is the first to test the *usability* of Basel III regulatory buffers *in a downturn* and contribute a bank capital-based transmission channel to the SME-pandemic literature.

JEL Codes: G20, G21, G28, D22.

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1. Introduction

> "Since the onset of the pandemic, however, questions have arisen over banks' ability and willingness to use the regulatory buffers available to them ... in a period of stress, banks might react with many of the same procyclical behaviors that we've seen in the past, such as reigning back new business activity."
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> — S&P Global, June 11, 2020[1]

Regulatory reforms implemented after the 2008 global financial crisis (GFC) played a central role in rebuilding banking system capital to the highest level in decades (nearly double that of 2008). Despite the high level of banking system capital and significant government support measures, business lending to small and medium-sized enterprises (SMEs) was strained during the first few quarters of the COVID-19 pandemic. While much of the decline in business lending is attributable to loan demand and credit quality concerns, a key question remains as to whether banks used their large capital cushions built post-GFC to support lending to creditworthy SMEs during the pandemic. Our paper investigates a novel supply-side transmission channel related to the "usability of regulatory capital buffers." Specifically, we explore whether banks that entered the pandemic with capital ratios close to their regulatory capital buffers constrained lending to creditworthy SMEs. Introduced as part of the Basel III capital reforms, regulatory capital buffers are costly regions of "rainy day" equity capital that sit on top of minimum capital requirements and are designed by regulation to act as a buffer to absorb losses and support lending in a downturn.[2] In

[1] In addition, Andrea Enria, chair of the European Central Bank's Single Supervisory Mechanism, stated "There has been a concern that the buffers were not being used and there was a reluctance to use them" (Arnold 2021).

[2] As part of the Basel III capital reforms, the Basel Committee on Banking Supervision (BCBS) introduced a series of measures to promote the buildup of regulatory capital buffers (i.e., the capital conservation buffer, the countercyclical capital buffer, and the capital surcharge for global systemically important banks) in good times that can be drawn upon in periods of stress to support new lending activity. See BCBS (2009). In the U.S. implementation, the Federal Reserve introduced the stress capital buffer as a replacement for the capital conservation buffer. Institutional details on the implementation of regulatory capital buffers in the United States are described in Section 3.

contrast to minimum capital requirements, which are "hard" mandates that activate resolution procedures when breached, regulatory capital buffers represent a "soft" mandate that limits the bank's ability to pay dividends and bonuses until its capital stock is rebuilt. These penalties are intended to act as a warning signal that disincentivizes any unnecessary use of buffers in normal times and allows banks time to recover from unforeseen shocks.

This brings to light an important policy question. To incentivize macroprudential behavior from intermediaries, the optimal design of regulatory capital buffers must ensure that the usage of buffers is *costly enough* that banks do not unnecessarily use them unnecessarily in good times, and *yet not so costly* that they choose not to use them during downturns. In other words, do banks actually view regulatory capital buffers as a capital *cushion* (above minimum requirements), as intended by Basel III? If banks instead find it optimal during downturns to deleverage and maintain an additional cushion above this regulatory capital buffer, then the introduction of regulatory capital buffers into the capital regime becomes economically similar to raising the de facto minimum capital requirements. In this way, it becomes a question of whether banks perceive the "soft" mandate as "harder" than anticipated. We see the pandemic as a downturn that forms the first opportunity in the United States since the introduction of Basel III capital reforms to test this macroprudential question of whether regulatory capital buffers are "usable" in bad times.

At the onset of the pandemic, the Federal Reserve publicly encouraged banks to use these buffers to support the economy during the downturn.[3] However, the prospect of large pandemic-related losses during 2020 appears to have caused banks to reduce the likelihood of dipping into their regulatory buffers in an attempt to avoid incurring associated costs, despite elevated capital levels.[4] Our results are consistent with the notion that banks found these buffers

[3]See https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315b.htm for the official press release.

[4]This regulatory issue expands beyond the case of the United States. In response to the concern that buffers were not be used, the European Central Bank even went as far as to provide pandemic capital relief by temporarily eliminating a significant portion of regulatory capital buffers.

too costly to use.[5,6] The proximity of a bank's capital ratio to its regulatory buffer threshold prior to the pandemic can be seen as a bank-specific measure of how binding the costs of the regulatory buffers were. For ease of exposition, we refer to banks that started the pandemic with a capital ratio relatively close to the regulatory buffer threshold as "low capital headroom" banks. We posit that banks starting the pandemic with low capital headroom were less willing to fully absorb pandemic losses without curbing lending to creditworthy borrowers. This response helps preserve capital headroom and avoids any supervisory costs associated with dipping into regulatory capital buffers. In Section 6, our event-study analysis suggests that the costs of using these buffers can be relatively large during downturns, implying regulatory capital buffers were likely too costly to use during the COVID-19 pandemic.

Figure 1 shows an outsized decline in the number of reported private SME exposures from low capital headroom banks during the pandemic whereas the number for high capital headroom banks remained relatively stable.[7] While some lending relationships may have ended due to pandemic-related demand-side factors, the relative difference between the two lines (high and low capital headroom banks) suggests that a sizable number of SMEs may have experienced credit supply shocks during the pandemic due to the usability of regulatory capital buffers.[8] We highlight a few facts to better understand the characteristics of firms that lost access to credit with low capital headroom banks during the pandemic period (Figure 1, red line). First, the affected firms were relatively small and bank dependent—the median borrower had assets of about \$8 million, and the largest firm had assets of about \$35 million. Nearly all firms in

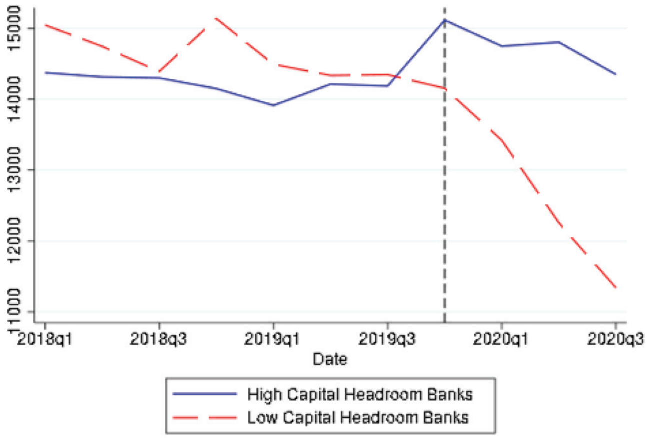
[5]Specifically, there are at least three reasons that the usage of regulatory buffers might prove costly for banks. First, associated dividend restrictions may lead to market stigma concerns for bank shareholders. Second, associated bonus restrictions for executive compensation may prove too costly for bank managers. Third, dipping into regulatory buffers may lead to downgrade risk from credit rating agencies, which can lead to an increase in bank funding costs.

[6]Unlike banks in several other countries, U.S. banks did not dip into their regulatory buffers during the pandemic.

[7]As described in Section 4, we define a firm to be an SME if the firm size is less than the median firm size in the sample as of 2019:Q4.

[8]This is covered more formally in our borrower exit specifications.

Figure 1. Bank Capital Headroom and the Number of SMEs



Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and global systemically important bank (G-SIB) surcharges to calculate the capital headroom.
Note: This plot shows the number of SMEs in the FR Y-14Q by lender type (low versus high capital headroom banks) as of each date. The relative difference between the two lines provides suggestive evidence that many SMEs (borrowing from low capital headroom lenders) exited the FR Y-14Q during the pandemic due to credit supply effects related to the usability of regulatory capital buffers. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

our sample had lending relationships with only one bank. This suggests these firms may have found it costly to substitute toward other sources of financing. Second, the small firms were highly profitable, demonstrating an average return on assets of about 15 percent pre-pandemic. Third, borrower leverage, measured as debt-to-assets, averaged about 30 percent, suggesting this set of firms were prudently managed and not highly leveraged. Lastly, these borrowers were spread across all 50 states and a diverse set of industries. On average, low capital headroom banks lent to less leveraged and more profitable firms, as compared to high capital headroom banks. Taken together, these facts suggest SMEs that banked with low capital headroom banks were creditworthy and may have lost access to credit for reasons other than demand-side considerations.

To examine the finding suggested by Figure 1 more formally, we utilize a novel set of confidential, supervisory loan-level data (FR Y-14Q) between the largest U.S. banks and their corporate borrowers.[9] The granular data provide us with a unique advantage to observe the lending outcomes at an important yet understudied segment of the economy, namely, private SMEs. Although identification of a credit supply effect would ideally compare changes in lending across two banks lending to the same firm (Khwaja and Mian 2008), nearly all private SMEs have a single lender in our data. To overcome the identification challenge for single-bank SMEs, we proceed with two approaches.[10] Firstly, we follow the Degryse et. al (2019) approach and compare the lending of low versus high capital headroom banks to *groups of similar borrower firms*. Specifically, these borrowers are grouped by industry*firmsize*location*time fixed effects.[11] In this way, our analysis shows that the relative closeness of a bank's capital ratio to the costly regulatory buffer region leads to significant changes in credit growth to a variety of firm groups, after controlling for time-varying demand shocks that are common to all firms within each group. We also present evidence of parallel trends for pre-pandemic credit growth across treatment and control groups. Secondly, we provide additional robustness for the purpose of identifying credit supply shocks, by showing evidence that low capital headroom banks contract credit to firms *whose*

[9]Given the minimum loan reporting threshold of USD 1 million, these data exclude small business loans (according to the thresholds defined in Call Reports). Y-14 data also exclude Paycheck Protection Program loan balances.

[10]Another point to note is that while the ex ante size of excess capital headroom may be endogenous with respect to future lending opportunities, these headroom sizes did not incorporate the arrival of the pandemic recession, as it was an unanticipated event. Thus, the size of capital headroom is orthogonal with respect to changes in risk or lending opportunities associated with the unexpected arrival of the COVID-19 pandemic recession.

[11]In both the intensive margin (panel) and borrower exit (cross-sectional) specifications to follow, these firm groups will be implemented via fixed effects. In the panel data specifications, the fixed effects will include an interaction with date, i.e., firmsize*industry*county*date. Please note that instead of the firm*time fixed effects (which would absorb single-bank firms) in the Khwaja and Mian approach, we use firm group*time fixed effects. Here firm groups are defined by size-industry-county combinations. In other words, to include single-bank firms in the estimation, we rely on grouping firms by size*industry*county buckets, as proposed by Degryse et al. (2019).

pre-pandemic credit lines contractually matured at the peak of the pandemic (as compared to similar firms whose credit lines were contractually locked in). This exercise provides additional robustness for the purpose of identifying credit supply shocks, as the selection rule for these treatment firms (firms with maturing credit lines) comes from a predetermined variable (i.e., the maturity of a pre-pandemic contract), which was determined several years prior to the unanticipated arrival of the pandemic. This suggests the results are not driven by changes in loan demand during the pandemic, but rather by a supply-side change in bank credit policies. Specifically, this result is consistent with the notion that banks needing to shed loan exposures (e.g., to avoid using their regulatory capital buffers) find it less costly to cut lending to this specific group of firms from a legal and contractual standpoint. In this way, the lender avoids any costs associated with violating contract terms of a pre-existing commitment. In this way, banks can shed exposures in a cost-efficient manner by choosing not to renew loan commitments to firms whose credit lines are up for renegotiation.[12]

Additionally, we utilize the granularity of the data to explore a second question: did low capital headroom banks curtail lending to certain *types* of firms more than others during the pandemic? First, low capital headroom banks disproportionately curtailed lending to private SMEs while leaving their valuable relationships with large public ("core") clients untouched. Second, low capital headroom banks curbed credit to firms whose lending relationship was relatively young (less than the median relationship age of six years). This is consistent with the literature on relationship lending (Bharath et al. 2011), which attributes a larger termination cost associated with older relationships.

With parallel trends in pre-pandemic commitment growth between low capital headroom banks and high capital headroom banks, we find that SMEs borrowing from low capital headroom banks were up to 11 percent more likely to exit during the pandemic.

[12] Any interpretation of this result as being reflective of loan demand is unlikely, as this would require proposing a story for why firms with pre-existing credit lines that happen to mature during the *unanticipated* arrival of the pandemic would have lower loan demand than firms whose credit lines were contractually locked in during the pandemic.

Furthermore, low capital headroom banks reduced loan commitment growth to SMEs by an average of 10 percentage points more annually during the pandemic than high capital headroom banks did. In aggregate, these credit effects comprise up to 21 percent in terms of aggregate SME commitments.[13] We also present some evidence that reductions in access to credit are associated with real effects at the industry-county level. Since our data do not contain information on firm-level employment, we show that industry-counties that borrowed from low capital headroom banks demonstrate 2 percent slower annualized employment growth during the pandemic as compared to industry-counties without such liabilities.

The evidence presented in our paper suggests regulatory capital buffers act as a "double-edged" policy sword, where the costliness of regulatory capital buffers that incentivized banks to raise their common equity tier 1 (CET1) ratios to historically high levels *during normal times* likely also made buffers *difficult to use during the downturn.* In a general sense, our findings uncover a novel transmission channel emanating from constraints related to bank capital that led to credit supply shocks during the pandemic, which potentially delayed the economic recovery for private SMEs. Rather than seeing the regulatory capital buffers as a cushion to be drawn upon during a downturn, as intended by Basel III, banks seem to have treated regulatory buffers as de facto minimum requirements. Proposing policy recommendations to improve the usability of capital buffers requires identifying the specific costs associated with their usage that are most binding for banks. As explored in Section 6, potential policy recommendations include improving the transparency of the buffer requirement to reduce market stigma—for example, reassuring market participants and credit-rating agencies that bank decisions to dip into their buffers do not necessarily signal weakness—or providing temporarily relief from the buffer constraint in downturns. Beyond this, if some form of buffer relief is granted, banks may still not find it incentive compatible to use buffers in a

[13] In the appendix, we explore whether borrowers with low capital headroom banks were more likely to source funds from the Paycheck Protection Program (PPP). Our results suggest there is no statistical difference in the likelihood that a low capital headroom bank (versus a high capital headroom bank) substitutes toward PPP lending. This suggests the probability of these credit effects potentially translating into real effects is non-trivial.

downturn if clear forward guidance is not provided about the precise time frame of the relief (Arnold 2021, International Monetary Fund 2021).

Section 2 summarizes related literature, Section 3 provides background on the capital buffer regime under Basel III, Section 4 describes our empirical specifications, Section 5 discusses our main results, Section 6 presents findings from robustness exercises, Section 7 highlights a few policy considerations, and Section 8 concludes.

2. Literature Review and Contribution

New to the COVID-19 literature, our paper uncovers the presence of a *transmission channel emanating from regulatory capital buffer constraints* that significantly impacted SMEs during the pandemic. Complementing studies that document the performance of SMEs during the pandemic, our paper establishes a supply-side transmission channel that likely contributed to a delay in economic recovery after the pandemic. Thus, our study contributes a new bank capital angle to an expanding literature that studies the various effects of the COVID-19 pandemic shock on the condition of private SMEs. For example, Bloom, Fletcher, and Yeh (2021) use survey data on an opt-in panel of around 2,500 U.S. small businesses to assess the impact of COVID-19 and find a significant negative sales impact that peaked with an average loss of 29 percent in sales. Of these, almost a quarter reported losses of more than 50 percent. In addition, they find these impacts to be persistent, as firms reporting the largest sales drops in mid-2020 were still forecasting large sales losses a year later in mid-2021. Gourinchas et al. (2020) estimate the impact of the COVID-19 crisis on business failures among SMEs in 17 countries using a large representative firm-level database. They estimate a large increase in the failure rate of SMEs under COVID-19 of nearly 9 percentage points, absent government support. Alekseev et al. (2020) use survey data collected via Facebook and find that about a quarter of small businesses had access to financing from financial institutions, and most small businesses were reliant on personal savings and informal sources of financing during the pandemic. Kapan and Minoiu (2021) find that despite the unexpected surge in credit line drawdowns at the onset of the COVID-19 pandemic, banks with significant exposures to credit lines tightened their lending standards and cut their commercial and industrial (C&I) loan supply to small businesses. Chodorow-Reich et al. (2020) document that, unlike large firms, SMEs take loans of shorter maturity, have less active maturity management, post more collateral, pay higher spreads, and have higher utilization rates. These facts, in their view, explain why during the pandemic SMEs did not draw down their credit lines as much as large firms did. Strahan and Li (2021) analyze the bank supply of credit under the emergency Paycheck Protection Program and conclude that PPP loans reflect a benefit of bank relationships, as they facilitate firms' access to government-subsidized lending. Our results are consistent and complementary to the findings in these papers, and cover a broader class of firms (those with young lending relationships as well as credit lines maturing at the peak of the pandemic). In addition, our paper contributes a novel bank capital-based *transmission channel* that affected firms during the pandemic due to the procyclical lending response to the usability of capital buffers.

In relation to the literature studying the credit impacts of *"hard-mandate"* capital requirements (Basel Committee on Banking Supervision 2009; Kashyap, Stein, and Hanson 2010; Hanson, Kashyap, and Stein 2011; Acharya, Engle, and Richardson 2012; Admati et al. 2014; Aiyar et al. 2014; Baker and Wurgler 2015; Greenwood et al. 2017), relatively little is known about the effects of new Basel III "soft-mandate" policy tools, such as regulatory capital buffers, *particularly during downturns like the pandemic.*[14] This literature can be categorized into two groups. The first set of papers present evidence on pre-Basel III changes in capital regulation and unequivocally find that higher regulatory requirements reduce bank lending. Jiménez et al. (2017) study bank lending responses to dynamic provisioning experiments in Spain and find that countercyclical regulatory capital buffers help to smooth credit cycles. Using European banking data, Gropp et al. (2019) provide evidence for

[14]Minimum requirements are "hard" mandates that send a bank into resolution when breached. Regulatory capital buffers, on the other hand, are "soft" requirements that impose penalties if breached, while allowing banks time to recover. For example, if the buffer is breached, the bank's ability to pay dividends and bonuses is restricted until its capital stock is rebuilt.

a similar lending response to the 2011 European Banking Authority capital exercise, showing that large European banks (required to maintain a higher capital ratio in the 2011 capital exercise) responded by reducing total asset size, while keeping equity capital and asset risk constant. Behn, Haselmann, and Wachtel (2016) and Fraisse, Lé, and Thesmar (2020) use German and French loan-level data, respectively, to show that banks are more likely to cut lending when capital charges on loans, under Basel II rules, increase. Meanwhile, the second set of papers based on U.S. loan-level data explore the impact of Basel III regulatory capital buffers on lending outcomes *during normal times*. Specifically, Berrospide and Edge (2019) find that the introduction of regulatory capital buffers emanating from stress-test disclosures led to a lower growth in C&I loan commitments, while Favara, Ivanov, and Rezende (2021) find that time variation in global systemically important bank (G-SIB) surcharge regulatory buffers result in significant declines in C&I loan commitments by G-SIBs. As both of these papers concentrate on normal periods, they both contribute the important finding that soft-mandate Basel III regulatory capital buffers did in fact play a key role in getting bank system capital to the historically high levels prior to the arrival of the pandemic. Our paper can be seen as a combination of both categories, as it is the first to empirically test whether the *Basel III* regulatory buffers were in fact usable *during a (pandemic) downturn.* We find evidence pointing to procyclical impacts of regulatory capital buffers during the pandemic downturn, particularly on private SMEs and other non-core firms for which it was relatively cheap to cut lending to. Couaillier et al. (2022) have found evidence for the lending impact of buffer usability during the pandemic in the context of European banks.[15]

Finally, our results also point to a different interpretation of the Basel III regulatory capital buffers. Rather than seeing the

[15]Additionally, several papers have explored the impact of capital buffers on related issues in Europe during the pandemic. Altavilla et al. (2023) note that during the pandemic there was an important complementarity between buffer releases and monetary policy easing. Budnik et al. (2021) focus on the measures taken by supervisors, macroprudential authorities, and national governments. Borsuk, Budnick, and Volk (2020) run a simulation that suggests that banks' use of capital buffers results in higher lending and better economic outcomes.

buffers as a cushion to be drawn upon during a downturn, as originally intended by Basel III, banks seem to be treating the regulatory buffers as higher minimum requirements. Several studies have been conducted to enumerate various possible reasons why banks may or may not find buffers expensive. Abad and Pascual (2022) use market expectations to show that banks only decide to use their buffers if the value creation from a larger loan book offsets the costs associated with a capital shortfall, which the authors find to be a rare occurrence. The April 2021 Global Financial Stability Report (GFSR) from the International Monetary Fund (IMF) addressed the usability of capital buffers and documents that, despite the vital role of capital buffers to ensure continued supply of credit to the real economy, banks remain reluctant to draw down their buffers.[16] Using a sample of 72 large global banks, representing 60 percent of the global banking system's aggregate market capitalization, the report finds that only banks accounting for 5 percent of market capitalization clear the hurdles to use their buffers. Thus, banks seem to lack the economic incentives to dip into their capital buffers, as regulation requires them to rebuild their buffers later. Low returns could make the usability of buffers a costly option if the additional value generated by the new lending does not offset the negative impact from the capital shortfall resulting from using the buffers in the first place. Schmitz et al. (2021) analyze possible stigma effects arising from distribution restrictions associated with a breach in the capital buffers for European banks during the pandemic.[17] Their analysis explores potential negative spillover effects to overall bank funding costs, and finds evidence against this channel. Kleinnijenhuis, Kodres, and Wetzer (2020) point to a lack of usable capital and propose several possible improvements in the current capital framework that could overcome such issues, such as setting clear expectations about the pathway banks should follow to rebuild their buffers post-crisis.

[16] See Chapter 1, "An Asynchronous and Divergent Recovery May Put Financial Stability at Risk," pages 22–25.

[17] On a related note, Dautovic et al. (2021) study the impact of payout restrictions during the pandemic and find that European banks that paid out less than planned tended to have higher loan growth.

3. Capital Ratios and Basel III Regulatory Capital Buffers

This section outlines some background on the CET1 capital ratio and regulatory capital buffers, as implemented in the United States via Basel III. Bank CET1 capital ratios can be split into three parts:

CET1 Capital Ratio = Minimum Requirement + Regulatory Capital Buffers + Excess Headroom.

(i) A regulatory minimum requirement to prevent undercapitalization. Following the Basel III capital rules, this is 4.5 percent for all banks and marks the ("hard" mandate) threshold below which a bank would be deemed insolvent by regulators. If a bank enters this regime, resolution procedures would be set in motion.[18]

(ii) Basel III regulatory capital buffers, such as the G-SIB surcharge, the countercyclical capital buffer (CCyB), and the stress capital buffer.[19] These are costly regions of "rainy-day"

[18]Several papers provide theoretical rationale for why banks find it optimal to maintain an equilibrium level of capital in excess of regulatory minimum requirements. Using a dynamic equilibrium model of relationship lending in which banks are unable to access the equity markets every period and the business cycle determines loans' probabilities of default, Repullo and Suarez (2013) show that banks hold endogenous capital buffers as a precaution against shocks that impair their future lending capacity. Koch, Richardson, and Van Horn (2016) compare optimal capital structure prior to the Great Depression, when no government guarantees existed, versus that of the Great Recession, and suggest that market discipline would have induced the largest U.S. banks to maintain higher capital buffers prior to the 2008 crisis. Baron (2020) further provides support for the case of strengthening countercyclical capital buffers since government guarantees can distort the incentives of banks to raise new equity and affect the dynamics of bank capital structure over the credit cycle. Nier and Zicchino (2008) provide evidence that losses lead to greater pull-back in lending for banks at a lower initial level of capital.

[19]The stress capital buffer (SCB) replaced Basel III's 2.5 percent capital conservation buffer in the United States in 2020 and integrated the Federal Reserve's non-stress regulatory capital requirement with its stress-test-based capital requirement. More specifically, the SCB requirement is calculated as the difference between the banks' starting and minimum CET1 capital ratios under the severely adverse scenario in the supervisory stress test plus four quarters of the bank's planned common stock dividends. It is floored at 2.5 percent.

capital that come with payout and bonus restrictions ("soft" mandate). Whereas the CCyB is symmetric across banks, the G-SIB surcharge and stress capital buffer vary across banks, depending on the bank's risk profile. These buffers are designed to provide added resilience to absorb bank losses in the event of a stress scenario.

(iii) Excess headroom reflects the amount of CET1 capital ratio in excess of the sum of (i) regulatory minimums plus (ii) regulatory buffers. For most large firms, this cushion is typically 3 percent or less. This excess cushion approximates the amount of capital that banks could lose without facing potential payout/bonus restrictions.

For illustrative purposes, Figure 2 depicts a hypothetical bank with a starting CET1 capital ratio of 12 percent. The bank's capital ratio is decomposed into a 4.5 percent Basel III minimum requirement, a 5.5 percent regulatory buffer representing the combination of the stress capital buffer and G-SIB surcharge, and an additional 2 percent headroom. As the bank's CET1 capital ratio declines due to the arrival of pandemic losses (downward-sloping blue line), the right panel of Figure 2 (in red) highlights an important choice the bank has to make regarding lending decisions. Specifically, the bank has two options:

(i) Shrink (e.g., by constraining credit) in order to remain above the regulatory buffer threshold. This saves the bank any costs associated with dipping into the buffer (i.e., payout restrictions, bonus restrictions, etc.).

(ii) Dip into the regulatory buffers to absorb pandemic losses and continue supporting creditworthy firms through the provision of lending.

Figure 3 presents the evolution of average CET1 headroom through the pandemic. Banks appear quick to replenish their pre-pandemic headroom levels by the third quarter of the pandemic, suggesting credit supply shocks associated with the usability of regulatory capital buffers are likely to be most prominent in the early part of the pandemic.

Figure 2. Visualizing the Bank's Decision to Avoid or Use Regulatory Buffers

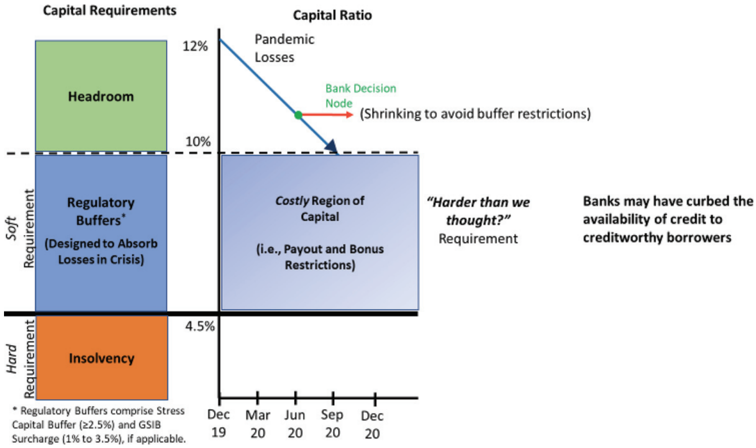
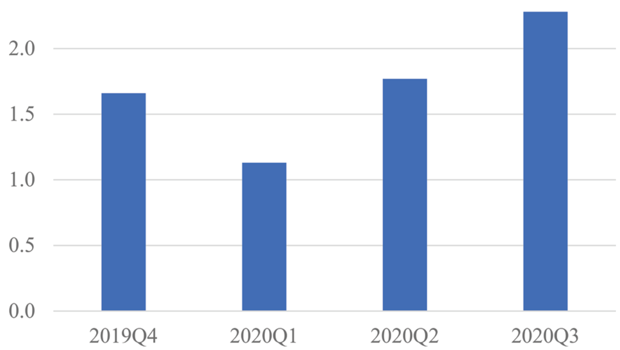


Figure 3. Evolution of CET1 Headroom



Source: FR Y-9C, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This plot shows the time-series evolution of average CET1 headroom across the 16 banks in the sample (weighted by total risk-weighted assets). Banks are quick to replenish their pre-pandemic headroom levels by the third quarter of the pandemic, suggesting credit supply shocks associated with the usability of regulatory capital buffers are likely to be most prominent in the early part of the pandemic.

4. Empirical Approach

4.1 Data Description and Summary Statistics

To perform our regression analysis, we access novel loan-level information on C&I credit lines (at the bank-firm-quarter level) sourced from the H1 Corporate Schedule of the confidential regulatory filing FR Y-14Q, and combine this with quarterly consolidated bank balance sheet level information at the bank holding company (BHC) level from the FR Y-9C regulatory filing. The FR Y-14Q Corporate Schedule is collected for very large BHCs that participate in the Comprehensive Capital Analysis and Review (CCAR) stress tests. While there are over 30 such BHCs that file, we exclude the filings of the U.S. intermediate holding companies (IHCs) of foreign banks, since the capital ratios of IHCs are internal to the organization and thus not subject to the same incentives.[20] In addition, we drop any BHCs that do not report in the FR Y-14Q during the pandemic, or those that have too little C&I loan exposure (i.e., custodian banks). Additionally, to keep the focus on lending outcomes at non-financial corporations, we exclude C&I loans to U.S. and foreign banks, other depository financial institutions, nondepository financial institutions, and loans to financial agricultural production and other loans to farmers. This leaves us with quarterly loan information for 16 domestic U.S. BHCs (413,953 bank-firm-time observations) between 2018:Q1 and 2020:Q3. The data in the FR Y-14Q Corporate Schedule includes loan information at the credit facility level for committed balances greater than or equal to \$1 million.[21] The advantage of using loan commitments is that they include both undrawn and drawn portions of credit facilities. This measure of commitments (rather than on-balance-sheet outstanding loan amounts) is immune to demand-driven swings in credit line drawdowns and repayments and is thus closer to the idea of bank credit supply decisions, compared to most other studies that use outstanding loan amounts.

[20] In addition, the excess headroom of the foreign parent of the IHC (located in the foreign home country) is unknown due to the confidentiality of a particular regulatory capital buffer implemented in Europe, known as the Pillar 2 guidance.

[21] For this reason, FR Y-14Q does not capture very small business lending (<\$1 million USD), and instead captures SMEs as well as large public firms.

The main balance sheet variable of interest that separates the set of treatment and control firms in our baseline specification is the lender's pre-pandemic distance to the regulatory buffer (as of 2019:Q4). This is equivalent to the size of the green excess capital headroom from Figure 2. Note that we use the standardized CET1 ratio in the calculation of the excess capital headroom.[22] As will be elaborated in the next section, we define a bank as being constrained by the regulatory buffer if the distance between its CET1 capital ratio and its regulatory buffer threshold is equal to or less than that of the median (2.14 percent). In other words, we posit that if a bank enters the pandemic with a relatively small headroom to absorb pandemic losses before having to dip into its regulatory buffers (and thereby incur a variety of regulatory costs), that bank may choose to curtail credit in order to avoid incurring any costs from regulatory buffer usage. We consider this a potentially undesirable outcome given that the CET1 ratio before the pandemic was historically high and yet went effectively unused.

Table 1, panel A, provides summary statistics at the bank-firm-time level for the control variables in our analysis across high capital and low capital headroom banks. C&I commitments have grown on average at an annualized rate of 4.33 percent at the bank-firm level. The median CET1 headroom (not shown) is 2.14 percent, underneath which we denote a bank as having low capital headroom. The average bank primarily funds its assets through deposit funding (65 percent), holds a sizable amount of liquid assets on its books (32 percent), and has maintained a quarterly return on assets of about 27 basis points. Panels B and C contain summary statistics for low capital headroom and high capital headroom banks. Compared to high capital headroom banks, low capital headroom banks are, on average, larger in total assets. Low capital headroom banks include primarily complex institutions with significant trading, derivatives, and investment banking activities and a large presence in syndicated loan markets. In contrast, high capital headroom banks are smaller on average, operate with a more traditional banking business model

[22]This is because the stress capital buffer applies to the standardized CET1 ratio, generally making it the more binding risk-based capital requirement, and because standardized CET1 ratios tend to be lower than advanced-approaches CET1 ratios.

Table 1. Summary Statistics

Variable	p10	Mean	p90	Std. Dev.
A. Summary Statistics for All Banks				
Annualized Growth in Commitments (%)	–24.99	4.33	22.22	64.77
CET1 Headroom (%)	1.01	2.04	2.73	0.61
Bank Log Assets	18.74	20.44	21.69	1.18
Bank Deposit Ratio (Dep/Assets) (%)	55.79	65.41	75.82	10.34
Bank Liquid Asset Ratio (Liq. Assets/Assets) (%)	22.15	31.62	39.18	7.26
Bank Provisions to RWA (%)	–0.01	0.06	0.28	0.12
Bank ROA (%)	0.12	0.27	0.37	0.11
Firm Credit Rating	6.00	7.06	8.00	1.13
Firm Leverage (Debt/Assets) (decimal)	0.00	0.33	0.71	0.27
Firm Log Assets	15.31	18.43	22.57	2.75
Firm ROA (decimal), Annual	–0.02	0.09	0.24	0.17
Firm Sales Ratio (Net Sales/Assets) (decimal), Annual	0.28	2.26	4.48	2.01
B. Summary Statistics for Low Capital Headroom Banks				
Annualized Growth in Commitments (%)	–29.91	4.91	31.19	69.58
CET1 Headroom (%)	1.01	1.65	2.14	0.50
Bank Log Assets	20.12	21.34	21.73	0.52
Bank Deposit Ratio (Dep/Assets) (%)	54.56	60.76	71.67	10.60
Bank Liquid Asset Ratio (Liq. Assets/Assets) (%)	33.10	36.80	41.54	3.74
Bank Provisions to RWA (%)	–0.01	0.06	0.28	0.11
Bank ROA (%)	0.11	0.25	0.35	0.11
Firm Credit Rating	6.00	7.05	8.00	1.14

(*continued*)

Table 1. (Continued)

Variable	p10	Mean	p90	Std. Dev.
Firm Leverage (Debt/Assets) (decimal)	0.00	0.31	0.66	0.25
Firm Log Assets	15.37	18.83	22.98	2.86
Firm ROA (decimal), Annual	–0.02	0.09	0.24	0.17
Firm Sales Ratio (Net Sales/Assets) (decimal), Annual	0.26	2.16	4.40	2.01
C. Summary Statistics for High Capital Headroom Banks				
Annualized Growth in Commitments (%)	–20.03	3.51	11.06	57.28
CET1 Headroom (%)	2.44	2.59	2.75	0.13
Bank Log Assets	18.59	19.18	19.91	0.52
Bank Deposit Ratio (Dep/Assets) (%)	67.02	71.99	76.86	5.01
Bank Liquid Asset Ratio (Liq. Assets/Assets) (%)	18.44	24.29	28.70	3.98
Bank Provisions to RWA (%)	–0.02	0.06	0.28	0.13
Bank ROA (%)	0.13	0.29	0.42	0.11
Firm Credit Rating	6.00	7.07	8.00	1.11
Firm Leverage (Debt/Assets) (decimal)	0.00	0.36	0.79	0.28
Firm Log Assets	15.25	17.88	21.69	2.48
Firm ROA (decimal), Annual	–0.03	0.09	0.24	0.17
Firm Sales Ratio (Net Sales/Assets) (decimal), Annual	0.33	2.40	4.58	2.00

Source: FR Y-9C, FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom. Note that the definition of Firm Credit Rating is 1 for NR, 2 for D, 3 for C, 4 for CC, 5 for CCC, 6 for B, 7 for BB, 8 for BBB, 9 for A, 10 for AA, and 11 for AAA.
Note: This table provides summary statistics for key variables in the FR Y-14Q data. The table reports the 10th percentile, mean, 90th percentile, and standard deviation for both BHC variables and firm variables. There are 413,953 bank-firm-time observations, which are spread across 16 lenders and 11 quarters. Low capital headroom banks have 242,498 observations.

(e.g., more reliant on deposits to fund their asset portfolios) and maintain an important regional presence. These banks are similar to high capital headroom banks in terms of loan loss provisions, and larger in terms of asset liquidity. Credit quality, as measured by banks' internal ratings assigned to borrowers, is similar across both bank types, suggesting that neither bank group started the pandemic with significantly riskier lending portfolios. On average, low capital headroom banks lend to less leveraged and equally profitable firms.

One appeal of the FR Y-14Q data set is that it includes a wide range of firms; that is, small and large firms, as well as publicly traded and private firms. Our use of the FR Y-14Q C&I loan-level data is quite novel, as this is the closest data set that the United States has to credit registry data.[23]

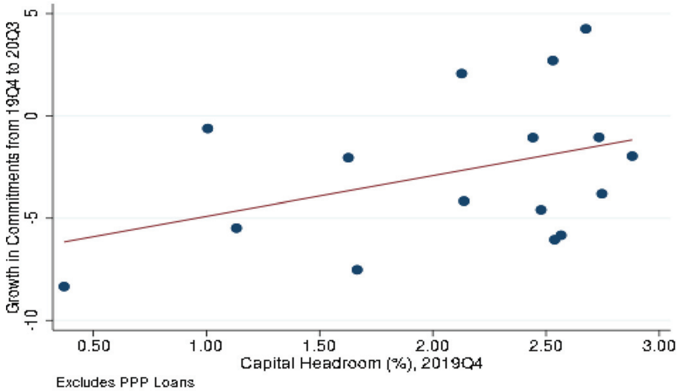
Figure 4 plots the relationship between the size of the capital headroom, measured as of 2019:Q4, versus the subsequent growth in C&I loan commitments during the pandemic period. The figure shows that commitment growth during the pandemic was weaker among banks that had low capital headroom ex ante—that is, those that entered the pandemic with CET1 capital ratios closer to the regulatory buffer.[24]

Next, we plot time trends by comparing C&I commitment growth rates across low versus high capital headroom banks. Suggestive of parallel trends, Figure 5 shows the average commitment growth rates before and after the pandemic for firms that borrow from low capital headroom lenders (red) versus high capital headroom lenders (blue). As shown in the figure, overall C&I commitment growth rates declined significantly after the pandemic, that is, from 2019:Q4 to 2020:Q3. The contraction was more severe for low capital headroom banks than for high capital headroom banks.

[23]While it is true that many studies using bank-borrower data focus on single countries, there are also studies focusing on several euro-area countries, such as Altavilla et al. (2020) and Altavilla et al. (2021).

[24]Please refer to the appendix for further analysis showing that this relation cannot be explained by plotting the pre-pandemic level of the CET1 ratio versus the pandemic commitment growth. Counter to intuition, excess capital cushions are not positively correlated with CET1 ratios.

Figure 4. Capital Headroom and Commitment Growth in the Cross-Section of Banks



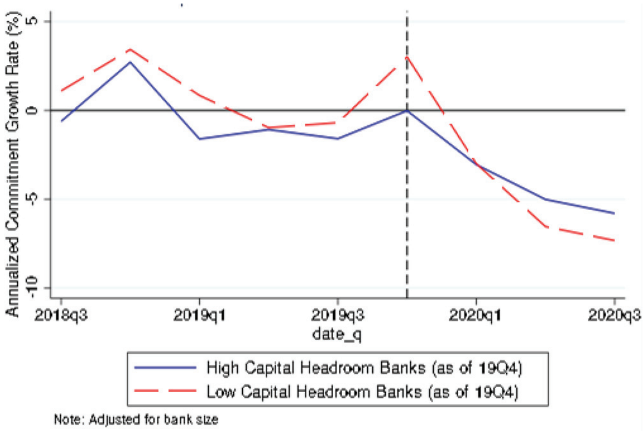
Source: FR Y-9C, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This plot explores credit effects in the cross-section of banks and shows a positive relationship between a bank's capital headroom ex ante to the pandemic (2019:Q4), and its cumulative percentage growth in loan commitments during the pandemic (from 2019:Q4 to 2020:Q3). Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

4.2 Regression Specifications

While using consolidated bank balance sheet data is less suitable for disentangling credit supply from credit demand, to overcome this issue, we use loan-level data on C&I credit lines. To account for all changes in lending, the credit effect analysis is broken into a cross-sectional borrower exit analysis as well as a panel data intensive margin analysis. Our cross-sectional specification for the borrower exit analysis considers the probability that a given pre-pandemic lending relationship ends anytime during the post-pandemic sample period, with all explanatory variables measured as of 2019:Q4. In this way, coefficients reflect a time-aggregated estimate of the total economic magnitude of borrower exits anytime during the pandemic.[25] Our intensive margin analysis uses bank-firm-date level spanning from

[25]For robustness, we show that a panel version of the borrower exit analysis leads to consistent results. These findings are presented in Tables B.1–B.3.

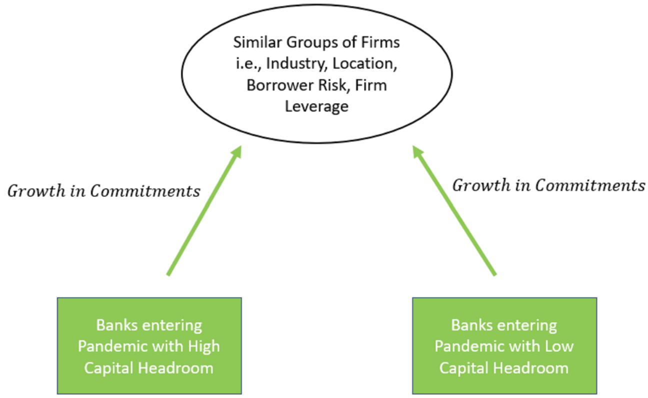
Figure 5. Bank Capital Headroom and C&I Commitment Growth through Time—Intensive Margin



Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This plot shows the time-series variation in average commitment growth across lender type. The average annualized commitment growth rate for low capital headroom banks declines more during the pandemic than that of high capital headroom banks. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

2018:Q1 to 2020:Q3. Because the bulk of firms in the FR Y-14Q data borrow from a single bank, we apply the Degryse et. al (2019) approach to compare the lending of low versus high capital headroom banks to *groups of similar borrowing firms* that are likely to experience common demand shocks (see Figure 6). Specifically, our identification strategy replaces firm fixed effects with firm-type fixed effects in the cross-sectional borrower exit analysis and replaces firm*time fixed effects with firm-type*time fixed effects in the panel data intensive margin analysis. Firm type includes firms grouped by industry*county*firm size (decile). These firm-type and firm-type*time fixed effects allow us to control for demand shocks that are common to firms in the same group in the cross-sectional and panel data analyses, respectively. Moreover, for the panel data specifications, we add bank*firm fixed effects to control for any unobserved characteristics specific to a given bank-firm lending relationship. Beyond including typical firm and bank characteristics as controls,

Figure 6. Empirical Setup



Note: This diagram illustrates our empirical setup, where we compare differences in pandemic-time commitment growth across low and high capital headroom banks. As SMEs typically only have one lender, we extend the Khwaja and Mian (2008) approach and compare the lending of low versus high capital headroom banks to *groups of similar borrower firms*, based on industry*location*size*time fixed effects. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

our regression specifications also control for the share of undrawn credit lines in bank assets and the share of loans granted under the Main Street Lending Program (MSLP) in bank assets.[26] As an alternative identification strategy to isolate credit supply shocks, we also perform a specification that compares lending responses of low and high capital headroom banks across firms whose pre-pandemic credit lines contractually matured at the peak of the pandemic versus firms whose credit lines did not. Here, the selection rule for assigning treatment comes from a predetermined variable (i.e., the maturity of a previous contract), which was made prior to the unexpected arrival of the pandemic and thus uncorrelated with firm-level demand shocks during the pandemic. We also explore whether the usability of capital buffers may have led to real effects. Finally, we conclude with additional robustness exercises for our credit effect results.

[26]In the appendix, we explore whether affected banks substitute to other funding sources, such as the Payment Protection Program (PPP).

4.2.1 Credit Effects (Borrower Exits)

Our first set of specifications study bank credit response with regards to borrower exits, based on Favara, Ivanov, and Rezende (2021). Figure 1 suggests this effect was significant for low capital headroom banks during the pandemic. We categorize banks as either "low capital headroom" or "high capital headroom" using a dummy variable *LowCapitalHeadroomBank*, which takes the value of 1 for banks that had CET1 capital ratios close to the regulatory buffer right before the onset of the pandemic and 0 for those that had CET1 capital ratios far from it. This threshold is based on whether this headroom is above or below the median headroom (2.14 percent) for CCAR banks as of 2019:Q4. Equation (1) below shows our cross-sectional regression specification:

$$\begin{aligned} &BorrowerExit[0/1]_{b,f,2020Q3} \\ &\quad = \beta_0 + \beta_1 LowCapitalHeadroomBank[0/1]_{b,2019Q4} \\ &\qquad + \beta_2\theta + \beta_3 LowCapitalHeadroomBank[0/1]_{b,2019Q4} * \theta \\ &\qquad + \beta_F FirmControls_{f,2019Q4} + \beta_B BankControls_{b,2019Q4} \\ &\qquad + \alpha_{FirmSize*Industry*County\ FEs} + \varepsilon_{bf}, \end{aligned} \tag{1}$$

where *BorrowerExit* is a dummy variable that equals 1 if a given firm f borrowing from bank b exits the FR Y-14Q as of 2020:Q3. The interaction coefficient β_3 captures the differential impact that low capital headroom banks have on the probability that a given borrower ends its lending relationship (exits) during the pandemic (as compared to that of a high capital headroom bank). For Tables 2, 4, and 6, θ takes on each respective element of the following set:

$$\left\{ \begin{matrix} PrivateSME[0/1]_{f,2019Q4},\ YoungRelationshipFirm[0/1]_{b,f,2019Q4}, \\ FirmCredLineMaturinginPandemic[0/1]_{b,f,2019Q4\to 2020Q2} \end{matrix} \right\},$$

where

- $PrivateSME_{f,2019Q4}$ is a dummy variable that equals 1 for all private firms f that are smaller than the median firm size in the sample as of 2019:Q4;

- $YoungRelationshipFirm_{b,f,2019Q4}$ is a dummy variable that equals 1 for all firms f that have maintained a lending relationship with their bank b for less than or equal to the median relationship age (six years), as of 2019:Q4;
- $FirmCredLineMaturinginPandemic_{b,f,2019Q4 \rightarrow 2020Q2}$ is a dummy variable that equals 1 for all firms f in 2019:Q4 whose pre-existing credit facility with bank b is set to contractually mature at the peak of the pandemic, 2020:Q2.

$BankControls_{b,2019Q4}$ include the ratio of bank MSLP loans to assets, ratio of bank MSLP state-level loans to assets, bank undrawn credit line exposure, bank size, share of deposits in assets, ratio of loan loss provisions to risk-weighted assets (RWA), share of liquid assets in total assets, and bank profitability. $Firm\ Controls_{f,2019Q4}$ include the firm probability, firm leverage as measured by the ratio of debt to total assets, firm sales ratio, and firm non-investment credit rating indicator (assigned by the bank).

According to our hypothesis, we expect a positive value for the coefficient β_3 on the interaction term, $LowCapitalHeadroomBank * \theta$. This is consistent with the hypothesis that banks entering the pandemic with relatively little capital headroom above the costly regulatory buffer region are more likely to subsequently reduce credit exposures to specific types of firms (i.e., private SMEs, those with relatively young lending relationships, and those whose pre-existing credit lines are set to mature at the peak of the pandemic) in a way that results in borrower exits.

4.2.2 Credit Effects (Intensive Margin)

Our second set of specifications study the bank lending response along the intensive margin. We categorize banks as either low capital headroom or high capital headroom using the same dummy variable *LowCapitalHeadroomBank* as in the previous subsection. Equation (2) below presents our panel data specification using the growth rate in commitments:

$$\frac{\triangle Commitments_{bft}}{Commitments_{bf,t-1}}$$

$$= \beta_0 + \beta_1 Post[0/1]_t + \beta_2 LowCapitalHeadroomBank[0/1]_{b,2019Q4}$$

$$+ \beta_3\theta + \cdots + \beta_7 Post[0/1]_t * LowCapitalHeadroomBank[0/1]_{b,2019Q4} * \theta$$
$$+ \beta_B BankControls_{b,t-1} + \beta_F FirmControls_{f,t-1}$$
$$+ \varphi_{Bank*FirmFEs}$$
$$+ \alpha_{FirmSizeDecile*Industry*County*DateFEs} + \varepsilon_{bft}, \quad (2)$$

where the "..." includes all pairwise interactions between the three interacting variables. $\frac{\triangle Commitments_{bft}}{Commitments_{bf,t-1}}$ is the growth rate in commitments from bank b to firm f at time t. We annualize this measure. $Post_t$ is a dummy variable that equals 1 starting 2020:Q1 or later. For regression Tables 3, 5, and 7, θ takes on each respective element of the following set:

$$\left\{\begin{array}{c} PrivateSME[0/1]_{f,2019Q4},\ YoungRelationshipFirm[0/1]_{b,f,2019Q4}, \\ FirmCredLineMaturinginPandemic[0/1]_{b,f,2019Q4\rightarrow 2020Q2} \end{array}\right\},$$

where the definitions are the same as in Section 4.2.1.

$BankControls_{b,2019Q4}$ include the ratio of bank MSLP loans to assets, ratio of bank MSLP state-level loans to assets, bank undrawn credit line exposure, bank size, share of deposits in assets, ratio of loan loss provisions to RWA, share of liquid assets in total assets, and bank profitability. $Firm\ Controls_{f,2019Q4}$ include the firm probability, firm leverage as measured by the ratio of debt to total assets, firm sales ratio, and firm non-investment credit rating indicator (assigned by the bank).

For this triple difference-in-differences specifications, we expect a negative estimate for the coefficient β_7, which is associated with the triple interaction term $Post * LowCapitalHeadroomBank * \theta$. A negative coefficient would be consistent with our prediction that low capital headroom banks curb commitments disproportionately more to firms with particular characteristics: private SMEs, those with relatively young lending relationships, and those whose pre-existing credit lines are up for renegotiation at the height of the unanticipated pandemic.

4.2.3 Real Effects

Our third set of specifications explore whether the credit effects analyzed in Sections 4.2.1 and 4.2.2 translate into real effects, particularly for local employment. Data limitations prevent us from testing the impact of low capital headroom on firm-level real outcomes like corporate investment because these variables are infrequently updated for many firms in the FR Y-14Q Corporate Schedule. This is partly because the majority of firms in the data set are private and thus likely only provide updated financial information as and when requested by lenders for the purpose of obtaining bank loans and satisfying bank monitoring procedures. In addition, the FR Y-14Q does not contain data on firm-level employment. Instead, we utilize panel data on local employment growth rates at the industry-county-month level provided by the Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW) as our real outcome variable of interest. We aggregate ex ante (2019:Q4) credit exposures of low capital headroom banks to firms within each industry-county group from the FR Y-14Q data set, and merge these onto the industry-county employment growth series from the BLS QCEW.

Equation (3) below presents our panel data specification that explores whether the usability of regulatory buffers led firms located within industry-county groups (with pre-pandemic exposures to low capital headroom banks) to reduce employment growth more during the pandemic than firms located within industry-county groups (with no pre-pandemic exposures to low capital headroom banks).

$$\begin{aligned}
&\frac{\triangle Employment_{c,i,t}}{Employment_{c,i,t-1}} \\
&\quad = \beta_0 + \beta_1 Post[0/1]_t + \beta_2 LowCapHeadroomBankExposure[0/1]_{c,i,2019Q4} \\
&\qquad + \beta_3 Post[0/1]_t * LowCapHeadroomBankExposure[0/1]_{c,i,2019Q4} \\
&\qquad + \alpha_{IndustryDateFEs} + \gamma_{CountyDateFEs} + \varepsilon_{c,i,t} \qquad (3)
\end{aligned}$$

$\frac{\triangle Employment_{c,i,t}}{Employment_{c,i,t-1}}$ is the growth rate in employment at all firms in industry i located in county c at month t. We annualize this measure. *Post* is a dummy variable that equals 1 starting April 2020 or later. *LowCapHeadroomBankExposure* is a dummy variable that equals 1 if firms in county c and industry i have an aggregated nonzero exposure to low capital headroom banks prior to the pandemic (2019:Q4), and 0 if they have zero credit exposure to low capital headroom banks before the pandemic. We include industry*date and county*date fixed effects to control for demand-side shocks associated with the local county-month business cycle and industry-month trends.

According to our hypothesis, we expect a negative estimate on the β_3 coefficient for the interaction term *Post∗LowCapHeadroomBankExposure*. This would be consistent with our prediction that low capital headroom banks contract credit during the pandemic, leading to potential real effects via the reduction in employment growth at firms located in exposed industry-counties.

5. Results

Tables 2 and 3 show the regression estimates for the borrower exit and intensive margin specifications, respectively, where columns gradually add on bank controls and firm controls within each table. Columns 1 through 3 of Table 2 show the negative and statistically significant impact of *LowCapitalHeadroomBank* on the probability that a given private SME exits the FR Y-14Q (as compared to that of similar firm borrowing from a high capital headroom bank). Specifically, firms borrowing from lenders that entered the pandemic with low capital headroom were up to 11.1 percent more likely to exit during the pandemic. Along the intensive margin, Table 3 shows that low capital headroom banks curtail commitment growth rates to private SMEs by 10.3 percent more annually than high capital headroom banks during the pandemic. These magnitudes are economically meaningful, given that the average growth rate in commitments for all firms across all quarters in the FR Y-14Q is 4.33 percent, as reported in Table 1. Our results point to concerns about potential delays in the economic recovery following the peak of the pandemic, as private SMEs typically incur higher costs in substituting to other sources of financing than do large firms. The fact that low capital headroom banks did not curb credit to large borrowers is consistent with the notion that banks protect relationships with large public borrowers, as those relationships tend to be more valuable (e.g., banks can service multi-line products for large firms).

Figure 7 shows evidence of parallel trends by running a panel data version of the borrower exit specification. Specifically, we follow the methodology for parallel trends used in Kovner and Van Tassel

Table 2. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs—Borrower Exits

Variables	Pr(Borrower Exits during Pandemic) (1)	(2)	(3)
PrivateSME	0.000113	–0.0314***	–0.0205**
LowCapitalHeadroomBank* PrivateSME	**0.131*** **	**0.135*** **	**0.111*** **
LowCapitalHeadroomBank	–0.0969*	–0.103**	–0.0716
Firm ROA			–0.0578***
Firm Leverage			–0.0645***
Firm Sales Ratio			–0.00393**
Firm Non-investment Grade Rating			0.00467***
Bank MLSP Total Loans to Assets		0.00265***	0.00162**
Bank MLSP State-Level Loans to Assets		–0.00244***	–0.00257***
Bank Undrawn Credit Line Ratio		–0.00273***	–0.00395***
Bank Log Assets		–0.00563	–0.0200***
Bank Deposit Ratio		–0.00105***	–7.27e-05
Bank Provisions to RWA		0.0528	0.0190
Bank Liquid Asset Ratio		0.00123	0.00325***
Bank ROA		–0.0434	0.0222
Constant	0.161***	0.375***	0.524***
Observations	46,042	46,042	39,883
R-squared	0.236	0.238	0.253
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	33,259	33,259	28,476

(*continued*)

Table 2. (Continued)

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table presents the regression results for the cross-sectional specification (1), focusing on private SMEs. All observations are as of 2019:Q4. The left-hand-side variable is a dummy variable that equals 1 if a given firm no longer exists in the FR Y-14Q at the end of the sample (2020:Q3). The interaction coefficient captures the differential impact that a low capital headroom bank has on the probability that a given private SME exits during the pandemic (as compared to that of a high capital headroom bank). *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent), as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample. Controls include firm- and bank-level characteristics. All specifications include fixed effects for firm-size-decile*industry*county. Standard errors are clustered by firm. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

(2022) and present the date-specific difference-in-difference coefficients (along with 90 percent confidence intervals) for the private SME subsample. These coefficients capture the relative difference in the probability that any existing SME borrower exits in the next quarter for low versus high capital headroom banks. As shown in the figure, the probability of SME borrower exits is not statistically different pre-pandemic, whereas the probability of exits for SME firms borrowing from low capital headroom banks rose post-pandemic (as compared to SME borrowers of high capital headroom banks).

Figure 8 explores firm entrants versus exits in the FR Y-14Q by lender type. While Figure 1 shows the stock of private SME exposures through time, Figure 8 shows the flow of new firm entrants and old borrower exits quarter by quarter. The top panel shows that low capital headroom banks show a significant widening during the pandemic, with higher borrower exits and lower firm entrants, whereas high capital headroom banks show no such widening.

It is important to note that the borrower exit effects occur across a variety of industries. While Figure 1 shows that low capital headroom banks exhibited larger reductions in private SME relationships during the pandemic (as compared to that of high capital headroom banks), Figure 9 illustrates the generality of this finding, as it holds for a wide variety of SME industries, including Education; Wholesale

Table 3. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs—Intensive Margin

Variables	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized) (1)	(2)	(3)
*Post*LowCapital HeadroomBank*	1.189	0.142	0.245
Post*LowCapital HeadroomBank* PrivateSME	**–9.289*****	**–9.516*****	**–10.28*****
*Post*PrivateSME*	4.780**	5.052**	5.314**
Firm ROA			3.201
Firm Leverage			–10.89***
Firm Sales Ratio			0.599***
Firm Non-investment Grade Rating			–1.772**
Bank MLSP Total Loans to Assets		–0.0845	0.122
Bank MLSP State-Level Loans to Assets		0.528***	0.584***
Bank Undrawn Credit Line Ratio		–0.715**	–0.938***
Bank Log Assets		–5.996	–6.298
Bank Deposit Ratio		0.0566	0.00159
Bank Provisions to RWA		–1.985	–2.142
Bank Liquid Asset Ratio		0.501	0.625*
Bank ROA		–2.610	–3.427
Constant	4.108***	117.7	130.0
Observations	413,935	413,935	365,854
R-squared	0.294	0.294	0.307
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	34,872	34,872	31,764

(*continued*)

Table 3. (Continued)

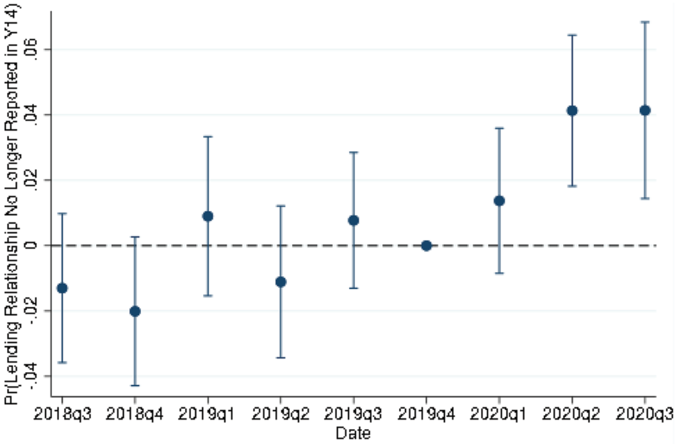
Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the regression results for panel data specification (2), focusing on private SMEs. The interaction coefficient captures the differential impact that a low capital headroom bank has on annualized commitment growth rates (along the intensive margin) to private SMEs (as compared to that of a high capital headroom bank) after the 2020:Q1 arrival of the pandemic. *Post* is a dummy variable denoting 2020:Q1 and after. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample. Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level, span 2018:Q1–2020:Q3, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

Trade; Construction; Food and Textile Manufacturing; Health Care; Information Technology; Technical Services; Retail Trade; Wood, Coal, and Plastics Manufacturing; Transportation; Administrative Services; Mining; Accommodation and Food Services; Machinery and Furniture Manufacturing; and Real Estate.[27] This shows that the issue of usability of regulatory buffers had potentially wide-reaching effects and was not limited to those industries directly affected by the COVID-19 pandemic.

Tables 4 and 5 provide borrower exit and intensive margin analysis estimates for credit supply adjustments with respect to borrowers whose lending relationships are relatively young. We define a lending relationship as relatively young if its age is below the median relationship age for all bank-firm pairs in the FR Y-14Q data (six years or less). Table 4 shows that firms having relatively young lending relationships with low capital headroom banks are 2.6 percent more likely to exit during the pandemic. Additionally, Table 5 shows that

[27]It is important to note that two industries that were highly affected by the pandemic recession were Tourism and Accommodation. Tourism (NAICS 5615) is a subsector within Administrative Services (NAICS 56), and Accommodation (NAICS 7211) is a subsector within Accommodation and Food Services (NAICS 72) in Figure 9.

Figure 7. Bank Capital Headroom and SME Exits

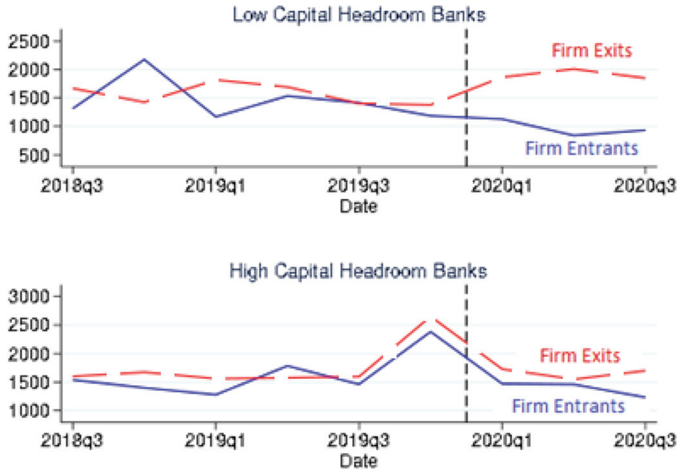


Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This chart presents the time-specific difference-in-difference coefficients $\beta_{2,\tau}$ (along with 90 percent confidence intervals) after estimating a panel data version of specification (1) for the private SME subsample, where the *Post* dummy is replaced by quarterly time dummies. These coefficients capture the relative difference in the probability that a given SME exits the FR Y-14Q in the next quarter for low versus high capital headroom lenders. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

low capital headroom banks reduce annual C&I commitment growth to young relationship firms by roughly 5 percentage points more during the pandemic. This result is consistent with the idea that curtailing credit to borrowers that have a younger relationship with the bank is less costly than incurring the reputational costs associated with curtailing credit to borrowers with older relationships.

Tables 6 and 7 explore the set of firms that have credit lines originated prior to the pandemic that contractually mature in the peak of the pandemic, 2020:Q2. These are the set of firms for which it is least costly (contractually) for a bank to cut lending to, since the bank does not need to break any terms of the pre-existing contract or wait for any covenants to be violated. The bank can simply decline to renew during the contract renegotiation and allow the exposure to costlessly roll off its books. Table 6 shows that such

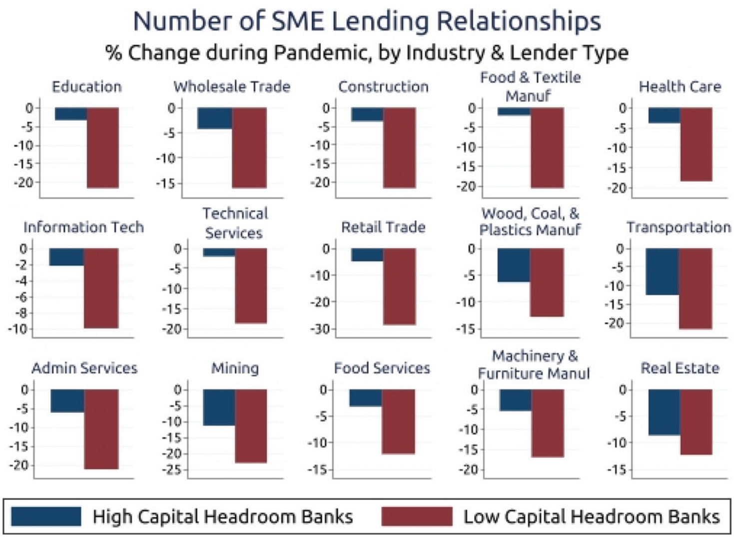
Figure 8. Firm Entry and Exit Flow



Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This plot shows the number of borrower exits and entrants (flow) in the FR Y-14Q for SMEs across low versus high capital headroom banks. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

firms borrowing from low capital headroom banks are 9.6 percent more likely to exit at the peak of the pandemic, while Table 7 shows that low capital headroom banks reduced annual C&I commitment growth to these firms by 33.8 percentage points more during the pandemic (as compared to that of high capital headroom banks). Note the economic significance of this result. This magnitude is expected, as it is consistent with the idea that low headroom banks find it contractually cheaper to curtail lending disproportionately to borrowers entering a renegotiation at an unfavorable bargaining time (COVID-19). Note also that this finding provides additional robustness for the purpose of identifying credit supply shocks since the selection rule for this treatment group of firms comes from a predetermined variable (e.g., the contractual maturity of a pre-pandemic credit line contract), which was set prior to the unexpected arrival of the pandemic downturn. This finding strongly suggests the presence of credit supply effects, as it would be difficult to explain this

Figure 9. Bank Capital Headroom and SMEs by Sector



Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This chart shows the percent change in the number of SMEs during the pandemic, by low versus high capital headroom lender type and by industry. This percent change is measured by counting the total number of private SME borrowers in the FR Y-14Q as of 2019:Q4 and 2020:Q3. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

result using a demand-side story. Tables 4 through 7 show that the credit effects associated with the usability of buffers expand to firms *beyond just SMEs*. Specifically, *any* firm with a young lending relationship or loans maturing at the start of the pandemic qualifies as a less costly option for low capital headroom banks to curtail lending to in order to preserve bank capital most efficiently and avoid the costs of buffer usage.

Table 8 shows the results of the employment growth regression from specification (3), providing suggestive evidence that the credit effects covered in previous tables likely led to real effects. Specifically, it is likely that SME firms borrowing from low capital headroom banks found it difficult to substitute toward other forms of finance and, thereby, may have had to adjust by reducing the growth rate of

Table 4. Differential Credit Effect of Low vs. High Capital Headroom Banks on Young Relationship Firms—Borrower Exits

Variables	Pr(Borrower Exits during Pandemic)		
	(1)	**(2)**	**(3)**
LowCapitalHeadroom Bank	0.0407***	0.00183	0.00721
LowCapitalHeadroomBank*YoungRelationshipFirm	**0.0354***	**0.0328***	**0.0257***
YoungRelationship Firm	0.0465***	0.0466***	0.0370***
Firm Log Assets			–0.0153***
Firm ROA			–0.0556***
Firm Leverage			–0.0677***
Firm Sales Ratio			–0.00371**
Firm Non-investment Grade Rating			–0.0431***
Bank MLSP Total Loans to Assets		0.00255***	0.00149*
Bank MLSP State-Level Loans to Assets		–0.00289***	–0.00429***
Bank Undrawn Credit Line Ratio		–0.00240***	–0.00247***
Bank Log Assets		–0.00447	–0.0219***
Bank Deposit Ratio		–6.58e-05	0.000690**
Bank Provisions to RWA		0.105	0.0795
Bank Liquid Asset Ratio		0.00283***	0.00491***
Bank ROA		–0.0158	0.0479
Constant	0.0827***	0.157*	0.691***

(*continued*)

Table 4. (Continued)

Variables	Pr(Borrower Exits during Pandemic)		
	(1)	**(2)**	**(3)**
Observations	46,042	46,042	39,883
R-squared	0.237	0.238	0.253
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	33,259	33,259	28,476

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table presents the regression results for the cross-sectional specification (1), focusing on young relationship firms. All observations are as of 2019:Q4. The left-hand-side variable is a dummy variable that equals 1 if a given firm no longer exists in the FR Y-14Q at the end of the sample period (2020:Q3). The interaction coefficient captures the differential impact that a low capital headroom bank has on the probability that a given young relationship borrower exits during the pandemic (as compared to that of a high capital headroom bank). *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *YoungRelationshipFirm* is a 0/1 variable denoting if the firm's relationship with its lender (as of 2019:Q4) is smaller than the median relationship age in the sample (six years). Controls include firm- and bank-level characteristics. All specifications include fixed effects for firm-size-decile*industry*county. Standard errors are clustered by firm. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

employment. The difference-in-difference estimate in Table 8 shows that firms in industry-counties that entered the pandemic with non-zero credit exposures to low capital headroom banks reduce their employment by an annualized growth rate of 1.87 percent as compared to firms located in other industry-counties. Figure 10 shows evidence of parallel trends by running a modified version of the employment specification. Specifically, we present the date-specific difference-in-difference coefficients (along with 90 percent confidence intervals) for the employment growth across industry-counties, and show that the coefficients before the pandemic are not statistically different from zero. Notice that the 1.87 percentage point estimate

Table 5. Differential Credit Effect of Low vs. High Capital Headroom Banks on Young Relationship Firms—Intensive Margin

Variables	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
	(1)	**(2)**	**(3)**
*Post*LowCapital HeadroomBank*	–0.42	–1.429	–1.277
Post*LowCapital HeadroomBank* YoungRelationship Firm	**–4.400****	**–4.436****	**–5.020****
*Post*YoungRelationship Firm*	–2.594**	–2.377**	–1.633
Firm Log Assets			–1.889***
Firm ROA			3.139
Firm Leverage			–10.07***
Firm Sales Ratio			0.645***
Firm Non-investment Grade Rating			–1.574**
Bank MLSP Total Loans to Assets		–0.289	–0.105
Bank MLSP State-Level Loans to Assets		0.553***	0.637***
Bank Undrawn Credit Line Ratio		–0.618*	–0.891***
Bank Log Assets		–6.117	–5.967
Bank Deposit Ratio		0.11	0.111
Bank Provisions to RWA		–2.727	–2.654
Bank Liquid Asset Ratio		0.404	0.538
Bank ROA		–2.506	–3.762
Constant	4.343***	118.6	152.8

(*continued*)

Table 5. (Continued)

Variables	**C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)** (1)	(2)	(3)
Observations	465,971	465,971	407,566
R-squared	0.299	0.299	0.312
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	43,487	43,487	38,476

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the regression results for panel data specification (2), focusing on young relationship firms. The interaction coefficient captures the differential impact that a low capital headroom bank has on annualized commitment growth rates (along the intensive margin) to young relationship firms (as compared to that of a high capital headroom bank) after the 2020:Q1 arrival of the pandemic. *Post* is a dummy variable denoting 2020:Q1 and after. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *YoungRelationshipFirm* is a 0/1 variable denoting if the firm's relationship with its lender (as of 2019:Q4) is smaller than the median relationship age in the sample (six years). Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level, span 2018:Q1–2020:Q3, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

from Table 8 embeds the fact that the largest difference-in-difference employment growth effect occurs in the month of May 2020, where industry-counties exposed to low capital headroom banks experienced 6 percentage points slower annualized employment growth (Figure 10). It is also interesting to note that the real effects appear to be large but short term in nature (lasting three months, from May through July of 2020), consistent with the notion illustrated in Figure 3 that the balance sheet constraints and costs emanating from buffer usability were binding in the short term but not in the

Table 6. Differential Credit Effect of Low vs. High Capital Headroom Banks to Firms with Pre-existing Credit Lines Set to Mature at the Peak of the Pandemic—Borrower Exits

Variables	Pr(Borrower Exits during Pandemic)		
	(1)	**(2)**	**(3)**
FirmCredLine Maturingin Pandemic	00422***	0.00713	0.0132
LowCapitalHeadroomBank*FirmCredLineMaturinginPandemic	**0.148*** **	**0.150*** **	**0.0965*** **
LowCapitalHeadroom Bank	0.00968	0.0122	0.0233
Firm Log Assets			–0.0166***
Firm ROA			–0.0503***
Firm Leverage			–0.0533***
Firm Sales Ratio			–0.00377***
Firm Non-investment Grade Rating			0.0463***
Bank MLSP Total Loans to Assets		0.00257***	0.00169**
Bank MLSP State-Level Loans to Assets		–0.00265***	–0.00264***
Bank Undrawn Credit Line Ratio		–0.00308***	–0.00442***
Bank Log Assets		–0.00120	–0.0197***
Bank Deposit Ratio		–0.000935***	0.000170
Bank Provisions to RWA		0.0500	0.0437
Bank Liquid Asset Ratio		0.00140	0.00407***
Bank ROA		0.0596*	0.100***
Constant	0.114***	0.201**	0.730***

(*continued*)

Table 6. (Continued)

Variables	Pr(Borrower Exits during Pandemic)		
	(1)	**(2)**	**(3)**
Observations	46,042	46,042	39,883
R-squared	0.237	0.239	0.254
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	33,259	33,259	28,476

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table presents the regression results for the cross-sectional specification (1), focusing on firms with pre-existing credit lines that were set to mature at the peak of the pandemic. All observations are as of 2019:Q4. The left-hand-side variable is a dummy variable that equals 1 if a given firm no longer exists in the FR Y-14Q at the end of the sample period (2020:Q3). The interaction coefficient captures the differential impact that a low capital headroom bank has on the probability that a firm (whose pre-existing credit line was set to mature during the pandemic) exits during the pandemic (as compared to that of a high capital headroom bank). *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *FirmCredLineMaturinginPandemic* is a 0/1 variable denoting if any portion of the firm's pre-existing credit lines (as of 2019:Q4) was set to mature at the height of the pandemic (2020:Q2). Controls include firm- and bank-level characteristics. All specifications include fixed effects for firm-size-decile*industry*county. Standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

long term, as banks were quick to replenish their headroom beyond pre-pandemic levels within a few quarters.

In summary, we find evidence that low capital headroom banks cut lending disproportionately to private SMEs, young relationship firms, and firms whose prior credit lines were set to mature at the peak of the pandemic (and thus were up for renegotiation). Altogether, these findings are consistent with the idea that a low capital headroom bank optimizes how best to curtail credit by choosing firms for which it is least costly to curtail lending to (even though

Table 7. Differential Credit Effect of Low vs. High Capital Headroom Banks on Firms with Pre-existing Credit Lines Set to Mature at the Peak of the Pandemic—Intensive Margin

	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
Variables	**(1)**	**(2)**	**(3)**
*Post*LowCapital HeadroomBank*	–1.680	–2.536	–2.212
Post*LowCapital HeadroomBank* FirmCredLine Maturingin Pandemic	**–36.47*****	**–36.48*****	**–33.80*****
*2020Q1*FirmCredLine MaturinginPandemic*	–4.844	–4.656	–5.939
Firm Log Assets			–1.949***
Firm ROA			3.827*
Firm Leverage			–11.19***
Firm Sales Ratio			0.636***
Firm Non-investment Grade Rating			–1.756***
Bank MLSP Total Loans to Assets		–0.341	–0.310
Bank MLSP State-Level Loans to Assets		0.662***	0.758***
Bank Undrawn Credit Line Ratio		–0.536	–0.772**
Bank Log Assets		–5.842	–5.765
Bank Deposit Ratio		0.230	0.199
Bank Provisions to RWA		–4.838	–5.553*
Bank Liquid Asset Ratio		0.303	0.418
Bank ROA		0.756	–0.242
Constant	4.638***	106.8	146.4

(*continued*)

Table 7. (Continued)

Variables	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized) (1)	(2)	(3)
Observations	413,953	413,953	365,482
R-squared	0.295	0.295	0.309
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	34,872	34,872	31,755

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the regression results for panel data specification (2), focusing on firms with pre-existing credit lines that were set to mature at the peak of the pandemic. This captures the relative differences across low versus high capital headroom banks in terms of annualized loan commitment growth rates (along the intensive margin) to firms whose pre-existing credit lines were set to mature during the pandemic. *Post* is a dummy variable denoting 2020:Q2. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *FirmCredLineMaturinginPandemic* is a 0/1 variable denoting if any portion of the firm's pre-existing credit lines (as of 2019:Q4) was set to mature at the height of the pandemic (2020:Q2). Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level, span 2018:Q1–2020:Q3, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

the firm is creditworthy), suggesting that regulatory buffers do not appear to be currently working as intended.

We can construct an estimate for the economic magnitude of the credit supply shock associated with usability of regulatory buffers by summing USD amounts for the credit adjustment for the intensive margin and borrower exit analyses. For the first component, our baseline estimate from Table 3, column 3, states that low capital headroom banks curbed lending to SMEs by roughly 10.3

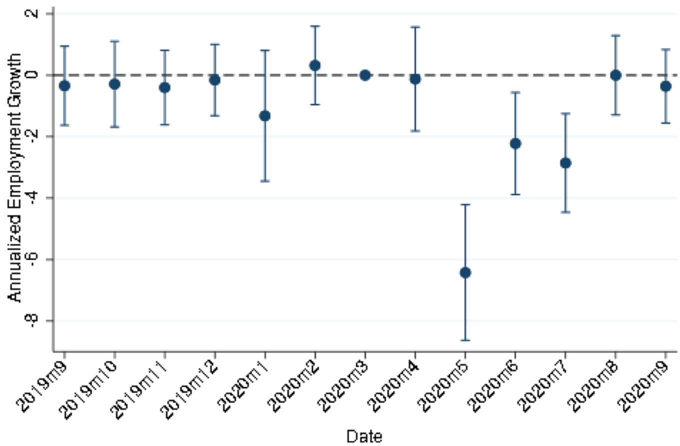
Table 8. Real Effects—Impact of Bank Capital Headroom on Industry-County Employment Growth

Variables	**Employment Growth Rate (Annualized)**
LowCapHeadroomBank Exposure	–0.214
Post*LowCapHeadroom BankExposure	**–1.867*** **
Constant	10.07***
Observations	4,090,347
R-squared	0.265
Industry-Date FE	Y
County-Date FE	Y

Source: FR Y-14Q H1 Schedule, BLS QCEW, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the regression results for the employment growth regression in specification (3). Observations are at the industry-county-month level. Bank-firm loan exposures ex ante to the arrival of the pandemic (2019:Q4) are aggregated to the industry-county level and merged to the monthly employment growth rates reported in the Bureau of Labor Statistics Quarterly Census of Employment and Wages. *Post* is a 0/1 variable denoting if the date is April 2020 or later. *LowCapHeadroomBankExposure* is a 0/1 variable denoting if a given industry-county has non-zero ex ante credit exposure to a low capital headroom lender as of 2019:Q4. County-date and industry-date fixed effects are included. Standard errors are clustered at the county level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

percentage points more (annually) during the pandemic. For the second component, the baseline estimate from Table 2, column 3 shows that SMEs borrowing from low capital headroom banks were 11.1 percent more likely to exit the FR Y-14Q during the pandemic. The total number of SME borrowers associated with low capital headroom banks in the FR Y-14Q H1 Schedule as of 2019:Q4 was 14,155 SMEs comprising $64.8 billion in total commitments. To establish an economic magnitude of the usability of regulatory capital buffers, we estimate that the associated credit supply shock resulted in up to roughly 1,571 SME exits (= 14155*0.111) across a diverse set of industries, comprising a credit contraction between $6.6 billion and

Figure 10. Bank Capital Headroom and Local Employment Growth



Source: FR Y-14Q H1 Schedule, Bureau of Labor Statistics Quarterly Census of Employment and Wages, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This chart shows the time-specific difference-in-difference coefficients $\beta_{2,\tau}$ (along with 90 percent confidence intervals) after estimating a modified version of specification (3), where the *Post* dummy is replaced with month-specific time dummies. These coefficients capture the relative difference each month in employment growth in industry-counties with non-zero ex ante credit exposures to low capital headroom banks (as of 2019:Q4) versus those without such ex ante exposures. Low capital headroom banks are lenders that start the pandemic with a capital ratio relatively close to the regulatory buffer threshold.

\$13.8 billion in total USD commitments.[28] In aggregate, this credit effect comprises anywhere from 10.2 percent (=\$6.6B/\$64.8B) to 21.3 percent of total SME commitments (=\$13.8B/\$64.8B).

6. Robustness Results

In this section, we test the robustness of our results in Section 5. For each test, our central result holds: low capital headroom

[28]\$6.6 Billion = \$64.8 Billion*0.103 (intensive margin), and \$13.8 Billion = \$64.8 Billion*0.103 (intensive margin) + 64.8 Billion*0.111 (borrower exit). The range is due to the fact that the borrower exit estimate of 11.1 percent is an upper-bound estimate of the extensive margin.

Table 9. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs Excluding Smallest Firms—Intensive Margin

	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
Variables	**(1)**	**(2)**	**(3)**
*Post*LowCapital HeadroomBank*	1.319	0.202	0.119
Post*LowCapital HeadroomBank* PrivateSME	**–10.41*****	**–10.80*****	**–10.95*****
*Post*PrivateSME*	4.814*	5.197**	5.309*
Firm ROA			1.549
Firm Leverage			–12.22***
Firm Sales Ratio			0.733***
Firm Non-investment Grade Rating			–2.075**
Bank MLSP Total Loans to Assets		0.02	0.2
Bank MLSP State-Level Loans to Assets		0.473**	0.560**
Bank Undrawn Credit Line Ratio		–0.903***	–1.090***
Bank Log Assets		–5.764	–6.317
Bank Deposit Ratio		0.0767	0.0156
Bank Provisions to RWA		–1.437	–1.648
Bank Liquid Asset Ratio		0.447	0.564
Bank ROA		–2.965	–3.974
Constant	5.335***	117.1	135.4

(*continued*)

Table 9. (Continued)

	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
Variables	**(1)**	**(2)**	**(3)**
Observations	375,603	375,603	333,877
R-squared	0.309	0.31	0.321
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	30,763	30,763	28,053

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This robustness table reports the regression results for panel data specification (2), focusing on SMEs, while dropping all observations that contain borrowers in the lowest decile of the firm size distribution. The interaction coefficient captures the differential impact that a low capital headroom bank has on annualized commitment growth rates (along the intensive margin) to private SMEs (as compared to that of a high capital headroom bank) after the 2020:Q1 arrival of the pandemic. *Post* is a dummy variable denoting 2020:Q1 and after. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample, and excludes commitments that are within the first decile. Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level, span 2018:Q1–2020:Q3, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

banks disproportionately reduced their lending to SMEs, firms with recently established lending relationships, and firms with credit lines that expired at the onset of the pandemic.

Table 9 includes robustness results for our estimates of Equation (2) by excluding firms with commitment amounts in the lowest decile of the commitment distribution. By performing this robustness test, we assess whether our results are potentially driven by firms near the $1 million reporting cutoff in the FR Y-14Q data. In other words, we drop all observations with commitment amounts less than \$1.3 million. The third column of Table 9, which includes all controls and fixed effects, shows that the coefficient estimate on the triple interaction term is −10.95 percent and remains statistically significant.[29]

Table 10 includes an interaction term between borrowers' credit quality and low capital headroom banks. To test whether our results are robust to firm credit risk, we include an additional triple interaction term (*Post*LowCapitalHeadroomBank*NonInvestment GradeFirm*) in Equation (2) to assess whether an alternative story about credit risk could be driving our results. To this end, we define *NonInvestmentGradeFirm* as a dummy variable equal to 1 if the credit rating assigned to a given borrower is BB or lower. We find that our key coefficient of interest, (*Post*LowCapitalHeadroom Bank*PrivateSME*), remains economically and statistically significant, even after incorporating this interacted firm credit risk control variable into the regression. This suggests that low capital headroom banks curtail their lending to SMEs, even after controlling for differences in firm credit risk.[30]

Table 11 presents results from an additional robustness exercise that performs a placebo test. This test takes the baseline regression from Table 3 and uses only the pre-pandemic period subsample (2018–19). We define a placebo dummy, *PostPlacebo2019*, which is equal to 1 in 2019 and 0 in 2018. As expected, Table 11 shows that our key coefficient of interest (*PostPlacebo2019*LowCapitalHeadroomBank*PrivateSME*) is neither economically nor statistically significant. This suggests that the results from our baseline regression in Table 3 constitute a result triggered by the pandemic, and not some other macro event.

Table 12 shows a robustness exercise that explores whether our baseline result from Table 3 about the declines in credit growth due to buffer usability survives an interacted control for lending to firms in COVID-affected industries. We measure an industry's COVID exposure by utilizing CRSP firm stock price data of firms to calculate the cumulative abnormal stock return for various industry

[29]This also holds for the borrower exit analysis. Results are available upon request.

[30]Results are also robust to using firm credit rating instead of an investment versus non-investment-grade dummy. Results are available upon request.

Table 10. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs Including Credit Risk—Intensive Margin

	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
Variables	**(1)**	**(2)**	**(3)**
*Post*LowCapital HeadroomBank*	3.058	1.976	2.060
Post*LowCapital HeadroomBank* PrivateSME	**–8.410*****	**–8.639*****	**–9.258*****
*Post*NonInvest mentGradeFirm*	–2.502*	–2.553**	–2.631**
*Post*LowCapital HeadroomBank* NonInvestment GradeFirm*	–3.089*	–3.020*	–3.192*
*Post*PrivateSME*	4.217*	4.489**	4.696*
*PrivateSME*Non InvestmentGrade Firm*	0.917	0.992	2.800
Firm ROA			3.154
Firm Leverage			–10.83***
Firm Sales Ratio			0.603***
Firm Non-investment Grade Rating	–0.444	–0.553	–1.255
Bank MLSP Total Loans to Assets		–0.180	–0.00440
Bank MLSP State-Level Loans to Assets		0.539***	0.600***
Bank Undrawn Credit Line Ratio		–0.734**	–0.954***
Bank Log Assets		–5.647	–5.906
Bank Deposit Ratio		0.0587	0.00290
Bank Provisions to RWA		–1.978	–2.088

(*continued*)

Table 10. (Continued)

	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
Variables	**(1)**	**(2)**	**(3)**
Bank Liquid Asset Ratio		0.506	0.634*
Bank ROA		–2.272	–3.081
Constant	4.641***	111.0	120.9
Observations	413,953	413,953	365,854
R-squared	0.294	0.294	0.308
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	34,872	34,872	31,764

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This robustness table reports the regression results for panel data specification (2), focusing on SMEs, while more closely controlling for borrower credit risk. The interaction coefficient captures the differential impact that a low capital headroom bank has on annualized commitment growth rates (along the intensive margin) to private SMEs (as compared to that of a high capital headroom bank) after the 2020:Q1 arrival of the pandemic, controlling for differences in firm credit risk. *Post* is a dummy variable denoting 2020:Q1 and after. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample. Controls include lagged firm- and bank-level characteristics. In this robustness exercise, we include a separate interaction term that controls for borrower credit risk, via a dummy variable for non-investment-grade borrower credit rating. All specifications are at the bank-firm-date level, span 2018:Q1–2020:Q3, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

portfolios upon the emergence of the COVID pandemic (February 19 to March 23, 2020). Specifically, Table 12 takes Equation (2) and adds a triple interaction term (*Post*LowCapitalHeadroomBank*BorrowerIndustryPandemicCAR*) to test whether our main baseline

Table 11. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs—Placebo Test

Variables	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized) (1)	(2)	(3)
*PostPlacebo2019*Low CapitalHeadroomBank*	0.162	–0.435	–0.323
PostPlacebo2019*Low CapitalHeadroom Bank*PrivateSME	**0.272**	**0.558**	**0.828**
PostPlacebo2019 PrivateSME*	–1.256	–1.358	–0.00516
Firm ROA			1.361
Firm Leverage			–13.01***
Firm Sales Ratio			0.708***
Firm Non-investment Grade Rating			–3.304***
Bank Undrawn Credit Line Ratio		–2.499**	–2.813***
Bank Log Assets		–8.716	–14.18
Bank Deposit Ratio		–0.0129	–0.00691
Bank Provisions to RWA		6.075	1.736
Bank Liquid Asset Ratio		0.596	0.712
Bank ROA		–7.834	–7.636
Constant	6.712***	203.4	320.7
Observations	291,688	291,688	255,148
R-squared	0.317	0.318	0.327
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	31,012	31,012	26,730

(*continued*)

Table 11. (Continued)

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the robustness tests for panel data specification (2), focusing on a placebo test during the pre-pandemic period. Specifically, we arbitrarily define 2018:Q1–2018:Q4 as the pre-placebo period and 2019:Q1–2019:Q4 as the post-placebo period. The pandemic (2020) observations have been excluded. The key triple interaction term captures the differential effect in annualized loan commitment growth rates (along the intensive margin) to private SMEs from low versus high capital headroom banks during the 2019 placebo period. *PostPlacebo2019* is a dummy variable denoting the period of 2019:Q1 to 2019:Q4. Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level, span 2018:Q1–2019:Q4, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

results may alternatively be driven by a story of banks divesting from borrowers in industries *directly* affected by COVID (COVID-exposed). We find that our key coefficient of interest (*Post*Low CapitalHeadroomBank*PrivateSME*) remains economically and statistically significant, even after incorporating this interacted control for COVID-exposed industries.

7. Policy Discussion

As described in the Introduction and Section 3, regulatory capital buffers are soft-mandate requirements, where banks are allowed to dip into but will incur penalties and costs for doing so. While our results point to the notion that banks find these regulatory capital buffers costly to use, potential discussion about policy recommendations would first require an exploration of *why* buffer usage is costly from the banks' perspective. In particular, there are at least three potential costs. Firstly, payout restrictions associated with the usage of buffers means banks face potential market stigma.[31] Secondly, dipping into the buffer may lead to the possibility of a downgrade from

[31] For example, Andreeva, Bochmann, and Couaillier (2020) suggest that financial market pressure may have been an impediment to the usability of regulatory capital buffers for European banks.

Table 12. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs, Controlling for COVID-Exposed Industries—Intensive Margin

	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
Variables	**(1)**	**(2)**	**(3)**
*Post*LowCapital HeadroomBank*	3.326*	2.240	2.417*
Post*LowCapital HeadroomBank* PrivateSME	**–9.300*****	**–9.543*****	**–10.28*****
*LowCapitalHeadroom Bank*Borrower IndustryPandemic CAR*	–0.536	–0.546	–0.642
*Post*LowCapital HeadroomBank* BorrowerIndustry PandemicCAR*	0.195*	0.191**	0.201**
*Post*PrivateSME*	4.788**	5.070**	5.336**
Firm ROA			3.185
Firm Leverage			–10.90***
Firm Sales Ratio			0.599***
Firm Non-investment Grade Rating			–1.778**
Bank MLSP Total Loans to Assets		–0.0711	0.147
Bank MLSP State-Level Loans to Assets		0.529***	0.582**
Bank Undrawn Credit Line Ratio		–0.730**	–0.951***
Bank Log Assets		–5.921	–6.251
Bank Deposit Ratio		0.0449	–0.0111
Bank Provisions to RWA		–1.865	–2.025
Bank Liquid Asset Ratio		0.494	0.617*

(*continued*)

Table 12. (Continued)

Variables	C&I Loan Commitment Growth Rate Perc. Pts. (Annualized)		
	(1)	**(2)**	**(3)**
Bank ROA		–2.444	–3.268
Constant	0.836	114.0	126.3
Observations	413,953	413,953	365,854
R-squared	0.294	0.294	0.307
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	34,872	34,872	31,764

Source: FR Y-14Q H1 Schedule, CRSP stock price data, authors' calculations.
Note: This table reports the robustness tests for panel data specification (2), controlling for the possibility that banks might have divested credit away from borrowers in industries that were negatively affected by the COVID pandemic. This captures the differential effect in annualized loan commitment growth rates (along the intensive margin) to private SMEs between low and high capital headroom banks after the 2020:Q1 arrival of the pandemic, controlling for any lending effects related to the deterioration in borrower industries directly exposed to the COVID shock. *Post* is a dummy variable denoting 2020:Q1 and after. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample. Controls include lagged firm- and bank-level characteristics. To control for any contractions in lending due to COVID-related industry-specific shocks, we add an interaction term that includes a measure of how exposed different industries were to COVID-related revenue shocks. Specifically, we calculate the cumulative abnormal return (February 19 to March 23, 2020) for different firm industries using CRSP stock price data. All specifications are at the bank-firm-date level, span 2018:Q1–2020:Q3, and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

credit rating agencies.[32] For example, during April 2020, Moody's released a statement that global investment banks are expected to

[32] Behn, Rancoita, and Rodriguez d'Acri (2020) suggest management buffers may also matter for bank credit ratings, which is associated with a major worsening of banks' access to external funding markets.

Table 13. Abnormal Stock Price Reaction to Dividend Cuts Using a (–1,1) Event Window

	Dividend Cut Events	(–1,1) CAR Percent
All	42	–2.34 Percent**
Normal Times	12	–1.07 Percent
GFC Crisis	28	–2.88 Percent**

maintain solid capital buffers *at or above 2019 levels.*[33] The actions of credit rating agencies can have unintended externalities for the usability of regulatory capital buffers. Thirdly, buffer usage also triggers bonus restrictions with respect to bank executive compensation. Data limitations prevented prior studies from pinning down why capital buffers are costly. While this task is not empirically possible to pin down in the context of the pandemic either, below we provide some historical evidence on the first two costs.

To test the impact of market stigma related to a reduction in dividends, we use daily stock price data from 1990 to the present to conduct an event study using a Fama-French three-factor model. For each dividend cut event i, we estimate coefficients for the Fama-French three-factor model in a 120-day estimation window (130 days before to 10 days before event) as shown in Equation (4).

$$R_{it} = \beta_i + \gamma_{it}(Mkt - Rf)_t + \alpha_2 HML_t + \tau_3 SMB_t + \varepsilon_{it} \tag{4}$$

We then use these coefficients to extract the abnormal stock return of bank i using a $(-1{,}1)$ three-day event window around the dividend cut. We find that bank dividend cut events are associated with negative cumulative abnormal stock returns (288 basis points) for banks during stress events such as the 2007–08 global financial crisis (see Table 13).

We also conduct a second event study, using bank credit rating downgrade events from 1990 to present. Overall, we find that credit rating downgrades (specifically in the 2008 crisis) led to negative

[33]See Moody's (2020).

Table 14. Abnormal Stock Price Reaction to Credit Rating Downgrades Using a (–1,1) Event Window

	Ratings Downgrade Events	(–1,1) CAR Percent
All	122	–1.29 Percent***
Normal Times	73	–0.43 Percent
GFC Crisis	48	–2.65 Percent***

cumulative abnormal returns of roughly 265 basis points during the three-day event window (see Table 14).

The costs associated with rating downgrades and dividend cuts during the GFC are economically large. Despite the potential caveats associated with the limited number of these events, these historical estimates suggest that the potential costs banks would have faced had they dipped into their regulatory capital buffers during the pandemic may have been sizable.

Due to data limitations, proposing specific policy remedies requires making strong assumptions about which of these proposed channels for the costliness of buffers was most binding for banks. The large abnormal returns associated with dividend cuts and ratings downgrades suggest it is not possible to eliminate either channel from consideration. However, there are a few policy insights that do emerge from our paper. Firstly, regulatory capital buffers appear to be acting as a kind of "double-edged" policy sword, where the costliness of regulatory capital buffers that incentivized banks to raise their CET1 ratios to historically high levels *during normal times* likely also made buffers *difficult to use during the downturn.* Secondly, potential policy recommendations include improving the transparency of the buffer requirement to reduce market stigma—for example, reassuring market participants and credit rating agencies that bank decisions to dip into their buffers do not necessarily signal weakness—or providing temporarily relief from the buffer constraint in downturns. However, beyond this, there has been evidence suggesting that the action of releasing regulatory buffers in a downturn may not necessarily lead to more *usable* capital, but rather may come with additional unanticipated costs. In particular, on March

12, 2020, the European Central Bank (ECB) posted a press release that allowed banks to operate temporarily below the level of capital defined by the Pillar 2 guidance (P2G) and the capital conservation buffer.[34] Out of the 115 euro zone banks supervised by the ECB, it is reported that only 9 banks took advantage of this relief measure. A possible reason for this reluctance, as proposed by Arnold (2021), is that "some banks have been reluctant to do so, worrying about how long the relief will last and the risk of stigma among investors." This points to the notion that *forward guidance uncertainty* may be a key friction associated with banks' incentive to use buffer relief. Corroborated by analysis done in the GFSR (IMF 2021), banks may not take advantage of the buffer relief if clear forward guidance is not provided on how long it will last.

In other words, without a specified time frame, banks may be hesitant to use the relief, as they could be forced to replenish capital at an unknown future date when the cost of capital is not ideal.

8. Conclusion

Sitting on top of minimum capital requirements, regulatory capital buffers introduced after the 2008 financial crisis are costly regions of "rainy-day" equity capital designed to absorb losses and support lending in a downturn. Although the implementation of these Basel III regulatory buffers played a key role in helping build banking system capital to historic levels, it appears this stockpile of capital went effectively unused during the pandemic. Our results suggest that banks were reluctant to use their regulatory buffers to absorb pandemic losses, and instead curtailed lending to SMEs during the pandemic.

To explore this, we employ a novel set of confidential, supervisory loan-level data between the largest U.S. banks and their corporate borrowers during the pandemic. The vast coverage of this data provides us with a unique ability to observe the lending outcomes at an important yet understudied segment of the economy, namely, private

[34] See ECB (2020). Unlike the European capital standards, the U.S. standards do not include a Pillar 2 guidance. The ECB's capital relief would have been equivalent to allowing banks to temporarily operate below the combined buffer requirements.

SMEs, whose survival was particularly dependent on financing from banks.

Controlling for borrower risk, we find that "low capital headroom banks" (e.g., lenders that entered the pandemic with a capital ratio relatively close to the regulatory buffer region) curtailed commitments to creditworthy SMEs along the intensive margin by 10.3 percent more than "high capital headroom" banks (e.g., lenders that entered the pandemic with a capital ratio relatively far from the regulatory buffer region). It also resulted in an 11.1 percent higher probability of borrower exits for low capital headroom banks. We further find heterogeneous effects across borrower type. Specifically, our results show that low capital headroom banks disproportionately curtailed lending to (i) private SMEs (while leaving valuable lending relationships with large public clients untouched), (ii) firms that had a relatively young lending relationship with their bank, and (iii) firms whose pre-pandemic credit lines contractually matured at the peak of the pandemic (and thus were up for renegotiation). These results are consistent with banks choosing cost-efficient ways of deleveraging, rather than utilizing the regulatory capital buffers for their intended purpose of maintaining the flow of credit to creditworthy businesses in a recession. We estimate that credit effects span a diverse set of industries comprising up to 21 percent of aggregate SME credit. We also find suggestive evidence of real effects on local employment growth during the pandemic (2 percent slower annually).

Our study brings a new angle to the literature on how the pandemic transmitted shocks to SMEs—specifically, these findings uncover a novel transmission channel emanating from constraints related to bank capital which led to credit supply shocks, potentially delaying the economic recovery for private SMEs. Rather than viewing the buffers as a cushion to be drawn upon during a downturn, as intended by Basel III, banks seem to have treated regulatory buffers as de facto minimum requirements.

Appendix A. Paycheck Protection Program (PPP)

One related question that arises is whether SMEs affected by the usability of regulatory buffers were able to substitute some of the loss in funds from their FR Y-14Q lender by participating in the PPP.

We explore this possible substitution by matching borrowing firms in the FR Y-14Q to the firms that participated in the PPP, utilizing a fuzzy matching algorithm (based on the text of the firm name) after filtering potential matches based on zip code and industry NAICS.

In order to then test whether firms that experienced negative credit supply shocks (from low capital headroom banks) subsequently sourced funding from the PPP, we run the following cross-sectional specification in Equation (A.1):

$$\begin{aligned} &\textit{Participant in PPP}[0/1]_{f,2020} \\ &\quad = \beta_0 + \beta_1 \textit{LowCapitalHeadroomBank}[0/1]_{b,2019Q4} \\ &\qquad + \beta_2 \textit{PrivateSME}[0/1]_{f,2019Q4} \\ &\qquad + \beta_3 \textit{LowCapitalHeadroomBank}[0/1]_{b,2019Q4} * \textit{PrivateSME}[0/1]_{f,2019Q4} \\ &\qquad + \beta_F \textit{FirmControls}_{f,2019Q4} + \beta_B \textit{BankControls}_{b,2019Q4} \\ &\qquad + \alpha_{BankFEs} + \gamma_{SizeIndusCountyFEs} + \varepsilon_{bf}, \end{aligned} \tag{A.1}$$

where $\textit{Participant in PPP}_{f,2020}$ is a binary variable that equals 1 if a given firm participates in the PPP. The interpretation of any given coefficient would be the impact of that particular right-hand-side variable on the probability that the firm participates in the PPP. The interaction coefficient captures the difference in the likelihood that a private SME that borrowed from a low capital headroom bank prior to the pandemic participates in the PPP during the pandemic (as compared to that of a private SME that borrows from a high capital headroom bank). We use the same firm controls, bank controls, and fixed effects as in the borrower exit analysis associated with Equation (1). The results of Table A.1 show that private SMEs borrowing from low capital headroom banks are *neither more nor less* likely to participate in the PPP as compared to private SMEs borrowing from high capital headroom banks. Thus, there is no such evidence of credit substitution effects, as the estimate for the interaction coefficient of interest is not statistically significant. Firms in the FR Y-14Q have minimum credit line balances of \$1 million, which is equivalent to the 99th percentile of PPP loan volume. In other words, firms that are considered small and medium size with respect to the FR Y-14Q population of firms are still much larger than the typical firm participating in the PPP, and so it is unlikely that the PPP would have been able to compensate for the

Table A.1. Are Firms Borrowing from Low Capital Headroom Banks More Likely to Participate in the PPP?

	Pr(Firm Participates in PPP)		
Variables	**(1)**	**(2)**	**(3)**
PrivateSME	0.207***	0.190***	0.225***
LowCapitalHeadroom Bank*PrivateSME	**–0.0132**	**–0.00121**	**–0.0125**
LowCapitalHeadroomBank	–0.00453		
Firm ROA			–0.0333*
Firm Leverage			0.0287**
Firm Sales Ratio			0.00843***
Firm Non-investment Grade Rating			0.00151
Constant	0.296***	0.298***	0.258***
Observations	46,042	46,042	39,883
R-squared	0.459	0.462	0.477
Bank FE	N	Y	Y
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	33,259	33,259	28,476

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table presents the regression results for the cross-sectional specification (A.1). All observations are as of 2019:Q4. The left-hand-side variable is a dummy variable that equals 1 if a given firm participates in the PPP during the pandemic. The interaction coefficient captures whether a firm borrowing from a low capital headroom bank (as opposed to a high capital headroom bank) in 2019:Q4 is more or less likely to substitute its funding by utilizing PPP financing. *LowCapitalHeadroom-Bank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample. Controls include firm- and bank-level characteristics. All specifications include fixed effects for firm-size-decile*industry*county. Standard errors are clustered by firm. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

loss in funding due to the supply-side credit contraction associated with the usability of regulatory buffers. This lack of substitution is also consistent with our employment results from Table 8. Specifically, because firms exposed to the usability of regulatory buffers via their lenders were not able to secure alternative sources of financing, it is possible that these firms may have had to adjust by slowing employment growth during the pandemic.

Appendix B. Panel Analysis of Borrower Exits

Tables B.1 through B.3 show the results for a panel regression version of the borrower exit analysis using a triple interaction term $Post{*}LowCapitalHeadroomBank{*}\theta$ for SMEs, firms with young lending relationships, and firms that have existing credit lines that contractually mature in the first quarter of the pandemic, respectively. The coefficient of interest on the interaction term of interest is economically and statistically significant for all three Tables B.1–B.3.

Table B.1. Differential Credit Effect of Low vs. High Capital Headroom Banks on SMEs—Borrower Exits (panel version)

Variables	Pr(Borrower Exits Next Quarter) (1)	(2)	(3)
*Post*LowCapitalHeadroomBank*	–0.00109	–0.00268	–0.00579*
Post*LowCapitalHeadroomBank*PrivateSME	**0.0573*****	**0.0580*****	**0.0568*****
*Post*PrivateSME*	–0.0191**	–0.0197**	–0.0206**
Firm ROA			–0.00392
Firm Leverage			–0.00338
Firm Sales Ratio			0.000644
Firm Non-investment Grade Rating			0.00184
Bank MLSP Total Loans to Assets		–0.00280	–0.00304
Bank MLSP State-Level Loans to Assets		0.000371	–0.000391
Bank Undrawn Credit Line Ratio		–0.00134	–0.00166
Bank Log Assets		–0.000218	0.00119
Bank Deposit Ratio		0.00169*	0.00178*
Bank Provisions to RWA		0.0131	0.0151
Bank Liquid Asset Ratio		–0.00108	–0.00136*
Bank ROA		0.000415	–0.0123
Constant	0.0262***	–0.0280	–0.0476

(*continued*)

Table B.1. (Continued)

Variables	Pr(Borrower Exits Next Quarter)		
	(1)	**(2)**	**(3)**
Observations	429,961	429,961	386,825
R-squared	0.397	0.398	0.414
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	35,459	35,459	32,994

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the regression results for panel data specification version of the cross-sectional specification (1), focusing on SMEs. The left-hand-side variable is a dummy variable that equals 1 if a given firm no longer exists in the FR Y-14Q in the next quarter. The interaction coefficient captures the differential effect that a low capital headroom bank has on the probability (each quarter) that a given private SME borrower exits during the pandemic (as compared to that of a high capital headroom bank). *Post* is a dummy variable denoting 2020:Q1 and after. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *PrivateSME* is a 0/1 variable denoting if the firm is private and is smaller than the median firm size in the sample. Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by bank-date and firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.2. Differential Credit Effect of Low vs. High Capital Headroom Banks on Young Relationship Firms—Borrower Exits (panel version)

	Pr(Borrower Exits Next Quarter)		
Variables	**(1)**	**(2)**	**(3)**
*Post*LowCapitalHeadroomBank*	0.0124**	0.0104*	0.00997
Post*LowCapitalHeadroomBank*YoungRelationshipFirm	**0.0163****	**0.0163****	**0.0139****
*Post*YoungRelationshipFirm*	0.0170***	0.0171***	0.0136***
Firm ROA			–0.0210***
Firm Leverage			–0.00456
Firm Sales Ratio			0.000443
Firm Non-investment Grade Rating			0.00196
Bank MLSP Total Loans to Assets		–0.00296	–0.00279
Bank MLSP State-Level Loans to Assets		–0.000277	–0.00133
Bank Undrawn Credit Line Ratio		–0.00324**	–0.00313**
Bank Log Assets		–4.28e-05	0.00256
Bank Deposit Ratio		0.00173	0.00169
Bank Provisions to RWA		0.00592	0.00763
Bank Liquid Asset Ratio		–0.00124	–0.00156
Bank ROA		–0.0181	–0.0220
Constant	0.0439***	0.0196	–0.0223

(*continued*)

Table B.2. (Continued)

Variables	Pr(Borrower Exits Next Quarter)		
	(1)	(2)	(3)
Observations	489,939	489,939	434,956
R-squared	0.423	0.423	0.433
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County-Date FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	45,483	45,483	40,977

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.
Note: This table reports the regression results for the panel data specification version of cross-sectional specification (1), focusing on young relationship firms. The left-hand-side variable is a dummy variable that equals 1 if a given firm no longer exists in the FR Y-14Q in the next quarter. The interaction coefficient captures the differential effect that low capital headroom bank has on the probability (each quarter) that a given young relationship borrower exits during the pandemic (as compared to that of a high capital headroom bank). *Post* is equal to 1 for 2019:Q4 to 2020:Q2. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *YoungRelationshipFirm* is a 0/1 variable denoting if the firm's relationship with its lender (as of 2019:Q4) is smaller than the median relationship age in the sample (six years). Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered by firm. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.3. Differential Credit Effect of Low vs. High Capital Headroom Banks to Firms with Pre-existing Credit Lines Set to Mature at the Peak of the Pandemic—Borrower Exits (panel version)

Variables	Pr(Borrower Exits Next Quarter)		
	(1)	**(2)**	**(3)**
*Post*LowCapitalHeadroomBank*	0.0334*	0.0345*	0.0334
Post*LowCapitalHeadroomBank*FirmCredLineMaturinginPandemic	**0.0773*****	**0.0765*****	**0.0593****
*Post*FirmCredLineMaturinginPandemic*	0.00574	0.00628	0.00735
Firm ROA			–0.00418
Firm Leverage			–0.00172
Firm Sales Ratio			0.000654
Firm Non-investment Grade Rating			0.00145
Bank MLSP Total Loans to Assets		–0.00340	–0.00334
Bank MLSP State-Level Loans to Assets		–6.85e-05	–0.000757
Bank Undrawn Credit Line Ratio		–0.00236**	0.00248**
Bank Log Assets		–0.0108	–0.00743
Bank Deposit Ratio		0.000983	0.00102
Bank Provisions to RWA		0.0207	0.0220
Bank Liquid Asset Ratio		–0.000456	–0.000812
Bank ROA		–0.0241	–0.0333**
Constant	0.0265***	0.235	0.177

(*continued*)

Table B.3. (Continued)

Variables	Pr(Borrower Exits Next Quarter)		
	(1)	(2)	(3)
Observations	429,961	429,961	429,961
R-squared	0.397	0.398	0.414
Bank-Firm FE	Y	Y	Y
FirmSize-Industry-County FE	Y	Y	Y
No. of Banks	16	16	16
No. of Firms	35,459	35,459	32,994

Source: FR Y-14Q H1 Schedule, aggregated calculations using bank-specific stress capital buffer and G-SIB surcharges to calculate the capital headroom.

Note: This table reports the regression results for the panel data specification version of cross-sectional specification (1), focusing on firms with pre-existing credit lines that were set to mature at the peak of the pandemic. The left-hand-side variable is a dummy variable that equals 1 if a given firm no longer exists in the FR Y-14Q in the next quarter. The interaction coefficient captures the differential quarterly effect that a low capital headroom bank has on the probability that a firm (whose pre-existing credit line was set to mature during the pandemic) exits during the pandemic (as compared to that of a high capital headroom bank). *Post* is equal to 1 in 2020:Q1. *LowCapitalHeadroomBank* is a 0/1 variable denoting if the firm borrows from a lender whose CET1 capital ratio was relatively close to the costly regulatory capital buffer threshold (headroom $\leq$ 2.14 percent) as of 2019:Q4. *FirmCredLineMaturinginPandemic* is a 0/1 variable denoting if any portion of the firm's pre-existing credit lines (as of 2019:Q4) was set to mature at the height of the pandemic (2020:Q2). Controls include lagged firm- and bank-level characteristics. All specifications are at the bank-firm-date level and include bank*firm as well as firm-size-decile*industry*county*date fixed effects. Standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively.

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