GSIB Surcharges and Bank Lending:
Evidence from U.S. Corporate Loan Data[*]

Introduction

In the aftermath of the Global Financial Crisis, many countries have raised bank capital requirements on systemically important banks to increase their capacity to absorb losses and foster financial stability. While there is broad agreement that higher capital requirements make the banking system more resilient to adverse shocks, it is still debated whether higher requirements also lead to reductions in credit availability and increases in the cost of credit (Hanson, Kashyap and Stein, 2011; Admati and Hellwig, 2013; U.S. Department of the Treasury, 2017). Moreover, higher requirements on banks may shift credit supply from banks to less-regulated lenders, raising concerns about the effectiveness of capital requirements for financial stability (Plantin, 2015).

This paper contributes to this debate by studying how capital surcharges on global systemically important banks (GSIB) affects business lending and, by implication, the real economy. GSIB surcharges are the additional capital that GSIBs must hold in excess of the minimum risk-based requirements imposed by Basel III. These surcharges may affect lending because they raise the capital that GSIBs must hold for a given risk-weighted loan amount. GSIB surcharges were phased-in starting in January 2016 and became fully effective in January 2019.

We show that GSIB surcharges affect business lending. Banks subject to higher capital surcharges reduce the dollar amount of loan commitments relative to non-GSIBs. Banks with higher surcharges are also less likely to originate new loans and more likely to assess the risk of firms as safer. The decline in GSIB credit supply, however, does not reduce firms' total borrowing, as firms switch to less-affected banks. In addition, the reduction in GSIB lending does not affect firm investment. These findings suggest that, while higher capital surcharges lower GSIBs lending, firms compensate this decline with credit from other sources.

Our empirical strategy exploits three features of GSIB surcharges that help us identify a causal effect of capital surcharges on bank lending. First, GSIB surcharges are a known function of banks' systemic importance indicators. U.S. banks subject to enhanced prudential standards under the Dodd-Frank Act—banks with $50 billion or more of total consolidated assets—receive a score based on the dollar amounts of on- and off-balance sheet assets and liabilities associated with systemic importance. Banks with a score exceeding a certain threshold are subject to a GSIB

surcharge and this surcharge increases with the score. The mapping from banks' systemic importance characteristics to bank surcharges allows us to estimate the effects of surcharges on lending, while controlling for the direct effects of these characteristics on bank lending. Second, systemic importance indicators depend on variables, such as market prices, that banks do not control. As a result, banks cannot precisely determine their surcharges. Third, because they were gradually phased in over four years, GSIB surcharges increase over time for reasons unrelated to banks' systemic characteristics.

These three features allow us to exploit plausibly exogenous variation in GSIB surcharges across banks and over time. We use an empirical strategy akin to a differences-in-differences analysis, in which non-GSIBs are the control group and GSIBs are the treated group, and the intensity of the treatment—the surcharge—varies over time.

To identify GSIBs and evaluate their response to higher capital surcharges, we use novel data on banks' systemic importance indicators and confidential data on corporate lending, both collected by the Federal Reserve. The data on systemic importance include the dollar amounts of on- and off- balance sheet exposures—such as committed and outstanding corporate loans—as well as indicators of bank's complexity and interconnectedness. We match these data with confidential supervisory data that provide detailed information on all new and outstanding commercial loans of $1 million of more from all banks subject to the Dodd-Frank Act Stress Tests. These data include information on loan terms and firms' balance sheet characteristics. The granularity of the data allows us to compare lending by different banks to the same firm, while controlling for firm's unobservable fundamentals. This research design helps identify the effects of higher capital requirements on bank lending from confounding factors related to changes in firms' credit demand or riskiness.

Our main finding is that GSIBs reduce lending following the introduction of GSIB surcharges. Surcharges lower both the intensive and the extensive margins of lending. At the intensive margin, our estimates indicate that, in response to a 1-percentage point increase in surcharges, loan commitments by GSIBs fall by roughly 4 percent relative to other banks that lend to the same firm. This estimate is similar across alternative specifications that account for changes in unobservable characteristics within firm-bank pairs over time. The response is economically significant, as the

average annual change in committed loan amount across banks during our sample period is less than 1 percent.

At the extensive margin, a 1-percentage point increase in capital surcharges reduces net loan originations—new loans minus loan terminations—by roughly 5 percentage points. We also find that a 1-percentage point increase in the surcharge increases the likelihood that a GSIB terminates its pre-existing lending relationship with a given firm by 3 percentage points. These results are consistent with the view that GSIBs may respond to an increase in capital surcharges by reducing either their systemic importance score—through lower on- and off- balance sheet exposure to the corporate loan market—or their risk-weighted assets, or both.

We also study whether higher GSIB surcharges lead to changes in loan contract terms as well as banks' internal assessment of borrower risk. GSIBs may reduce risk-weighted assets not only by cutting total loan exposure but also through lower borrower risk. We find that GSIBs reduce risk-weighted assets by renegotiating loans in a manner that increases collateral and guarantee requirement and lengthens loan maturity. GSIBs' internal estimates of firm risk also improve with higher surcharges.

Taken together, this evidence suggests that higher surcharges lead GSIBs to not only reduce loan supply, but also lower their exposure to and assessment of borrower risk. In aggregate, however, these changes do not seem to affect firms' total borrowing. Using data aggregated at the firm level, we find that firms offset the decline in GSIB lending by borrowing from less-affected banks. The share of firms' borrowing from non-GSIBs as well as the likelihood of new lending relationship with non-GSIBs increase. These results indicate that capital surcharges lead to migration of business lending away from systemically important banks and toward less-affected banks.

The results in this paper contribute to the ongoing debate on the costs and benefits of higher bank capital requirements. Evidence based on European loan-level data and changes in capital regulation pre-Basel III unequivocally suggests that higher regulatory requirements reduce bank lending. Gropp, Mosk, Ongena, and Wix (2018) document that European banks required to maintain a higher capital ratio in a 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 (2018) show that banks are more likely to cut lending when capital charges on loans, under Basel II rules, increase. Jimenez, Saurina, Ongena, and Peydró (2018) find that banks cut loan commitments and increase risk-taking in response to bank specific increases in dynamic provisioning requirements. These papers also conclude that the reduction in bank lending has real consequences, as firms are not fully able to substitute borrowing away from affected banks.[3]

We contribute to this literature by providing novel evidence based on confidential supervisory U.S. data on corporate loans and Basel III capital regulation. To the best of our knowledge, this is the first paper that evaluates the effects of GSIB surcharges on bank lending. The loan-level data allow us to distinguish changes in bank credit supply from changes in firm credit demand. Our empirical strategy also identifies the consequences of GSIB surcharges from confounding effects of other prudential standards, as it focuses on a sample of large and complex organizations, which are all subject—under Basel III and the Dodd-Frank Act—to comparable risk-based capital rules, liquidity rules, and supervisory stress testing requirements.

Our findings that bank lending declines with higher capital requirements but that total firm borrowing does not change also contribute to the debate on the effects of capital regulation for the compositional change in the supply of credit across financial institutions (Hanson, Kashyap and Stein, 2011). Related analysis on the implications of capital requirements on bank lending and credit migration to the unregulated financial sector includes Irani, Iyer, Meisenzahl and Peydró (2018).

The paper is organized as follows. Section I discusses the institutional background on GSIB capital surcharges. Section II describes the data and Section III presents our empirical methodology. Sections IV and V provide results on bank lending and firm borrowing. Section VI concludes.

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[3] Other papers, surveyed in the Basel Committee on Banking Supervision (2016), study the link between pre-Basel III capital requirements and bank lending. For the most part, these papers do not rely on loan-level data. As a result, supply and demand factors may conflate the estimates of the effects of changes in capital requirements on bank lending.

I. Institutional background

In the aftermath of the global financial crisis, regulators reacted to the financial stability risks posed by GSIBs by requiring these banks to strengthen their capital positions. The rationale for the GSIB surcharge is that the greater the capital buffer, the lower the probability of failure of a GSIB and the smaller the harm such failure may cause to the financial system.

In the United States, the Federal Reserve Board (FRB) adopted a rule that determines whether a bank holding company (henceforth bank) is a GSIB and, if so, its capital surcharge. The GSIB surcharge is the additional Common Equity Tier 1 (CET1), Tier 1, and total capital as a percentage of risk-weighted assets that a GSIB must hold over the minimum Basel III requirements on these three capital ratios. Thus, a GSIB surcharge increases minimum requirements for GSIBs as follows:

$$\frac{E_i}{RWA} \geq k_i + Surcharge(systemic\ importance\ indicators), \tag{1}$$

where $E_i \in \{CET1, Tier\ 1, total\ capital\}$, RWA stands for risk-weighted assets, and k_i is the Basel III minimum risk-weighted capital ratio i. Risk-weighted assets are the sum of bank assets multiplied by their respective risk weights. In equation (1), $Surcharge(.)$ does not vary with i, but it depends on banks' systemic importance indicators.

Under the U.S. rule, all banks with $50 billion or more of total consolidated assets receive systemic importance scores based on a linear function of systemic importance indicators that measure a bank's size, interconnectedness, complexity, cross-jurisdictional activity, and substitutability.[4] Banks with a score higher than a fixed threshold are considered GSIBs and are subject to additional capital requirements.[5]

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[4] Size is measured with total exposures (on- and off- balance sheet); interconnectedness depends on the bank's intra-financial system assets and liabilities and on securities outstanding; complexity is measured by the bank's notional amount of over-the-counter derivatives, trading and available-for-sale securities, and level 3 assets; cross-jurisdictional activity depends on the bank's cross-jurisdictional claims and liabilities; substitutability depends on bank's payments activity, assets under custody, and underwriting activity.

[5] Eight U.S. banks are currently identified as GSIBs under this rule: Bank of America Corporation; The Bank of New York Mellon Corporation; Citigroup, Inc.; The Goldman Sachs Group, Inc.; JPMorgan Chase & Co.; Morgan Stanley; State Street Corporation; and Wells Fargo & Company. Appendix A provides more details on the computation of the GSIB surcharge.

As outlined in Figure 1, the FRB published the U.S. rule on GSIB surcharges in August 2015, introducing surcharges effective January 1, 2016. Surcharges became fully phased in on January 1, 2019, and range from 1.0 to 3.5 percent of each bank's total risk-weighted assets.

[Insert Figure 1 about here]

The surcharge in a given calendar year is determined by year-end bank data from two years earlier. This lag implies that, when the rule was first published, banks could not strategically adjust their balance sheets to lower capital surcharges in 2016, as these surcharges were determined by banks' systemic importance indicators as of December 2014. In fact, the definition of the systemic indicators and the coefficients of the linear function that determines GSIB surcharges became known to the public only when the final rule was published.

Figure 2 shows how banks' scores map into GSIB surcharges over time. GSIB surcharges are equal to zero in 2014 and 2015 and increase each year, starting in 2016 and until 2019, by 25 percent of the fully phased-in GSIB surcharge. The gradual introduction of the surcharge implies that its slope, as a function of the scores, increases every year. We exploit this unique setting to evaluate how GSIBs adjusted business lending over time in response to the exogenous increase of capital surcharges.

[Insert Figure 2 about here]

II. Data

Data on GSIBs status and capital surcharges come from the Banking Organization Systemic Risk Reports, FR Y-15. The Federal Reserve uses the FR Y-15 data to monitor the systemic risk profile of the institutions that are subject to enhanced prudential standards under the Dodd-Frank Act, to identify institutions that present significant systemic risk, and to compute GSIB surcharges. The FR Y-15 reports banks' systemic importance indicators for each year starting in 2013. The

reporting panel consists of all U.S. bank holding companies with $50 billion or more of total consolidated assets.[6] Table 1 summarizes these data.

To measure the response of bank lending to GSIB surcharges, we rely on confidential supervisory data on commercial and industrial (C&I) loans from the Federal Reserve's Y-14 Collection. The Federal Reserve uses these data to evaluate the capital adequacy of large BHCs through the Comprehensive Capital Analysis and Review (CCAR), the Dodd-Frank Act Stress Test (DFAST), and other supervisory efforts.

Schedule H.1 of the FR Y-14 data contains quarterly information on all corporate loans and leases with commitment amounts exceeding $1 million that are held by reporting banks. Currently the reporting panel consists of 34 banks, 8 of which are GSIBs. Loans in the FR Y-14 data account for approximately three-quarters of total U.S. commercial and industrial lending.

For each loan facility, the FR Y-14 data provide information on the identity of the borrower and the lender, the committed amount, and loan characteristics such as the origination and maturity dates, interest rate, loan type (credit line or term loan) and whether the loan is secured. In addition, the FR Y-14 data include information on the internal risk ratings and the probability of default (PD) that banks assign to firms. To smooth out quarterly fluctuations in corporate lending, we aggregate the data to the bank-firm-year level.

The bank-firm-year panel runs from 2014 through 2017. The sample starts in 2014 because FR Y-15 data start in 2013, and our empirical analysis requires matching bank lending data in each year to GSIB surcharges in the following year, which in turn depend on the systemic importance indicators measured two years earlier. The sample ends in 2017 because firm financial statement information in the FR Y-14 data—used to examine the real consequences of GSIB surcharges—is only available with a delay of one to two years.

Panel A of Table 2 reports summary statistics for the bank-firm-year observations in our sample. During the 2014-2017 period, the average dollar committed amount across both credit lines and

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[6] The data on systemic importance indicators are available at
https://www.ffiec.gov/npw/FinancialReport/FRY15Reports. The rule that describes how the FRB determines which banks are GSIBs and calculates their surcharges is available at https://www.gpo.gov/fdsys/pkg/FR-2015-08-14/pdf/2015-18702.pdf.

term loans is $86 million with a sizeable standard deviation of roughly $83 million. The average interest rate charged is 2.7 percent and it varies little across bank-firm-years. Panel A also summarizes measures of borrower risk based on banks' internal risk assessments: banks rate the average borrower just below investment grade (roughly equivalent to a BB Standard & Poor's (S&P) rating, and the average PD is 2.2 percent.

In addition to the FR Y-14 and FR Y-15 data, we use data from the Consolidated Financial Statements for Holding Companies, FR Y-9C. We use these data to control for time-varying bank characteristics that may affect lending. We use measures of bank size (total assets), liquidity (deposit-to-assets ratio), and profitability (return on assets , ROA; charge-offs; net interest margin, NIM; and interest rate expenses-to-assets ratio), as well as a measure of bank capital (leverage ratio) and the stress testing CET1 ratio.[7] The descriptive statistics for the bank data are in Panel B of Table 2. Appendix B defines and presents the source of each variable used in the analysis.

The FR Y-14 data also provide annual information on firms' balance sheet and income statements. We use this information to assess the real effects of capital surcharges on firms. We aggregate the loan and the financial statements data to the firm-year level, and build a firm-specific measure of exposure to GSIB surcharges. This measure is equal to the average surcharge of the GSIBs that lend to the firm in that year, weighted by the share of loans that the firm has with these GSIBs in the previous year.

Panel C of Table 2 summarizes firms' total bank borrowing and their exposure to GSIB surcharges. The average firm-year in our sample has total commitments of approximately $50 million. The average debt-to-assets ratio is 33 percent, and the majority of firms hold less than 5 percent of cash as a fraction of total assets. The average exposure of firms to GSIBs capital surcharge is 0.44 percent.

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[7] For each bank, this ratio is defined as the minimum value of the CET1 ratio over the 9-quarter stress horizon under the Federal Reserve's supervisory severely adverse stress scenario. The data are published annually, starting in 2013, on the Federal Reserve's website, https://www.federalreserve.gov/supervisionreg/dfast-archive.htm.

III. Empirical Strategy

We study the effect of GSIB surcharges on bank credit supply by estimating the following regression:

$$Y_{b,f,t} = \beta Surcharge_{b,t+1} + \delta S_{b,t-1} + \gamma X_{b,t} + \psi_b + \varphi_{f,t} + \epsilon_{b,f,t}, \tag{2}$$

where, b, f, and t index bank, firm, and year, respectively. $Y_{b,f,t}$ is the credit outcome of interest for a given bank-firm pair in year t, such as the log of loan committed amount, the interest rate, or other non-price loan terms. $Surcharge_{b,t+1}$ is the GSIB surcharge that applies to bank b in year $t+1$, $S_{b,t-1}$ is a vector of systemic importance indicators for bank b as of the end of year $t-1$, $X_{b,t}$ is a vector of time-varying bank characteristics measured as of the end of year t, ψ_b and $\varphi_{f,t}$ are bank and firm-year fixed effects, respectively, and $\epsilon_{b,f,t}$ is an idiosyncratic shock. In this regression model, the outcome variable in year t depends on the next year's surcharge, $Surcharge_{b,t+1}$, under the assumption that banks adjust their balance sheets at t to lower required capital in $t+1$. The model is estimated using ordinary least squares with standard errors adjusted for correlation of observations within a bank-firm pair.

The parameter of interest is β, which measures the effects of GSIBs surcharges on bank lending, The null hypothesis is $\beta = 0$, which means that GSIB surcharges do not affect bank lending. Bank credit may not depend on surcharges if, for example, banks are highly capitalized, or they can raise additional capital costlessly. However, if banks find it optimal to reduce total exposures in response to higher GSIB surcharges, and do so by cutting lending, the coefficient β will be negative. In addition, β could be positive if firms prefer to borrow from banks subject to higher capital requirements, for instance, because bank-dependent firms are more likely to borrow from banks with more capital (Schwert, 2018).

Our empirical strategy is similar to a difference-in-differences setting. Specifically, we compare the change in lending activity by banks in the treated (GSIBs) and control (non-GSIBs) groups around the introduction of GSIB surcharges. Moreover, as the size of GSIB surcharges vary over time, our empirical framework also exploits the variation in surcharges within the treated group.

The identifying assumption is that GSIB and non-GSIB lending would have trended similarly in the absence of GSIB surcharges. To support this assumption, Figure 3 plots the average committed amounts of C&I lending for GSIBs and non-GSIBs. Total C&I lending of GSIBs tracked non-GSIB lending closely prior to the introduction of the GSIB surcharge, and diverges thereafter. This graphical evidence suggests that lending for the two types of banks would have continued to evolve in a similar way in the absence of GSIB surcharges.

[Insert Figure 3 about here]

The fact that the two series diverge after 2016—with loan commitment by GSIB banks decreasing sharply after the introduction of GSIB capital surcharges and the loan commitment by non-GSIB banks increasing—also provides preliminary evidence that GSIB surcharges lead to reallocation of corporate credit from GSIBs to non-GSIBs.

There are several challenges in estimating the casual effects of GSIB surcharges on bank lending. An important one is that the assignment of GSIB surcharges to banks is not random. Banks, and firms that borrow from GSIBs, may have characteristics correlated with $Surcharge_{b,t+1}$, leading to inconsistent estimates of β.

To alleviate this concern, we include in equation (2) a vector $S_{b,t-1}$ of (predetermined) banks' systemic importance indicators. This vector controls for observable heterogeneity among banks that determine both GSIB status and the size of the GSIB surcharge in $t + 1$. Equation (2) also includes a vector $X_{b,t}$ of time-varying observable bank characteristics and bank fixed effects ψ_b. $X_{b,t}$ contains measures of banks' conditions and income.[8] ψ_b absorbs time-invariant bank characteristics that may affect bank lending, irrespective of the GSIB surcharges, including risk management practices, risk attitude, diversification, and ability to raise capital.

One limitation of a specification that includes only bank fixed effects is that it does not account for banks' specialization in lending to firms with different characteristics. For this reason, we also consider alternative specifications of equation (2) in which bank-firm fixed effects replace bank

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[8] The vector $X_{b,t}$ includes the following variables: the stress test CET1 capital ratio, leverage ratio, charge-off ratio, total assets, ROA, NIM, total deposits, and the interest rate expenditure ratio.

fixed effects, so that we control for unobservable time-invariant characteristics of banks, firms, and bank-firm relationships that may be correlated with $Surcharge_{b,t+1}$. Many unobservable dimensions of a bank-firm relationship, including banks' internal assessments of firms' credit quality, soft information in a lending relationship and the non-random matching of firms with banks may correlate with the systemic importance of banks, leading to inconsistent estimates of β. With bank-firm fixed effects, instead of bank fixed effects, we identify β by comparing changes in lending within bank-firm relationships.

To mitigate further concerns that the relationship between GSIB surcharges and bank lending depends on firm-level demand shocks, we also add firm-year fixed effects to equation (2). Similar to Khwaja and Mian (2008), these fixed effects control for unobserved time-varying firm fundamentals, such as risk, management quality, and investment opportunities, which may be correlated with the GSIB status and surcharge. With firm-year fixed effects, we identify β by comparing differences in credit to the same firm in the same year by banks subject to different surcharges. One drawback of this specification is that it restricts the sample to firms that borrow from multiple banks in a given year. Many firms in our sample have loans with more than one bank, but these firms also tend to be larger and possibly less dependent on bank financing than other firms. For this reason, in some specifications we also use industry-year fixed effects, which account for time-varying industry shocks and do not restrict the sample to firms with multiple lending relationships.

One final concern related to the identification of the effect of GSIB surcharges on bank lending is that banks may have adjusted their systemic importance characteristics in anticipation of the introduction of the surcharge. These adjustments could change the treated and control groups and bias our estimates of the effects of the surcharge on bank lending. To evaluate this concern, we examine whether banks in our sample changed their systemic risk scores ahead of the introduction of the GSIB surcharge. Figure 4 displays banks' systemic importance scores in 2013 and 2014. As shown, banks' scores are very persistent and none of the banks identified as GSIBs or non-GSIBs in 2013 changed status before the introduction of the capital surcharge.

[Insert Figure 4 about here]

IV. GSIB Surcharges and Bank Lending

This section presents our main findings. The first part of the section uses bank-firm-year level data to estimate the effects of GSIB surcharges on the intensive and extensive margins of bank lending. The second part presents evidence on GSIBs' incentives to adjust their assessment of firms' credit risk and other loan terms in response to higher surcharges. The next section uses firm-year level data to infer the overall effects of the introduction of the GSIB surcharges on firms' total borrowing and investment.

IV.1 Capital Surcharges and the Intensive Margin of Lending

We first examine how GISB surcharges affect the intensive margin of lending. Table 3 presents the results of the regression model described in equation (2), with (the log of) loan committed amount as dependent variable. The model is estimated using a sample of 8 GSIBs and 24 non-GSIBs between 2014 and 2017, with data aggregated to the bank-firm-year level. The coefficient on $Surcharge_{b,t+1}$ measures the change in commitment amounts in response to GSIB surcharges. Each specification includes a different set of fixed effects, and controls for the time-varying banks' systemic importance indicators and balance sheet characteristics.

The first column in Table 3 reports the results with firm-year fixed effects to control for firm time-varying shocks. This specification exploits variation in loan committed amounts across banks that face different capital surcharges and lend to the same firm in a given year. It thus requires a sample of firms with multiple bank relationships. We also include bank fixed effects to control for cross-sectional differences across banks, such as banks' business and funding models.

The estimate of β indicates that, after the introduction of the surcharge, GSIBs reduce loan commitments. The estimate suggests that a 1-percentage point increase in the GSIB surcharge lowers loan commitments by approximately 4 percent. This is a sizeable effect, as the average annual change across banks in loan commitments between 2014 and 2017 is only 0.2 percent.

In Column 2, we use the same sample of firms, but replace firm-year fixed effects with industry-year fixed effects as an alternative to account for time-varying demand shocks. In column 3, we add to the sample firms that borrow from only one bank, allowing us to use a larger and richer

sample of firms. Firms that borrow from just one bank may differ from those with multi-bank relationships for many reasons, and surcharges may affect these firms differently. Estimates of β change little in columns 2 and 3 despite the substantial decline in the R^2 relative to column 1. The stability of this coefficient suggests that the introduction and the size of the GSIB surcharge is orthogonal to shocks to firm credit demand.

Columns 4 to 6 present results using the same samples as columns 1 to 3, but now with fixed effects at the bank-firm level instead of firm-year fixed effects. The specifications in columns 4 to 6 exploit variation in credit availability within the same bank-firm pair over time. These fixed effects control for unobservable characteristics related to bank-firm relationships. The point estimate changes little across these alternative specifications and samples, and varies between 2 and 3 percent.

Overall, the results in Table 3 indicate that, in response to the capital surcharge, GSIBs reduce corporate lending compared to non-GSIBs. Moreover, the stability of the coefficient estimates in this table suggests that surcharges are orthogonal to unobservable shocks to firms, banks, and bank-firm relationships. This finding also helps us to draw casual inference on the effects of GSIB surcharges for firm borrowing using firm-level regressions (see Section IV.3), for which we cannot use firm-year fixed effects.

IV.2 Capital Surcharges and the Extensive Margin of Lending

We next turn to the extensive margin of lending. The evidence presented in Table 2 suggests that GSIB surcharges reduce existing loan commitments. However, GSIB surcharges could also affect banks' incentives to terminate existing loans or originate new ones.

We use two variables to measure originations and terminations of lending relationships: *Net Loan Originations* and *Exit*. *Net Loan Originations* is the number of loans originated minus the number of loans terminated. *Exit* is an indicator variable that takes the value of one whenever a bank-firm pair has at least one loan originated before 2014 that is terminated or not renewed in a given year, and is zero otherwise.

Table 4 presents the results using firm-bank fixed effects and either firm-year or industry-year fixed effects. In columns 1 and 2, the coefficient estimates of $Surcharge_{b,t+1}$ are negative, indicating that banks terminate more loans than they originate when surcharges rise. The estimates imply that a 1-percentage point increase in capital surcharges leads to a net decline in loan originations of 4 to 6 percentage points. The coefficient estimate is larger when we use the full sample of firms, suggesting that the decline in loan originations in response to higher GSIB surcharges is stronger for borrowers with a single bank relationship. However, the larger coefficient may reflect the confounding effects of unobservable shocks to firms that the firm-year fixed effects in column 1 can absorb but the industry-year fixed effects in column 2 cannot.

Columns 3 and 4 focus on the *Exit* margin. As shown, the likelihood that that loans are terminated or not renewed increases with higher GSIB surcharges. The estimates imply that the probability of termination increases by at least 3 percentage points for each 1-percentage point rise in the GSIB surcharge. This estimate is large given that approximately 30 percent of bank-firm-year pairs in our sample experience loan terminations, and it implies an increase of about 10 percent in that probability.

IV.3 Capital Surcharges Risk Reduction and Other Loan Terms

As discussed in Section II, surcharges increase the amount of capital that GSIBs must hold per dollar of risk-weighted assets. As a result, GSIB may reduce risk-weighted assets not only by shrinking total loan exposure but also by reducing exposure to borrower risk. Specifically, banks may reduce risk-weighted assets by renegotiating loans in a manner that increases collateral and guarantee requirements, lengthens loan maturities, or increases interest rates. Banks may also lower their estimates of borrower risk.

The 8 GSIBs in our sample are subject to the Advanced Approaches capital framework, which requires banks to use their internal ratings to calculate risk weights for corporate loans. These risk weights depend on risk parameters that banks assign to borrowers, such as internal credit ratings and PDs. Thus, the incentives for GSIBs to either reduce borrower risk or adjust risk parameters may increase with the surcharges.

Table 5 examines whether GSIBs adjust their assessment of firm's credit risk in response to higher surcharges. The table reports results for two measures of firm risk—*High Yield*—an indicator for banks' internal credit ratings equivalent to an S&P rating lower than BBB—and *Risky Firm*—an indicator of whether the firms' probability of default is in the top quartile of the sample distribution.

Columns 1 and 2 suggest that a 1-percentage point increase in the GSIB surcharge reduces the share of borrowers in banks' portfolio that banks rate as high-yield by 2 percentage points. Columns 3 and 4 imply that a 1-percentage point increase in the surcharges lowers the share of firms that banks rate as risky by approximately 1 percentage point. Taken together, these results indicate that banks subject to higher surcharges either lower their estimates of borrower risk or take measures that attenuate their exposure to borrower risk to reduce risk-weighted assets and raise their capital ratios.

We next examine whether higher surcharges also lead GSIBs to change other loan contract terms besides committed amounts. Banks may offer less-attractive loan terms to lower credit supply in response to surcharges, but may also change interest rates and other loan terms to attract less risky borrowers.

To study changes in loan terms, we use four variables: *Guaranteed*, is the fraction of loan guaranteed; *Collateral*, the fraction of loans that are secured and give lenders a first lien senior position; *Maturity*, the log of loan maturity in quarters; and *Interest Rate*, the average interest rate on loans that a bank has committed to a firm. For each bank-firm pair, we compute the annual weighted average of loan terms using banks' commitments to each firm as weights.

Table 6 presents the results using the same combinations of fixed effects as in Table 5. Consistent with the earlier findings that surcharges reduce GSIBs' estimates of credit risk, columns 1 to 4 of Table 6 indicate that, on average, higher surcharges are associated with a larger share of guaranteed and secured loans. Higher GSIB surcharges incentivize banks to demand guarantees and collateral, which lower risk weights in the Basel framework. Likely reflecting the increase in secured lending, banks also lengthen the loan maturity. In contrast, there is not a significant change in interest rates. The low-interest rate environment can explain, in part, the "non-result" on interest rates, as during

our sample period the average interest rate is only 2.7 percent, and varies minimally across bank-firm pairs (the standard deviation is just 1.2 percent).

V. GSIB Surcharges and Firm Borrowing

This section studies whether firms offset the decline in GSIB lending by borrowing from banks less affected by the surcharge, and whether surcharges have any real effects on firms. To tackle these questions, we collapse the loan-level data at the firm-year level and match these data to firm-year balance sheet data. We then estimate the following regression:

$$Y_{f,t} = \beta \overline{Surcharge}_{f,t} + \theta W_{f,t} + \psi_f + \varphi_{i,t} + \epsilon_{f,t}, \tag{3}$$

where f indexes firms, t time, $Y_{f,t}$ is the firm-level outcome of interest, $W_{f,t}$ a vector of time-varying firm characteristics, ψ_f and $\varphi_{i,t}$ are firm and industry-year fixed effects, respectively, and $\epsilon_{f,t}$ is a firm-year idiosyncratic error. Because the analysis is at the firm level, we cannot include firm-year fixed effects to absorb time-varying firm shocks. However, we know from the loan-level regressions in Table 3 that estimates of the effect of the GSIB surcharge on bank lending are about the same when we use industry-year fixed effects instead of firm-year fixed effects. This result suggests that industry-year fixed effects can account for time-varying unobservable shocks to firms in our setting, which allows us to draw causal inference on the consequences of GSIB surcharges on firm outcomes from estimates of β in equation (3).

In equation (3), we define the firm-level average surcharge as:

$$\overline{Surcharge}_{f,t} \equiv \sum_b w_{f,b,t-1} Surcharge_{b,t}, \tag{4}$$

where b denotes bank and the weights, $w_{f,b,t-1}$, are the previous year's share of loans from bank b to firm f. As banking relationships are sticky over time, the intensity of the GSIB surcharge on a particular firm in a given year is a function of the previous year's share of a firm's borrowing from each bank. Additionally, we define these weights in terms of lending in the previous year instead of the current year to avoid feedback effects from lending to our measure of weighted surcharges.

Table 7 shows estimates of equation (3) for bank credit outcomes aggregated at the firm-year level. The first column suggests that total committed amounts increase slightly for firms that borrow from banks subject to the capital surcharge. This result appears to be in contrast with the evidence in Table 3 that GSIB surcharges lower credit supply. The second column of Table 7 explains this apparent contradiction: A 1-percentage point increase in the surcharge adds 1 percentage point to the share of non-GSIB credit in total credit, indicating that the drop in GSIB credit driven by the surcharges is offset by an increase in borrowing from non-GSIBs.

The remaining columns in this table provide further evidence that firms offset the decline in GSIB lending by borrowing from non-GSIBs. Columns 3 and 4 show that, on net, the number of originations at the firm-level decreases as surcharges increase, but this effect is partially compensated by an increase in net originations from non-GSIBs. The coefficient on $\overline{Surcharge}_{f,t}$ in column 4 implies that a 1-percentage point increase in firm exposure to GSIB surcharge is associated with an increase in net loan origination by non-GSIBs of approximately 8 percent.

Column 5 indicates that the risk that a lending relationship ends over the next year is higher if the firm borrows more from GSIBs than non-GSIBs. However, column 6 implies that the odds that relationships with non-GSIBs end drop 3 percentage points per percentage point of weighted surcharge. Overall, both the intensive and extensive margin results of Table 7 provide evidence of reallocation of firms' borrowing from GSIBs to non-GSIBs in response to higher surcharges.

We next examine whether exposure to GSIB surcharges have any real effects on firms. Table 8 presents the results. Debt to assets ratio, fixed assets, and cash holdings all increase with the weighted surcharge. However, the point estimates imply that GSIB surcharges have a very small effect on firms' outcomes. The estimate in column 1 indicates that a 1-percentage point increase in the weighted surcharge adds less than 1 percentage point to the debt to assets ratio, while the estimates in columns 2 and 3 suggest that fixed assets and cash holdings increase less than 1 percent. Columns 4 to 6 show that the effects are roughly the same on smaller firms, defined as firms with total assets below the cross-sectional median. Together with the findings in Table 7, the firm-level evidence in Table 8 suggests that GSIB surcharges have little to no implication for firms' outcome, as firms seem to compensate the reduction in GSIB credit switching to non-GSIBs or other financial intermediaries.

VI. Conclusion

This paper shows that GSIB surcharges—additional capital requirements imposed on systematically important banks—reduce the supply of credit to corporate borrowers. In particular, credit committed to borrowers by GSIBs drops in response to higher GSIB surcharge. However, the overall impact of such credit reduction is limited, as firms switch to non-GSIBs.

We establish this result using data on corporate loans, which allow us to identify changes in the credit availability unrelated to firms' demand factors. However, the result that firms can switch from GSIBs to non-GSIBs lending to offset the decline in bank lending due to GSIB surcharge may depend on the sample period of our analysis, which covers four years of economic expansion and broadly available bank credit to firms. During an economic contraction, credit conditions tighten, and firms may find it difficult to switch to other sources of finance. Accordingly, the real consequences of changes in credit supply due to higher GSIB surcharges may be different in bad times compared to good times.

This paper contributes to the debate on the costs and benefits of capital requirements on banks. While our results unequivocally indicate that higher surcharges lead to a reduction in bank credit supply, the analysis is almost silent on whether higher capital requirements improve financial stability. The evidence that GSIBs reduce lending indicates that surcharges may lower the systemic importance of these banks, which may improve financial stability. However, the finding that credit supply shifts from GSIBs to non-GSIBs also suggests that these surcharges may move financial intermediation to institutions subject to less stringent regulatory requirements, which would undermine stability.

A. Appendix A: GSIB Surcharge Calculation

In this appendix, we explain in more detail how surcharges are calculated. A bank is identified as a GSIB if a measure of its systemic importance—the method 1 score—exceeds 130.

To calculate the method 1 score of a bank, the FRB uses five broad measures of bank's systemic importance: size, interconnectedness, cross-jurisdictional activity, substitutability, and complexity. Each of these five categories receives a weight of 20 percent in a bank's method 1 score. The 12 indicators listed in Table A1 measure the contributions of these five categories.

[Insert Table A.1 about here]

The dollar amount of each of these 12 indicators is multiplied by a weight, shown on the rightmost column of this table, and divided by the respective denominator, which the FRB provides annually. Each denominator is the sum of the respective indicators across the 75 largest U.S. and foreign banking organizations and any other banking organizations that the Basel Committee on Banking Supervision, (BCBS) decides to include in the sample for that year. Each denominator is converted from euros to U.S. dollars using the exchange rate observed on December 31 of the reference year. The sum of the 12 indicators is the method 1 score of the bank. Because the method 1 score of a bank depends on characteristics of other banks, exchange rates, and other market prices, a bank cannot accurately manipulate its method 1 score by changing its own characteristics.

The method 1 fully phased-in GSIB surcharge of a bank is determined as indicated in Table A.2:

[Insert Table A.2 about here]

The method 1 surcharge of a non-GSIB is equal to 0, while the method 1 surcharge of a GSIB is at least equal to 1 percent. This surcharge increases 0.5 percentage points for every 100 basis points in the method 1 score between 130 and 529 and 1 percentage point for every 100 basis points above 529. The larger impact of the score on the surcharge above a score of 529 provides a stronger incentive for GSIBs above this score to limit their systemic footprint.

The calculation of the method 1 score and the mapping of this score into GSIB status and method 1 surcharges in the U.S. rule is identical to the calculation of the score and the mapping of the score into GSIB status and surcharges established by the BCBS (2013). However, while the BCBS rule uses a single score, the U.S. rule includes the method 1 and the method 2 score, with the latter generally yielding higher surcharges.

Specifically, in the United States, banks classified as GSIBs must calculate another score—the method 2 score—which uses the same measures of size, interconnectedness, cross-jurisdictional activity, and complexity as method-1, but replaces the substitutability measure with a measure of the bank's short-term wholesale funding. Since a bank must provide data to calculate the method 2 score only if it is a GSIB, short-term wholesale funding data and method 2 scores are not available for all non-GSIBs.

The method 2 score of a bank is equal to the 12 indicators multiplied by the fixed coefficients in Table A.3. Accordingly, the method 2 score of a bank does not depend on the denominators, which vary annually, as the method 1 score does. Method 2 uses fixed coefficients to make its scores easier to predict and to facilitate capital planning by GSIBs. Nevertheless, banks cannot accurately manipulate their method 2 scores and surcharges, because these scores depend on market prices, such as exchange rates, which banks cannot control.

[Insert Table A.3 about here]

The method-2 fully phased-in GSIB surcharge of a bank depends on its method-2 score as described in Table A.4:

[Insert Table A.4 about here]

The final GSIB surcharge is the maximum of the surcharges implied by the method 1 and the method 2 scores.

B. Appendix B: Variable Definitions and Data Sources

Table B1 defines the variables used in the paper and their data sources.

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Figure 1. GSIBs Capital Surcharges Timeline
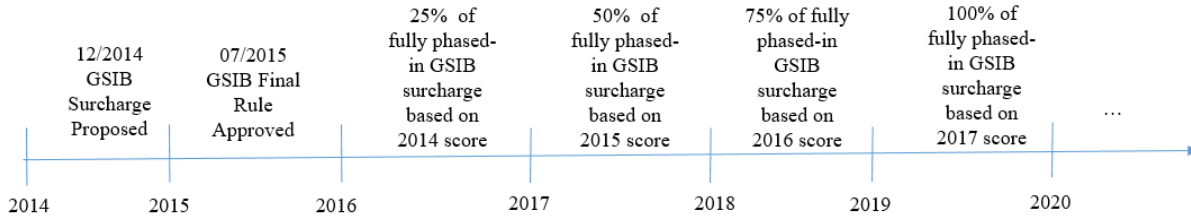
Note: The figure shows the timeline of the GSIB surcharges. Source: Federal Register (2015).

Figure 2. GSIB Surcharges and GSIB Systemic Importance Scores
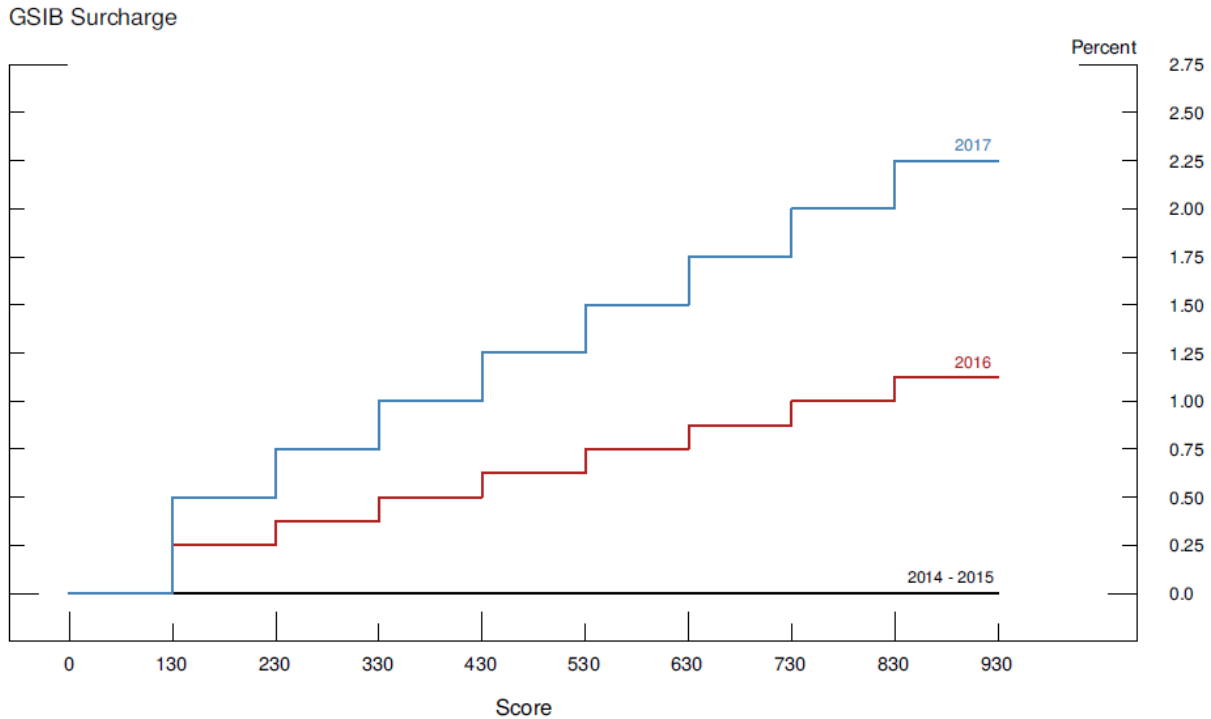
Note: This figure shows the evolution of the GSIB surcharges as a function of a bank's systemic importance score. The systemic importance $Score = max\{method\ 1\ Score, method\ 2\ Score\}$. Banks with score below 130 are non-GSIBs. Source: Federal Register (2015).

Figure 3. Loan Committed Amount around the Introduction of the GSIB Surcharge
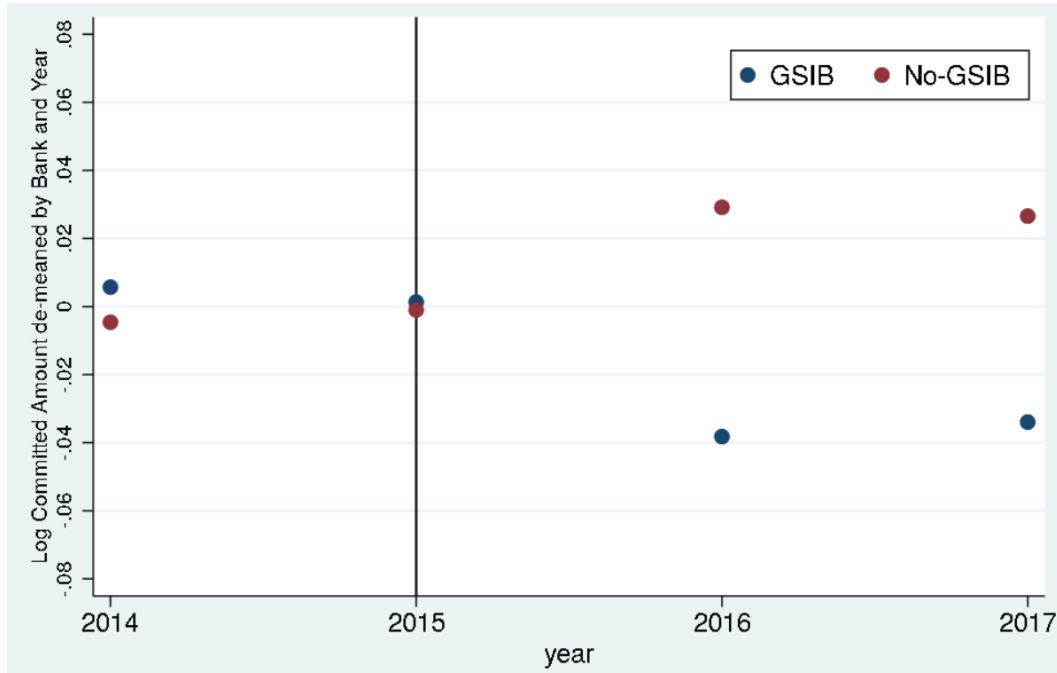
Note: This figure compares lending by GSIBs and No-GSIBs. For each bank type, the log amount is de-meaned relative to bank- and year-average loan amount. If GSIB surcharges affect bank lending there should be no difference in lending between GSIB and no-GSIB before the introduction of the GSIB surcharge, and a divergence afterward.

Figure 4. Banks' Systemic Importance Scores in 2013 and 2014
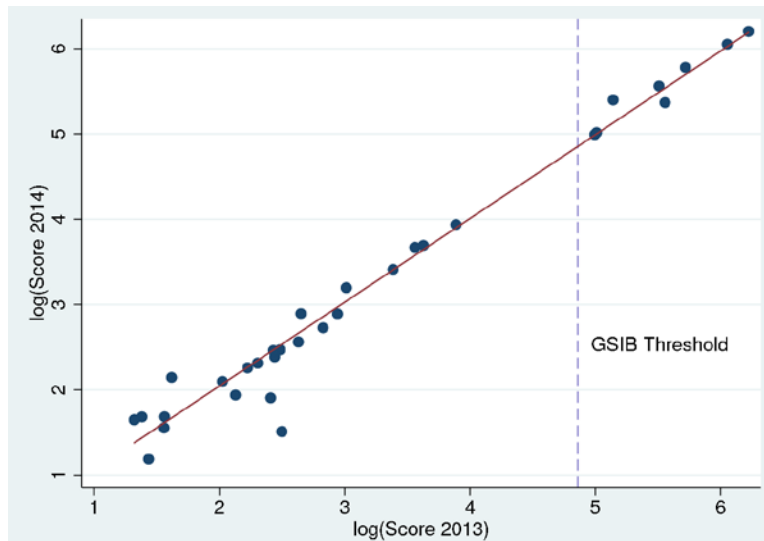
Note: Scatter plot of banks' systemic importance method 1 scores at year-end 2013 and 2014. Banks' scores at *t* determine GSIB surcharges at *t+2*. Source: FR Y-15.

Table 1. Systemic Importance Indicators

This table reports summary statistics of the 12 indicators (in million of U.S. dollars) of banks' systemic importance used to calculate the method 1 score based on information in the FR Y-15 data. The data are at the bank-year level from 2013 to 2016.

	obs	mean	sd	p10	p50	p90
	(1)	(2)	(3)	(4)	(5)	(6)
Size						
Total Exposure	125	602.9	888.8	88.17	174.4	2,275
Interconnectedness						
Intra-financial system assets	125	66.70	117.5	1.528	12.41	290.1
Intra-financial system liabilities	125	67.77	121.2	2.221	10.10	219.9
Securities outstanding	125	67.77	121.2	2.221	10.10	219.9
Substitutability						
Payments activity	125	35,559	75,621	253.4	1,917	109,319
Assets under custody	125	2,952	6,659	2.487	85.34	12,521
Underwritten transactions in debt and equity markets	125	78.43	145.8	0	6.139	346
Complexity						
Notional Amount of OTC derivatives	125	7,863	17,347	18.21	88.64	42,555
Trading and AFS securities	125	45.83	82.13	1.083	8.144	161.7
Level 3 assets	125	7.109	13.04	0.0327	1.347	26.16
Cross-Jurisdiction Activity						
Cross-jurisdictional claims	125	93.90	195.2	0.834	4.463	353.4
Cross-jurisdictional liabilities	125	92.41	186.9	0.0130	1.989	298.2

Table 2. Summary Statistics

This table reports summary statistics of the main variables used in the analysis over the sample period running from 2014 to 2017. Panel A, shows summary statistics of loan-level data, based on the FR Y-14Q corporate loan schedule, aggregated to the bank-firm-year level. Panel B, reports summary statistics for banks using FR Y-9C and FR Y-15 data aggregated at the bank-year level. Panel C, reports summary statistics of FR Y-14Q data aggregated at the firm-year level. Definitions for all variables are in Appendix B.

A. Bank-firm-year level data

	obs	mean	sd	p10	p50	p90
	(1)	(2)	(3)	(4)	(5)	(6)
Committed amount ($millions)	297,522	85.960	83.17	12.63	64.49	172
Log committed amount	297,522	17.80	1.100	16.35	17.98	18.96
Syndicated loan	297,522	0.670	0.453	0	1	1
Credit line	297,522	0.828	0.303	0.291	1	1
Net loan originations	297,522	-0.122	0.928	-1	0	1
Exit	297,522	0.333	0.471	0	0	1
Interest rate	240,194	0.027	0.012	0.015	0.025	0.043
Maturity	297,522	23.95	12.63	12	20	38.02
Log maturity	297,522	3.054	0.511	2.485	2.996	3.638
Secured	297,218	0.600	0.474	0	1	1
Rating	297,365	BB	AAA	A	BB	B
High yield share	297,522	0.554	0.497	0	1	1
Probability of default	266,999	0.022	0.083	0	0.004	0.039
Risky firm	297,522	0.235	0.424	0	0	1

B. Bank-year level data

	obs	mean	sd	p10	p50	p90
	(1)	(2)	(3)	(4)	(5)	(6)
Surcharge	117	0.62	1.12	0	0	2.5
Stress test CET1 ratio	117	8.64	3.09	6.6	8.01	10.85
Leverage ratio	117	9.64	1.54	7.77	9.69	11.27
Charge-offs	117	0.48	0.64	0.01	0.3	1.32
Log Assets	117	19.31	1.09	18.09	18.91	21.35
ROA	117	0.82	0.45	0.41	0.86	1.28
NIM	117	2.68	1.39	0.92	2.82	3.37
Log total deposits	117	10.42	5.88	4.28	9.65	18.66
Interest rate expenditure	117	2.47	5.59	-0.14	1.49	6.12

C. Firm-year level data

	obs	mean	sd	p10	p50	p90
	(1)	(2)	(3)	(4)	(5)	(6)
Weighted Surcharge	94,127	0.440	0.671	0	0	1.50
Log committed amount	94,127	16.17	1.550	14.41	15.89	18.38
Committed amount	94,127	50.36	162.40	1.81	8.00	96.14
Net Loan origination	94,127	-0.214	0.956	-1	0	0
Exit	94,127	0.268	0.443	0	0	1
Debt to assets	92,852	0.326	0.250	0.00	0.29	0.67
Fixed Assets	94,094	0.252	0.247	0.02	0.17	0.62
Cash to assets	94,098	0.107	0.146	0.01	0.05	0.29

Table 3. GSIB Surcharge and Bank Lending: Intensive Margin

This table reports OLS regressions of the GSIB surcharges on banks' loan committed amount. Observations are at the bank-firm-year level. The sample period runs from 2014 to 2017. The dependent variable, *Committed Amount,* is the logarithm of a bank's total loans (credit lines and term loans) committed to a firm in a given year. *Surcharge* denotes the GSIB capital surcharge prevailing in the next year: it is zero in 2015, and 25, 50, and 75 percent of the fully phased-in capital surcharge in 2016, 2017, and 2018, respectively. *Score Components* is a vector of 12 indicators of banks' systemic importance: it includes measures of bank's size, interconnectedness, cross-jurisdictional activity, substitutability and complexity. Each specification includes fixed effects and time-varying *Bank-level controls*, which include the stress test CET1 capital ratio, leverage ratio, charge-off ratio, total assets, ROA, NIM, total deposits, and the interest rate expenditure ratio. t-statistics in parenthesis are based on standard errors clustered at the firm-bank level. *, **, and *** indicate that the coefficients estimated are satistically significant at the 10, 5, and 1 percent level, respectively.

| | Committed Amount | | | | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Surcharge	-0.0370***	-0.0374***	-0.0374***	-0.0285***	-0.0313***	-0.0204***
	(-4.90)	(-3.31)	(-3.65)	(-4.95)	(-4.96)	(-4.37)
Bank FE	Y	Y	Y	N	N	N
Bank-Firm FE	N	N	N	Y	Y	Y
Firm*Year FE	Y	N	N	Y	N	N
Ind*Year FE	N	Y	Y	N	Y	Y
Multi Bank-Firm FE	Y	Y	N	Y	Y	N
Score components	Y	Y	Y	Y	Y	Y
Bank-level controls	Y	Y	Y	Y	Y	Y
Observations	96,841	97,799	297,522	85,640	86,509	269,656
R2	0.7951	0.2140	0.2107	0.9713	0.9390	0.9672

Table 4. GSIB Surcharge and Bank Lending: Extensive Margin

This table report OLS regressions of the GSIB surcharges on the extensive margin of loan origination. Observations are at the bank-firm-year level. The sample period runs from 2014 to 2017. The dependent variable is either *Net Loan Origination* or *Exit*. *Net Loan Origination* is the number of loan soriginated minus the number of loans terminated. *Exit* is a dummy variable that is equal to one if a loan is not renewed at some point between 2015 and 2017. *Surcharge* denotes the GSIB capital surcharge prevailing in the next year: it is zero in 2015, and 25, 50, and 75 percent of the fully phased-in capital surcharge in 2016, 2017, and 2018, respectively. *Score Components* is a vector of 12 indicators of banks' systemic importance: it includes measures of bank's size, interconnectedness, cross-jurisdictional activity, substitutability and complexity. Each specification includes fixed effects and time-varying *Bank-level controls*, which include the stress test CET1 capital ratio, leverage ratio, charge-off ratio, total assets, ROA, NIM, total deposits, and the interest rate expenditure ratio. t-statistics in parenthesis are based on standard errors clustered at the firm-bank level. *, **, and *** indicate that the coefficients estimated are satistically significant at the 10, 5, and 1 percent level, respectively.

	Net Loan Originations		Exit	
	(1)	(2)	(3)	(4)
Surcharge	-0.0356	-0.0588***	0.0235**	0.0484***
	(-1.62)	(-3.30)	(2.08)	(5.68)
Bank-Firm FE	Y	Y	Y	Y
Firm*Year FE	Y	N	Y	N
Ind*Year FE	N	Y	N	Y
Multi Bank-Firm FE	Y	N	Y	N
Score components	Y	Y	Y	Y
Bank-level controls	Y	Y	Y	Y
Observations	85,640	269,656	85,640	269,656
R2	0.6758	0.3587	0.6905	0.4059

Table 5. GSIB Surcharge and Borrower Risk

This table report OLS regressions of the GSIB surcharges on banks' assessment of borrower's risk profile. Observations are at the bank-firm-year level. The sample period runs from 2014 to 2017. The dependent variable is either *High Yield Firms* or *Risky Firms*. *High Yield Firms* is a dummy that is equal to one if a bank rates firms below BBB S&P credit rating category. *Risky Firms* is a dummy that is equal to one if a bank assesses that the ex-ante firm's default probability is in the top quartile of its distribution. *Surcharge* denotes the GSIB capital surcharge prevailing in the next year: it is zero in 2015, and 25, 50, and 75 percent of the fully phased-in capital surcharge in 2016, 2017, and 2018, respectively. *Score Components* is a vector of 12 indicators of banks' systemic importance: it includes measures of bank's size, interconnectedness, cross-jurisdictional activity, substitutability and complexity. Each specification includes fixed effects and time-varying *Bank-level controls*, which include the stress test CET1 capital ratio, leverage ratio, charge-off ratio, total assets, ROA, NIM, total deposits, and the interest rate expenditure ratio. t-statistics in parenthesis are based on standard errors clustered at the firm-bank level. *, **, and *** indicate that the coefficients estimated are satistically significant at the 10, 5, and 1 percent level, respectively.

	High Yield Firms		Risky Firms	
	(1)	(2)	(3)	(4)
Surcharge	-0.0243***	-0.0163***	-0.0103**	-0.0146***
	(-3.54)	(-3.31)	(-2.34)	(-4.19)
Bank-Firm FE	Y	Y	Y	Y
Firm*Year FE	Y	N	Y	N
Ind*Year FE	N	Y	N	Y
Multi Bank-Firm FE	Y	N	Y	N
Score components	Y	Y	Y	Y
Bank-level controls	Y	Y	Y	Y
Observations	85,640	269,656	85,640	269,656
R2	0.9011	0.8450	0.9079	0.8347

Table 6. GSIB Surcharge and Loan Terms

This table report OLS regressions of the GSIB surcharges on loan terms: collateral, maturity and interest rate (in percentange points). Observations are at the bank-firm-year level. The sample period runs from 2014 to 2017. In columns (1)-(2) the dependent variable, *Guaranteed* is the fraction of loans that are guaranteed, In columns (3)-(4), the dependent *Collateral*, is the fraction of loans that are secured and give lenders a first lien senior position. In columns (5)-(6), the dependent variable, *Maturity*, is the log of loan maturity in quarters. The dependent variable in column (7)-(8) is *Interest Rate*, which is the average (strictly positive) interest rate on both credit lines and term loans that a bank has committed to a firm in a given year: the average loan rate is weighted by the total committed loan amount that a firm recieves from a bank in a given year. *Surcharge* denotes the GSIB capital surcharge prevailing in the next year: it is zero in 2015, and 25, 50, and 75 percent of the fully phased-in capital surcharge in 2016, 2017, and 2018, respectively. *Score Components* is a vector of 12 indicators of banks' systemic importance: it includes measures of bank's size, interconnectedness, cross-jurisdictional activity, substitutability and complexity. Each specification includes fixed effects and time-varying *Bank-level controls*, which include the stress test CET1 capital ratio, leverage ratio, charge-off ratio, total assets, ROA, NIM, total deposits, and the interest rate expenditure ratio. t-statistics in parenthesis are based on standard errors clustered at the firm-bank level. *, **, and *** indicate that the coefficients estimated are satistically significant at the 10, 5, and 1 percent level, respectively.

	Guaranteed		Collateral		Maturity		Interest Rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surcharge	0.0557***	0.0375***	0.0367***	0.0316***	0.0165***	0.0465***	0.0001	0.0001
	(9.34)	(9.69)	(6.48)	(8.30)	(2.89)	(9.94)	(1.52)	(0.68)
Bank-Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Year FE	Y	N	Y	N	Y	N	Y	N
Ind*Year FE	N	Y	N	Y	N	Y	N	Y
Multi Bank-Firm FE	Y	N	Y	N	Y	N	Y	N
Score components	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	85,640	269,642	85,585	269,528	85,640	269,656	64,743	214,162
R2	0.9017	0.8758	0.9466	0.9213	0.8985	0.8514	0.9663	0.9129

Table 7. GSIB Surcharge and Firm's Borrowing

This table report OLS regressions of firms' exposure to GSIB surcharge and firm's credit availability. Observations are at the firm-year level, and the sample period runs from 2014 to 2017. In column (1), the dependent variable is the (log of) loan committed amount; in column (2) it is the ratio of loan commitments by non-GSIBs to total loan commitments; in column (3), it is the number of loan originations minus the number of loan terminations; in column (4) it is the number of loan originations by non-GSIBs minus the number of loan terminations by non-GSIBs; in column (5), it is a dummy variable that is equal to one if at least one loan originated to the firm before 2014 was not renewed at some point between 2015 and 2017 and equal to zero otherwise; and in column (6) it is a dummy variable that is equal to one if at least one loan originated to the firm by a non-GSIB before 2014 was not renewed at some point between 2015 and 2017 and equal to zero otherwise. *Weighted Surcharge* is the main explanatory variable and measures firms' exposure to capital surcharges on GSIBs. It is the firm-specific weighted capital surcharge with weights given by the ratio of loan amount committed by a GSIB to the total loan committed by all banks to a given firm in 2015. Each specification includes firm fixed effects, three-digit industry and year fixed effects, and firms controls, such as the lagged (log) assets, net income to assets and the ratio of inventory to sales. *t*-statistics in parenthesis are based on standard errors clustered at the three-digit industry level. *, **, and *** indicate that the coefficients estimated are satistically significant at the 10, 5, and 1 percent level, respectively.

	Committed amount	Share of Committed Amount by non-GSIBs	Net Loan Origination	Net Loan Origination by non-GSIBs	Exit	Exit from non-GSIBs
	(1)	(2)	(3)	(4)	(5)	(6)
Weighted Surcharge	0.0138*	0.0118***	-0.0345***	0.0846***	0.0217***	-0.0311***
	(1.75)	(9.15)	(-2.98)	(12.16)	(3.18)	(-6.14)
Firm FE	Y	Y	Y	Y	Y	Y
Industry*Year FE	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Obs	94,127	94,127	94,127	94,127	94,127	94,127
R2	0.9752	0.9655	0.3315	0.3059	0.4613	0.4859

Table 8. GSIB Surcharge and Firm's Outcomes

This table report OLS regressions of firms' exposure to GSIB surcharges and firm's real outcomes. Observations are at the firm-year level, and the sample period runs from 2014 to 2017. The dependent variables in each column, *Debt to Assets*, *Investment*, *Cash Holdings*, measure firm's leverage, investment and precautionary savings, respectively. *Weighted Surcharge* is the main explanatory variable and measures firms' exposure to capital surcharges on GSIBs: it is computed as the firm-specific weighted capital surcharge with weights given by the ratio of loan amount committed by a GSIB to the total loan committed by all banks to a given firm in 2015. Each specification includes firm fixed effects, three-digit industry and year fixed effects, and firms controls, such as the lagged (log) assets, net income to assets and the ratio of inventory to sales. Columns (1) to (3) report results for the whole set of firms; columns (4) to (6) include only small and medium sized firms, where the cutoff is based on terciles of the firms' asset-size distribution. *t*-statistics in parenthesis are based on standard errors clustered at the three-digit industry level. *, **, and *** indicate that the coefficients estimated are satistically significant at the 10, 5, and 1 percent level, respectively.

	All Firms			Small and Medium Sized Firms		
	Debt to Assets	Fixed Assets	Cash Holdings	Debt to Assets	Fixed Assets	Cash Holdings
	(1)	(2)	(3)	(4)	(5)	(6)
Weighted Surcharge	0.0068***	0.0035***	0.0011	0.0062***	0.0041***	0.0013
	(4.29)	(2.77)	(1.00)	(3.28)	(2.64)	(0.87)
Firm FE	Y	Y	Y	Y	Y	Y
Industry*Year FE	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Observations	92,723	94,089	94,095	59,387	60,080	60,091
R2	0.9035	0.9179	0.8445	0.9095	0.9158	0.8367

Table A1. Systemic Importance Indicator Weights for Method 1 Score

This table reports the weights assigned to the 12 systemic importance indicators used to calculate the method 1 score of each bank. The dollar amount of each of these 12 indicators is multiplied by the respective weight and divided by the respective denominator, which the FRB provides annually. The sum of the 12 indicators after these adjustments is the method 1 score of each bank. Source: Federal Register (2015).

Category	Systemic Importance Indicator	Weight (%)
Size	Total Exposure	20.00
Interconnectedness	Intra-financial system assets	6.67
	Intra-financial system liabilities	6.67
	Securities outstanding	6.67
Substitutability	Payments activity	6.67
	Assets under custody	6.67
	Underwritten transactions in debt and equity markets	6.67
Complexity	Notional Amount of OTC derivatives	6.67
	Trading and AFS securities	6.67
	Level 3 assets	6.67
Cross-Jurisdiction Activity	Cross-jurisdictional claims	10.00
	Cross-jurisdictional liabilities	10.00

Table A2. Method 1 score and GSIBs surcharge

This table shows the method 1 surcharge of each bank as a function of its method 1 score. The method 1 surcharge of a non-GSIB is equal to 0, while the method 1 surcharge of a GSIB is at least equal to 1 percent. This surcharge increases 0.5 percentage points for every 100 basis points in the method 1 score between 130 and 529 and 1 percentage point for every 100 basis points above 529. Source: Federal Register (2015).

Method 1 Score	Method 1 Surcharge (%)
130 or less	0.00
130-299	1.00
230-329	1.50
330-429	2.00
430-529	2.50
530 or more	3.5 + 1.0 for each 100bps above 530

Table A3. Systemic Importance Indicator Weights for Method 2 Score

This table reports the coefficients assigned to the 10 systemic importance indicators used to calculate the method 2 score of each bank. The dollar amount of each of these 10 indicators is multiplied by the respective coefficient. The sum of the 10 indicators after these adjustments is the method 2 score of each bank. Source: Federal Register (2015).

Category	Systemic Indicator	Weight (%)
Size	Total Exposure	4.423
Interconnectedness	Intra-financial system assets	12.007
	Intra-financial system liabilities	12.490
	Securities outstanding	9.056
Short-term wholsesale funding	Short-term wholsesale funding score	1.000
Complexity	Notional Amount of OTC derivatives	0.155
	Trading and AFS securities	30.169
	Level 3 assets	16.1177
Cross-Jurisdiction Activity	Cross-jurisdictional claims	9.277
	Cross-jurisdictional liabilities	9.926

Table A4. Method 2 score and GSIBs surcharge

This table shows the method 2 surcharge of each bank as a function of its method 2 score. The method 2 surcharge of a non-GSIB is equal to 0, while the method 2 surcharge of a GSIB is at least equal to 1 percent. This surcharge increases 0.5 percentage points for every 100 basis points in the method 2. Source: Federal Register (2015).

Method 2 Score	Method 2 Surcharge (%)
130 or less	0.00
130-299	1.00
230-329	1.50
330-429	2.00
430--529	2.50
530-629	3.00
630-729	3.50
730-829	4.00
830-929	4.50
930-1029	5.00
1030-1129	5.50
1130 or more	6.5 + 0.5 for each 100bps above 1130

Table B1. Variable definitions

This Appendix table presents the definition and the data source of the variables used thoroughout this paper.

Variable	Definition	Source
Panel A: Bank-borrower level variables		
Committed amount	Total committed exposure amount. Computed as the sum of all loan commitments for each firm-bank pair	FR-Y14
Interest aate	Average interest rate on all loan commitments for each firm-bank pair, weighted by the commitment amount of each loan commitment for the same firm-bank pair	FR-Y14
Net loan originations	Net sum of new loan originated and exisiting loans terminated for each bank-firm pair in a given quarter	FR-Y14
Exit	Dummy variable that is equal to one if for each bank-firm pair a loan originated before 2014-Q1 is not renewed at some point between 2015 and 2017 and is zero otherwise	FR-Y14
High-yield firms	Dummy variable that is equal to one if a bank rates firms below BBB S&P credit rating category and is zero otherwise. Credit ratings are generates by bank's internal model and mapped into a ten-grade S&P scale	FR-Y14
Risky firms	Dummy variable that is equal to one if a bank assessement of a firm default probability is in the top quartile of its distribution and is equal to zero otherwise. Probability of default is generated by banks' internal risk models.	FR-Y14
Collateral	Fraction of loans secured that give lenders a first lien senior position.	FR-Y14
Guaranteed	Fraction of loans that are guaranteed	FR-Y14
Maturity	Log of loan maturity in quarters	FR-Y14
Panel B: Bank-level variables		
Surcharge	GSIB surcharge	FR-Y 9C
Stress test CET1 ratio	Minimum value of the CET1 ratio over the 9-quarter stress horizon for each bank in our sample under the Federal Reserve's supervisory severely adverse stress scenario.	FR-Y 9C
Leverage ratio	Total liabilities divided by the total assets	FR-Y 9C
Charge-off ratio	Dollar amount of charge-offs divided by total assets	FR-Y 9C
Size	Natural logarithm of total assets	FR-Y 9C
ROA	Net income scaled by the total assets	FR-Y 9C
NIM	Net interest margin scaled by total assets	FR-Y 9C
Total deposits	Sum of all deposits	FR-Y 9C
Interest rate expenditure ratio	Interest rate expenditures scaled by the total assets	FR-Y 9C
Panel C: Firm-level variables		
Committed amount	Total committed exposure amount. Computed as the sum of all loan commitments to a firm in a given year	FR-Y14
Net loan originations	Number of loans originatated minus loans terminated for a firm in a given year.	FR-Y14
Exit	Dummy variable that is equal to one if for each bank-firm pair at least one loan originated before 2014 was not renewed at some point between 2015 and 2017 and equal to zero otherwise.	FR-Y14
Fixed assets	Total firm assets	FR-Y14
Debt to assets ratio	Total firm debt in year *t* scaled by total assets in year *t-1*	FR-Y14
Cash to assets ratio	Cash and short-term equivalents of firm in year *t* scaled by firm total assets in year *t-1*	FR-Y14