# Leverage Regulations and Treasury Market Participation: Evidence from Credit Line Drawdowns*

Giovanni Favara, Sebastian Infante, and Marcelo Rezende†

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**Abstract**

We examine the effects of the supplementary leverage ratio (SLR) on large banks' participation in U.S. Treasury markets. Exploiting exogenous shocks to credit line drawdowns and data on bank's holdings of Treasury securities, we show that an increase in banks' balance sheet size reduces their incentives to participate in the Treasury market. This effect is weaker for banks with higher SLRs and muted when a regulatory change excluded Treasury securities from the computation of the SLR. Accounting for regulatory liquidity or risk-based capital ratios does not change these results. These findings support the hypothesis that banks' ability to participate in markets for safe assets may be curtailed by leverage regulations.

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† Federal Reserve Board. Address: 20th and Constitution Ave. NW, Washington, DC 20551. Email: giovanni.favara@frb.gov, sebastian.infantebilbao@frb.gov, marcelo.rezende@frb.gov.

## Introduction

In response to the 2007-08 Global Financial Crisis (GFC), regulators implemented reforms to strengthen bank capital and improve the resilience of the banking system. Prominent among them, the supplementary leverage ratio (SLR) was introduced as a backstop for risk-based capital requirements. The SLR determines a minimum amount of capital that large U.S. banks must hold irrespective of the risks of their exposures, whereas risk-based capital requirements depend on those risks.

Because the SLR requires that banks hold the same amount of capital for each dollar of safe or risky asset, it may incentivize banks to shed low-yielding safe assets, such as U.S. Treasury securities. Indeed, academics and policymakers have warned about the unintended effects of leverage requirements arguing that the SLR may reduce banks' willingness and ability to intermediate markets for safe assets (Duffie, 2018; Group of Thirty Working Group on Treasury Market Liquidity, 2021; Powell, 2021). Some have also claimed that the SLR requirement contributed to reduce liquidity in the U.S. Treasury market at the onset of the COVID-19 crisis (Duffie, 2020; He, Nagel, and Song, 2022), and that the Federal Reserve Board (FRB)'s decision to exclude Treasury securities and reserves—deposits at Federal Reserve Banks—from the SLR denominator helped restore liquidity in this market (FRB, 2020).

This paper evaluates the effects of the SLR requirements on large banks' participation in the Treasury market. Treasury securities play a key role in the financial system and in the transmission of monetary policy. These securities account for a sizeable share of large domestic banks' assets in the form of direct holdings and secured lending, that is, reverse repurchase agreements (reverse repos) with Treasury securities as collateral. Because the Treasury market is typically highly liquid and Treasury securities are safe assets, a bank can easily dispose of these securities to reduce its balance sheet size, either by selling its direct holdings or by not rolling over existing reverse repos. Thus, a binding SLR requirement could constrain materially large banks' participation in Treasury markets—both via direct holdings of Treasuries and reverse repos backed by Treasuries—with implications outside the banking system and for market functioning.[3]

Establishing a causal channel from the SLR to Treasury market participation, however, is challenging for several reasons. First, exogenous variation in SLR buffers—the difference between banks' SLRs and the minimum regulatory requirement—is scarce, limiting researchers' ability to identify the effect of changes in SLR buffers from other shocks. We overcome this challenge by exploiting exogeneous shocks to the size of banks' balance sheets driven by credit line drawdowns from nonfinancial firms. Drawdowns create assets—loans—on banks' balance sheets, and thus increase banks' total exposures, lowering SLR buffers.[4] Holding bank capital fixed, these shocks could be offset by shedding Treasury securities to reduce overall exposures and increase SLR buffers.

A second challenge is that the largest banks account for most of the Treasury market's intermediation, implying that inference based on differences between large and small banks would likely be misleading. Third, data on banks' participation in Treasury markets for most banks are collected at a low frequency, which limits the researcher's ability to identify how Treasury holdings respond to high-frequency shocks. To address these challenges, our analysis focuses on banks with the largest footprint in the U.S. Treasury market and exploits confidential supervisory data on these banks' daily positions of Treasury securities and reverse repo backed by such securities.

In the analysis, we focus on *encumbered* Treasury securities that are either held directly or via reverse repos. Encumbered securities are, by definition, funded by debt, implying that changes in these positions affect a bank's SLR.[5] Importantly, changes in encumbered securities do not affect

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[3] We characterize reverse repos backed by Treasuries as part of banks' Treasury holdings because (1) these reverse repos contribute to the total amount of Treasury securities that banks can access and (2) the contribution of reverse repos backed by Treasuries on total bank size is identical—excluding the haircut—to the amount of Treasury collateral received.

[4] Undrawn amounts of credit lines, which are off-balance sheet items, receive a smaller weight than drawn amounts, which are on-balance sheet items, in the computation of total exposure, the SLR denominator. For this reason, a credit line drawdown necessarily lowers the SLR.

[5] Unencumbered securities may be funded with equity, and therefore a change in their amount may not affect the SLR. For example, an increase in unencumbered Treasury bonds may be the result of a purchase of those bonds with cash (say, from retained earnings), which would keep the numerator and the denominator of the SLR

a bank's liquidity position because banks buy and sell encumbered securities with funds that they ultimately borrow from or repay to cash investors. Thus, a change in encumbered holdings does not materially affect a bank's liquidity position, nor regulatory liquidity metrics. Our analysis runs from January 2018, when the minimum requirement for the SLR was introduced, to March 2022; it thus covers the period from April 2020 to March 2021, when the FRB excluded reserves and direct Treasury holdings from the SLR requirements.

This setting allows us to estimate how unanticipated shocks to the size of large banks' balance sheets affect their incentives to shed encumbered Treasury securities, how the elasticity of Treasury holdings to balance sheet shocks vary with banks' SLR buffers, and how these relationships changed in response to a regulatory intervention that excluded reserves and Treasuries from the SLR. These elasticities are important in an environment in which the size of the Treasury market has outgrown dealers' capacity to intermediate the market. Figure 1 shows that the total level of primary dealers' participation—the main subsidiaries of large banks that intermediate the Treasury market—, measured by the sum of their long positions in, and reverse repos backed by, Treasury securities, has remained stagnant since the GFC.[6] Meanwhile, the amount of marketable Treasury securities, that is, the total amount outstanding net of Treasury securities held by the Federal Reserve in the System Open Market Account (SOMA) portfolio has risen steadily.[7] This widening gap underscores the importance of banks' ability to respond to a surge in intermediation demand, with potentially adverse effects the overall market functioning.

We find that credit line drawdown shocks reduce bank participation in Treasury markets. This sensitivity is particularly large in March 2020, when nonfinancial firms scrambled for liquidity on news from the spread of the COVID-19 virus, prompting a spike in credit line drawdowns amid a Treasury securities sell-off. Also, banks' response to these balance sheet shocks is concentrated

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unchanged. However, an increase in encumbered Treasury bonds would necessarily be coupled with debt issuance, thereby increasing the SLR denominator.

[6] In the United States, most dealer subsidiaries of large banks are primary dealers, the trading counterparties of the New York Fed in its implementation of monetary policy. Primary dealers are expected to make markets for the New York Fed on behalf of its official accountholders as needed, and to bid on a pro-rata basis in all Treasury auctions at reasonably competitive prices. These entities provide immediacy to buy and sell securities, and to provide secured borrowing and lending, in the Treasury market. Consequently, their ability and willingness to provide these services are integral to the resiliency of the market (Federal Reserve Bank of New York, 2022).

[7] These trends are similar to those documented by Duffie (2020), who shows the widening gap between Treasury outstanding and total assets in the banking system. Figure 1 nets out SOMA holdings and focuses on primary dealers' Treasury participation.

in reverse repo activity, which accounts for the largest share of banks' Treasury market participation. We estimate that, in March 2020, each dollar drawn from banks was associated with a four-dollar decline in the total amount of Treasuries held. In addition, we show that banks respond to drawdowns mostly by adjusting Treasury holdings through their affiliated dealers.

Our central tenet is that shocks to balance sheet size reduce bank participation in Treasury markets because they lower SLRs. We show that a higher SLR buffers attenuate the negative relation between drawdowns and Treasury market participation. Our estimates suggest that, in March 2020, the decline in dollar amounts of Treasuries in response to each dollar of credit line drawn for a bank in the bottom quartile of the SLR distribution was about twice as large and the decline for a bank in the top quartile.

We also study whether the exclusion of Treasuries and reserves from the SLR supported bank participation in Treasury markets. This regulatory relief increased SLRs by 1 percentage point on average, and likely weakened banks' incentives to decrease direct Treasury holdings in response to the increase in balance sheet size. Our evidence indicates that the exclusion achieved its objective: banks stopped shedding Treasury reverse repos in response to drawdowns when Treasuries and reserves were excluded from the SLR. Moreover, we find that during the exclusion period, the sensitivity of outright positions to drawdowns turned positive, indicating that by reducing the SLR burden of directly holdings, banks were willing to increase their Treasury positions in response to balance sheet shocks, possibly to manage other risks related to the drawdowns. Taken together, our results indicate that the SLR affects bank participation when the SLR is close to the regulatory minimum and banks experience large balance sheet shocks.

We next perform robustness tests to ensure that the effects that we attribute to the SLR are not driven by liquidity or risk-based capital requirements. Separating the impact of the SLR from the effects of these requirements is difficult because the minimum SLR was introduced soon after the minimum liquidity coverage ratio (LCR) and amid tightening risk-based capital requirements. Moreover, the SLR and risk-based capital ratios are positively correlated by construction. We show that our estimates of the effects of the SLR on bank participation in Treasury markets remain unchanged when we also account for the LCR requirement and any of the three risk-based capital requirements—total, tier 1, and common equity tier 1 (CET1) capital ratios—that banks in our sample must meet. These findings support the hypothesis that the SLR affects bank Treasury market participation independently of other regulatory requirements.

Our focus on encumbered securities not only ensures that reductions in these holdings reduce balance sheet size, but also concentrates the analysis in an activity that is more relevant for Treasury market functioning. In effect, while encumbered securities account for approximately 50 percent of the combined Treasury holdings (i.e., encumbered plus unencumbered) for the banks in our sample, they account for over 90 percent of the combined holdings of their dealer subsidiaries, which are the largest market makers in the Treasury market. To confirm the relevance of encumbered exposures, we repeat the main analysis using banks' combined Treasury holdings and find economically similar estimates. This suggest that bank sensitivities to changes in balance sheet size, and the effects of the SLR, are relevant for banks' aggregate participation in the Treasury market.

This paper is most closely related to the literature on regulation and the behavior of financial intermediaries in safe asset markets. A commonly held view is that leverage regulations have contributed to episodes of low liquidity and violations of no-arbitrage conditions, particularly at times of market stress, with implications for intermediary asset pricing (Anderson, Duffie, and Song, 2018; Du, Tepper, and Verdelhan, 2018; Correa, Du, and Liao, 2020; Duffie, 2020; Fleckenstein and Longstaff, 2020; Cenedese, Della Corte, and Wang, 2021; Du, Hébert, and Huber, 2021; Infante and Saravay, 2021; He, Nagel, and Song, 2022; Du, Hebert, and Li, 2022; Allen and Wittwer, 2022).[8] We contribute to this literature by focusing on banks' participation in the Treasury market in response to exogenous variation in SLR buffers across banks over time.[9]

Our paper is also related to the academic and policy discussion on bank capital regulation. First, it contributes to the debate on tailoring bank regulation (Greenwood *et al.*, 2017; Quarles, 2018; Barr, 2022), which has influenced the post-GFC regulatory capital framework, including the

[8] Some researchers have argued that leverage regulations have had a smaller impact on market functioning than the government purchases of sovereign bonds (Pelizzon *et al.*, 2022).

[9] Two earlier papers document some effects from the publication of the SLR rule over dealer and bank behavior, mostly relying on data from a period when banks were not yet required to report and meet the SLR. They show that dealer activity in the tri-party repo market changed after the publication of a rule proposal for the SLR in 2012 (Allahrakha, Cetina, and Munyan, 2018) and that, in response to the publication of the final SLR rule in 2014, banks that would eventually be subject to the SLR held riskier securities than other banks (Choi, Holcomb, and Morgan, 2020).

Economic Growth, Regulatory Relief, and Consumer Protection Act of 2018. Second, our work is related to discussions on the costs and benefits of heightened capital requirements on large banks (Hanson *et al.*, 2011; Sarin and Summers, 2016; Greenwood *et al.*, 2017; Financial Stability Board, 2021). Our evidence indicates that, under extreme circumstances, the SLR may prevent banks from intermediating markets for safe assets. Third, we contribute to the debate on the interaction between risk-based and leverage requirements. This debate has valued the simplicity of leverage ratios (Haldane and Madouros, 2012; Jenkins, 2012) but has also recognized the costs of requiring capital for holding safe assets and the distortions that arise when banks are subject to various binding constraints (Greenwood *et al.*, 2017; Duffie, 2018). Our evidence suggests that leverage requirements may indeed have distortionary effects by weakening banks' incentives to intermediate markets for safe assets.

Our work is also related to the literature on the effects of credit line drawdowns on banks and financial markets during the GFC (Ivashina and Scharfstein, 2010; Ippolito *et al.*, 2016) and the COVID-19 crisis (Acharya and Steffen, 2020; Li, Strahan, and Zhang, 2020; Kapan and Minoiu, 2021; Cooperman *et. al* 2022). Some of these papers examine how the effects of drawdowns vary with bank capitalization, but none of them studies how leverage requirements affect banks' participation in U.S. Treasury markets.

The paper proceeds as follows: Section I discusses the regulatory environment that banks are subject to. Section II describes the data and Section III introduces our empirical strategy. Section IV presents the results, and Section V offers concluding remarks.

## I. Institutional Background and Large Banks' Role in U.S. Treasury Markets

In this section, we discuss the regulatory environment and institutional characteristics that are central to our analysis. We first describe the capital and liquidity requirements that apply to large banks. Next, we discuss how credit line drawdowns affect capital and liquidity ratios and, in turn, banks' incentives to participate in Treasury markets. Finally, we outline how large banks' participation in Treasury markets affects market functioning.

### I.1 Capital Requirements

During the GFC, large and complex banks suffered financial distress, destabilizing the financial system, and harming the real economy, despite having risk-based capital ratios well above regulatory minima. To prevent similar stress events, regulators implemented reforms that raised the required quality and quantity of capital, improved risk coverage, and introduced a new leverage ratio to serve as a backstop to the risk-based requirements for those banks (Basel Committee on Banking Supervision (BCBS), 2018).

In the Unites States, Basel III capital regulations requires that bank holding companies (BHCs) and commercial banks must independently meet new risk-based and leverage capital requirements.[10] We next describe the capital regulatory requirements that U.S. BHCs must meet.

### I.1.1 Supplementary Leverage Ratio

The SLR is a version of the Basel III leverage ratio. U.S. global systemically important banks (GSIBs) must hold a minimum ratio of Tier 1 capital to total leverage exposure—the SLR ratio—of 5 percent every quarter.[11]

$$SLR \equiv \frac{Tier\ 1\ capital}{Total\ leverage\ exposure} \geq 5\ percent. \tag{1}$$

The total leverage exposure—the denominator of the SLR ratio—is the sum of the dollar amounts of on-balance sheet exposures, derivatives and repo-style transactions, and off-balance sheet exposures such as undrawn credit lines. Banks calculate their total leverage exposure using daily averages of on-balance sheet exposures and the average of the three month-end amounts of off-balance sheet exposures to minimize window dressing. The SLR requirement was adopted in 2014 and it became effective on January 1st, 2018 (Federal Register, 2014).[12] Failure to meet the

[10] For the sake of brevity and in the absence of any risk of confusion, we generally refer to BHCs as banks.
[11] The SLR applies to all Advanced Approaches (AA) banks. The U.S. GSIBs and other AA banks, respectively, must hold SLRs of at least 5 percent (the enhanced SLR) and 3 percent. Subsidiaries of U.S. GSIBs must hold SLRs of 6 percent of more.
[12] Before 2018, banks were already subject to a leverage requirement, the Tier 1 leverage ratio, equal to Tier 1 capital divided by average total assets. The minimum required Tier 1 leverage ratio is 4 percent. The minimum Tier 1 leverage ratio requirement is redundant for U.S. GSIBs because this ratio and the SLR use the same numerator, the SLR uses a larger denominator, and the minimum SLR for GSIBs of 5 percent is higher than the 4 percent Tier 1 leverage ratio requirement. For this reason, in this paper we do not study the effects of the Tier 1 leverage ratio requirement on bank behavior.

minimum SLR may restrict capital distributions to shareholders and bonus payments to bank officers.

The definition of total leverage exposure was modified between April 1st, 2020, and March 31, 2021, when the FRB excluded reserves and on-balance sheet Treasury positions from the denominator of banks' SLRs. This measure was intended to allow banks to continue to act as financial intermediaries amid disruptions in economic conditions and strains in U.S. financial markets caused by COVID-19 pandemic (Federal Register, 2020b). Figure 2 shows that between April 2020 and March 2021 the exclusion of Treasury securities and reserves increased the average SLR of the banks in our sample by about one percentage point.

### I.1.2 Risk-Based Capital Ratios

U.S. BHCs are subject to minimum Basel III requirements for total, tier 1, and CET1 capital as a percentage of risk-weighted assets (RWA) as follows:

$$\frac{E_j}{RWA} \geq k_j, \quad (2)$$

where $j \in \{total\ capital, tier\ 1\ capital, CET1\ capital\}$, $E_j$ is the amount of capital of type $j$, and $k_j$ is the capital ratio $j$. Total capital includes all Tier 1 capital, and Tier 1 capital includes all CET1 capital.[13] $k_j$ includes a Basel III minimum requirement, which is the same for every bank, and a GSIB surcharge, which varies with bank-level systemic importance indicators. Since October 2020, the minimum CET1 ratio also contains a stress capital buffer requirement, which the FRB calculates annually using bank-level data (Federal Register, 2020a).

## I.2 Liquidity Coverage Ratio

The LCR is the ratio between a bank's high-quality liquid assets (HQLA) and its projected net cash outflow over a 30-day stress scenario. Assets that qualify as HQLA must be easily and immediately convertible to cash with little to no loss of value. Unencumbered Treasury positions and reverse repos qualify as Level 1 HQLA, the only class of HQLA that add to the numerator of

[13] $E_j$, $RWA$, and $k_j$ vary over time and across banks.

the LCR without any haircuts. Banks subject to the LCR requirement must meet a minimum ratio of 100 percent. [14]

### I.3 Credit Line Drawdowns, SLR, and Treasury Holdings

Credit line drawdowns lower the SLR because they increase its denominator—total leverage exposure. Total leverage exposure includes both drawn and undrawn amounts of credit lines. However, each dollar drawn from a credit line counts as one dollar for the total leverage exposure, whereas undrawn amounts enter at a discount: each undrawn dollar is multiplied by a credit conversion factor (CCF), which varies between 0 percent and 50 percent, depending on the maturity of the credit commitment and whether the bank can cancel it unconditionally. The product of this multiplication—the credit equivalent amount (CEA)—is then added to the total leverage exposure (Code of Federal Regulations, 2022). Because an undrawn amount is larger than its CEA, a drawdown increases the total leverage exposure and lowers the SLR.

A bank with a narrowing SLR buffer may reduce the amount of Treasuries it holds to raise its SLR. Treasuries and drawn amounts of credit lines enter the SLR denominator equally and thus, a bank may decide to decrease Treasury securities to accommodate an increase in drawdowns to continue to meet the SLR requirement. Because Treasuries are assigned a risk-weight of zero, risk-based capital requirements do not offer banks the same incentive to lower Treasury holdings that are financed via debt in response to drawdowns as the SLR.

### I.4 Large Banks in the U.S. Treasury Holdings During March 2020 and Beyond

The effects of credit line drawdowns on Treasury amounts became apparent during March 2020, at the onset of the COVID-19 pandemic. In early 2020, uncertainty created by the pandemic led nonfinancial firms to "dash for cash." Amid worsening financing conditions and liquidity shortages, nonfinancial firms drew unprecedented amounts of cash from their bank credit lines. Commercial and industrial (C&I) loans on commercial banks' balance sheets rose by about half a

[14] A bank's LCR is the ratio between unencumbered high-quality liquid assets (HQLA) that can be converted into cash easily and the amount of liabilities that are expected to run off or breakdown during a stress scenario. In the United States, the run-off rate for liabilities backed by Treasuries is zero. Therefore, changes in encumbered Treasury securities does not affect either the amount of HQLA (the LCR's numerator), nor the amount of run off liabilities (the denominator). See Macchiavelli and Pettit (2018) for a discussion on the impact of Treasury amounts on the LCR.

trillion dollars between the first week of March and the first week of April.[15] This shock, which has a nonfinancial origin, was considered unexpected by firms and banks (see, for example, Li, Strahan, and Zhang, 2020). For the banks in our sample, the dollar amount of drawn credit lines to nonfinancial firms increased by roughly 50 percent over the course of March 2020. This jump in the drawn amount of credit lines likely contributed to the drop in the average SLR of banks in our sample, which in March 2020 reached its lowest level since the SLR requirement became effective. Moreover, Cooperman *et. al* (2022) estimate that during this time most of firms' drawdowns were placed into low-interest-bearing deposit accounts, suggesting that the increase in banks' balance sheet size was relatively persistent.

Against this backdrop, investors also sought to liquidate Treasury securities (He, Nagel, and Song, 2021), suggesting that dealers affiliated to large BHCs absorbed much of that selling pressure. In fact, relative to the beginning of March 2020, the banks in our sample expanded their encumbered holdings of Treasury securities by 7 percent. Still, bid-ask spreads for some Treasury securities were 20 times larger than typical levels for a few days in March, indicating that banks decided to absorb only part of the soaring supply of Treasuries despite their attractive terms (Younger, 2020). The SLR reportedly contributed to curb bank demand for Treasuries over that period (for example, Seidner *et al.*, 2021), and this view supported the FRB's decision to temporarily exclude outright Treasury positions and reserves from the SLR from April 2020 to March 2021.

## II. Data

We use BHC-level data on credit lines security inflows and outflows, and holdings of high-quality liquid assets from the Complex Institution Liquidity Monitoring Report (FR 2052a). These reports were introduced to enable U.S. regulators to assess the liquidity position of reporting banks and monitor their compliance with liquidity requirements. These data start in December 2015, but we restrict the analysis to the period from January 2018—when the SLR requirement became effective—to March 2022. Table 1 summarize the data.

All banks with $700 billion or more of total consolidated assets or with $10 trillion or more in assets under custody—the eight U.S. GSIBs and four foreign banks that operate in the United

[15] According to the H.8 data release from the FRB, the total C&I loan amount at commercial banks increased $485 billion between March 4, 2020, and April 1, 2020.

States—must report these data daily. We restrict our sample to U.S. GSIBs because foreign banks are subject to a different regulatory framework. We also drop from our sample Bank of New York Mellon and State Street because they are much smaller and because these custodial banks have very different business models than the larger GSIBs.[16] In addition, we do not include Wells Fargo because it has been subject to an asset cap since February 2018, which may constrain its lending and Treasury market participation. The final sample of banks consists of Bank of America, Citigroup, Goldman Sachs, JP Morgan, and Morgan Stanley.

The analysis focuses on the banks' *encumbered* Treasury positions and Treasury reverse repo. Positions and reverse repo together account for the total amount of U.S. Treasuries held by banks. Because banks risk exposure and market impact may differ across positions and reverse repo, and because their regulatory treatment different in the period where Treasuries and reserves were excluded from the SLR, we examine their amounts separately. We focus on encumbered Treasury securities to ensure that their amounts increase banks' leverage.

The largest U.S. GSIBs have an outsized role in the Treasury market. Figure 3 shows that the GSIBs we consider have an average encumbered Treasury market participation of approximately $700 billion, approximately 75 percent of all GSIB Treasury market participation with daily reporting in the FR 2052a. The average fraction of encumbered Treasuries relative to both encumbered and unencumbered Treasuries is approximately 51 percent (71 percent for reverse repos and 25 percent for positions) at the BHC level, and 89 percent (90 percent for reverse repos and 81 percent for positions) at the dealer level. This underscores the relevance of these firms' encumbered participation in Treasury markets, particularly for dealer subsidiaries.

Our analysis uses credit line data to nonfinancial firms to minimize endogeneity issues resulting from credit line drawdowns by other financial firms. Credit line data in the FR2025a reports include the drawn amounts from credit lines and the undrawn committed amounts from nonfinancial firms.

Drawdowns on credit lines mechanically increase a bank's total leverage exposure, lowering its SLR. We use FR Y-9C data to gauge the impact of drawdowns on total leverage exposure for the

[16] For example, these two banks have much smaller amounts of commercial and industrial lending than other GSIBs.

five banks in our sample. Figure 4 shows that the CEA of the total unused commitments—the amount of unused commitments that factor into the SLR calculation—has stayed close to 20 percent relative to the total unused commitments for the banks in our sample. Total unused commitments reported in the FR Y-9C include credit lines to nonfinancial firms as well as other commitments. Assuming that the CEA of undrawn amounts of credit lines to nonfinancial firms as a share of the total of these undrawn amounts is close to that percentage, we estimate that each dollar that a borrower draws from a credit line simultaneously subtracts about $0.20 (the CEA of the unused credit line amount) and adds $1.00 (the amount drawn that becomes an on-balance sheet item) to the bank's total leverage exposure, thereby increasing its total leverage exposure by approximately $0.80 on net.

To compare the magnitudes of Treasury positions, reverse repo, and credit lines outstanding, Figure 5 shows the cross-sectional average allocation of each of these asset classes relative to total bank assets. Reverse repo is the largest asset class, suggesting that banks may adjust the size of their balance sheets mainly by first changing reverse repo amounts instead of Treasury positions. Figure 5 also shows that the three asset types rose sharply in March 2020, suggesting their contributions to changes in SLRs were meaningful in that month.

From other regulatory reports and public data, we use quarterly data on bank total assets (from the FR Y-9C) and total exposure (from the FR Y-15). Quarterly averages of LCR are collected from BHCs' public disclosures. SLRs and risk-based capital ratios come from FR Y-9C filings.[17] Minimum risk-based capital ratios vary across banks because U.S. GSIBs are subject to capital surcharges and a stress capital buffer requirement. We compute GSIB surcharges using FR Y-15 data and we use stress capital buffer requirement data that the FRB reports annually. We subtract the minimum requirements from the respective capital ratios to calculate capital buffers, which we use in our regressions. We focus on the capital requirements at the BHC level because we are interested in the impact of credit line drawdowns, which mainly occur at the commercial banks,

[17] We collect SLR data from banks' public disclosures over the period when the FRB excluded Treasuries and reserves from the denominator of the SLR to calculate the SLR that banks would have reported in the absence of the exclusion.

on Treasury security amounts, which are intermediated by dealer subsidiaries. All BHCs in our sample have at least one dealer and one large commercial bank as subsidiaries.

We also use financial market and bank-level data as controls in our regressions. Specifically, we use information on Treasury note and bonds outstanding, Treasury bills outstanding, and Treasury System Open Market Account (SOMA) holdings to control for changes in the U.S. Treasury market stemming from Treasury issuance activity and the Federal Reserve asset purchases. We also control for other determinants of Treasury market's activity, including the safe asset convenience yield measured through the Treasury bill (T-bill) overnight index swap (OIS) spread, the general collateral finance (GCF) triparty repo spread, the slope of Treasury term structure, the Chicago Board Options Exchange Volatility Index (VIX), and individual bank credit default swap (CDS) quotes as measure of bank-level riskiness.

## III. Empirical Strategy

We begin the analysis by estimating the response of banks' positioning in the Treasury market to credit line drawdowns through the following regression:

$$\Delta Y_{it} = \beta \Delta CLOutstanding_{it} + \beta' \Delta CLOutstanding_{it} \times 1_{Mar2020} + \alpha_{im(t)} + \eta \Delta Y_{it-5} + \gamma X_{it-5} + \zeta W_t + \epsilon_{it}, \tag{3}$$

where $i$ and $t$ index bank and day, respectively and $\Delta$ denotes a 5-day first difference operator. $Y_{it} \equiv \{UST\ Total_{it}, UST\ Positions_{it}, UST\ RevRepo_{it}\}$ is the bank-$i$ day-$t$ total amount of encumbered Treasury positions and Treasury reverse repo, and $CL\ Outstanding_{it}$, is the dollar amount of total credit lines outstanding to non-financial firms; these variables are normalized by BHCs' total assets reported in the previous quarter. $1_{Mar2020}$ is an indicator variable for March 2020, which marks the beginning of Treasury market turmoil at the onset of the COVID 19 pandemic. $\alpha_{im(t)}$ are bank-month-year fixed effects, which absorb time-varying observable and unobservable bank characteristics, $X_{it-5}$ are lagged bank level CDS quotes, and $W_t$ are daily financial variables relevant to the Treasury market, including 5-day changes in U.S. Treasury bills and notes outstanding, and the level of relevant market spreads and indices. We exclude data on quarter-end dates, and the two days before and after quarter-end, to eliminate the effect of window dressing that could influence banks' holding of Treasury securities.[18] Given the small-N-large-T setting of our panel, we use Driscoll-Kraay (1988) standard errors, which account for general forms of cross-sectional and temporal dependence of the residuals, $\epsilon_{it}$.[19]

The coefficients of interest are $\beta$ and $\beta'$, which measure the effects of drawdowns on banks' participation in the Treasury market over the whole sample period and in March 2020, respectively. The null hypotheses are $\beta = 0$ and $\beta' = 0$. Rejection of these hypotheses imply that drawdowns affect banks' positioning in the Treasury market.

In a second step, we augment the baseline regression to include banks' SLR buffer, and the SLR buffer interacted with the indicator variable during March 2020. We first focus on the period before April 2020 when the FRB excluded U.S. Treasuries and reserves from the denominator of banks' SLRs—an exclusion that affected the level of the SLR and, possibly, banks sensitivity to drawdowns. We then study how these sensitivities changed during the carve out period, that is between April 2020 and March 2021. We next control for liquidity and risk-based capital regulatory ratios to test whether the SLR or other regulatory requirements drive the relationship we estimate. In a final step, we study whether our results are modified if we use changes in combined Treasury holdings (i.e., the sum of encumbered and unencumbered securities) as the dependent variable, instead of changes in the amount of encumbered Treasuries only.

## IV. Results

### IV.1 Drawdowns and Treasury Market Participation

Table 2 reports the estimates of equation (3) using 5-day changes in the dollar amounts of total Treasury holdings, Treasury reverse repos, and Treasury positions as dependent variables, and changes in the total amount of amounts credit lines outstanding as the main independent variable. The first three columns of Table 2 show results with data at the BHC level; the last three columns report results using BHC-affiliated dealer level data.

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[18] Banks in jurisdictions that require quarterly regulatory reporting are incentivized to significantly alter their balance sheet on quarter-ends, which is particularly relevant for their participation in deep and liquid markets, such as the U.S. Treasury markets. See Munyan (2017) for one example on banks' window dressing activity in repo markets.

[19] The lag-length of autocorrelation residuals is set to 11, given the 5-day overlapping nature of the dependent variables.

In Panel A, which considers the sample prior to 2020, the estimate of $\beta$ is negative when we consider changes in total and reverse repo Treasury holdings as the dependent variable at the BHC level. These results confirm that GSIBs tend to cut down on reverse repo in response to unexpected increases in the size of their balance sheets. Panel B repeats the exercise of Panel A for the period that includes the large change in credit lines outstanding during March 2020. The point estimates on the sensitivity of Treasury reverse repo and total Treasury securities are much larger than the pre-March 2020 sample, particularly for dealers.

In Panel C, we include the term $\beta' \Delta CLOutstanding_{it} \times 1_{Mar2020}$ as an independent variable. This interaction term reveals how the relationship between drawdowns and Treasury market participation changed in March 2020. Estimates of $\beta'$ are negative, statistically significant, and economically large: for example, the -0.311 and -4.020 estimates of $\beta$ and $\beta'$ in column 1 imply that each dollar drawn from a credit line lowers the amount of total Treasuries holdings by 4 dollars. Together, the estimates in this table indicate that drawdowns had a material impact on Treasury market participation, especially during March 2020.

Figure 6 shows that in March 2020 drawdowns of nonfinancial corporate credit lines surged to approximately 8 standard deviations relative to their historical mean. The sheer size of this shock, at a time when the banks' participation in the Treasury market was relatively large, likely explains the magnitude of the point estimates reported in Panel C and suggest that the mechanism described in this paper is particularly important when large and unexpected changes to BHCs' balance sheet size materialize.

### IV.2 Effects of the SLR on Treasury Market Participation

In Table 3, we examine how the SLR affects the relationship between drawdowns and Treasury market participation before April 2021, when the FRB excluded Treasury securities and reserves from the SLR. We add to equation (3) interaction terms between $SLR_{i,q(t)-1}$—the SLR minus the 5 percent minimum threshold, i.e., the SLR buffer, of bank $i$ at the end of the most recent quarter before day $t$—and the terms $\Delta CLOutstanding_{it}$ and $\Delta CLOutstanding_{it} \times 1_{Mar2020}$, the loading of which are denoted by $\phi'$ and $\phi'$, respectively. The coefficient estimates of the terms that include a March 2020 indicator, $\beta'$ and $\phi'$, are always large and significant, whereas the coefficient estimates for the respective terms without the March 2020 indicator are smaller and never significant, offering further evidence that the relationship between drawdowns and Treasury market participation was particularly strong in March 2020.

Across the six columns in the table, estimates of $\beta'$ and $\phi'$ are always negative and positive, respectively, implying that drawdowns lower Treasury market participation and that a larger SLR buffer attenuates this effect. In column 1, the sum of the estimates of $\beta$, $\beta'$, $\phi$, and $\phi'$ implies that 1 dollar drawn from credit lines from a bank with a 1-percentage point SLR buffer lowers the amount of total Treasury market participation by approximately 13 dollars. Comparing the sensitivity of reverse repo and positions to changes in outstanding credit amounts shows that the magnitudes are much larger for reverse repo. This observation is consistent with the idea that in response to balance sheet shocks BHCs are more likely to adjust reverse repos than positions because they hold larger average dollar amounts on their balance sheets. BHCs may also find it easier to reduce reverse repo amounts because they can passively do so by not renewing those agreements.

Figures 7 and 8 illustrate how the sensitivity of reverse repo and positions to credit line drawdowns during March 2020 varies with the SLR buffer. The figures show the point estimate of the total effect of drawdowns during March 2020 and the estimated 95 percent confidence interval for the BHC (in black) and the broker dealer subsidiary (in blue). The shaded gray area indicates the support of the SLR buffers of banks in our sample during March 2020. The estimates in Figures 7 and 8 are based on the results from columns 2 and 5, and from columns 3 and 6, respectively, of Table 3. Drawdowns decrease Treasury market participation in both reverse repos and positions for banks with SLR buffers below 1.75 percentage points. As shown in Figure 1, the average SLR buffer stayed below this value throughout the whole sample period, except when the FRB excluded Treasuries and reserves from the SLR, implying that the SLR attenuates the impact of drawdowns on Treasury market participation across the range of SLRs that banks have reported. The sensitivity is much larger for reverse repo than for outright positions, consistent with the estimates in Table 3.

### IV.3 SLR on Treasury Market Participation during Carve Out Period

We next examine the impact of the FRB's decision to exclude Treasuries and reserves from the SLR over the period from April 1, 2020, to March 31, 2021, which we label as the "Carve Out" period. In Table 4 we augment the regressions estimated in Table 3 with interaction terms between an indicator for the carve out period (denoted by $1_{CarveOut}$) and the terms $\Delta CLOutstanding_{it}$ and $\Delta CLOutstanding_{it} \times SLR_{i,q(t)-1}$. In addition, we extend the sample period to March 2022. As shown, the insights from Table 3 still hold. Namely, drawdowns during March 2020 had a particularly strong negative effect on Treasury market participation and a higher SLR buffer reduce this sensitivity. Across all specifications, the total effect of a shock to banks' balance sheet size on their participation in the Treasury market (i.e., $\beta + \phi + \beta' + \phi'$) is negative and statistically significant for banks with an SLR buffer of one. The picture, however, is different during the carve out period. The total effect of drawdowns on a bank with an SLR buffer of one (i.e., $\beta + \phi + \beta'' + \phi''$) is *positive* and statistically significant for total Treasury holdings, and it is driven by the positive elasticity on outright positions. The estimated elasticity on reverse repo is also positive, albeit not statistically significant.

These results point to two effects from the carve out of Treasury positions and reserves. First, there is a level effect: The observed increase in SLR buffers following the carve out period result in a less sizeable elasticity of drawdowns on reverse repos that also loses statistical significance. Second, there is a marginal effect: The exclusion of outright position from the SLR calculation made holding Treasuries outright relatively more attractive. Likely as a result, banks raised their Treasury positions in response to drawdowns to their credit lines. These findings indicate that, during the carve out period, the SLR did not negatively affect the Treasury market participation of a bank in response to a shock to its balance sheet size. These results again suggest that the effects documented in the paper are more relevant when shocks are large and banks are close to their regulatory minimums.

Figures 9 and 10 display these results by showing the total sensitivity (and associated confidence intervals) of reverse repos and positions to drawdowns for different levels of SLR buffers. As before, the shaded gray area indicates the support of the SLR buffers of banks in our sample during the carve out period. The two figures are based on the coefficients estimated in Table 4 (columns 2 and 5 for reverse repos and 3 and 6 for positions). In Figure 9, the response of reverse repo is not statistically significant for all levels of SLR buffers, suggesting that the overall change in SLR levels during the carve out period mitigated banks' incentives to reduce their encumbered reverse repos in response to shocks to their balance sheet. In Figure 10, the sensitivity of positions is positive and statistically significant for low levels of SLR buffers, indicating that the change in SLR rule altered banks' incentives to hold Treasuries outright.

### IV.4 SLR versus Risk-Based Capital Requirements and the LCR

We also study whether the effects that we have so far attributed to the SLR are driven by risk-based capital requirements or the LCR. Leverage ratios and risk-based capital ratios are positively correlated, implying that we may confound effects of the SLR with those from risk-based capital ratios. Also, the SLR was introduced one year after the LCR was fully phased in. To separate these competing impacts, we add to equation (3) interaction terms between risk-based capital ratio and LCR buffers (the bank's regulatory ratio minus the minimum requirement) and the terms $\Delta CLOutstanding_{it}$ and $\Delta CLOutstanding_{it} \times 1_{Mar2020}$, the loadings of which are denoted by $\hat{\phi}$ and $\hat{\phi}'$, respectively. To avoid multicollinearity problems—the three risk-based capital ratios are highly correlated by construction—the specifications use Total, Tier 1, and CET1 capital ratio, and the LCR buffers separately. For the sake of brevity, we only report estimates of the BHC-level regressions, but the results are similar when we use dealer-level data.

In Table 5, the estimates of $\beta'$ and $\phi'$, which capture the effect of drawdowns and the SLR, are little changed relative to those reported in Table 3, indicating that the effects of drawdowns and the SLR in March 2020 remain robust when we account for risk-based capital ratios or the LCR.[20] Together, the estimates in this table support our interpretation that the results in Tables 3 and 4 are not driven by risk-based capital ratios or the LCR and strengthen our interpretation that the SLR plays a role in attenuating the impact of on Treasury market participation of shocks on banks' balance sheet size.

### IV.5 Drawdowns and Banks' Combined Treasury Market Participation

So far, our empirical analysis has solely focused on the effect of drawdowns on banks' and dealers' holdings of encumbered securities. We restricted our attention to encumbered Treasuries because they necessarily affect a bank's balance sheet size and because they do not affect a bank's liquidity position or LCR. Altogether, our results show that balance sheet size shocks decrease the amount

[20] As we move from column 1 to 3 in Table 5, the definition of capital of the risk-based capital ratio narrows, implying that these ratios decrease. Accordingly, the coefficient estimates of the risk-based capital interaction terms, $\phi'$, increase in absolute terms.

of encumbered Treasury securities at banks, and that this effect is attenuated by larger SLR buffers. However, the combined amount of Treasuries—the sum of encumbered and unencumbered amounts—might remain unchanged or even increase in response to these shocks. In this case, our findings based on encumbered securities would arguably add little to our understanding of how balance sheet shocks affect banks' combined amounts of Treasury securities.

To study how combined Treasury amounts respond to banks' balance sheet shocks, we repeat the exercise in equation (3), but using combined total Treasury holdings, combined Treasury reverse repos, and combined Treasury positions as dependent variables. As in Table 2, Table 6 shows the response of banks' unencumbered Treasury holdings to drawdowns prior to 2020 in Panel A, using the entire sample in Panel B, and using the entire sample with an interaction term for March 2020 in Panel C at the BHC- and dealer-level.

The coefficient estimates show that the results based on encumbered securities only (Table 2) are very similar to those based on the sum of encumbered and unencumbered securities (Table 6). This finding is expected given that encumbered securities account for a large share of the Treasury holdings at banks. Still, the estimates in Panels B and C at the BHC-level are larger in Table 6 than in Table 2, which is also expected considering that unencumbered Treasury amount rose materially at BHCs over the full sample period.

In Table 7, we replicate Table 4 to analyze whether our main results regarding the SLR based on encumbered securities also apply to the combined amount of Treasury securities. Once again, the coefficient estimates are similar in the two tables, albeit with some notable differences. Estimates of $\phi'$ in Table 7 are larger at the BHC level and smaller at the dealer-level than in Table 4, consistent with the fact that an important banks' sensitivities to drawdowns are largely driven by changes in their encumbered securities.

In summary, we find that drawdowns cause a larger drop in the total amount of Treasuries than in the amount of encumbered Treasuries alone, implying that banks also reduce their amount of unencumbered Treasuries in response to drawdowns. Yet the impact of drawdowns on encumbered Treasuries is proportionally larger than on unencumbered Treasuries. This lower effect on unencumbered Treasuries is expected because a drop in these securities does not necessarily raise a bank's SLR, whereas a drop in encumbered securities does. Thus, banks constrained by the SLR would generally decrease their amounts of encumbered securities by more than their amount of unencumbered securities in response to negative shocks to this ratio.

### IV.6 Discussion

The results presented so far support the notion that the SLR may have unintended consequences on large banks' ability to participate in the U.S. Treasury market. In particular, the evidence suggests that these effects are more pronounced when SLR buffers are at low levels and banks suffer large, unexpected shocks to their balance sheets.

An alternative channel to the one operating via a tightening of leverage constraints is that in the face of large shocks to their balance sheets, banks' risk management practices change. For example, in the context of our empirical setting, a credit line drawdown may affect a bank deposit base and its exposure to credit risk, inducing such bank to increase its Treasury positions and reverse repo. We find evidence against this alternative view, as banks and dealers reduce their encumbered Treasury holdings in response to shocks to their credit lines, and that the sensitivity is attenuated for banks with higher SLR butters, in line with a regulatory balance sheet channel.

A second alternative channel of the effects of balance sheet shocks on Treasury amounts goes through banks' liquidity needs. Amid market dislocations, bank reserves and cash are readily available to meet cash outflows, whereas Treasury securities must be monetized before they can be used to settle cash transactions. As a result, banks' demand for Treasuries falls relative to their demand of reserves and cash. Thus, banks suffering balance sheet shocks would arguably monetize their Treasury securities for this reason (Copeland, Duffie, and Yang, 2021; d'Avernas and Vandeweyer, 2021).

This channel likely accounts for some of the response of unencumbered securities—the Treasury securities that banks can monetize—to drawdowns that our estimates using encumbered and combined amounts imply. However, our estimates also imply a stronger effect of drawdowns on encumbered securities, indicating that leverage constraints are an important driver of how banks' Treasury market participation responds to balance sheet shocks.

## V. Conclusion

This paper shows that a large increase in the size of a banks' lance sheet reduces banks' incentives to participate in Treasury market, and that this effect is weaker for banks with higher SLRs. These findings support the hypothesis that banks' ability to participate in markets for safe assets are curtailed by leverage regulations.

Our results are based on daily data on outstanding credit line amounts and Treasury holdings from the most systemically important U.S. banks from 2018 to 2022. Over this period, the supply of safe assets, including Treasuries, stayed near historical highs, thereby compressing banks' leverage ratios. Also, in March 2020 banks suffered unprecedented draws from their credit lines. Thus, our findings are based on data from a unique period with characteristics that may never repeat, and the relationship between leverage constraints and Treasury market participation may depend on those characteristics. Future research may help us understand whether this relationship remains the same under different economic conditions.

While our results indicate that leverage regulations limit bank participation in Treasury markets, our analysis should not be interpreted as an evaluation of these regulations. To properly understand whether these regulations increase or decrease welfare, a much more comprehensive empirical framework is necessary.

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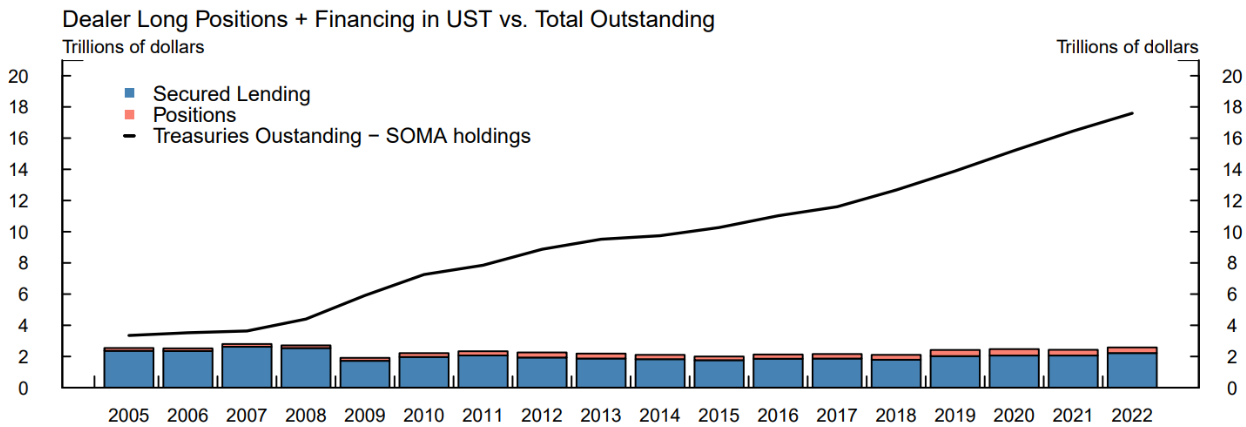
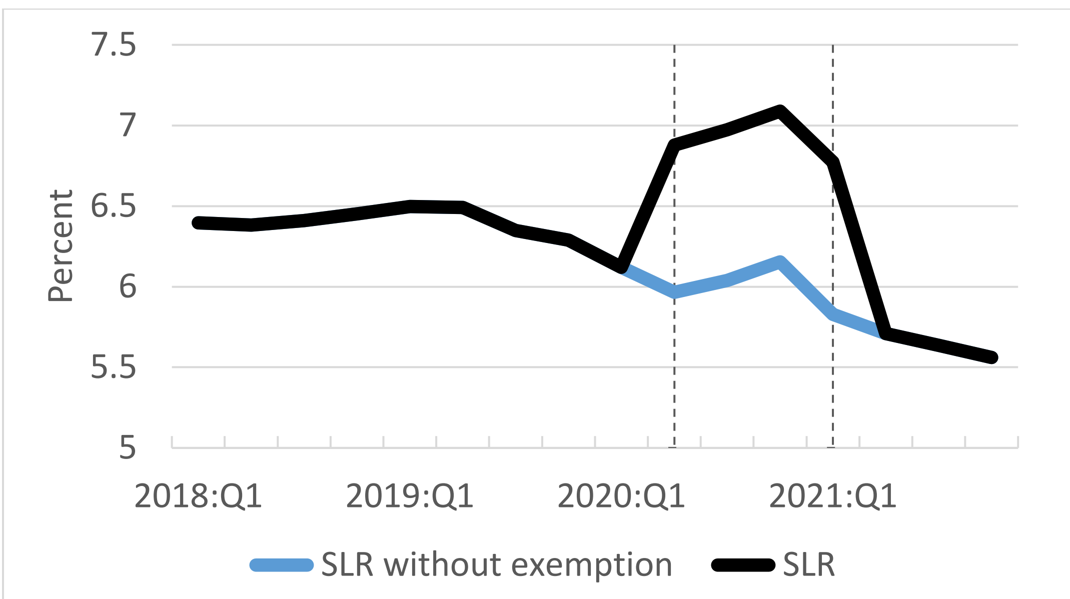
**Figure 1. Total Primary Dealer Participation in U.S. Treasury Markets**



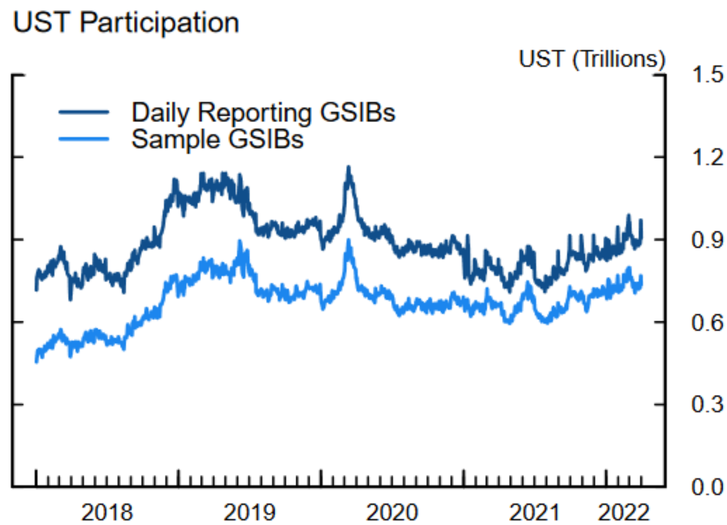

Note: Secured lending includes reverse repos and securities lending transactions. Total outstanding UST series excludes Treasury holdings of the SOMA portfolio.
Source: FR2004A, FR2004C, TreasuryDirect, FRBNY.

**Figure 2. Average SLR over Time**



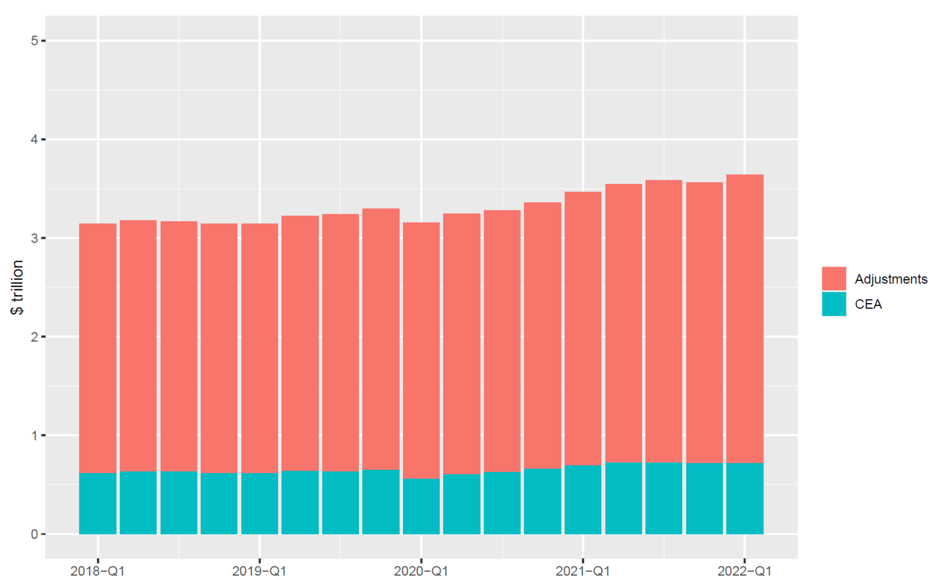

Note: The figure shows the average of the SLRs reported by the banks in our sample. Source: FR Y-9C.

**Figure 3. Total Encumbered U.S. Treasury Participation of GSIBs in our Sample and All GSIBs**



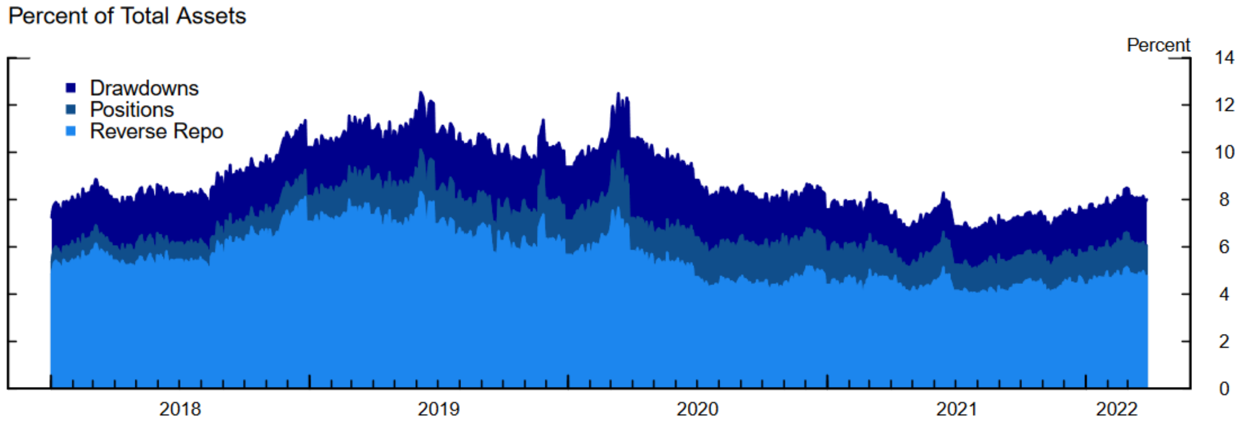

Note: The figure shows the total daily participation in the encumbered Treasury market (long positions and reverse repo) by the U.S. GSIBs in our sample and by all daily reporting GSIBs. The U.S. GSIBs in the sample are Bank of America, Citigroup, Goldman Sachs, JPMorgan Chase, and Morgan Stanley. The daily reporting GSIBs are the U.S. GSIBs in the sample plus Bank of New York Mellon, Barclays, Credit Suisse, Deutsche Bank, State Street, UBS, and Wells Fargo. Data from U.S. GSIBs' are at the BHC level and data from foreign banking organizations are at the consolidated U.S. operations level. Source: FR 2052a.

**Figure 4. Unused Commitments of the Five Most Systemically Important GSIBs**



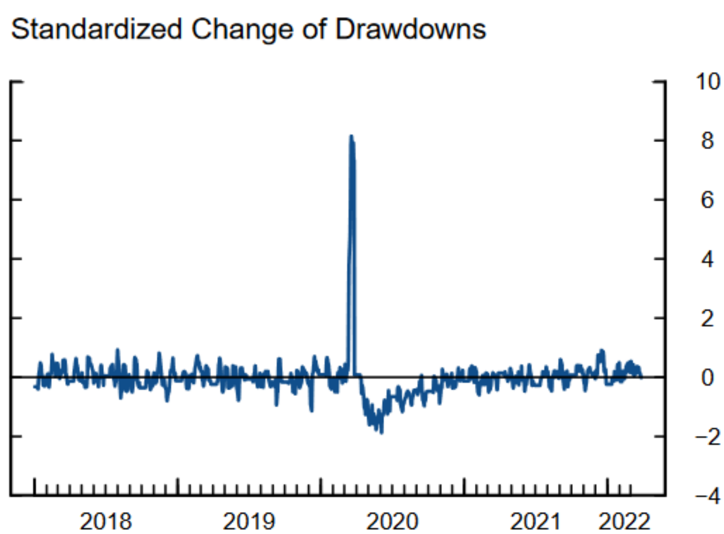

Note: The blue bars show the total CEA and the sum of the red and blue bars show the total unused committed amounts reported by the five banks in our sample. The CEA of an exposure is defined as the product of its amount committed and a CCF, which is a coefficient that ranges between 0 and 0.5. Accordingly, the total CEA has stayed close to 0.2 of the total unused committed amount throughout our sample period. The red bar shows the amounts of unused commitments discarded by the CCF. Source: FR Y-9C.

**Figure 5. Cross-Sectional Average of GSIBs Allocation to Treasury Reverse Repo, Treasury Positions, and Credit Lines Outstanding Relative to Total Assets**



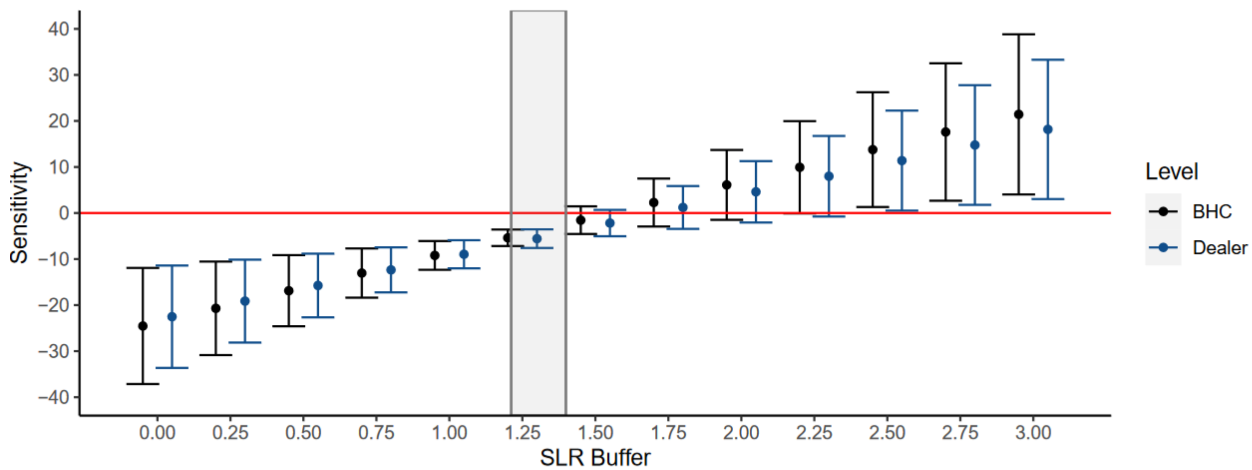

Note: This figure shows the total amounts of Treasury reverse repos, Treasury positions, and drawn amounts credit lines divided total assets of the five U.S. GSIBs in our sample, namely Bank of America, Citigroup, Goldman Sachs, JPMorgan Chase, and Morgan Stanley. Source: FR 2052a.

**Figure 6. Cross-Sectional Average of Standardized Changes in GSIBs Outstanding Credit Lines Outstanding Relative to Total Assets**



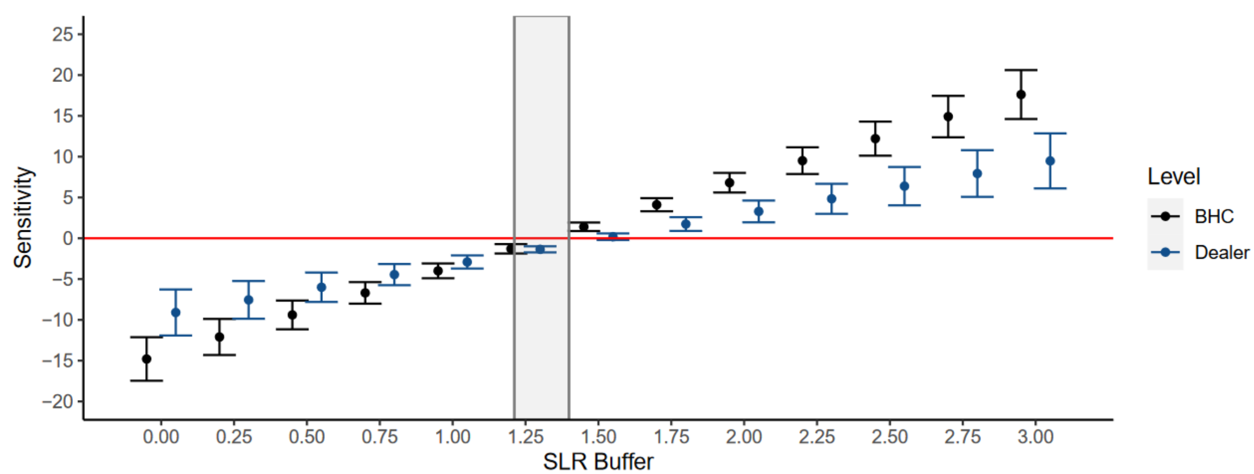

Note: This figure shows the daily amounts drawn from credit line as a ratio of total assets for the five U.S. GSIBs in our sample. The vertical axis measures these amounts in standard deviations from the mean over this sample period. The five U.S. GSIBs in our sample are Bank of America, Citigroup, Goldman Sachs, JPMorgan Chase, and Morgan Stanley. Source: FR 2052a.

**Figure 7. Total Estimated Sensitivity of Encumbered Treasury Reverse Repo for Different Levels of SLR Buffer During March 2020**



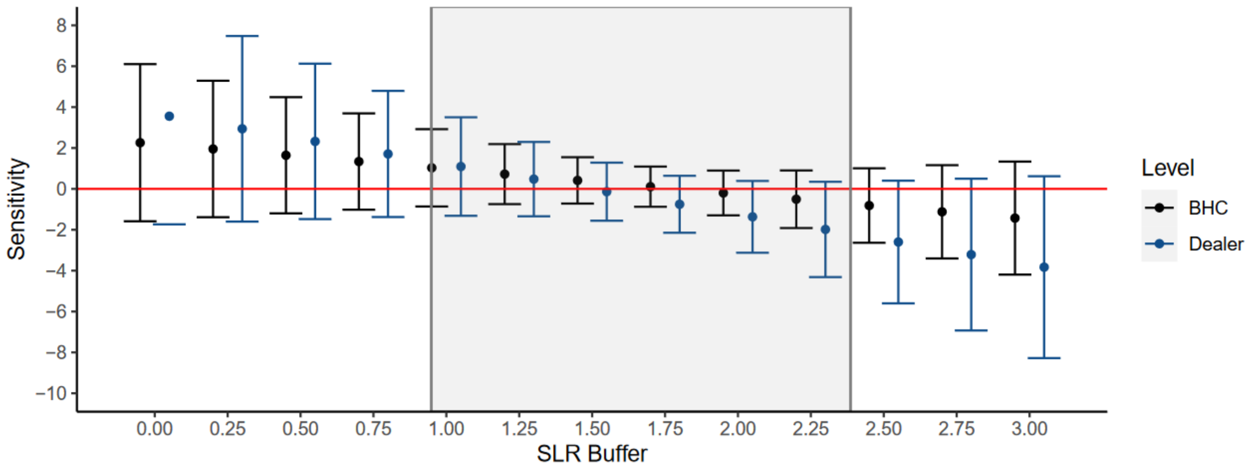

Note: The figure shows the estimated sensitivity of encumbered U.S. Treasury reverse repos to drawdowns, and associated 95 percent confidence interval, for different levels of SLR buffers at the BHC and dealer level during March 2020. Estimates are implied by the results in the 2nd and 5th columns of Table 3. The grey shaded area is the support of SLR buffers during March 2020.

**Figure 8. Total Estimated Sensitivity of Encumbered Treasury Positions for Different Levels of SLR Buffer During March 2020**



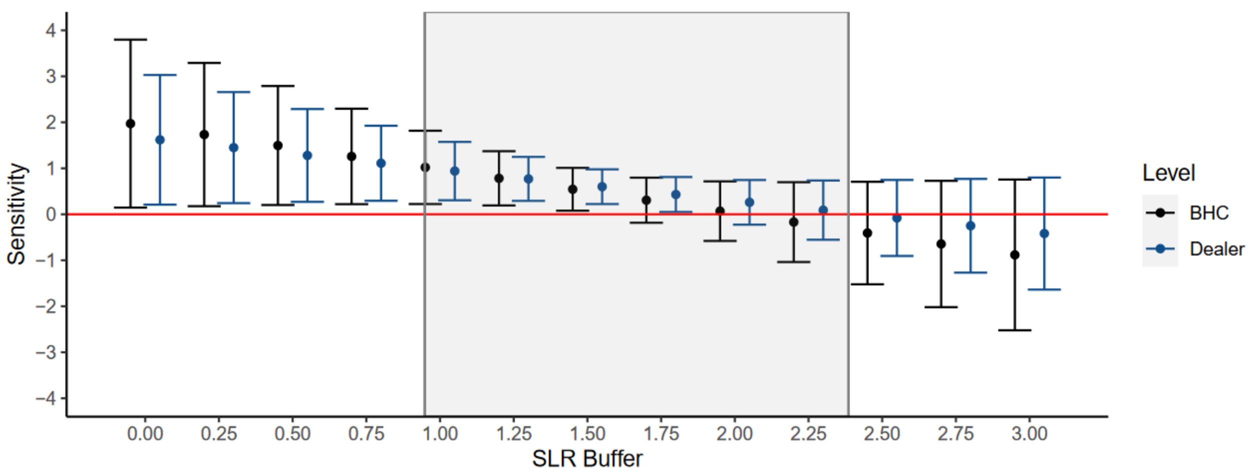

Note: The figure shows the estimated sensitivity of encumbered U.S. Treasury positions to drawdowns, and associated 95 percent confidence interval, for different levels of SLR buffers at the BHC and dealer level during March 2020. Estimates are implied by the results in the 3rd and 6th columns of Table 3. The grey shaded area is the support of SLR buffers during March 2020.

**Figure 9. Total Estimated Sensitivity of Encumbered Treasury Reverse Repo for Different Levels of SLR Buffer During April 2020 and March 2021 (Carve Out Period)**




Note: The figure shows the estimated sensitivity of encumbered U.S. Treasury reverse repos to drawdowns, and associated 95 percent confidence interval, for different levels of SLR buffers at the BHC and dealer level during April 2020 and March 2021 (i.e., carve out period). Estimates are implied by the results in the 2nd and 5th columns of Table 4. The grey shaded area is the support of SLR buffers during April 2020 and March 2021.

**Figure 10. Total Estimated Sensitivity of Encumbered Treasury Positions for Different Levels of SLR Buffer During April 2020 and March 2021 (Carve Out Period)**




Note: The figure shows the estimated sensitivity of encumbered U.S. Treasury positions to drawdowns, and associated 95 percent confidence interval, for different levels of SLR buffers at the BHC and dealer level during April 2020 and March 2021 (i.e., carve out period). Estimates are implied by the results in the 3rd and 6th columns of Table 4. The grey shaded area is the support of SLR buffers during April 2020 and March 2021.

**Table 1: Summary Statistics**

| | Obs | Mean | StDev | $1^{st}$ Percentile | $99^{th}$ Percentile |
|---|---|---|---|---|---|
| Daily Frequency Data — BHC-Level (×1000) | | | | | |
| $\Delta Total_{i,t}$ | 4,469 | 0.400 | 5.477 | -15.680 | 17.355 |
| $\Delta RevRepo_{i,t}$ | 4,469 | 0.294 | 4.695 | -13.335 | 14.782 |
| $\Delta Position_{i,t}$ | 4,469 | 0.099 | 2.180 | -5.952 | 6.678 |
| $\Delta CL\,Outstanding_{t,i}$ | 4,469 | 0.019 | 0.503 | -1.526 | 2.626 |
| Daily Frequency Data — Dealer-Level (×1000) | | | | | |
| $\Delta Total_{i,t}$ | 4,469 | 0.317 | 5.755 | -16.234 | 18.855 |
| $\Delta RevRepo_{i,t}$ | 4,469 | 0.249 | 5.401 | -15.869 | 18.168 |
| $\Delta Position_{i,t}$ | 4,469 | 0.059 | 1.672 | -4.579 | 5.108 |
| Quarterly Frequency Data — BHC-Level | | | | | |
| $SLR_{i,q(t)}$ | 85 | 1.383 | 0.481 | 0.384 | 2.386 |
| $Total_{i,q(t)}$ | 85 | 4.032 | 2.207 | 1.068 | 10.970 |
| $Tier1_{i,q(t)}$ | 85 | 3.800 | 2.129 | 1.044 | 10.173 |
| $CET1_{i,q(t)}$ | 85 | 3.075 | 1.976 | -0.237 | 9.292 |

Note: This table shows the summary statistics of the main variables of interest. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of encumbered reverse repo backed by Treasuries, encumbered Treasury positions, and the sum between the two, respectively, at the BHC- and dealer-level; and $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding at the BHC-level. These 5-day changes are computed as ratios to banks' total assets. $SLR_{iq(t)}$ is the supplementary leverage ratio buffer, $Total_{iq(t)}$ is the total capital ratio buffer, $Tier1_{iq(t)}$is the tier 1 capital ratio bufffer, and $CET1_{iq(t)}$ is the common tier 1 capital ratio buffer; all reported at the end of the quarter at the BHC-level. The sample runs daily from the January 2018 to March 2022. Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, $\Delta Total_{it}$, and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%.

**Table 2: Sensitivity of Changes in Encumbered U.S. Treasury Holdings to Credit Line Drawdowns by Nonfinancial Corporates**

| | BHC | | | Dealer | | |
|---|---|---|---|---|---|---|
| | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ |
| Panel A: Baseline Pre January 2020 | | | | | | |
| $\beta : \Delta CL\, Outstanding_{t,i}$ | -0.669** | -0.548** | -0.121 | -0.554* | -0.384 | -0.177* |
| | (0.312) | (0.260) | (0.121) | (0.296) | (0.271) | (0.096) |
| Adj Rsq | .279 | .294 | .339 | .272 | .272 | .295 |
| Obs | 1841 | 1841 | 1841 | 1841 | 1841 | 1841 |
| Panel B: Baseline Full Sample | | | | | | |
| $\beta : \Delta CL\, Outstanding_{t,i}$ | -0.772** | -0.735*** | -0.060 | -0.991*** | -0.892*** | -0.115 |
| | (0.336) | (0.283) | (0.115) | (0.376) | (0.326) | (0.099) |
| Adj Rsq | .27 | .273 | .317 | .265 | .256 | .32 |
| Obs | 3961 | 3961 | 3961 | 3961 | 3961 | 3961 |
| Panel C: Interaction March 2020 Full Sample | | | | | | |
| $\beta : \Delta CL\, Outstanding_{t,i}$ | -0.311 | -0.325 | 0.005 | -0.372 | -0.359 | -0.014 |
| | (0.250) | (0.210) | (0.108) | (0.247) | (0.228) | (0.086) |
| $\beta' : \Delta CL\, Outstanding_{t,i} \times 1_{Mar2020}$ | -4.020*** | -3.576*** | -0.565** | -5.375*** | -4.621*** | -0.875*** |
| | (0.904) | (0.889) | (0.259) | (0.950) | (0.949) | (0.155) |
| Adj Rsq | .276 | .28 | .318 | .276 | .265 | .324 |
| Obs | 3961 | 3961 | 3961 | 3961 | 3961 | 3961 |

Note: This table shows the empirical results from equation (3) using daily overlapping data. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of encumbered reverse repo backed by Treasuries relative to total assets, encumbered Treasury positions relative to total assets, and the sum between the two, respectively, at the BHC- and dealer-level. $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding relative to total assets at the BHC-level. $1_{Mar2020}$ is an indicator function equal to one in March 2020 and zero otherwise. Controls include 5-day log changes in Treasury bills outstanding, U.S. Treasury notes outstanding, and Federal Reserve's U.S. Treasury holdings; as well as lagged levels of the spread of the GCF Treasury repo rate minus the TPR rate, the spread of the 10- minus 2-year U.S. Treasury yield, the spread of the OIS rate over the four-week Treasury bill rate, the VIX volatility index, and bank level CDS quotes. All specification include a 5-day lag of the dependent variable and bank-year-month fixed effects. For panel A the sample runs daily from the January 2018 to December 2019, and for panels B and C the sample runs daily from the January 2018 to March 2022. Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, $\Delta Total_{it}$, and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%. Standard errors reported in parenthesis are Newey-West with 11 lags. *, **, ***, denote significance at the 10%, 5%, and 1% levels, respectively.

**Table 3: Sensitivity of Changes in Encumbered U.S. Treasury Holdings to Credit Line Drawdowns by Nonfinancial Corporates, Interacted with Firm-Level Measure of SLR Buffer (pre-April 2020)**

| | BHC | | | Dealer | | |
|---|---|---|---|---|---|---|
| | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ |
| SLR Pre Carve Out (2nd Quarter of 2020) w/ Interaction March 2020 | | | | | | |
| $\beta : \Delta CL\, Outstanding_{t,i}$ | 0.947 | 1.230 | -0.368 | 2.941 | 2.834 | 0.091 |
| | (2.574) | (2.411) | (0.958) | (2.503) | (2.430) | (0.771) |
| $\phi : \Delta CL\, Outstanding_{i,t} \times SLR_{i,q(t)-1}$ | -0.976 | -1.065 | 0.143 | -2.195 | -2.023 | -0.163 |
| | (1.506) | (1.435) | (0.580) | (1.453) | (1.429) | (0.472) |
| $\beta' : \Delta CL\, Outstanding_{i,t} \times 1_{Mar2020}$ | -38.429*** | -25.760*** | -14.431*** | -33.830*** | -25.355*** | -9.191*** |
| | (7.535) | (6.889) | (1.572) | (6.923) | (6.203) | (1.700) |
| $\phi' : \Delta CL\, Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{Mar2020}$ | 25.769*** | 16.385*** | 10.661*** | 21.449*** | 15.585*** | 6.356*** |
| | (5.708) | (5.273) | (1.080) | (5.240) | (4.663) | (1.187) |
| Est $\beta + \phi$ | -0.029 | 0.165 | -0.225 | 0.746 | 0.811 | -0.072 |
| | (1.082) | (0.990) | (0.387) | (1.063) | (1.015) | (0.307) |
| Est $\beta + \phi + (\beta' + \phi')$ | -12.689*** | -9.210*** | -3.995*** | -11.636*** | -8.959*** | -2.907*** |
| | (1.739) | (1.587) | (0.461) | (1.675) | (1.553) | (0.409) |
| Adj Rsq | 0.286 | 0.286 | 0.358 | 0.276 | 0.266 | 0.329 |
| Obs | 2076 | 2076 | 2076 | 2076 | 2076 | 2076 |

Note: This table shows the empirical results from equation (3) using daily overlapping data. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of encumbered reverse repo backed by Treasuries relative to total assets, encumbered Treasury positions relative to total assets, and the sum between the two, respectively, at the BHC- and dealer-level. $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding relative to total assets at the BHC-level. $SLR_{iq(t)-1}$is the supplementary leverage ratio reported at the end of the previous quarter at the BHC-level, minus the 5 percent minimum threshold. $1_{Mar2020}$ is an indicator function equal to one in March 2020 and zero otherwise. Controls include 5-day log changes in Treasury bills outstanding, U.S. Treasury notes outstanding, and Federal Reserve's U.S. Treasury holdings; as well as lagged levels of the spread of the GCF Treasury repo rate minus the TPR rate, the spread of the 10- minus 2-year U.S. Treasury yield, the spread of the OIS rate over the four-week Treasury bill rate, the VIX volatility index, and bank level CDS quotes. All specification include a 5-day lag of the dependent variable and bank-year-month fixed effects. The sample runs daily from the January 2018 to March 2020 (pre carveout period). Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, $\Delta Total_{it}$, and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%. Standard errors reported in parenthesis are Newey-West with 11 lags. *, **, ***, denote significance at the 10%, 5%, and 1% levels, respectively.

**Table 4: Sensitivity of Changes in Encumbered U.S. Treasury Holdings to Credit Line Drawdowns by Nonfinancial Corporates, Interacted with Firm-Level Measure of SLR Buffer and an Indicator During the Carve Out Period of Reserves and Treasury Positions from the SLR Calculation**

| | BHC | | | Dealer | | |
|---|---|---|---|---|---|---|
| | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ |
| Interaction Carve Out w/ Interaction March 2020 | | | | | | |
| $\beta : \Delta CL\, Outstanding_{i,t}$ | 1.026 | 0.856 | 0.155 | 1.681* | 1.620** | 0.090 |
| | (0.869) | (0.750) | (0.389) | (0.891) | (0.822) | (0.213) |
| $\phi : \Delta CL\, Outstanding_{i,t} \times SLR_{i,q(t)-1}$ | -1.075** | -0.899** | -0.166 | -1.488*** | -1.355*** | -0.149 |
| | (0.517) | (0.451) | (0.248) | (0.526) | (0.491) | (0.142) |
| $\beta' : \Delta CL\, Outstanding_{i,t} \times 1_{Mar2020}$ | -36.290*** | -23.190*** | -14.909*** | -31.654*** | -23.411*** | -9.177*** |
| | (6.681) | (5.994) | (1.409) | (6.121) | (5.359) | (1.433) |
| $\phi' : \Delta CL\, Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{Mar2020}$ | 24.782*** | 15.031*** | 11.042*** | 20.048*** | 14.239*** | 6.426*** |
| | (5.249) | (4.809) | (0.981) | (4.883) | (4.324) | (1.030) |
| $\beta'' : \Delta CL\, Outstanding_{i,t} \times 1_{CarveOut}$ | 3.412* | 1.403 | 1.817* | 3.640 | 1.935 | 1.530** |
| | (1.946) | (2.134) | (1.012) | (2.562) | (2.852) | (0.752) |
| $\phi'' : \Delta CL\, Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{CarveOut}$ | -1.199 | -0.331 | -0.786 | -1.720 | -1.107 | -0.531 |
| | (1.198) | (1.181) | (0.622) | (1.563) | (1.683) | (0.454) |
| Est $\beta + \phi$ | -0.050 | -0.043 | -0.011 | 0.192 | 0.265 | -0.059 |
| | (0.397) | (0.344) | (0.161) | (0.402) | (0.369) | (0.092) |
| Est $\beta + \phi + (\beta' + \phi')$ | -11.558*** | -8.203*** | -3.878*** | -11.414*** | -8.907*** | -2.810*** |
| | (1.564) | (1.346) | (0.462) | (1.395) | (1.225) | (0.415) |
| Est $\beta + \phi + (\beta'' + \phi''')$ | 2.163*** | 1.029 | 1.020** | 2.112** | 1.093 | 0.940*** |
| | (0.771) | (0.964) | (0.406) | (1.063) | (1.228) | (0.323) |
| Adj Rsq | 0.282 | 0.283 | 0.325 | 0.281 | 0.268 | 0.330 |
| Obs | 3961 | 3961 | 3961 | 3961 | 3961 | 3961 |

Note: This table shows the empirical results from equation (3) using daily overlapping data. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of encumbered reverse repo backed by Treasuries relative to total assets, encumbered Treasury positions relative to total assets, and the sum between the two, respectively, at the BHC- and dealer-level. $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding relative to total assets at the BHC-level. $SLR_{iq(t)-1}$is the supplementary leverage ratio reported at the end of the previous quarter at the BHC-level, minus the 5 percent minimum threshold. $1_{Mar2020}$ is an indicator function equal to one in March 2020 and zero otherwise and $1_{CarveOut}$ is an indicator function equal to one in April 2020 to March 2021 and zero otherwise. Controls include 5-day log changes in Treasury bills outstanding, U.S. Treasury notes outstanding, and Federal Reserve's U.S. Treasury holdings; as well as lagged levels of the spread of the GCF Treasury repo rate minus the TPR rate, the spread of the 10- minus 2-year U.S. Treasury yield, the spread of the OIS rate over the four-week Treasury bill rate, the VIX volatility index, and bank level CDS quotes. All specification include a 5-day lag of the dependent variable and bank-year-month fixed effects. The sample runs daily from the January 2018 to March 2022. Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, $\Delta Total_{it}$, and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%. Standard errors reported in parenthesis are Newey-West with 11 lags. *, **, ***, denote significance at the 10%, 5%, and 1% levels, respectively.

**Table 5: Sensitivity of Changes in Encumbered U.S. Treasury Holdings to Credit Line Drawdowns by Nonfinancial Corporates and Interaction with Risk Based Capital Ratios and the LCR.**

| | Total Capital | Tier 1 Capital | CE Tier 1 Capital | Liq. Coverage |
|---|---|---|---|---|
| Pre Carve Out (2nd Quarter of 2020) w/ Interaction March 2020 | | | | |
| $\beta' : \Delta CL\,Outstanding_{i,t} \times 1_{Mar2020}$ | -37.252*** | -40.926*** | -41.695*** | -35.482*** |
| | (6.841) | (6.947) | (7.054) | (6.845) |
| $\phi' : \Delta CL\,Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{Mar2020}$ | 28.332*** | 31.448*** | 32.188*** | 30.037*** |
| | (5.319) | (5.456) | (5.612) | (5.588) |
| $\hat{\phi}' : \Delta CL\,Outstanding_{i,t} \times Total_{i,q(t)-1} \times 1_{Mar2020}$ | -1.363*** | | | |
| | (0.410) | | | |
| $\hat{\phi}' : \Delta CL\,Outstanding_{i,t} \times Tier1_{i,q(t)-1} \times 1_{Mar2020}$ | | -1.629*** | | |
| | | (0.413) | | |
| $\hat{\phi}' : \Delta CL\,Outstanding_{i,t} \times CET1_{i,q(t)-1} \times 1_{Mar2020}$ | | | -1.816*** | |
| | | | (0.456) | |
| $\hat{\phi}' : \Delta CL\,Outstanding_{i,t} \times LCR_{i,q(t)-1} \times 1_{Mar2020}$ | | | | -0.417*** |
| | | | | (0.131) |
| Adj Rsq | 0.299 | 0.301 | 0.300 | 0.300 |
| Obs | 2076 | 2076 | 2076 | 2076 |

Note: This table shows the empirical results from equation (3) using daily overlapping data. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of encumbered reverse repo backed by Treasuries relative to total assets, encumbered Treasury positions relative to total assets, and the sum between the two, respectively, at the BHC- level. $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding relative to total assets at the BHC-level. $SLR_{iq(t)-1}$ is the supplementary leverage ratio, $Total_{iq(t)-1}$ is the total capital ratio, $Tier1_{iq(t)-1}$is the tier 1 capital ratio, $CET1_{iq(t)-1}$ is the common tier 1 capital ratio, and $LCR_{iq(t)-1}$ is the liquidity coverage ratio; all minus their ratio requirements, reported at the end of the previous quarter at the BHC-level. $1_{Mar2020}$ is an indicator function equal to one in March 2020 and zero otherwise. Controls include 5-day log changes in Treasury bills outstanding, U.S. Treasury notes outstanding, and Federal Reserve's U.S. Treasury holdings; as well as lagged levels of the spread of the GCF Treasury repo rate minus the TPR rate, the spread of the 10- minus 2-year U.S. Treasury yield, the spread of the OIS rate over the four-week Treasury bill rate, the VIX volatility index, and bank level CDS quotes. All specifications include a 5-day lag of the dependent variable and bank-year-month fixed effects. The sample runs daily from the January 2018 to March 2020. Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta Total_{it}$ and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%. Standard errors reported in parenthesis are Newey-West with 11 lags. *, **, ***, denote significance at the 10%, 5%, and 1% levels, respectively.

**Table 6: Sensitivity of Changes in Combined U.S. Treasury Holdings to Credit Line Drawdowns by Nonfinancial Corporates**

| | BHC | | | Dealer | | |
|---|---|---|---|---|---|---|
| | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ |
| Panel A: Baseline Pre January 2020 | | | | | | |
| $\beta : \Delta CL\,Outstanding_{t,i}$ | -0.677* | -0.193 | -0.512*** | -0.285 | -0.241 | -0.163 |
| | (0.348) | (0.345) | (0.175) | (0.420) | (0.306) | (0.100) |
| Adj Rsq | .286 | .293 | .313 | .258 | .26 | .307 |
| Obs | 1841 | 1841 | 1841 | 1688 | 1841 | 1688 |
| Panel B: Baseline Full Sample | | | | | | |
| $\beta : \Delta CL\,Outstanding_{t,i}$ | -1.343** | -0.778** | -0.577** | -0.910** | -0.799** | -0.104 |
| | (0.595) | (0.391) | (0.264) | (0.454) | (0.343) | (0.109) |
| Adj Rsq | .292 | .283 | .347 | .258 | .248 | .324 |
| Obs | 3946 | 3961 | 3946 | 3750 | 3961 | 3750 |
| Panel C: Interaction March 2020 Full Sample | | | | | | |
| $\beta : \Delta CL\,Outstanding_{t,i}$ | -0.359 | -0.169 | -0.200 | -0.125 | -0.237 | 0.015 |
| | (0.308) | (0.261) | (0.154) | (0.296) | (0.244) | (0.089) |
| $\beta' : \Delta CL\,Outstanding_{t,i} \times 1_{Mar2020}$ | -8.553*** | -5.313*** | -3.268*** | -5.748*** | -4.877*** | -0.874*** |
| | (1.289) | (1.027) | (0.490) | (0.984) | (0.908) | (0.190) |
| Adj Rsq | .31 | .292 | .361 | .269 | .257 | .326 |
| Obs | 3946 | 3961 | 3946 | 3750 | 3961 | 3750 |

Note: This table shows the empirical results from equation (3) using daily overlapping data. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of combined (i.e, unencumbered plus encumbered) reverse repo backed by Treasuries relative to total assets, combined (i.e, unencumbered plus encumbered) Treasury positions relative to total assets, and the sum between the two, respectively, at the BHC- and dealer-level. $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding relative to total assets at the BHC-level. $1_{Mar2020}$ is an indicator function equal to one in March 2020 and zero otherwise. Controls include 5-day log changes in Treasury bills outstanding, U.S. Treasury notes outstanding, and Federal Reserve's U.S. Treasury holdings; as well as lagged levels of the spread of the GCF Treasury repo rate minus the TPR rate, the spread of the 10- minus 2-year U.S. Treasury yield, the spread of the OIS rate over the four-week Treasury bill rate, the VIX volatility index, and bank level CDS quotes. All specification include a 5-day lag of the dependent variable and bank-year-month fixed effects. For panel A the sample runs daily from the January 2018 to December 2019, and for panels B and C the sample runs daily from the January 2018 to March 2022. Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, $\Delta Total_{it}$, and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%. Standard errors reported in parenthesis are Newey-West with 11 lags. *, **, ***, denote significance at the 10%, 5%, and 1% levels, respectively

**Table 7: Sensitivity of Changes in Combined U.S. Treasury Holdings to Credit Line Drawdowns by Nonfinancial Corporates, Interacted with Firm-Level Measure of SLR**

| | BHC | | | Dealer | | |
|---|---|---|---|---|---|---|
| | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ | $\Delta Total_{i,t}$ | $\Delta RevRepo_{i,t}$ | $\Delta Position_{i,t}$ |
| Interaction Carve Out w/ Interaction March 2020 | | | | | | |
| $\beta : \Delta CL\,Outstanding_{i,t}$ | 1.993* | 1.621** | 0.496 | 1.869* | 1.980** | 0.073 |
| | (1.091) | (0.779) | (0.553) | (0.960) | (0.836) | (0.249) |
| $\phi : \Delta CL\,Outstanding_{i,t} \times SLR_{i,q(t)-1}$ | -1.667** | -1.221** | -0.538 | -1.444** | -1.505*** | -0.127 |
| | (0.656) | (0.474) | (0.329) | (0.562) | (0.492) | (0.165) |
| $\beta' : \Delta CL\,Outstanding_{i,t} \times 1_{Mar2020}$ | -49.356*** | -22.219*** | -28.054*** | -28.491*** | -20.803*** | -8.122*** |
| | (4.369) | (5.433) | (2.932) | (5.588) | (5.128) | (1.479) |
| $\phi' : \Delta CL\,Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{Mar2020}$ | 31.139*** | 12.803*** | 19.007*** | 17.343*** | 12.013*** | 5.632*** |
| | (3.687) | (4.386) | (2.163) | (4.472) | (4.109) | (1.057) |
| $\beta'' : \Delta CL\,Outstanding_{i,t} \times 1_{CarveOut}$ | 3.277 | 2.231 | 1.154 | 3.893 | 1.666 | 1.593** |
| | (2.837) | (3.184) | (1.391) | (3.455) | (3.391) | (0.679) |
| $\phi'' : \Delta CL\,Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{CarveOut}$ | -1.642 | -1.325 | -0.365 | -1.995 | -0.990 | -0.562 |
| | (1.865) | (1.872) | (0.784) | (1.985) | (1.943) | (0.440) |
| Est $\beta + \phi$ | 0.326 | 0.400 | -0.042 | 0.425 | 0.474 | -0.054 |
| | (0.492) | (0.370) | (0.247) | (0.456) | (0.385) | (0.104) |
| Est $\beta + \phi + (\beta' + \phi')$ | -17.891*** | -9.017*** | -9.088*** | -10.723*** | -8.315*** | -2.544*** |
| | (1.016) | (1.285) | (0.823) | (1.291) | (1.210) | (0.431) |
| Est $\beta + \phi + (\beta'' + \phi''')$ | 1.961* | 1.306 | 0.747 | 2.323 | 1.149 | 0.977*** |
| | (1.112) | (1.440) | (0.610) | (1.529) | (1.508) | (0.264) |
| Adj Rsq | 0.315 | 0.294 | 0.370 | 0.272 | 0.260 | 0.330 |
| Obs | 3946 | 3961 | 3946 | 3750 | 3961 | 3750 |

Note: This table shows the empirical results from equation (3) using daily overlapping data. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, and $\Delta Total_{it}$ are the 5-day changes of combined (i.e, unencumbered plus encumbered) reverse repo backed by Treasuries relative to total assets, combined (i.e, unencumbered plus encumbered) Treasury positions relative to total assets, and the sum between the two, respectively, at the BHC- and dealer-level. $\Delta CLOutstanding_{it}$ are the 5-day changes of credit lines outstanding relative to total assets at the BHC-level. $1_{Mar2020}$ is an indicator function equal to one in March 2020 and zero otherwise. Controls include 5-day log changes in Treasury bills outstanding, U.S. Treasury notes outstanding, and Federal Reserve's U.S. Treasury holdings; as well as lagged levels of the spread of the GCF Treasury repo rate minus the TPR rate, the spread of the 10- minus 2-year U.S. Treasury yield, the spread of the OIS rate over the four-week Treasury bill rate, the VIX volatility index, and bank level CDS quotes. All specification include a 5-day lag of the dependent variable and bank-year-month fixed effects. The sample runs daily from the January 2018 to March 2022. Quarter-end observations, $\pm 2$ days around quarter-end, are excluded. $\Delta RevRepo_{it}$, $\Delta Position_{it}$, $\Delta Total_{it}$, and $\Delta CLOutstanding_{it}$ are winsorized at the 1% and 99%. Standard errors reported in parenthesis are Newey-West with 11 lags. *, **, ***, denote significance at the 10%, 5%, and 1% levels, respectively.