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

Giovanni Favara
Federal Reserve Board

Sebastian Infante
Federal Reserve Board

Marcelo Rezende
Federal Reserve Board

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Side Effects of Bank Capital Regulation

- **After the Global Financial Crisis, regulators added non-risk-weighted capital requirements as a backstop for risk-based requirements**
  - A prominent example is the supplementary leverage ratio (SLR), which does not weight assets based on their risk.

- **Leverage ratio requirements may have side effects**
  - "…the leverage ratio has caused a distortionary reduction in the incentives for banks to intermediate markets for safe assets, especially the government securities repo market…" (Duffie, 2018)

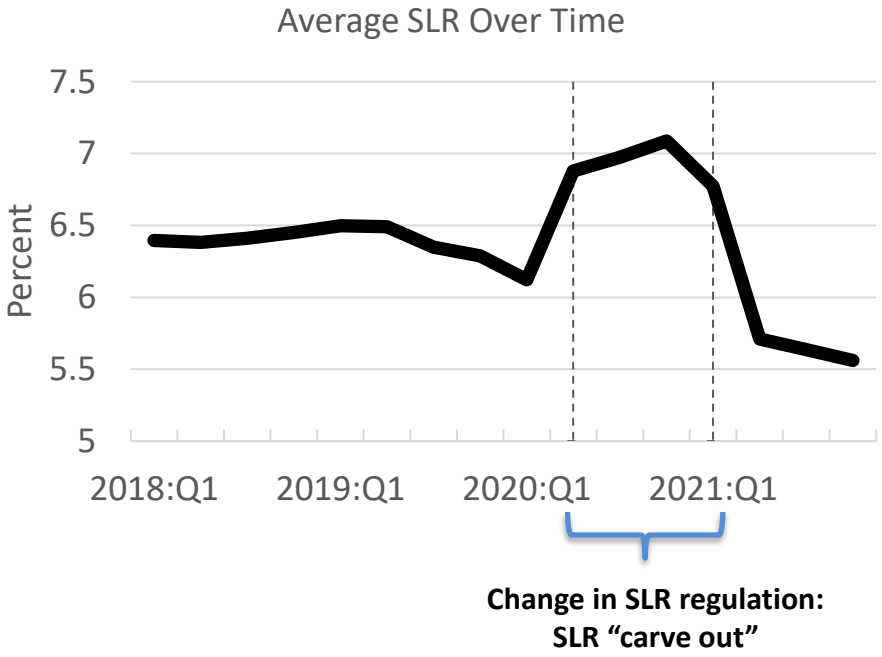
SLR and Banks' Intermediation of Safe Assets

- SLR: capital relative to *Total Exposures*

$$\boldsymbol{SLR = \frac{Capital}{Total\ Exposures} \geq 5\%}$$

- SLR disincentivizes banks to intermediate markets for safe assets and low-yield balance-sheet-intensive activities:
  - Important for U.S. Treasury securities

- SLR calculation changed during Q2 2020-Q1 2021: Carve out of U.S. Treasury positions and reserves
  1. Increased the overall level of SLRs
  2. Changed incentives to hold U.S. Treasuries



Main Question and Findings

- **Does the SLR affect banks' ability to participate in Treasury markets?**
  - Shocks to banks' balance sheet sizes reduce their regulatory incentives to hold and lend against safe securities
  - These incentives should be smaller for banks with SLRs close to the minimum requirement

- **Main findings:**
  - Shocks that significantly increase banks' balance sheets reduce banks' participation in Treasury markets
  - This sensitivity is muted for banks with higher SLRs
  - SLR carve out increased banks' incentives to hold U.S. Treasuries directly

Related Academic Literature

- **Impact of leverage regulations and no arbitrage**
  - Duffie (2018); Andersen, Duffie and Song (2018); Du, Tepper, and Verdelhan (2018); Correa, Du and Liao (2020); Fleckenstein and Longstaff (2020)
- **Bank capital regulation**
  - Hanson, Kashyap, and Stein (2011); Greenwood, Hanson, Stein and Sunderam (2017)
- **Treasury markets at onset of COVID-19 pandemic**
  - Duffie (2020); He, Nagel and Song (2021), Vissing-Jorgenssen (2021)
- **Credit line drawdowns**
  - Ivashina and Scharfstein (2010); Acharya and Steffen (2020); Li, Strahan, and Zhang (2020); Kaplan and Minoiu (2021)

Data and Empirical Framework

Natural Experiment: Credit Line Drawdowns

- **Credit line drawdowns**
  - These balance sheet shocks increase total exposures, lowering leverage ratios
  - In response, banks may reduce their participation in **encumbered** liquid assets
    - Direct holdings of Treasury securities and reverse repo backed by Treasury securities

- **A binding SLR may exacerbate this effect**

- **Identifying assumption:**
  - Drawdowns may affect banks' ability to participate in markets for safe assets through the increase in bank balance sheet size and not through other channels

Data

- **Daily data on BHC- and dealer-level holdings (positions and reverse repo) of Treasury securities, and nonfinancial corporate credit line drawdowns**
  - FR 2052a
- **Quarterly balance sheet data and regulatory ratios at the BHC level**
  - FRY-9C and banks' public disclosures
- **Daily financial market data**
  - Treasury securities outstanding from TreasuryDirect, Treasury SOMA holdings from FRBNY, and money market spreads from Bloomberg and FRBNY

Data Restrictions

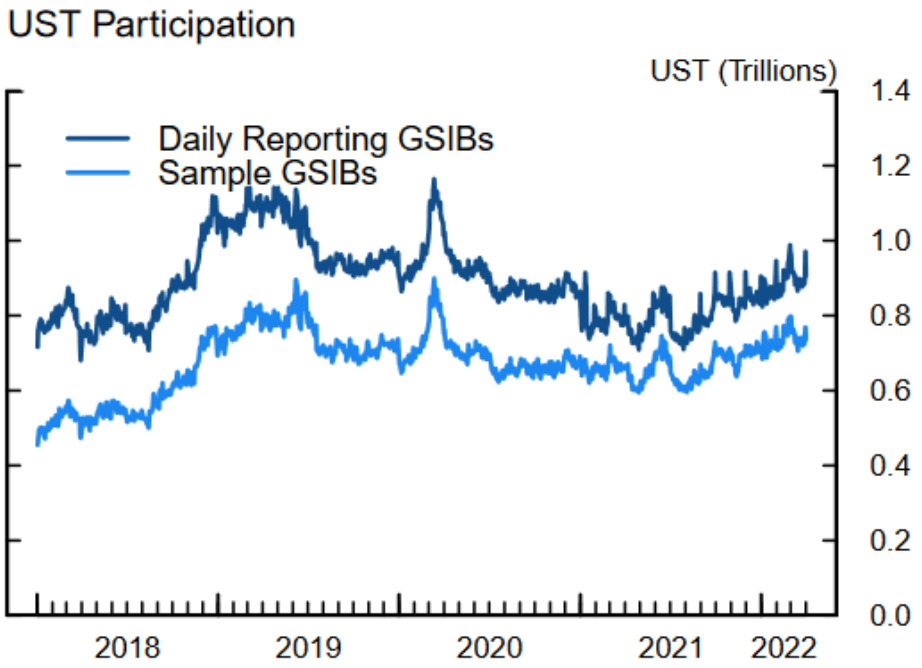
- **Focus on 5 large U.S. GSIBs active in U.S. Treasury Markets**
  - High data quality and frequency
  - Treasury activity is concentrated among the largest banks

- **Data from January 2018 to March 2022**
  - SLR became a requirement in 2018
  - Exclude quarter-end dates, +/- two days around quarter-end

- **Encumbered securities only**
  - Encumbered securities lower the SLR because they are funded with secured debt
  - Unencumbered may be funded with equity or earnings, which would not affect the SLR

Sample of Banks

- **The five GSIBs in our sample account for most of large bank participation in the U.S. Treasury market**
  - Activity by these banks is the most relevant for Treasury market functioning, particularly from their dealer subsidiaries



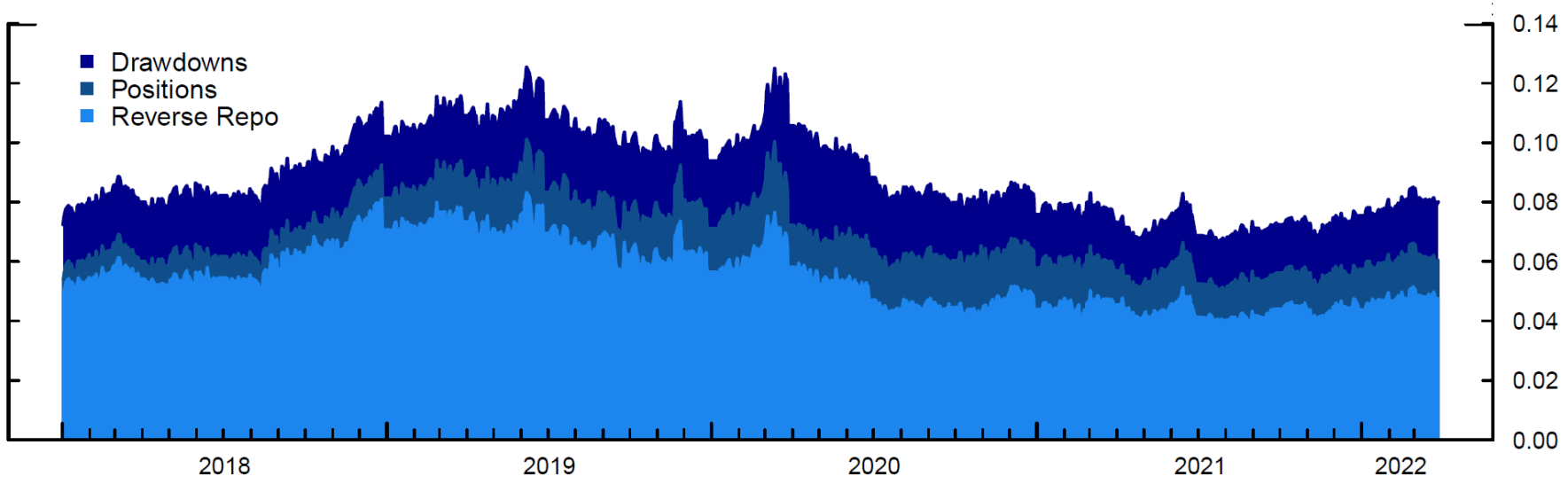
Variables of Interest

- **Balance sheet variables over total assets at the BHC-level:**
  - Encumbered Treasury holdings: $UST\ Positions_{it}$
  - Encumbered Reverse repo backed by Treasury securities: $UST\ RevRepo_{it}$
  - Nonfinancial Corporate Credit Lines Outstanding: $CL\ Outstanding_{it}$

- **Total participation is U.S. Treasury market is:**

$$UST\ Total_{it} = UST\ Positions_{it} + UST\ RevRepo_{it}$$

Credit Line Drawdowns, Positions, and Reverse Repo in U.S. Treasuries (ratio to total assets)



Regression Framework

- **Regression with bank (i) and day(t) data**

$$\Delta Y_{it} = \beta \Delta CL\,Outstanding_{it} + \beta' \Delta CL\,Outstanding_{it} \times 1_{\text{Mar2020}}$$
$$+\alpha_{im(t)} + \eta_1 \Delta Y_{it-5} + \gamma_1 X_{it} + \gamma_2 W_t + \epsilon_{it}$$

  - $Y_{it} \in \{UST\ Total_{it}, UST\ Positions_{it}, UST\ RevRepo_{it}\}$, of encumbered variables at the BHC and dealer level
  - $1_{Mar2020}$ is an indicator in March 2020
  - Δ is the 5-day change of variable, winsorize at the 1st and 99th percentile
  - X_{it} and W_t are vectors of time-varying bank controls, and Treasury market and financial var. controls
  - $\alpha_{im(t)}$ are year-month-bank fixed effects
  - Driscoll-Kraay standard errors clustered at the BHC level to account for serial correlation in small N/large T setting

- **Hypotheses that we test:**
  - $\beta, \beta' < 0$: Credit line drawdowns reduce participation in Treasury markets

Credit Line Drawdowns and Treasury Holdings

With and without March 2020 dummy

	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

- **Credit line drawdowns reduce BHCs' participation in U.S. Treasury participation**
  - Unconditionally, $1 increase in credit line drawdowns is associated with a $0.67 drop in banks' total encumbered U.S. Treasury, largely driven by reverse repo
  - Sensitivity is particularly pronounced in March 2020, when drawdowns surged
- **Sensitivity of positions is also statistically significant, but smaller**

Credit Line Drawdowns and Treasury Holdings

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Modified Regression Framework

- **Augment baseline regression by including SLR buffer interacted with drawdowns:**
  - $SLR_{i,q(t)-1}$ is the previous quarter BHC i's buffer (SLR minus the regulatory minimum)
- **Period of analysis:**
  - Pre Q2 2020, before carve out period
  - Full sample including an indicator equal to one during carve out period
- **Hypotheses that we test:**
  - Bank with a less binding SLR should be less reactive to drawdowns
  - During carve out period, bank positions should respond differentially to drawdowns

SLR, Drawdowns, and Treasury Holdings

Sample Pre Q2 2020 — Before Carve Out Period

	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

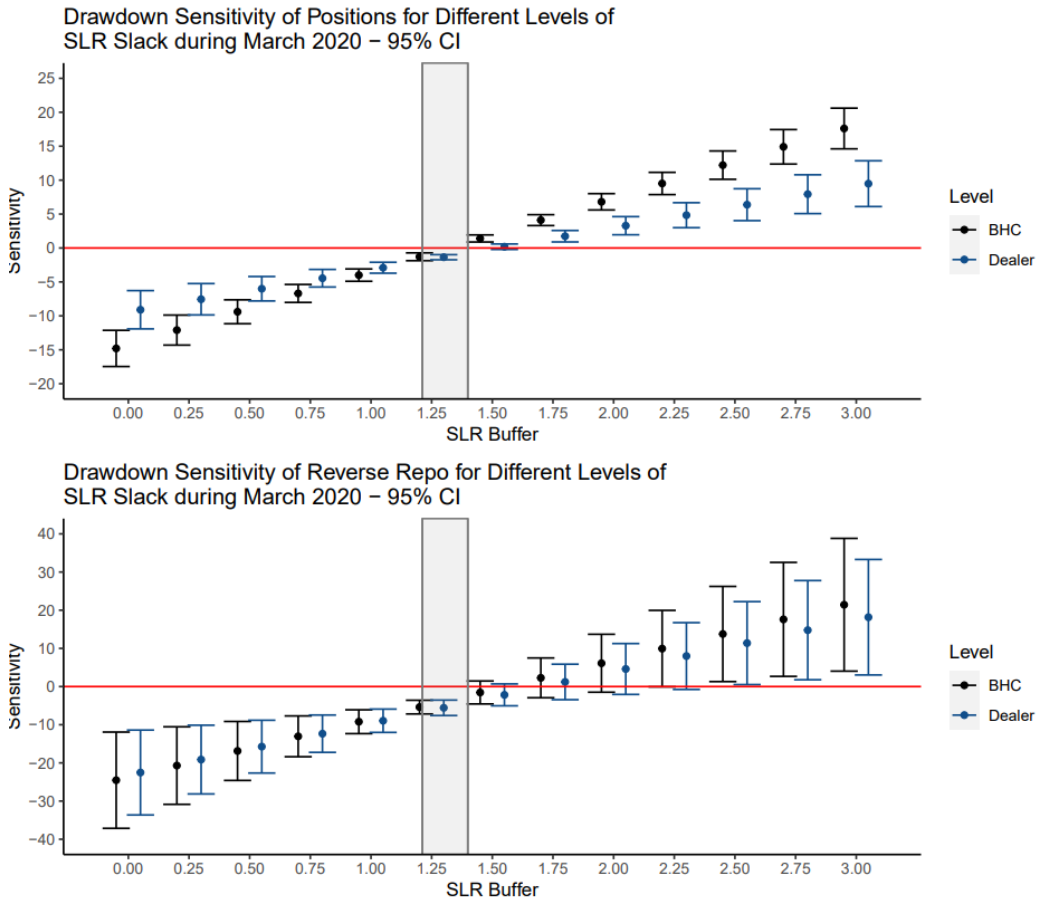
- **A higher SLR reduces the negative sensitivity of drawdowns for positions and reverse repo at the BHC level when drawdowns are large ($\phi' > 0$)**
  - Aggregate effect for a firm with an SLR of 6 (i.e., $\beta + \phi + (\beta' + \phi')$) is negative for positions and reverse repo at both the BHC and dealer level in March 2020, when drawdowns skyrocketed

Drawdowns Sensitivity of SLR During March 2020

Sample Pre Q2 2020 — Before Carve Out Period

The sensitivity during March 2020 is increasing for different levels of SLR slackness

- i.e., $\beta + \beta' + (\phi + \phi') \times SLR$ is increasing in SLR
- Low levels of SLR slackness banks reduce their participation in positions and reverse repo

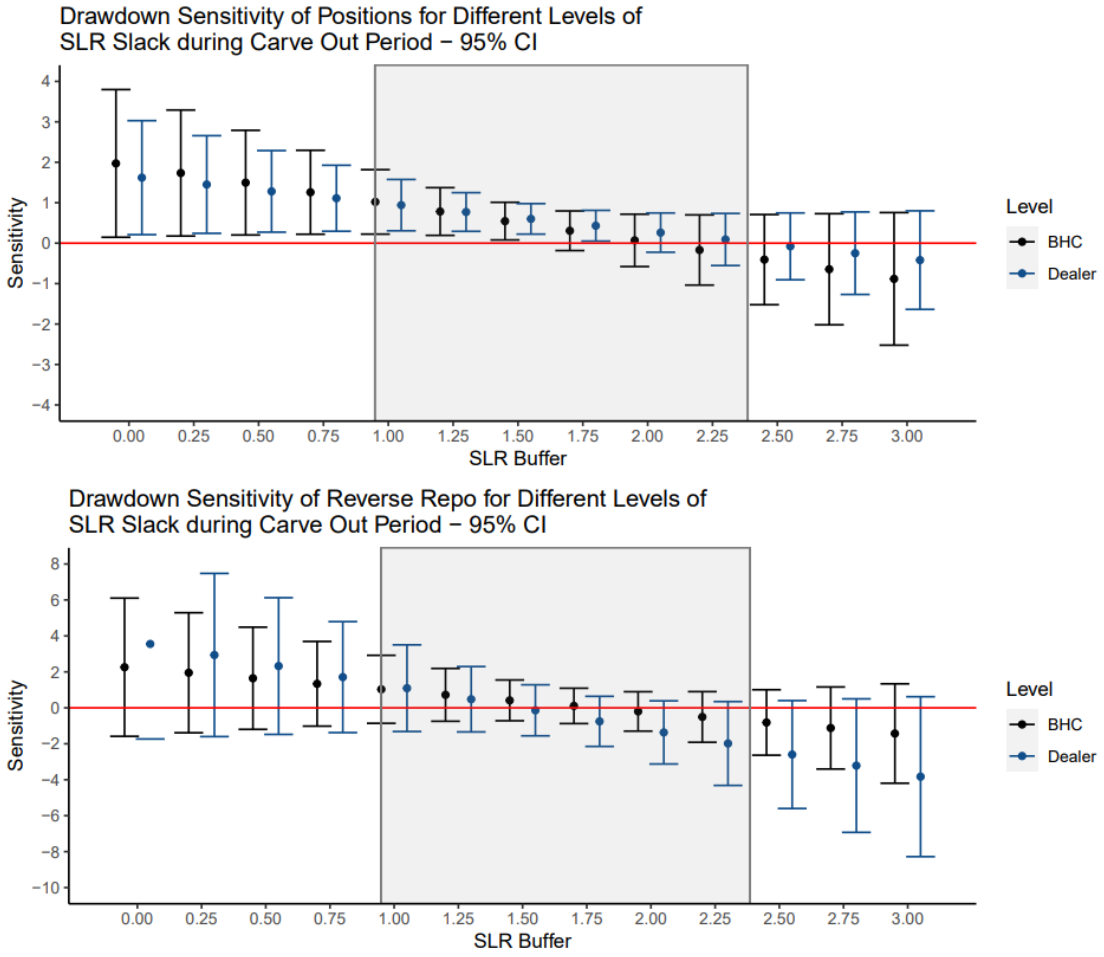


Drawdowns Sensitivity of SLR During Carve Out Period

Full Sample

Considering the full sample during carve out period, aggregate effect on *positions is reversed* → incentives to increase holdings in response to shocks

— Total effect for reverse repo is statistically insignificant



Encumbered Treasury holdings with liquidity and risk risk-based capital requirements in March 2020

	Total Capital	Tier 1 Capital	CE Tier 1 Capital	Liq. Coverage
Pre Carve Out (2nd Quarter of 2020) w/ Interaction March 2020				
β' : $\Delta CL\,Outstanding_{i,t} \times 1_{Mar2020}$	-37.252***	-40.926***	-41.695***	-35.482***
	(6.841)	(6.947)	(7.054)	(6.845)
ϕ' : $\Delta CL\,Outstanding_{i,t} \times SLR_{i,q(t)-1} \times 1_{Mar2020}$	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

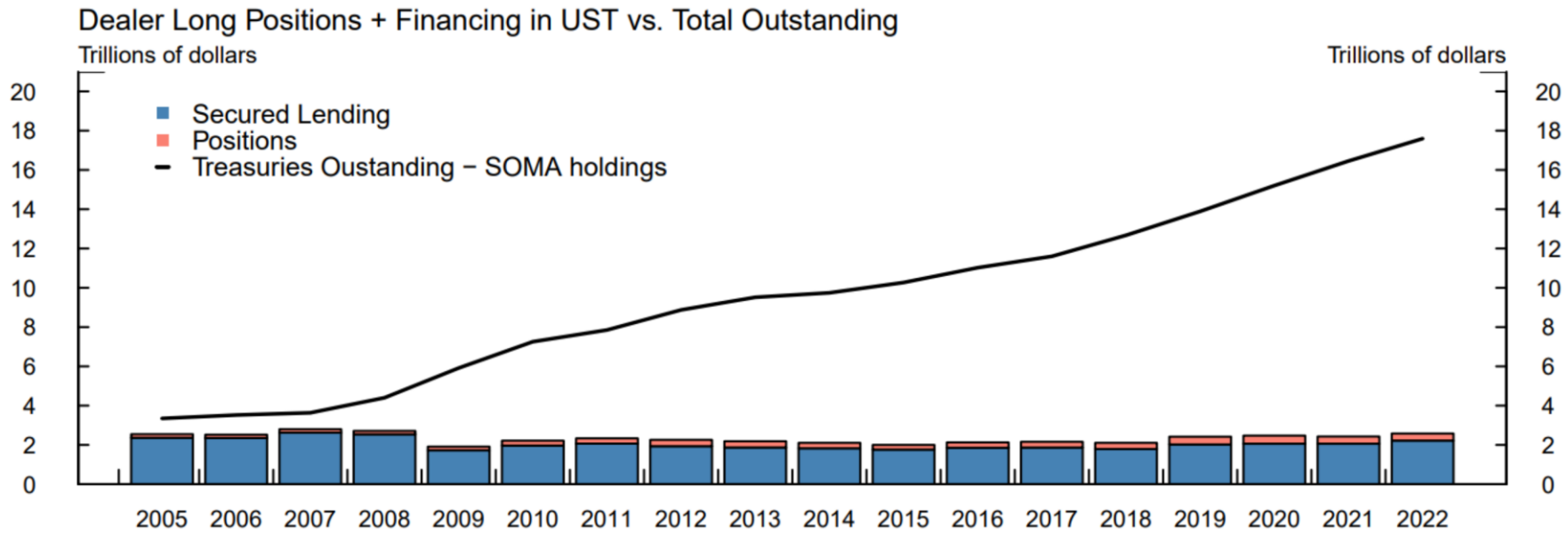
- **Sensitivity to SLR still holds**
- **Liquidity and risk-based capital requirements during March 2020 have a small effect in the opposite direction**
  - If financed with debt, Liquidity Coverage Ratio (LCR) should not affect encumbered Treasury holdings
  - Risk-based capital ratios do not penalize Treasury market activity, on the margin, firms with a higher capital ratio tend to reduce their exposure in response to balance sheet shocks

Concluding Remarks

- **Exogenous increases in banks' balance sheet size decrease BHCs' and dealers' participation in Treasury reverse repo & positions**
  - Sensitivity is particularly acute for reverse repos
- **Sensitivity is smaller for firms with higher SLR buffers**
- **Using data during carve out period shows sensitivity of U.S. Treasury positions are reversed**
- **Results suggest that regulatory leverage ratios reduce incentives for banks to intermediate U.S. Treasury markets in response to large shocks to their balance sheets**

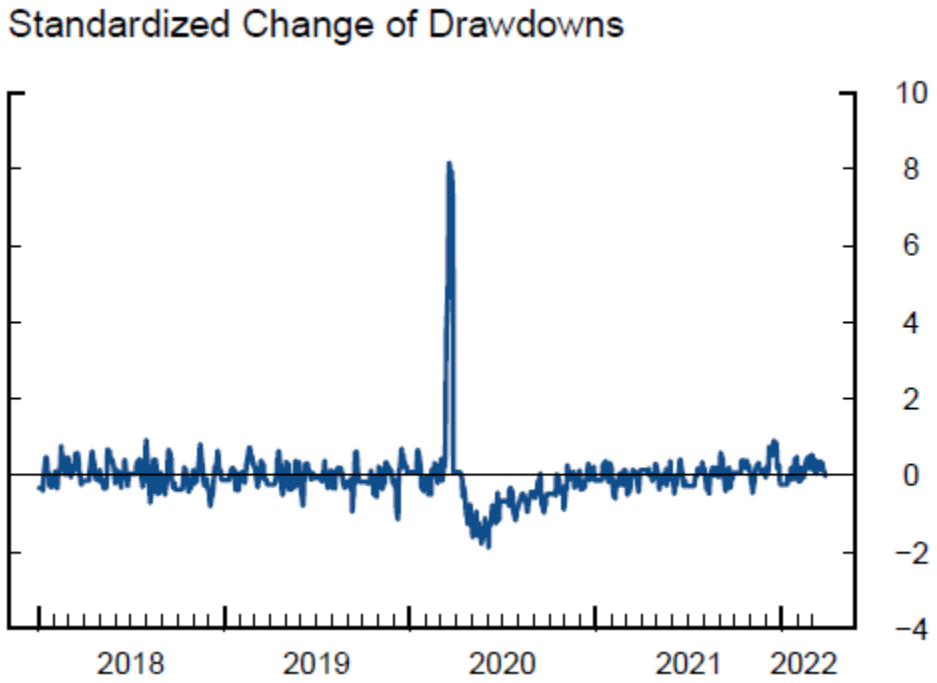
Thank you!

Motivation: Dealer Balance Sheets and Treasuries Outstanding



- Primary dealer Treasury market activities have not grown since 2008, even as the amount of outstanding Treasury securities available to investors continued to increase

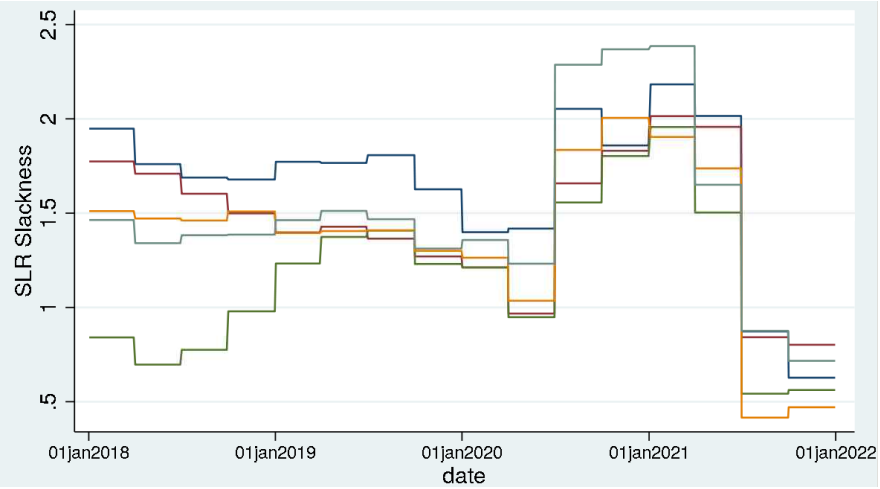
Average Credit Line Drawdowns During March 2020

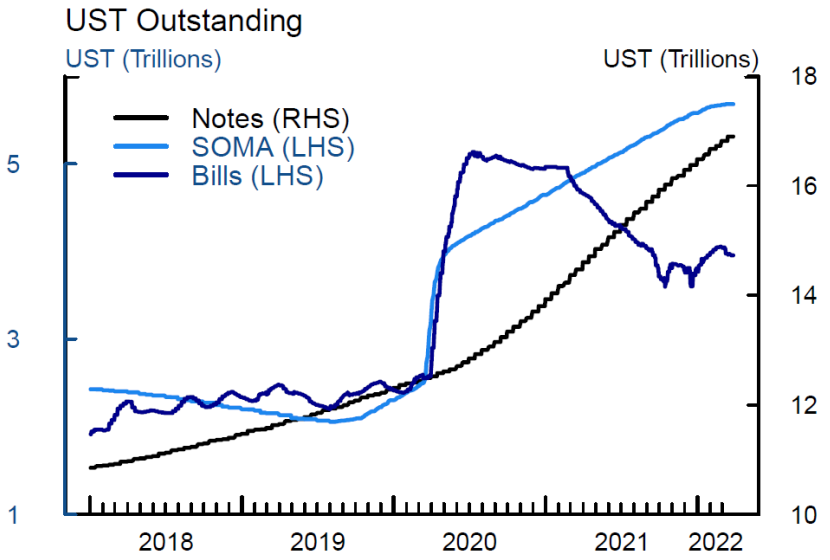


- **Drawdowns surged in March 2020**
  - U.S. Treasury participation is affected by **large shocks** to bank balance sheets
- **The impact is on SLRs is likely more meaningful when participation in the Treasury market is high**

SLR and Treasury Market Functioning During the COVID Shock

- Just before the COVID shock nearly all SLR ratios were at their lowest level since 2018, the year the regulation was implemented
- In March 2020, Treasury market liquidity presented evidence of serious stress
  - Bid-Ask spreads and deviations between cash and futures prices widened
- Unprecedented official sector intervention to support market functioning:
  - Sharp increase in Treasury Bill issuance and Fed asset purchases





Drawdowns, Treasuries, and the SLR at BHC- and dealer-level

Full Sample — Indicator for time period of SLR Carve Out

	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

- **Using longer sample period still results in a strong sensitivity for large drawdowns**
- **Aggregate effect on outright holdings is reversed for positions: incentives to increase holdings in response to shocks**
  - $(\beta + \phi) + (\beta'' + \phi'')$ for reverse repo is statistically insignificant

Drawdowns, Treasuries, and the SLR at BHC- and dealer-level

Combined (encumbered + unencumbered) U.S. Treasury holdings

	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

- **Using longer sample period still results in a strong sensitivity for large drawdowns**
- **Aggregate effect on outright holdings is reversed for positions: incentives to increase holdings in response to shocks**
  - $(\beta + \phi) + (\beta'' + \phi'')$ for reverse repo is statistically insignificant

Summary Statistics – Drawdowns, U.S. Treasuries, SLR, and First Difference U.S. Treasuries

	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