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Abstract

Using a quasi-natural experiment, we show that quantitative easing (QE) interacts with bank regulation, impacting the size and portfolio choices of non-banks. In 2021, upon the expiration of the Supplementary Leverage Ratio (SLR) relief, banks were incentivized to reduce leverage, shedding deposits and reducing the supply of wholesale debt. We show that as a result, money-market funds (MMFs) experienced large inflows and shifted their portfolios toward the Federal Reserve's ONRRP facility. Our results imply that when non-banks can access the central-bank balance sheet, they end up holding a share of central-bank liabilities, draining reserves and attenuating the impact of QE.

Key words: balance sheet constraints, banks, leverage ratio, monetary policy, money market funds, ONRRP

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1 Introduction

In this paper, using a quasi-natural experiment, we show that quantitative easing (QE) interacts with bank regulation and, by increasing banks' balance-sheet costs, impacts both the size and portfolio choices of non-bank financial institutions.

After the Great Financial Crisis, the Federal Reserve grew its balance sheet sharply to stimulate the economy through QE, increasing bank reserves, deposits, and leverage. Concurrently, US regulators implemented several reforms that penalize banks' balance-sheet expansions; the goal of these regulations is to reduce bank risk-taking by curbing bank leverage. The most notable example of these rules is the SLR, which sets an explicit limit on the amount of leverage that large banks can take.[1] This regulatory constraint makes balance-sheet expansions more costly for banks; moreover, since the SLR ratio is not risk-weighted, the cost is especially high for balance-sheet expansions associated with safe and low-margin activities, such as intermediation in the market for repurchase agreements (repos) collateralized by Treasuries.

Several recent papers have highlighted the importance of banks' balance-sheet costs in explaining arbitrage deviations in asset prices and excess volatility in money-market rates. It is less clear, however, how the interaction of banks' balance-sheet costs with the central bank's balance-sheet policies affects non-bank financial institutions, their portfolio choices, and, in turn, the effectiveness of QE itself.

An increase in balance-sheet costs incentivizes banks to reduce their debt. This can have two effects on non-bank financial institutions. First, banks could push their depositors into non-bank financial institutions that are seen as close substitutes to bank deposits, increasing the size of these non-banks. Second, banks could also borrow less in the wholesale market, including from non-banks, changing the portfolio composition of these non-banks. If non-banks have access to the central bank's balance sheet, they can accommodate the increase in size or change in investment opportunities by investing at the central bank.

In this paper, we identify these two effects focusing on a key type of non-bank financial institutions, money market funds (MMFs). We do that for two main reasons. First, MMFs

[1]The SLR, which was implemented as part of the Basel III reforms, was approved in July 2013 and became effective in the US on January 1, 2018.

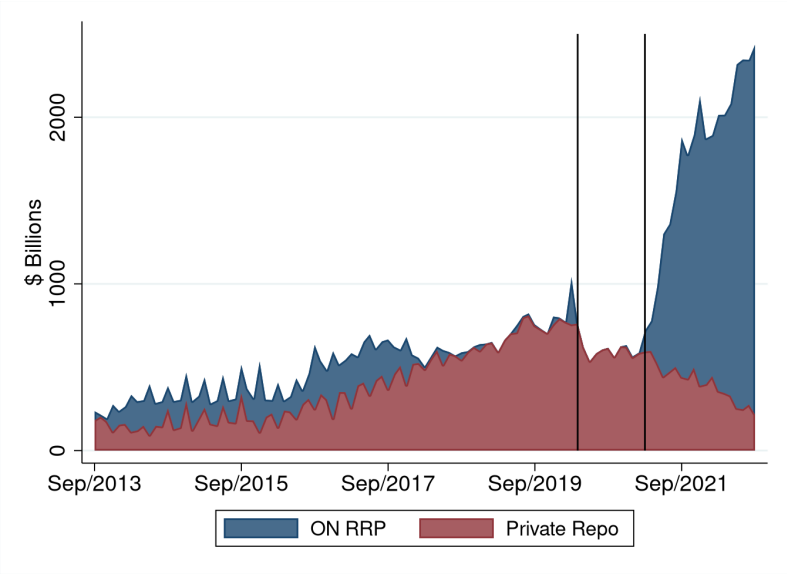


Figure 1: **Public and Private Overnight Treasury-Backed Repo Investment by US MMFs.** Repo investment is in billions of dollars at the monthly frequency. Calculations are restricted to repos collateralized by Treasuries. The blue area represents MMFs' repo investment at the ON RRP. The red area represents MMFs' repo investment with private counterparties; data are from the Office of Financial Research (OFR) US Money Market Fund Monitor. The vertical lines indicate the start-date and end-date of the SLR relief for bank holding companies (BHCs): April 2020 and March 2021.

are both the main non-bank substitutes to bank deposits—with $6.3 trillion of assets under management at the end of 2023—and the main providers of short-term wholesale liquidity to large banks; therefore, when banks' balance-sheet costs are tightened, MMFs are the non-bank financial institutions more likely to be impacted. Second, MMFs can invest at the Federal Reserve through the ON RRP, a facility set up to support the implementation of monetary policy; indeed, since the facility inception in September 2013, MMFs have represented 89 percent of total usage. As Figure 1 shows, investment in the ON RRP by MMFs increased dramatically between April 2021 and December 2021, accompanied by a reduction in MMF holdings of private Treasury repos. Indeed, overall ON RRP take up grew from a few billions to $2.4 trillion, with 92% of the increase due to MMFs.

To identify the effect of banks' balance-sheet costs on the size and portfolio composition of the MMF industry, we use a difference-in-differences strategy around an episode of exogenous variation in the tightness of the SLR constraint. The variation comes from the end of the

2020-2021 "SLR relief." The SLR relief—a regulatory change put in place at the same time as the Federal Reserve expanded its balance sheet by $4.6 trillion in response to the Covid-19 pandemic—temporarily excluded US Treasury securities and central bank reserves from bank assets in the SLR calculation; therefore, after the SLR relief ended in March 2021, banks' balance-sheet costs increased immediately and permanently, as banks had to once again include their Treasury and reserve holdings in their SLR calculations.

To identify the impact of balance-sheet costs on the size of the MMF industry, we focus on MMFs affiliated with banks subject to the SLR regulation. These MMFs should receive larger investor flows than other MMFs around the end of the relief, as their affiliated banks try to shed depositors to improve their SLR. The reason is twofold: banks have an incentive to retain their clients within the same complex, and investors have an incentive to stay within the same group to lower their switching costs. Consistent with this hypothesis, we find that in the two quarters around the end of the SLR relief, the assets under management (AUM) of MMFs affiliated with banks subject to the SLR increased by $3.4 billion more than those of other MMFs on average, for a total of $364 billion.

We strengthen our identification in two ways. First, we use regulatory data on banks' SLR and show that, within those MMFs affiliated with banks subject to the SLR, funds whose bank was closer to the regulatory requirement experienced larger inflows (as their bank had stronger incentives to push away depositors than banks with larger buffers). Second, we exploit the differential regulatory treatment of custodial banks, which were allowed to permanently exclude reserves from their SLR calculation before the SLR relief came into place; as a result, the increase in balance-sheet costs caused by the end of the relief was smaller for these banks. Consistent with this, we find that MMFs affiliated with custodial banks subject to the SLR experienced significantly less inflows than MMFs affiliated with other banks subject to the SLR.

As we explain above, banks' balance-sheet costs also affect non-bank financial institutions by tilting their portfolio choices, as banks respond to tighter constraints by reducing the supply of wholesale debt. To identify this effect, we focus on the share of MMF portfolio invested at the ON RRP and rely on the fact that this channel should be stronger for government MMFs than for prime MMFs. The reason is that government MMFs have more limited investment options: in addition to the ON RRP, they can only invest in government

debt (e.g., Treasury securities) or private repos collateralized by government debt, which are typically issued by the banking sector; prime MMFs, in contrast, can also lend to non-financial corporates. Consistent with this, we find that after the expiration of the SLR relief, the portfolio share of government MMFs invested at the ON RRP increased by 19 percentage points more than that of prime MMFs.

We further strengthen our identification in two ways. First, we restrict our analysis to government MMFs and show that funds that invested more in private repos in 2019—and were therefore more exposed to changes in the banking sector's supply of such assets—increased their portfolio share at the ON RRP more after the SLR relief ended. A ten-percentage-point increase in the pre-sample share of private repos in a government MMF's portfolio increases the share of the fund portfolio invested at the ON RRP by 2.4 percentage points after the expiration of SLR relief.

Second, we explicitly control for two other possible drivers of ON RRP investment that are likely to affect government MMFs more strongly: interest-rate risk and the supply of Treasury bills (T-bills). Since MMFs hold debt securities, higher interest-rate uncertainty should push them to tilt their portfolios towards short-term investments such as the ON RRP, with the effect being stronger for government funds because they have fewer options to manage interest-rate risk. By reducing MMFs' investment opportunities, a decrease in T-bill supply should tilt MMF portfolios towards the ON RRP; this effect should also be stronger for government MMFs as their investment options are more limited than those of prime funds.[2]

Our results on the effect of banks' balance-sheet costs on the share of MMF portfolio invested at the ON RRP are robust to controlling for the effects of interest-rate risk and T-bill supply. Importantly, we also find that both interest-rate risk and T-bill supply have significant effects on ON RRP take-up by MMFs. A 10-point increase in the MOVE index—a measure of interest rate uncertainty—increases the share of ON RRP investment in government-MMF portfolios by 2.4 percentage points more than it does in prime-MMF portfolios. A monthly decrease of T-bill issuance by $100 billion increases the portfolio share of ON RRP investment significantly more in government MMFs than in prime MMFs, by

[2]For MMF investment, T-bills are significantly more important than longer-term Treasuries because, by regulation, MMFs cannot hold securities with a remaining maturity greater than 397 days.

0.4 percentage point.

Finally, we show that the increase in ON RRP take-up of 2020-2021 highlighted in Figure 1 was due to the surge in banks' balance-sheet costs caused by the end of the SLR relief; in particular, we quantify the effect of banks' balance-sheet costs on MMFs' investment at the ON RRP in dollar terms, through both its effect on MMF size and its effect on MMF portfolio allocation. MMFs affiliated with banks subject to the SLR—whose AUM increased on average by $3.4 billion per fund between January and June 2021—grew their daily ON RRP investment by $1.3 billion per fund relative to other MMFs after the end of the SLR relief. Similarly, government MMFs increased their daily ON RRP investment by $9.6 billion per fund relative to prime MMFs.

Our results have important implications for monetary policy implementation. When MMFs invest in the ON RRP, they use their banks to execute the investment, which, in turn, use their reserve balances to make the transfer. This transfer results in an increase in ON RRP take-up and an equal decrease in the aggregate reserves available to the banking system, without any intervention by the Federal Reserve. Variation in the drivers of ON RRP take-up may therefore limit the Federal Reserve ability to efficiently expand and contract its balance sheet, as it affects bank reserves through factors outside the Federal Reserve control. For instance, a persistent increase in the ON RRP while the Federal Reserve reduces its balance sheet would increase the speed at which banks' reserves decline, which would pose a challenge both to banks, as they need to quickly adjust to lower reserve levels, and to the Federal Reserve, as it assesses the effect of lower reserves on interest rate control.

Moreover, if the goal of the Federal Reserve balance-sheet expansions is to stimulate the real economy through QE, an increase in ON RRP take-up due to banks' regulatory constraints stunts the central bank's ability to do so: as the Federal Reserve injects liquidity into the economy by purchasing assets in the open markets, this liquidity ends up invested with the Federal Reserve itself through the MMF industry, rather than supporting private credit and investment.

Importantly, the findings of this paper explain not only the dramatic increase in ON RRP take-up that started in 2021 and continued through the first half of 2022 but also the sharp reduction in ON RRP take-up that we observed since July 2023. Over the last year, the ON RRP dropped from $2.3 trillion in March 2023 to $400 billion in March 2024. This decline

is consistent with the three channels of ON RRP investment we identify in our paper. First, the size of banks' balance sheet plateaued at the end of 2022, while their reserves declined as the Federal Reserve started to shrink its balance sheet, relaxing banks' balance-sheet constraints. Second, interest rate uncertainty has been decreasing since its all-time high of March 2023. Finally, the supply of T-bills sharply picked up in 2023, as a response to the federal government fiscal expansion. The sharp reduction of investment in the ON RRP allows the Federal Reserve to reduce the size of its balance sheet without creating scarcity in the supply of reserves.

This paper is related to three strands of literature. The first is the literature studying the effects of post-crisis capital regulation, and especially banks' balance-sheet costs, on financial markets. Most empirical papers in this field have focused on the effect of balance-sheet costs on asset prices and market liquidity (Duffie and Krishnamurthy 2016, Adrian et al. 2017, Duffie 2018, Bao et al. 2018, Du et al. 2018, Andersen et al. 2019, Fleckenstein and Longstaff 2020). Munyan (2017) and Allahrakha et al. (2018), instead, show that after the introduction of the SLR, broker-dealers affiliated with bank holding companies decreased their repo borrowing; similarly, Boyarchenko et al. (2020) study the effect of the SLR on the relationship between hedge funds and prime brokers affiliated global systemically important banks. Finally, Diamond et al. (2023) show that large injections of central bank reserves have the unintended consequence of crowding out bank loans because of bank balance-sheet costs. We contribute to this literature by studying the effects of banks' balance-sheet costs, namely the SLR, on non-bank financial intermediaries such as MMFs, both in terms of size of the industry and in terms of its portfolio choices.

Our paper is also related to the growing literature about non-reserve central bank liabilities, such as the ON RRP, and the central bank's ability to supply short-term safe assets to the financial sector, including non-banks, to affect financial stability (Greenwood et al. 2015, Carlson et al. 2016). Frost et al. (2015) and Cipriani and La Spada (2022) specifically discuss the design features of the ON RRP, its role in the implementation of monetary policy, and its possible implications for financial stability. Anderson and Kandrac (2018) show that, during its first two years of operation, the ON RRP partly crowded out private repos in MMF portfolios and increased MMFs' bargaining power. Doerr et al. (2023) study MMFs' portfolio choice between repos (including the ON RRP) and T-bills and its effects on the the liquidity

premium of T-bills and on money-market liquidity. Stein and Wallen (2023) study MMFs' elasticity of substitution between ON RRP investment and T-bills and its effect on T-bill rates depending on different levels of T-bill supply. Recently, several theoretical papers have also studied the role of the central bank's balance-sheet on money-market dislocations and monetary policy transmission, focusing on facilities such as the ON RRP (Anbil et al. 2023; d'Avernas and Vandeweyer 2023; Huber 2023; d'Avernas et al. 2024; and Eisenschmidt et al. 2024). We contribute to the this literature by causally identifying for the first time the three main drivers of ON RRP investment by MMFs: banks' balance-sheet costs, interest-rate risk, and T-bill supply.

Finally, our paper is related to the recent literature on estimating banks' demand for reserves after the 2008 crisis. Since changes in ON RRP take-up mechanically impact aggregate reserves, by showing that MMFs' ON RRP investment is affected by variation in banks' balance-sheet costs, we highlight the importance of controlling for endogenous ON RRP fluctuations when estimating the reserve demand curve (Afonso et al. 2022; Lagos and Navarro 2023).

The remainder of the paper is organized as follows. Section 2 introduces the institutional background. Section 3 describes the data. Section 4 estimates the effects of banks' balance-sheet constraints on the size of the MMF industry, the main investor at the ON RRP facility. Section 5 identifies the effect of banks' balance-sheet costs on the share of MMFs' portfolio invested at the ON RRP; in this section, we also identify the effects of interest-rate risk and T-bill supply on MMFs' investment at the ON RRP and show that controlling for these channels does not reduce the importance of banks' balance-sheet costs. Section 6 concludes.

2 Institutional Background

2.1 The Supplementary Leverage Ratio

The supplementary leverage ratio (SLR) is the US implementation of the Basel III leverage ratio; it is the ratio between a bank's tier 1 capital and its "total leverage exposure," which

includes both on-balance sheet assets and certain off-balance sheet exposures:[3]

$$\text{SLR} = \frac{\text{Tier 1 capital}}{\text{Total leverage exposure}}.$$

US bank regulators have set a minimum SLR for large banks and their depository institutions of 3%.[4] Additionally, bank holding companies (BHCs) with more than $700 billion in total consolidated assets or more than $10 trillion in assets under custody are subject to a minimum SLR requirement of 5% and their insured depository institutions (DIs) to a minimum requirement of 6%.

This regulation was adopted in response to the 2008 financial crisis, which highlighted how excessive bank leverage can become a key driver of financial turmoil (BIS, 2014). Similarly to traditional capital ratios, the SLR requirement limits a bank's ability to expand its balance sheet by issuing more debt. Importantly, however, since this leverage constraint is not risk-weighted, it particularly penalizes balance-sheet expansions used to finance safe assets, such as reserves and US Treasury securities, or safe intermediation activities, such as overnight Treasury repo intermediation.

In April 2020, US regulators temporarily revised the SLR calculation to alleviate strains in the Treasury market that arose at the beginning of the COVID-19 pandemic. The change, usually referred to as "SLR relief," excluded on-balance sheet holdings of US Treasury securities and reserves from the calculation of the SLR denominator (Federal Register, 2020b).[5] At the BHC level, the relief became effective on April 14, 2020; it was extended to the SLR of DIs on May 15, becoming effective on June 1. At the time of its introduction, the regulators also stated that the temporary relief would end on March 31, 2021, for both BHCs and DIs. Table 1 presents a brief summary of the implementation of the SLR relief.

[3]Tier 1 capital is the core equity of a bank; it includes common stock and related surplus, retained earnings, accumulated other comprehensive income, non-cumulative perpetual preferred stock, and qualifying minority interest. The total leverage exposure includes on-balance sheet assets, derivatives exposures, repo-style exposures, and other off-balance sheet exposures.

[4]This minimum ratio applies to banking organizations with at least $250 billion in total consolidated assets or at least $10 billion in total on-balance sheet foreign exposure. The 2013 final rule required these large banks to comply with the minimum SLR starting on January 1, 2018.

[5]This interim final rule applied to BHCs, savings and loan holding companies, and US intermediate holding companies of foreign banking organizations.

	SLR relief	
	Bank holding companies (BHCs)	**Depository institutions (DIs)**
Announcement date	April 1, 2020	May 15, 2020
Start date	April 14, 2020	June 1, 2020
End date	March 31, 2021	March 31, 2021
Rule	Excludes on-balance sheet US Treasuries and deposits at Federal Reserve Banks (i.e., central bank reserves) from the SLR denominator	

Table 1: **Timeline and description of the temporary SLR relief rule of 2020-2021.**

Figure 2 from Cochran et al. (2023) shows the SLRs of the six largest US BHCs. Although there is variability both across time and across banks, the SLRs of these banks increased significantly during the relief period, to then decline sharply immediately after it ended. In our analysis, we will focus on the period around the end of the relief so that results are not contaminated by the money-market turmoil of March 2020. The sudden tightening of the SLR constraint due to the end of the relief sharply increased banks' regulatory costs associated with balance-sheet size; as discussed above, this regulatory increase in balance-sheet costs was particularly material for safe, low-return intermediation activities, such as intermediation in Treasury repos.

In our empirical strategy, we also exploit the fact that the end of the SLR relief affected custodial banks—banks whose main business purpose is to hold assets on behalf of their parents—significantly less than other banks. The reason is that US bank regulators had *permanently* excluded reserves from the calculation of custodial banks' SLRs in January 2020, with the change becoming effective on April 1, 2020, long before the end of the SLR relief (Federal Register, 2020a).[6]

2.2 Money Market Funds (MMFs)

MMFs are open-end mutual funds investing in money-market instruments with the aim of maintaining the value of their shares stable. They are regulated by the Securities and Exchange Commission (SEC) under Rule 2a-7 of the Investment Company Act of 1940.

[6]Under this rule, a custodial banking organization is defined as a depository institution holding company with a ratio of assets under custody to total assets of at least 30. There are three custodial banks in the US: the Bank of New York Mellon, Northern Trust Corporation, and State Street Corporation.

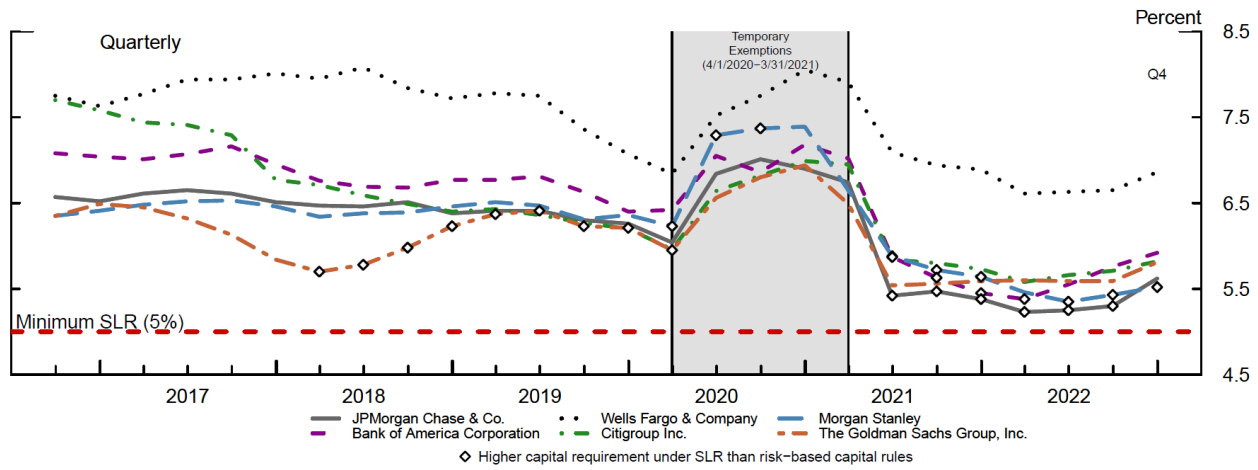


Figure 2: **Supplementary Leverage Ratio (SLR) of the Six Largest US BHCs.** The figure is from Cochran et al. (2023). The SLR is measured in percent; data are quarterly from the regulatory form FR Y-9C. The sample include the 6 largest US BHCs in the last quarter of 2022: "JP Morgan Chase & Co." (solid grey line), "Bank of America Corporation" (dashed purple line), "Wells Fargo & Company" (dotted black line), "Citigroup Inc." (dashed and dotted green line), "Morgan Stanley" (dashed blue line), and "The Goldman Sachs Group, Inc." (dashed orange line). The horizontal dashed red line represents the minimum SLR requirement for these BHCs (5%). The grey-shaded vertical region represents the SLR-relief period for BHCs: April 2020–March 2021.

By regulation, MMFs must invest in short-term debt securities of high credit quality. For example, they must hold securities with remaining maturity within 397 days; the weighted average maturity of their portfolios (WAM) must be within 60 days; and at least 30% of their portfolios must be invested in Weekly Liquid Assets (WLA)—that is, cash, Treasuries, agency discount notes with remaining maturities within 60 days, and securities that mature or are subject to a demand feature that is exercisable and payable within 5 business days.[7]

Based on their portfolio holdings, MMFs can be divided in two types: government MMFs—which can only hold Treasuries, agency debt, and repos collateralized by these asset classes—and prime MMFs—which can also hold commercial paper, certificates of deposit, floating-rate notes, and repos backed by non-government collateral. Over the last decade, government funds have grown significantly more than prime funds: on average, between January 2020 and December 2021, government MMFs represented 78% of the industry's $4.9 trillion in total assets under management (AUM).[8]

Two episodes, in particular, contributed to the relative growth of government MMFs. The first one was the 2014 SEC reform, which, by making prime MMFs less money-like, led investors to move more than $1 trillion from prime to government MMFs between November 2015 and the reform compliance date of October 14, 2016 (Cipriani and La Spada, 2021). The second episode is the turmoil of March 2020, when investors withdrew $140 billion from prime funds and poured $720 billion in government funds; the flight-to-safety only abated at the end of the month, after the introduction of the Money Market Mutual Fund Liquidity Facility (MMLF) and the other 13(3) emergency facilities (Cipriani and La Spada, 2020; Cipriani et al., 2020; Li et al., 2021; Anadu et al., 2022).

MMFs can be offered by stand-alone asset managers or BHCs. Importantly, the AUM of the MMFs offered by a bank are not part of the bank's balance sheet and, therefore, are not included in the calculation of the bank's SLR.

[7]MMFs are also required to hold at least 10% of their portfolios in Daily Liquid Assets (DLA): cash, Treasuries, and securities that mature or are subject to a demand feature that is exercisable and payable within one business day. In July 2023, the SEC increased the required minimum levels of WLA and DLA to 50% and 25% (Securities Exchange Commission, 2023), a change that became effective in April 2024.

[8]There is a third type of MMF, tax-exempt funds, which mainly invest in short-term floating-rate debt issued by local governments and authorities. They are much smaller than prime and government funds; on average, between January 2020 and December 2021, they held 2.4% of MMF total AUM.

2.3 The Overnight Reverse Repo Facility (ON RRP)

The ON RRP is a policy tool to help control the federal funds rate and other money-market rates.[9] Through the ON RRP, banks, primary dealers, MMFs, and government sponsored enterprises invest at the Federal Reserve via overnight Treasury repos with a fixed interest rate, which is set by the Federal Open Market Committee (FOMC).[10] The ON RRP rate has been always set below the interest rate on reserve balances (IORB).[11]

The ON RRP is a liability on the balance sheet of the Federal Reserve. ON RRP investment does not change the size of the Federal Reserve's balance sheet: the securities backing the repos still show as assets held by the Federal Reserve. ON RRP investment, however, changes the composition of the Federal Reserve liabilities: all else being equal, it lowers the supply of reserves in the banking system. When an institution invests in the ON RRP, there is a transfer from its reserve account or from the reserve account of its bank (if the institution does not have a reserve account, like an MMF) to the Federal Reserve; such a transfer reduces reserve liabilities on the Federal Reserve's balance sheet and increases ON RRP liabilities by the same amount. An opposite movement from ON RRP to reserves takes place when an ON RRP investor closes its position with the Federal Reserve.[12]

In addition to banks and primary dealers, the only other institutions eligible to invest at the ON RRP are MMFs and government-sponsored enterprises (GSEs).[13] These institutions, especially MMFs, are the main providers of overnight wholesale liquidity to the banking sector, both secured and unsecured. However, MMFs do not have accounts with the Federal

[9]The Federal Reserve began testing ON RRPs in September 2013 and announced the intention to use the facility as a supplementary policy tool in September 2014.

[10]The FOMC also sets a counterparty limit for ON RRP investment, currently at $160 billion; in addition, the facility has an aggregate limit, currently set equal to the value of unencumbered Treasury securities held by the Federal Reserve. Neither the counterparty limit nor the aggregate limit is binding in our sample. Also, technically, the FOMC sets the maximum rate that the Federal Reserve is willing to pay—the offering rate; the actual rate is determined through an auction process. Only if the amount bid exceeds the aggregate amount offered, the two rates will differ. Such an occurrence, however, is unlikely given the amount of Treasury securities held by the Federal Reserve. In fact, in the history of the facility, the amount bid exceeded the amount offered only once, at the end of September 2014, when the aggregate cap was only $300 billion. Finally, ON RRP transactions are cleared and settled in the tri-party repo platform, on the books of a clearing bank (Bank of New York Mellon).

[11]The IORB is the interest rate that DIs earn on their reserve balances with the Federal Reserve.

[12]See Frost et al. (2015) and Cipriani and La Spada (2022) for a discussion on the design of the ON RRP.

[13]The list of counterparties is available at `https://www.newyorkfed.org/markets/rrp_counterparties`.

Reserve and, therefore, cannot earn IORB; similarly, GSEs do not earn the IORB on their Federal Reserve cash holdings. By offering MMFs and GSEs a safe overnight investment option at a fixed rate, the ON RRP helps set a floor under money-market rates.

As shown in Figure 3 and Table 2, MMFs are the main ON RRP investors, accounting for 83% of total investment on average since September 2013. Investment by government MMFs, in particular, accounts for the largest share, representing on average 79% of total MMF ON RRP take-up since the inception of the facility.

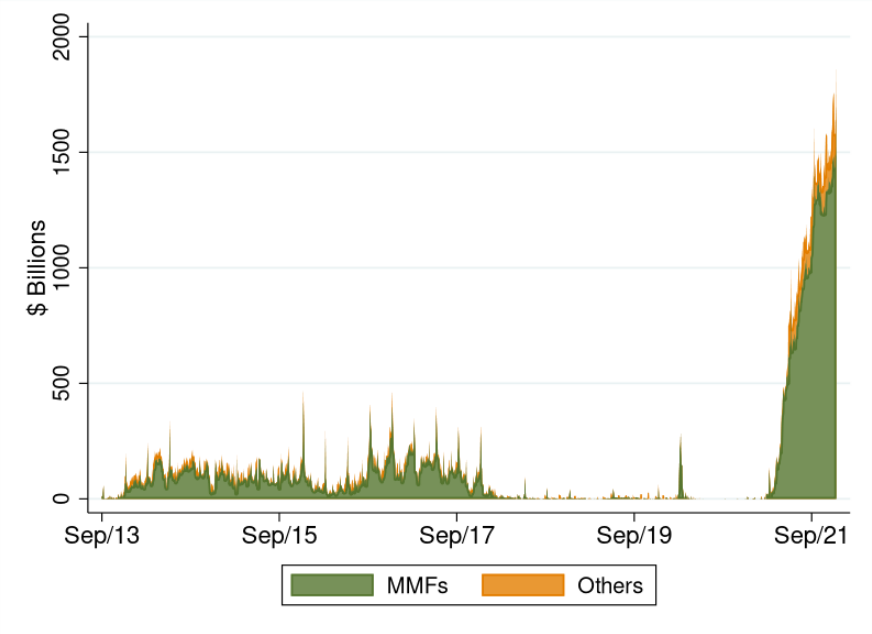


Figure 3: **ON RRP Take-up by Counterparty Type.** ON RRP investment is calculated in billions of dollars, at the daily frequency. Data are from the Federal Reserve Bank of New York (`https://www.newyorkfed.org/markets/desk-operations/reverse-repo`). The green area represents take-up by money market funds (MMFs); the orange area shows take-up by other counterparties, i.e., banks, government-sponsored enterprises (GSEs), and primary dealers.

Take-up at the ON RRP facility has fluctuated significantly since its inception. During the last four months of 2013, average take-up hovered around $15 billion, whereas over the next four years, it oscillated around $120 billion. Average daily take-up decreased to $8.5 billion over the 2018-2020 period, as the Federal Reserve shrank its balance sheet, and remained at around $8 billion through the end of March 2021. At that time, daily investment at the ON RRP facility started to increase steadily, reaching an average of $1.6 trillion in

	Daily ON RRP Take-up								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total ($ billions)	15	123	112	104	145	12	5	9	725
MMF Share (%)	72	84	89	87	93	80	53	93	89
Gov-MMF Share of MMF Take-up (%)	59	72	74	83	79	87	79	79	87

Table 2: **ON RRP Take-up.** The first row shows daily average total take-up (by all counterparties) at the ON RRP in billions of dollars for each year between 2013 and 2021. For 2013, the time period starts in September (when the ON RRP facility was established by the Federal Reserve). The second row presents daily average ON RRP take-up by MMFs as a percentage of total take-up. The third row shows daily average take-up by government MMFs as a percentage of overall take-up by all MMFs.

December 2021—a growth rate of $177 billion per month. Volume continued to increase through 2022, with take-up reaching an average of around $2 trillion in 2022.

3 Data

To study the impact of banks' balance-sheet costs on the size of the MMF industry, we use daily data on MMFs' net flows, net yields, and bank affiliation from iMoneyNet;[14] these data also allow us to distinguish between prime and government MMFs. We complement iMoneyNet data with the monthly N-MFP filings submitted by MMFs to the SEC, which are publicly available on the SEC website; these filings allow us to identify feeder funds, which we drop from our MMF sample.

For each MMF affiliated with a bank, we match iMoneyNet fund-level data with publicly available bank data, including whether the bank is subject to the SLR requirement, whether it is a custodial bank, its minimum SLR requirement, and its quarterly SLR, both at the BHC and at the DI levels.

To study the impact of banks' balance-sheet costs on MMFs' investment at the ON RRP, we use Federal Reserve confidential data about ON RRP investment at the individual fund level and daily frequency.[15] We match these data with the MMF-level data from iMoneyNet

[14] `https://financialintelligence.informa.com/products-and-services/data-analysis-and-tools/imoneynet`.

[15] Aggregated daily data on ON RRP take-up by institution type (e.g., MMF, primary dealer) are publicly

based on the funds' SEC series IDs, which are available in both datasets. By doing so, we can calculate the daily share of a fund's portfolio invested in the ON RRP (i.e., the fund's ON RRP dollar investment divided by the fund's AUM) and the weekly amount of a fund's portfolio invested in private repos (i.e., the fund's total repo investment minus the fund's ON RRP investment).[16] For this analysis, we also use monthly data on MMFs' investment in "sponsored repos" from the Office of Financial Research (OFR);[17] sponsored repos are a particular type of Treasury repos that are cleared on the Fixed Income Clearing Corporation's (FICC) repo platform and can be netted, lowering balance-sheet costs (see Section 5).

Finally, to measure interest-rate uncertainty, we use the MOVE index, publicly available at the daily frequency from Yahoo!Finance (`https://finance.yahoo.com/quote/%5EMOVE/`); and to measure the T-bill supply, we use publicly available, monthly data on T-bill issuance and the total amount of T-bills outstanding from Haver Analytics (`https://www.haver.com/`).

4 Banks' Balance-sheet Costs and MMF Flows

In this section, we show that, in 2020-2021, banks reacted to increased balance-sheet costs by shedding their deposits, which then flew into MMF shares—the closest substitute to bank deposits.

To identify the impact of balance-sheet costs, we exploit as a quasi-natural experiment the SLR regulatory relief of 2021, which allowed banks to temporarily exclude Treasury securities and reserves from their SLR calculations. For banks subject to the SLR, balance-sheet costs increased markedly after the end of the relief on March 31, 2021.[18] We focus on the end of the relief to avoid our results being confounded by the money-market turmoil

available at `https://www.newyorkfed.org/markets/desk-operations/reverse-repo`.

[16] iMoneyNet data on funds' AUM are available daily, whereas their data on funds' investments by asset class, such as repos, are only available weekly.

[17] `https://www.financialresearch.gov/money-market-funds/`.

[18] Our estimation strategy does not imply that the SLR requirement is the only driver of banks' balance-sheet constraints; we are focusing on the SLR because the introduction of the temporary relief in 2020 allows us to exploit material time-series variation in the tightness of this specific balance-sheet constraint.

of March 2020, which caused substantial volatility on MMF flows (Cipriani and La Spada, 2020).

Ceteris paribus, transferring funds from a bank's deposit account to a MMF sponsored by the same bank—rather than to a third-party's MMF—is easier for depositors, who minimize search costs, and more convenient for the bank, which retains its clients. Therefore, in our identification, we exploit the fact that, if banks became constrained after the end of the SLR relief, we should observe greater inflows in MMFs that are affiliated with banks subject to the SLR requirement.

Importantly, the assets and liabilities of affiliated MMFs are not included in the calculation of banks' SLR and therefore flows from bank deposits to MMF shares reduce banks' SLR.[19] For this reason, around the end of the SLR relief, banks' subject to the SLR had an incentive to push their depositors into their affiliated MMFs, so as to increase their regulatory leverage ratio and counteract the increase in balance-sheet costs due to the end of the relief.

Figure 4 shows the cumulative dollar flows in MMFs affiliated with banks subject to the SLR requirement ("SLR banks") and in all other MMFs, that is, MMFs that are not affiliated with banks or that are affiliated with banks that are not subject to the SLR. Consistent with our hypothesis, around the end of the SLR-relief period, funds affiliated with SLR banks grew more than the other funds. The growth of MMFs affiliated with SLR banks started in the first quarter of 2021, as the end date of the SLR relief had been announced at the time of its introduction. Investor flows usually happen in the months ahead of the implementation of pre-announced regulatory changes, such as the 2014 SEC reform of the MMF industry, when flows from prime to government MMFs were observed a year before the reform came into effect (Cipriani and La Spada 2021).

To formalize the observation in Figure 4, we run the following panel regression at the fund level and daily frequency, from June 1, 2020 (when the SLR relief became effective for

[19] Also note that MMF shares represent a fund's equity; all else being equal, inflows decreases a fund's leverage. Moreover, although the SEC limits the amount of mutual funds' borrowing to 1/3 of their total assets (i.e., the minimum leverage ratio measured as equity over assets is 2/3), MMF borrowing is practically zero.

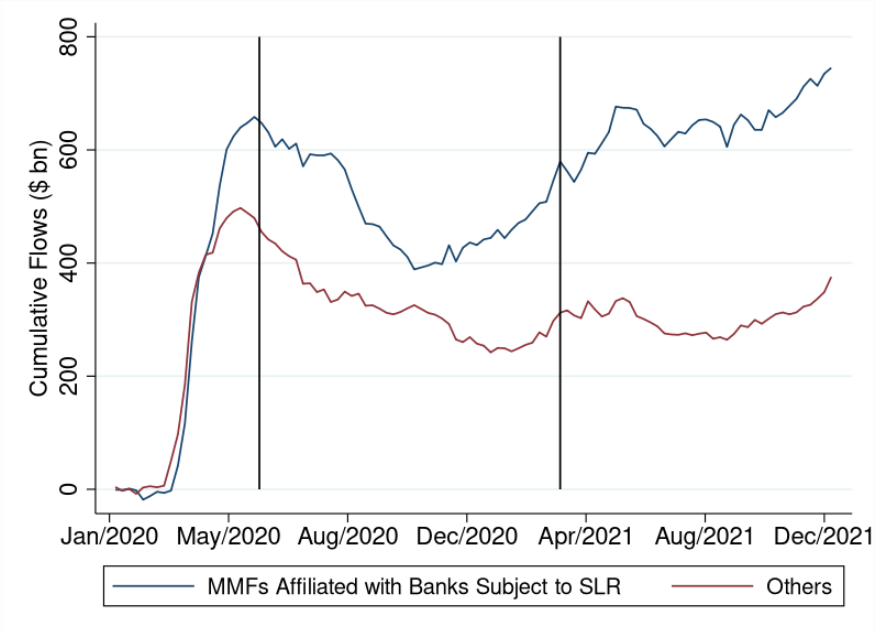


Figure 4: **MMF Cumulative Flows from January 2020 to December 2021, by Affiliation to SLR Banks.** Flows are calculated in billions of dollars, at the daily frequency. The blue line represents aggregate flows for MMFs affiliated with banks subject to the SLR; the red line is for all other MMFs. The vertical lines represent the start-date and end-date of the SLR relief for depository institutions (DIs): June 1, 2020, and March 31, 2021.

DIs), to December 31, 2021:

$$\begin{aligned}\text{Flow}_{it} =& \beta_1\, 2021\text{Q1}_t \times \text{SLR-Bank MMF}_i + \beta_2\, 2021\text{Q2}_t \times \text{SLR-Bank MMF}_i \\ &+ \Gamma X_{i,t-1} + \alpha_i + \mu_t + \varepsilon_{it}. \end{aligned} \tag{1}$$

Flow_{it} is fund i's net flow on day t in billions of dollars. Since the end of the relief implied an immediate, permanent jump in banks' balance-sheet costs and the expiration date (March 31, 2021) was announced when the relief was introduced, we study the effects on MMF flows in the quarter before and the quarter after the end of the relief; these quarters are represented by the dummies 2021Q1_t and 2021Q2_t. SLR-Bank MMF_i is a dummy for funds affiliated with SLR banks. $X_{i,t-1}$ is a fund-level vector of lagged time-varying controls, including net flows (to control for flow persistence) and net yield (to control for flow-performance relations). Finally, α_i are fund-fixed effects, and μ_t are time-fixed effects. Results are in Table 3;

standard errors are robust to heteroskedasticity, serial correlation, and cross-correlation.[20]

Column (1) of Table 3 shows that, in the quarter prior to the end of the SLR relief, net flows in MMFs affiliated with a bank subject to the SLR requirement increased significantly more than those in other MMFs by \$34 million per day (p-value = 0.028). The effect in the following quarter is positive but insignificant, consistent with banks acting mostly ahead of end of the relief. In total, these net flows correspond to an increase of \$3.4 billion in the fund's AUM over the two quarters around the end of the relief. Since there are 107 MMFs affiliated with SLR banks, this segment of the industry increased by additional \$364 billion in the six months around the end of the SLR relief program, relative to the rest of the industry—whose size was relatively stable during this period.

One concern with our results could be that the flows in MMFs affiliated with SLR banks increased more around the end of the SLR relief simply because those funds are affiliated with banks, not because the banks are subject to the SLR requirement. To rule out this possibility, we re-estimate regression (1) including an additional interaction of the time dummies for the quarters around the relief's end with a dummy for MMFs affiliated with any bank. Results are in the Column (2) of Table 3: bank affiliation does not per se lead to larger inflows around the end of the SLR relief; only MMFs affiliated with banks subject to the SLR experience greater flows; the impact of being affiliated to an SLR bank (the sum of the two coefficients in the new regression) is \$37 million per day (p-value = 0.043), very close to what we estimated in Column (1).

As Figure 4 shows, our results are not driven by a violation of the parallel trend assumption: during June-December 2020, flows in MMFs affiliated with banks subject to the SLR were not increasing relative to those in other MMFs; if anything, they were decreasing. To show this formally, in Column (3), we regress Flow_{it} against the interaction of a linear time trend (in days) and the dummy for MMFs affiliated to SLR banks, from June 1 to December 31, 2020 ("pre sample"); we also include the same set of controls and fixed effects as in regression (1). The coefficient on $\text{Linear Trend}_t \times \text{SLR-Bank MMF}_i$ is both economically and statistically insignificant, indicating that the parallel trend assumption holds in our data.

In Column (4) of Table 3, we replicate Column (1) restricting our sample to government MMFs. The effect of banks' balance-sheet costs on MMF size is even stronger: daily net

[20] We use Driscoll-Kraay standard errors with 5 lags.

flows in government MMFs affiliated with banks subject to the SLR increase by $44 million per day in the quarter before the end of the relief (p-value = 0.039) and by additional $30 million per day in the following quarter, for an increase in fund AUM of $4.4 billion in the first six months of 2021; results are similar when we control for the general effect of bank affiliation, which may confound our findings (Column (5)).

To rule out more general forms of endogeneity, we strengthen our identification in two ways. First, we exploit the differential regulatory treatment of custodial banks, which are subject to the SLR requirement but have been less affected by the SLR relief than other SLR banks. As we explain in Section 2, in January 2020, custodial banks were allowed to *permanently* exclude their central bank reserves from the calculation of their SLRs, starting from April 2020; this provision did not have expiration and has remained in place since then. As a result, the balance sheet costs of custodial banks tightened less than those of other SLR banks after the end of the SLR relief.[21] For this reason, custodial banks had lower incentives to push deposits into affiliated MMFs around March 2021. In our regression analysis, if banks respond to increased balance-sheet costs by pushing deposits into affiliated MMFs, we should observe MMFs affiliated with custodial banks experiencing smaller inflows around the end of the relief than MMFs affiliated with other SLR banks.

Columns (1) and (2) in Table 4 replicate the results in Columns (1) and (4) of Table 3, separating MMFs affiliated to SLR banks based on whether the bank is a custodial bank or not. Namely, we replace the SLR-Bank MMF_i dummy with two dummies: Custodial SLR-Bank MMF_i and Non-custodial SLR-Bank MMF_i.[22] Consistent with our hypothesis, around the end of the relief, MMFs affiliated with custodial banks received significantly less inflows than MMFs affiliated with other banks subject to the SLR requirement. In fact, in both the quarter before and the quarter after the end of the relief, the net flows in custodial SLR banks are positive but both economically and statistically insignificant, both for all MMFs (Column (1)) and when we restrict the sample to government MMFs (Column (2)). In contrast, the effect on the flows in MMFs affiliated to non-custodial SLR banks is even stronger than in our baseline regressions: additional $50 million per day in 2021Q1,

[21] Because the different regulatory treatment of custodial banks regarding the SLR was limited to reserves—and did not include Treasuries—they also experienced some tightening of the constraints after the end of the relief.

[22] All custodial banks in our sample are subject to the SLR.

when considering all MMFs (p-value = 0.014), and \$65 million per day when considering only government MMFs (p-value = 0.027).

Our second way to strengthen our identification is to use data on individual banks' SLR levels: the incentive to shed deposits and push them into affiliated MMFs should be stronger for banks whose SLR is closer to the regulatory requirement. To identify this effect, we therefore restrict our sample to MMFs affiliated with banks subject to the SLR requirement and run the following daily regression at the fund level:

$$\begin{aligned}\text{Flow}_{it} = {} & \beta_1 \, 2021\text{Q1}_t \times (\text{SLR} - \text{SLR Req})_{i,2019Q4} + \beta_2 \, 2021\text{Q2}_t \times (\text{SLR} - \text{SLR Req})_{i,2019Q4} \\ & + \Gamma X_{i,t-1} + \alpha_i + \mu_t + \varepsilon_{it}, \end{aligned} \tag{2}$$

where $(\text{SLR} - \text{SLR Req})_{i,2019Q4}$ is the difference between the SLR and the required SLR of the bank to which MMF i is affiliated, calculated in 2019Q4 to control for endogeneity.

The results of regression (2) are in Column (3) of Table 4. MMFs affiliated with SLR banks whose SLR is closer to the minimum requirement experience significantly greater inflows in the quarter prior to the end of the SLR relief: a 10-percentage-point reduction in a bank's SLR buffer leads to inflows into the affiliated MMFs of \$50 million per day (p-value = 0.025), an increase in funds' AUM of \$3 billion over 2021Q1. As in regression (1), results for the quarter following the end of the relief have the same sign but are smaller in magnitude and statistically insignificant. Results are practically the same when we restrict the sample to government MMFs (Column (4)).

In Appendix A, we run several robustness checks. First, we replicate Tables 3 and 4 starting the sample on April 14, 2020—when the SLR relief became effective for BHCs—instead of June 1, 2020; see Tables 9 and 10. Results are similar. Second, instead of using the distance of the bank's SLR from the requirement in 2019Q4, we replicate regression (2) using the bank's SLR buffer lagged by one quarter, to capture time variation in the tightness of bank balance-sheet constraints; see Table 11. Results are similar. Finally, for robustness, we also replicate Tables 3 and 4 using fund AUM as dependent variable instead of fund flows; that is, we run our analysis in levels rather than changes. Results are similar; see Tables 12 and 13.

5 Banks' Balance-sheet Costs and MMF Portfolios

5.1 The effect of balance-sheet costs

In this section, we identify a different channel through which banks' balance-sheet costs operate: namely, by reducing banks' incentive to borrow, increased balance-sheet costs also limit MMFs' investment options, pushing them to invest more at the ON RRP. In other words, when banks' balance-sheet constraints tighten—as it happened after the end of the SLR relief—banks' supply of private short-term debt available for purchase shifts leftward; this supply shift is particularly strong in the private repo market because the SLR is not risk-weighted, and as a result it penalizes the use of banks' balance-sheet for low-margin investment, such as repo intermediation (Duffie, 2018).

MMFs can absorb a negative shock to banks' supply of private short-term debt by substituting these assets with ON RRP investment. Consistent with this hypothesis, Figure 1 in the introduction shows that MMF private repo holdings decreased steadily after March 2021, whereas their ON RRP investment—the closest substitute to private repo—increased steeply.[23]

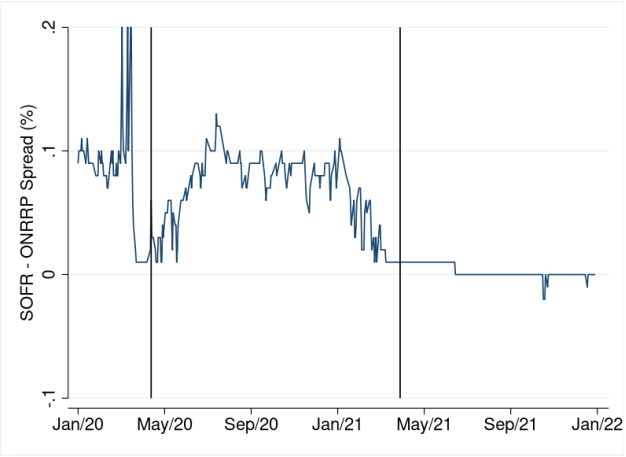
The shift from private to public repos shown in Figure 1, however, could be the result of a negative demand shock (e.g., bank debt may have become riskier, leading MMFs to demand less), rather than a supply shock. Figure 5 strongly suggests that this is not the case. Panel (a) of Figure 5 shows the spread between the Secured Overnight Financing Rate (SOFR)—a broad measure of the interest rate on overnight Treasury-backed private repos—and the ON RRP rate; consistent with the introduction of the SLR relief being a shock to banks' repo supply, the SOFR-ON RRP spread increases sharply right after the introduction of the relief and decreases when the relief ends.

Further evidence that MMFs' shift from private to public repos shown in Figure 1 is due to a tightening of banks' balance-sheet constraints—a negative shock to banks' supply of debt—comes from the sponsored repo market. Sponsored repos are repo transactions in

[23]Since the 2014 SEC reform of the MMF industry, which shrank prime funds and expanded government funds by more than $1 trillion dollars, repos have become the most important form of private debt available for investment to MMFs (Cipriani and La Spada, 2021).

which a dealer sponsors non-dealer counterparties, such as MMFs (cash lenders) and hedge funds (cash borrowers), on the cleared repo platform operated by the Fixed Income Clearing Corporation (FICC). For a dealer affiliated with a bank holding company, the benefit of sponsored repos, versus other types of repo borrowing from MMFs, is that sponsored repos can be netted, reducing their balance-sheet costs. Panel (b) of Figure 5 shows that while total private repos held by MMFs declined sharply after the end of the SLR relief—by roughly $300 billion from March to December 2021—the amount of sponsored repos in MMF portfolios remained roughly stable.[24] This is further evidence consistent with tighter balance sheet constraints being the shock that led MMF to reallocate their repo investments.

(a) SOFR - ON RRP Spread



(b) Private Repos and Sponsored Repos held by MMFs

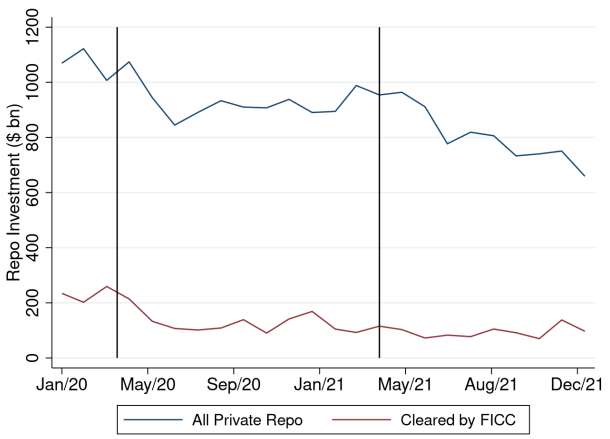


Figure 5: **Repo Spreads and MMF Investment in Sponsored Repos.** Panel (a) shows the spread between the Secured Overnight Financing Rate (SOFR)—a broad measure of the interest rate on overnight Treasury-backed private repos—and the ON RRP rate, from January 2020 to December 2021. Rates are in percentage points; data are from FRED. Panel (b) shows the total amount of private repos held by MMFs (blue line) and the amount of private repos held by MMFs that are cleared by the Fixed Income Clearing Corporation (FICC) in its sponsored repo platform (red line). MMF holdings are in billions of dollars; data are from the from the Office of Financial Research (OFR) US Money Market Fund Monitor. The vertical lines represent the start-date and end-date of the SLR relief for BHCs: April 14, 2020, and March 31, 2021.

To casually identify the effect of banks' balance-sheet costs on MMFs' ON RRP investment, we exploit the fact that some funds have more limited portfolio options and therefore

[24]By August 2022, total private repos held by MMFs declined by $408 billion, whereas the amount of sponsored repos in MMF portfolios stayed around $116 billion. See Figure 7 in Appendix B.

should be more affected by a decrease in the supply in bank debt due to the increase in balance-sheet costs. Government MMFs, in particular, can only lend to the private sector via repos backed by government debt, which are typically issued by dealers affiliated with large bank holding companies; prime funds, in contrast, can also lend to non-financial corporations and local governments through unsecured debt. For this reason, variation in banks' balance-sheet costs should have a stronger impact on the ON RRP investment of government MMFs.

Figure 6 shows the share of funds' portfolios invested in the ON RRP for government and prime MMFs, from January 2020 to December 2021. For both MMF types, ON RRP investment was practically zero up to the end of the SLR relief in March 2021. Since then, both fund types have increased their ON RRP investment as a share of their portfolios, but the effect was significantly stronger for government MMFs, with an increase by 36 percentage points between the first quarter of 2021 and the last quarter of 2021, versus only 20 percentage points for prime MMFs.[25]

To test our hypothesis, we run the following panel regression at the fund level and daily frequency, on the sample of MMFs eligible to invest in the ON RRP:

$$\begin{aligned}\%\text{ONRRP}_{it} =& \beta_1 \,\text{Post SLR Relief}_t \times \text{Gov}_i + \beta_2 \,2021\text{Q1}_t \times \text{Gov}_i + \Gamma X_{i,t-1} \\ &+ \alpha_i + \mu_t + \sum_{m \in \{\text{Month ends}\}} \delta_m \text{Month End}_t^{(m)} \times \text{Gov}_i + \varepsilon_{it}, \end{aligned} \tag{3}$$

where $\%\text{ONRRP}_{it}$ is the percentage of MMF i's portfolio invested in the ON RRP on day t, Post SLR Relief_t is a dummy for the period after the SLR relief expired (March 31, 2021), 2021Q1_t is a time dummy for the first quarter of 2021 (to allow for anticipatory effects), and Gov_i is a dummy for government funds. $\Gamma X_{i,t-1}$ is the same set of lagged fund-level controls as in regression (1), and α_i and μ_t are fund and time fixed effects. We also include the interaction of the government fund dummy with a dummy for one-day windows around

[25] Prime MMFs' investment in the ON RRP spikes at month ends because European banks, whose overnight debt represents a sizable share of prime-MMF portfolios but a small share of government-MMF portfolios, reduce their wholesale short-term borrowing around those dates. They do so because, in Europe, the Basel III leverage ratio is calculated using only month-end data, which gives European banks an incentive to temporarily "window-dress" their balance-sheets. Note that European banks are not subject to the US implementation of the SLR and therefore were not exposed to the effects of the SLR relief.

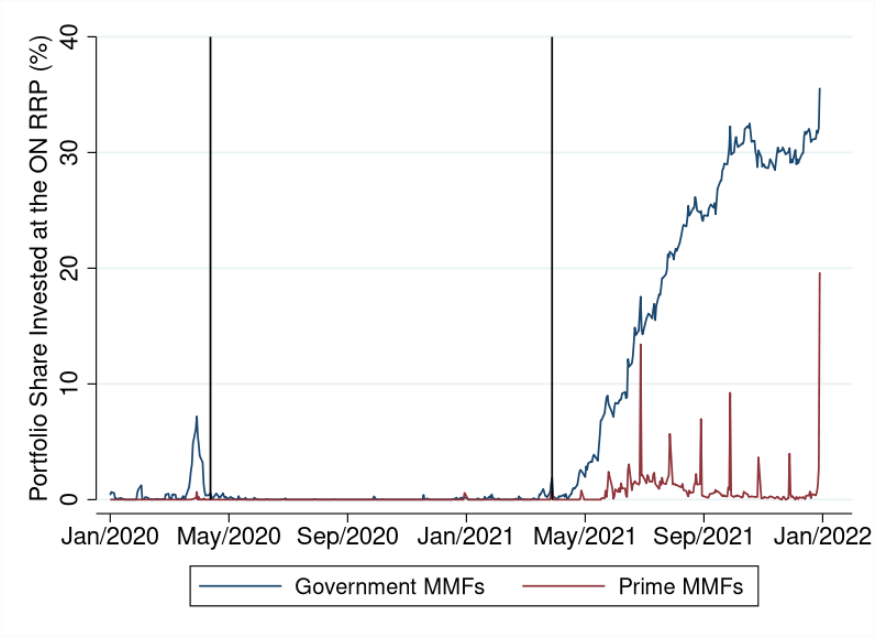


Figure 6: **Share of Portfolio Invested at the ON RRP by Government (blue line) and Prime MMFs (red line) from January 2020 to December 2021.** Portfolio shares are in percentage points. The vertical lines represent the start-date and end-date of the SLR relief for BHCs: April 14, 2020, and March 31, 2021.

month-ends (Month End$_t^{(m)} = \mathbb{1}\ (t \in \{m-1, m, m+1\})$ for each month-end m), to allow for the differential effect of European banks' window-dressing on the ON RRP investment of prime and government MMFs; we include a different dummy for each month-end in the sample to allow this effect to vary over time. The regression is estimated from April 14, 2020, when the SLR relief was established for BHCs, to December 2021. Results are in Table 5; standard errors are robust to heteroskedasticity, serial correlation, and cross-correlation.

Column (1) shows that, after the expiration of the SLR relief, the share of MMFs' portfolios invested at the ON RRP increased significantly more in government MMFs than in prime MMFs, by 19 percentage points (p-value < 0.001). As Figure 6 shows, our results are not driven by a violation of the parallel trend assumption: before the end of the SLR relief, there was no differential time trend in the portfolio share invested at the ON RRP by government and prime MMFs; we run a formal test in Column (2) of Table 5.[26]

[26]In Column (2) of Table 5, we regress %ONRRP$_{it}$ against the interaction of a linear time trend (in days) and the government-MMF dummy, together with the same set of controls and fixed effects as in regression (3),

Another possible concern is that, right after the end of the SLR relief, some factor other than a shift in the supply of bank debt may have affected the ON RRP investment of government MMFs more than that of prime MMFs. To strengthen our identification, we restrict our analysis to government MMFs and use the average share of a fund's portfolio invested in private repos during 2019Q4 as our treatment variable.[27] This treatment variable aims to represent a fund's reliance on private repos as an investment option; we expect funds that rely more heavily on private repos to be more exposed to the negative supply shock at the end of the SLR relief. Results are in Column (3) of Table 5 and are consistent with those of our baseline specification: after the expiration of SLR relief, a ten-percentage-point increase in the pre-sample share of private repos in a government-MMF portfolio increases the fund's ON RRP portfolio share by 2.4 percentage points (p-value < 0.001).

For robustness, in Appendix B, we replicate the regressions in Table 5 starting the sample on June 1, 2020—the day the SLR relief became effective for depository institutions. Results are similar; see Table 14.

5.2 Other Determinants of ON RRP Investments

In this section, we identify two additional drivers of MMFs' investment at the ON RRP: interest rate uncertainty and the supply to T-bills; when we control for these drivers, the effect of banks' balance-sheet costs on the share of ON RRP investment in MMF portfolios remains significant.

5.2.1 Interest rate risk

When interest-rate risk increases, MMFs—similarly to other fixed-income mutual funds—have an incentive to shorten the duration of their portfolios (La Spada, 2018; Afonso et al., 2021); since ON RRP investment is overnight, higher interest-rate uncertainty leads MMFs to increase their portfolio share in the ON RRP. The effect is stronger for government MMFs

from April 14 to December 31, 2020. The coefficient on Linear Trend$_t$ $\times$ Gov$_i$ is both economically and statistically insignificant, indicating that the parallel trend assumption hols in our data.

[27] We measure the share of a fund's portfolio invested in repos during 2019Q4 to control for endogeneity issues; also, ON RRP take-up was practically zero in that time period, and most repos held by MMFs were private repos.

because they have a more limited set of options to manage interest-rate risk than prime MMFs; the latter, in fact, can invest in a broader set of financial instruments—including privately-issued floating-rate notes—to protect their portfolios against interest-rate risk.

To identify the effect of interest-rate uncertainty on government MMFs' investment in the ON RRP, we run the following fund-level panel regression at the daily frequency:

$$\begin{aligned}\%\text{ONRRP}_{it} =& \beta\, \text{MOVE}_{t-1} \times \text{Gov}_i + \Gamma X_{i,t-1} + \alpha_i + \mu_t \\ &+ \sum_{m \in \{\text{Month ends}\}} \delta_m \text{Month End}_t^{(m)} \times \text{Gov}_i + \varepsilon_{it}, \end{aligned} \tag{4}$$

where MOVE_{t-1} is the MOVE index, a measure of interest-rate risk based on option-implied bond volatility, lagged by one day to control for possible endogeneity. All the other variables are defined as in regression (3).

The results of regression (4) are in Table 6; standard errors are robust to heteroskedasticity, serial correlation, and cross-correlation. In Column (1), we show the results of regression (4) estimated on 4/14/2020-12/31/2021, the same period as in our analysis of the effect of balance-sheet costs. A 10-point increase in the MOVE leads government MMFs to increase their portfolio share of ON RRP investment by 5 percentage points more than prime MMFs (p-value < 0.001).

To capture more variation in interest-rate risk, we also estimate regression (4) on a longer sample, starting in January 2016.[28] In this specification, we add two interaction terms: the interaction of the government-MMF dummy with a time dummy for January 2016-October 2016, when more than $1 trillion dollars flowed from prime to government MMFs in response to the 2014 SEC reform of the industry, and the interaction of the government-MMF dummy with a time dummy for the March 2020 run on prime MMFs, which caused a flight-to-safety of hundreds of billions of dollars into government MMFs. We control for these episodes because the sudden and large inflows experienced by government MMFs may have affected their incentive to invest in the ON RRP.

Results for the longer sample are in Column (4) of Table 6 and are similar to our baseline

[28] We expand the sample to right after the Federal Reserve removed the aggregate cap on ON RRP investment; see Section 2. We do not go back further in time because, before January 2016, MMFs were constrained in their ON RRP decision by the cap.

results: a 10-point increase in the MOVE leads government MMFs to increase their portfolio share of ON RRP investment by 0.9 percentage points more than prime MMFs (p-value $<$ 0.001). Given that the MOVE standard deviation during January 2016-December 2021 was 14 points, interest-rate uncertainty is a significant driver of MMF investment into the ON RRP. Moreover, since the effect is stronger for government funds, changes in interest-rate uncertainty around the SLR relief may bias our results.

5.2.2 T-bill Supply

A second driver of MMF investment at the ON RRP that could confound our identification strategy is the supply of T-bills. The availability of T-bills limits MMFs' investment options, which are restricted by SEC regulation to invest in securities with remaining maturity within 397 days; this effect is stronger for government MMFs, which may be pushed toward ON RRP investment when the availability of T-bills dwindles, because these funds have more limited investment options.

To identify the effect of T-bill supply on MMFs' investment at the ON RRP, we run the following daily, panel regression on ON RRP-eligible MMFs:

$$\begin{aligned}\%\text{ONRRP}_{it} =& \beta\, \text{T-bill Supply}_{t-30} \times \text{Gov}_i + \Gamma X_{i,t-1} + \alpha_i + \mu_t \\ &+ \sum_{m \in \{\text{Month ends}\}} \delta_m \text{Month End}_t^{(m)} \times \text{Gov}_i + \varepsilon_{it}, \end{aligned} \tag{5}$$

where T-bill Supply_{t-30} is either the total T-bill issuance in the calendar month before the month of day t in trillions of dollars (Columns (2) and (5) in Table 6) or the total value of T-bills outstanding relative to the average MMFs' AUM in percentages (Columns (3) and (6)); these measures of T-bill supply are only available monthly, and we lag them to control for endogeneity issues. All other variables are defined as in regression (3). Results of regression (5) are in Table 6; Columns (2) and (3) are for our baseline period (4/14/2020-12/31/2021), whereas Columns (5) and (6) are for the same extended period (1/1/2016-12/31/2021) that we used for the analysis of interest-rate risk. Standard errors are corrected for serial correlation, cross-correlation, and heteroskedasticity.

As Column (2) of Table 6 shows, during April 2020-December 2021, a monthly decrease

of T-bill issuance by $100 billion increases the portfolio share of ON RRP investment significantly more in government MMFs than in prime MMFs, by roughly 1 percentage point (p-value < 0.001). Similarly, Column (3) shows that a decline of 10 percentage points in the ratio of T-bills outstanding to the total AUM of MMFs leads government funds to increase their portfolio share at the ON RRP by additional 2.9 percentage points relative to prime funds (p-value < 0.001). Given that the standard deviations of these measures of T-bill supply in our sample were $321 billion and 15 percentage points, these effects are economically important. Columns (5) and (6) show that results are similar for the extended sample period, starting in January 2016.

5.3 Putting It All Together

In this section, we identify the effect of banks' balance-sheet costs on MMFs' investment at the ON RRP, after controlling for the effect of interest-rate uncertainty and T-bill supply. Namely, we re-estimate regression (3) adding the interactions of the government-MMF dummy with T-bill supply (measured as T-bill issuance in Column (1) and as T-bill outstanding over total MMF AUM in Column (2)) and with interest-rate risk (measured by the MOVE index). Results are in Table 7.

The impact of balance-sheet costs on MMFs' portfolio choice to invest in the ON RRP remains significant and large: after the end of the SLR relief, government MMFs increased their portfolio share of ON RRP investment by 14 percentage points more than prime MMFs (p-value < 0.001). Interest-rate uncertainty and T-bill supply also affect government MMFs' portfolios in a way that is consistent with the results of the previous section: a ten-point increase in the MOVE leads government MMFs to increase their portfolio share at the ON RRP by 2.4 percentage points more than prime MMFs (p-value < 0.001); similarly, a $100-billion dollar decline in last month's T-bill issuance leads to a relative increase of 0.4 percentage points (p-value $= 0.001$).

In other words, although both interest-rate risk and T-bill supply are important determinants of the share of MMFs' portfolio invested at the ON RRP, accounting for these channels does not make the effect of banks' balance-sheet costs disappear. The increase of banks' balance-sheet costs due to the end of the SLR relief does explain government MMFs'

decision to tilt their portfolios towards the ON RRP relatively more than prime MMFs after March 2021.

We also quantify the effect of banks' balance-sheet costs—as well as the effects of T-bill supply and interest-rate risk—on the dollar investment of MMFs at the ON RRP. In terms of dollar value, an increase in banks' balance-sheet costs affects MMFs investment at the ON RRP in two ways: it increases both the size of the MMF industry (Section 4) and the ON RRP share in the industry portfolio. To capture both the size and portfolio channels, we run a regression that merges regressions (1) and (3), while also controlling for the effects of interest-rate uncertainty and T-bill supply from regressions (4) and (5).

Namely, we run the following daily regression on the panel of MMFs that are eligible to invest at the ON RRP, from April 14, 2020 to December 31, 2021:

$$\begin{aligned}\$\text{ONRRP}_{it} = {} & \beta_1 \,\text{Post SLR Relief}_t \times \text{SLR-Bank MMF}_i + \gamma_1 \,2021\text{Q1}_t \times \text{SLR-Bank MMF}_i \\ & + \beta_2 \,\text{Post SLR Relief}_t \times \text{Gov}_i + \gamma_2 \,2021\text{Q1}_t \times \text{Gov}_i \\ & + \beta_3 \,\text{MOVE}_{t-1} \times \text{Gov}_i + \beta_4 \,\text{T-bill Supply}_{t-30} \times \text{Gov}_i \\ & + \Gamma X_{i,t-1} + \alpha_i + \mu_t + \sum_{m \in \{\text{Month ends}\}} \delta_m \text{Month End}_t^{(m)} \times \text{Gov}_i + \varepsilon_{it}, \end{aligned} \tag{6}$$

where all variables are defined as in regressions (1)-(5). Results are in Table 8; standard errors are robust to heteroskedasticity, serial correlation, and cross-correlation.

Column (1) of Table 8 shows that after the end of the SLR relief, MMFs affiliated with banks subject to the SLR—whose AUM increased on average by $3.5 billion per fund between January and June 2021—increased their daily ON RRP investment by $1.3 billion per fund relative to other MMFs (p-value < 0.001). Similarly, after the end of the SLR relief, government MMFs—whose portfolio was more impacted by banks' reduction in repo borrowing than that of prime MMFs—increased their daily ON RRP investment by $9.6 billion per fund relative to prime MMFs (p-value < 0.001).

Interest-rate uncertainty and T-bill supply continue to have an important effect on the dollar-value of ON RRP take-up in 2020-2021. Between April 2020-March 2021 and April-December 2021, the MOVE increased by 12 points, leading to an additional daily ON RRP investment of $2.2 billion for the average government MMF, relative to the average prime

MMF (p-value < 0.001). Similarly, T-bill issuance decreased by \$300 billion during the same period, leading to an additional daily investment by the average government MMF of \$690 million (p-value $= 0.006$). In Column (2), we replicate the regression in Column (1) measuring T-bill supply as the ratio between T-bills outstanding and MMFs' total AUM in the previous month; results are qualitatively and quantitatively similar.

In Columns (3) and (4) of Table 8, we replicate Columns (1) and (2) adding the interactions Post SLR Relief$_t$ $\times$ SLR-Bank MMF$_i$ $\times$ (SLR $-$ SLR Req)$_{i2019Q4}$ and 2021Q1$_t$ $\times$ SLR-Bank MMF$_i$ $\times$ (SLR $-$ SLR Req)$_{i2019Q4}$. Results are similar. In particular, after the end of the SLR relief, MMFs affiliated with SLR banks whose 2019Q4 SLR was exactly equal to the minimum requirement increased their daily ON RRP investment by an additional \$4.1 billion per fund, compared to unaffiliated funds (p-value < 0.001). Relative to this effect, a one-percentage point increase in the bank's 2019Q4 SLR buffer leads to a decline of \$1.1 billion in the fund's ON RRP investment post SLR relief (p-value < 0.001). The effects of all other channels are practically unchanged.

For robustness, in Appendix B, we replicate Tables 7 and 8 starting the sample from June 1, 2020, when the SLR relief became effective for DIs. Results are similar; see Tables 15 and 16.

6 Conclusions

This paper shows that banks' balance-sheet costs—introduced by the post Global Financial Crisis bank regulations—have an important impact on non-bank financial institutions. We do that by looking at MMF investment at the Federal Reserve's ON RRP facility—a facility through which MMFs can place cash with the Federal Reserve at a fixed rate. In the US, MMFs are an important type of non-bank financial intermediaries that are both the closest substitute to bank deposits for corporations and households and the largest providers of wholesale overnight liquidity to the banking system and money markets at large.

In order to identify the impact of balance-sheet costs, we use a quasi-natural experiment: the variation in banks' balance-sheet costs caused by the SLR relief of 2020-2021, which temporarily excluded Treasuries and reserves from the calculation of banks' SLRs. Around the

end of the relief in March 2021, MMFs affiliated with banks subject to the SLR experienced significantly larger inflows, as these banks had an incentive to shed depositors and push them into their affiliated funds. Moreover, MMFs with more limited investment options—such as government MMFs—shifted their portfolios towards the ON RRP more, as banks reduced their repo borrowing to shrink the size of their balance sheets.

Our findings imply that central-bank balance-sheet policy—through its interaction with bank regulation—impacts financial markets beyond the direct effect on the banking system. In an environment where banks face balance-sheet costs and non-bank financial institutions have access to the central bank balance sheet, non-banks may end up holding a fraction of the central bank's liabilities, therefore limiting the impact of central bank balance-sheet expansions. In contrast, if only banks access to the central-bank balance sheet, their balance-sheet space is more limited, as banks must hold all the liquidity injected by the central bank; central-bank balance-sheet expansions are thus likely to increase non-bank financial intermediation, which may pose risks to financial stability.

			Flow$_{it}$		
	(1) MMF	(2) MMF	(3) MMF	(4) Gov MMF	(5) Gov MMF
2021Q1$_t$ × SLR-Bank MMF$_i$	0.034**	0.037**		0.044**	0.048*
	(2.201)	(2.026)		(2.068)	(1.874)
2021Q2$_t$ × SLR-Bank MMF$_i$	0.022	0.022		0.030	0.026
	(1.145)	(1.046)		(1.162)	(0.928)
2021Q1$_t$ × Bank MMF$_i$		-0.004			-0.005
		(-0.624)			(-0.494)
2021Q2$_t$ × Bank MMF$_i$		0.000			0.005
		(0.027)			(0.526)
Linear Trend$_t$ × SLR-Bank MMF$_i$			0.000		
			(1.616)		
Fund FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
R^2	0.02	0.02	0.04	0.03	0.03
Sample Period	6/20-12/21	6/20-12/21	6/20-12/20	6/20-12/21	6/20-12/21
Observations	78237	78237	30255	57895	57895

Table 3: **Banks' Balance-Sheet Costs and MMF Size.** Panel regressions at the fund-day level. In Columns (1)–(3), the sample includes all MMFs; in Columns (4) and (5), the sample is restricted to government MMFs. In Columns (1)–(2) and (4)–(5), the time period is June 1, 2020 (when the SLR relief was established for DIs)-December 31, 2021; in Column (3), the time period is June 1, 2020–December 31, 2020 ("pre period"). Flow$_{it}$ is the fund's daily net flow in billions of dollars. 2021Q1$_t$ and 2021Q2$_t$ are two time dummies for the quarters immediately before and immediately after the end of the SLR relief (March 31, 2021). SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR. Bank MMF$_i$ is a fund dummy for MMFs affiliated to any bank. Linear Trend is a linear time trend in days. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	Flow$_{it}$			
	(1) MMF	(2) Gov MMF	(3) MMF	(4) Gov MMF
2021Q1$_t$ × Non-Custodial SLR-Bank MMF$_i$	0.050**	0.065**		
	(2.461)	(2.226)		
2021Q2$_t$ × Non-Custodial SLR-Bank MMF$_i$	0.030	0.040		
	(1.180)	(1.122)		
2021Q1$_t$ × Custodial SLR-Bank MMF$_i$	0.009	0.014		
	(0.485)	(0.595)		
2021Q2$_t$ × Custodial SLR-Bank MMF$_i$	0.008	0.015		
	(0.378)	(0.546)		
2021Q1$_t$ × (SLR - SLR Req)$_{i2019Q4}$			-0.005**	-0.005**
			(-2.252)	(-2.054)
2021Q2$_t$ × (SLR - SLR Req)$_{i2019Q4}$			-0.002	-0.002
			(-0.855)	(-0.624)
Fund FE	Y	Y	Y	Y
Date FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
R^2	0.02	0.03	0.05	0.06
Sample Period	6/20-12/21	6/20-12/21	6/20-12/21	6/20-12/21
Observations	78237	57895	25110	18361

Table 4: **Banks' Balance-Sheet Costs and MMF Size: Identification through Custodial Banks and Banks' SLR Buffers.** Panel regression at the fund-day level. In Columns (1) and (2), the sample includes all MMFs; in Columns (3) and (4), the sample is restricted to MMFs affiliated with banks subject to the SLR. The sample period is from June 1, 2020 (when the SLR relief was established for DIs) to December 31, 2021. Flow$_{it}$ is the fund's daily net flow in billions of dollars. 2021Q1$_t$ and 2021Q2$_t$ are two time dummies for the quarters immediately before and immediately after the end of the SLR relief (March 31, 2021). Non-custodial SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR that are not custodial banks. Custodial SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated to custodial banks subject to the SLR. (SLR-SLR Req)$_{i2019Q4}$ is the difference between the SLR of the bank to which MMF i is affiliated and its minimum SLR requirement in the last quarter of 2019. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	%ONRRP$_{it}$		
	(1)	(2)	(3)
	MMF	MMF	Gov MMF
Post SLR Relief$_t$ × Gov$_i$	19.422***		
	(11.807)		
2021Q1$_t$ × Gov$_i$	0.381		
	(1.530)		
Linear Trend$_t$ × Gov$_i$		-0.000	
		(-0.728)	
Post SLR Relief$_t$ × Private Repo Share$_{i2019Q4}$			0.237***
			(10.382)
2021Q1$_t$ × Private Repo Share$_{i2019Q4}$			0.006
			(1.554)
Fund FE	Y	Y	Y
Date FE	Y	Y	Y
Controls	Y	Y	Y
$\sum_{m\in\{\text{Month ends}\}}$ Month End$_t^{(m)}$ × Gov$_i$	Y	Y	N
$\sum_{m\in\{\text{Month ends}\}}$ Month End$_t^{(m)}$ × Private Repo Share$_{i2019Q4}$	N	N	Y
R^2	0.75	0.17	0.81
Sample Period	4/20-12/21	4/20-12/20	4/20-12/21
Observations	33593	14412	24280

Table 5: **Banks' Balance-Sheet Costs and the Share of MMF Portfolio Invested at the ON RRP.** Panel regressions at the fund-day level. In Columns (1) and (2), the sample includes all MMFs eligible to invest in the ON RRP; in Column (3), the sample is restricted to government MMFs. In Columns (1) and (3), the time period is from April 14, 2020 (when the SLR relief was established for BHCs) to December 31, 2021; in Column (2), the time period is from April 14, 2020 to December 2020 ("pre period"). %ONRRP$_{it}$ is the percentage of a fund's AUM invested at the ON RRP. Post SLR Relief$_t$ is a time dummy for the period after the end of the SLR relief (March 31, 2021); 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the relief. Gov$_i$ is a fund dummy for government MMFs; Private Repo Share$_{i,2019Q4}$ is the percentage of private repo investment in the fund portfolio in 2019Q4. Linear Trend is a linear time trend in days. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. Columns (1) and (2) also include the interactions of month-end dummies (one for each month) with the government-MMF dummy; Column (3) includes the interactions of month-end dummies (one for each month) with the the percentage of private repo investment in the fund portfolio in 2019Q4. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	%ONRRP$_{it}$					
	(1) MMF	(2) MMF	(3) MMF	(4) MMF	(5) MMF	(6) MMF
MOVE$_{t-1}$ × Gov$_i$	0.505***			0.089***		
	(9.347)			(4.427)		
T-bill Issuance$_{t-30}$ × Gov$_i$		-10.262***			-0.195	
		(-6.055)			(-0.265)	
$\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ × Gov$_i$			-29.284***			-1.804**
			(-7.088)			(-1.975)
Fund FE	Y	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y
$\sum_{m\in\{\text{Month ends}\}}$ Month End$_t^{(m)}$ × Gov$_i$	Y	Y	Y	Y	Y	Y
2014Reform$_t$ × Gov$_i$	N	N	N	Y	Y	Y
2020Run$_t$ × Gov$_i$	N	N	N	Y	Y	Y
R^2	0.71	0.69	0.70	0.52	0.51	0.51
Sample Period	4/20-12/21	4/20-12/21	4/20-12/21	1/16-12/21	1/16-12/21	1/16-12/21
Observations	33593	33593	33593	121573	123449	123449

Table 6: **Interest Rate Risk, T-bill Supply, and the Share of MMF Portfolio Invested at the ON RRP.** Panel regressions at the fund-day level. The sample includes all MMFs eligible to invest in the ON RRP. In Columns (1)–(3), the time period is from April 14, 2020 (when the SLR relief was established for BHCs) to December 31, 2021. In Columns (4)–(6), the time period is from January 1, 2016 (right after the Federal Reserve removed the aggregate cap on ON RRP investment) to December 31, 2021. %ONRRP$_{it}$ is the percentage of fund AUM invested at the ON RRP. Gov$_i$ is a fund dummy for government MMFs. MOVE$_{t-1}$ is the MOVE index, lagged by one day. 2014Reform$_t$ is a time dummy for January 2016-October 2016 to capture the industry dislocation in response to the 2014 SEC reform; 2020 Run$_t$ is a time dummy for the March 2020 run on prime MMFs. T-bill Issuance$_{t-30}$ is the total T-bill issuance in the calendar month before the month of day t in trillion dollars. $\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ is the share of T-bills outstanding relative to the average total AUM for the previous calendar month. All regressions include MMF and day fixed effects, the fund's lagged net yield and net flows as controls, and the interactions of month-end dummies (one for each month) with the government-MMF dummy. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	$\%\text{ONRRP}_{it}$	
	(1)	(2)
	MMF	MMF
Post SLR Relief$_t$ × Gov$_i$	14.326***	13.558***
	(7.283)	(6.734)
2021Q1$_t$ × Gov$_i$	-2.256**	-0.017
	(-2.305)	(-0.021)
MOVE$_{t-1}$ × Gov$_i$	0.238***	0.246***
	(4.858)	(5.608)
T-bill Issuance$_{t-30}$ × Gov$_i$	-4.101***	
	(-3.452)	
$\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ × Gov$_i$		-15.893***
		(-5.378)
Fund FE	Y	Y
Date FE	Y	Y
Controls	Y	Y
$\sum_{m\in\{\text{Month ends}\}} \text{Month End}_t^{(m)} \times \text{Gov}_i$	Y	Y
R^2	0.76	0.76
Sample Period	4/20-12/21	4/20-12/21
Observations	33593	33593

Table 7: **Banks' Balance-Sheet Costs and the Share of MMF Portfolio Invested at the ON RRP: Controlling for the Effect of Interest Rate Risk and T-bill Supply.** Panel regressions at the fund-day level. The sample includes all MMFs eligible to invest in the ON RRP. The sample period is from April 14, 2020 (when the SLR relief was established for BHCs) to December 31, 2021. $\%\text{ONRRP}_{it}$ is the percentage of fund AUM invested at the ON RRP. Post SLR Relief$_t$ is a time dummy for the period after the end of the SLR relief (March 31, 2021); 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the relief. Gov$_i$ is a fund dummy for government MMFs. T-bill Issuance$_{t-30}$ is the total T-bill issuance in the calendar month before the month of day t in trillions of dollars. $\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ is the share of T-bills outstanding relative to the average total AUM of MMFs in the previous calendar month. All regressions include MMF and day fixed effects, the fund's lagged net yield and net flows as controls, and the interactions of month-end dummies (one for each month) with the government-MMF dummy. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	$\$\text{ONRRP}_{it}$			
	(1) MMF	(2) MMF	(3) MMF	(4) MMF
Post SLR Relief$_t$ × SLR-Bank MMF$_i$	1.285***	1.224***	4.121***	3.974***
	(6.690)	(6.391)	(11.562)	(10.871)
2021Q1$_t$ × SLR-Bank MMF$_i$	0.006	-0.075***	0.043	-0.127**
	(0.278)	(-2.924)	(0.944)	(-2.444)
Post SLR Relief$_t$ × SLR-Bank MMF$_i$ × (SLR - SLR Req)$_{i2019Q4}$			-1.153***	-1.116***
			(-14.148)	(-13.240)
2021Q1$_t$ × SLR-Bank MMF$_i$ × (SLR - SLR Req)$_{i2019Q4}$			-0.013	0.025*
			(-0.978)	(1.942)
Post SLR Relief$_t$ × Gov$_i$	9.591***	9.254***	10.053***	9.762***
	(7.864)	(7.293)	(8.103)	(7.542)
2021Q1$_t$ × Gov$_i$	-1.325*	-0.130	-1.177*	-0.012
	(-1.939)	(-0.224)	(-1.727)	(-0.021)
MOVE$_{t-1}$ × Gov$_i$	0.181***	0.184***	0.178***	0.180***
	(5.380)	(6.038)	(5.206)	(5.826)
T-bill Issuance$_{t-30}$ × Gov$_i$	-2.288***		-2.328***	
	(-2.780)		(-2.734)	
$\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ × Gov$_i$		-8.272***		-7.981***
		(-4.146)		(-3.955)
Fund FE	Y	Y	Y	Y
Date FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
$\sum_{m\in\{\text{Month ends}\}} \text{Month End}_t^{(m)} \times \text{Gov}_i$	Y	Y	Y	Y
R^2	0.52	0.52	0.53	0.53
Sample Period	4/20-12/21	4/20-12/21	4/20-12/21	4/20-12/21
Observations	33593	33593	33593	33593

Table 8: **Banks' Balance-Sheet Costs, Interest Rate Risk, T-bill Supply, and MMFs' Investment at the ON RRP.** Panel regressions at the fund-day level. The sample includes all MMFs eligible to invest in the ON RRP. The sample period is from April 14, 2020 (when the SLR relief was established for BHCs) to December 31, 2021. $\$\text{ONRRP}_{it}$ is the fund's dollar investment at the ON RRP in billions of dollars. Post SLR Relief$_t$ is a time dummy for the period after the end of the SLR relief (March 31, 2021); 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the relief. SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR. (SLR-SLR Req)$_{i2019Q4}$ is the difference between the SLR of the bank to which MMF i is affiliated and its minimum SLR requirement in the last quarter of 2019. Gov$_i$ is a fund dummy for government MMFs. MOVE$_{t-1}$ is the MOVE index, lagged by one day. T-bill Issuance$_{t-30}$ is the total T-bill issuance in the calendar month before the month of day t in trillions of dollars. $\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ is the share of T-bills outstanding relative to the average total AUM of MMFs in the previous calendar month. All regressions include MMF and day fixed effects, the fund's lagged net yield and net flows as controls, and the interactions of month-end dummies (one for each month) with the government-MMF dummy. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

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Appendix

A Banks' Balance-Sheet Costs and MMF Size

In this appendix, we present robustness checks of our results on the effect of banks' balance-sheet costs on MMF size (Section 4 of the paper). Table 9 replicates the results of Table 3, starting the sample on April 14, 2020, when the SLR relief became effective for bank holding companies (BHCs)—instead of starting on June 1, when it became effective for depository institutions (DIs). To make sure that our results are not contaminated by the MMF flows caused by the money-market turmoil of March 2020, we also include the interaction of a time dummy for April 2020 with the fund dummy for MMFs affiliated with SLR banks.

Results are very similar to those reported in the main text. In the quarter prior to the end of the SLR relief, net flows in MMFs affiliated with a bank subject to the SLR requirement increased significantly more than those in other MMFs, by $30 million per day when considering all MMF types (p-value = 0.045) and by $40 million per day when restricting the sample to government MMFs (p-value = 0.060). As in Table 3, the effect in the following quarter is positive and economically important but statistically insignificant, consistent with banks acting mostly ahead of the end of the relief. Also as in Table 3, we show that the parallel trend assumption is not violated. Finally, the coefficient on the interaction between the April-2020 dummy and the dummy for MMFs affiliated with SLR banks is positive and significant, showing that in the aftermath of the money-market stress of March 2020, those funds experienced significant inflows.

We also replicate the results of Table 4 in the main text, starting the sample on April 14, 2020; see Table 10. As in Table 9, we also include the interaction of the dummy for April 2020 with the dummy for MMFs affiliated with SLR banks, to make sure that our results are not contaminated by the MMF flows caused by the money-market turmoil of March 2020. Results are quantitatively and qualitatively similar to those in the main text: MMFs affiliated with non-custodial banks subject to the SLR experience significant inflows around the end of the SLR relief, whereas MMFs affiliated with custodial banks subject to the SLR do not. Similarly, MMFs affiliated with SLR banks with a lower SLR buffer in 2019Q4 experience larger inflows around the end of the relief.

Table 11 replicates the results of regression (2) of the main text (see Columns (3) and (4) of Table 4), using the three-month lagged difference between a bank's SLR and its regulatory requirement, ($\text{SLR}_{i,t-60} - \text{SLR Req}_{i,t-60}$), as the treatment variable. Similarly to the bank's 2019Q4 SLR buffer used in regression (2), this variables aims to measure the tightness of the bank's balance-sheet constraints and therefore the exposure of its affiliated MMFs to the bank's balance-sheet costs; in contrast to the 2029Q4 SLR buffer, however, this proxy can capture time variation in the tightness of bank's balance-sheet constraints. As in Table 4, the regression is run on the sample of MMFs affiliated to banks subject to the SLR. In Column (1), we include both prime and government MMFs; in Column (2), we restrict the sample to government MMFs.

Results in Table 11 are very similar to those in Columns (3) and (4) of Table 4. A 10-percentage-point reduction in a bank's SLR buffer leads to inflows into the affiliated MMFs of \$60 million per day in the quarter ahead of the end of the SLR relief (p-value = 0.019), for a total increase in AUM of \$3.6 billion over 2021Q1; the effect is even stronger when restricting the sample to government MMFs (\$70 million per day, with p-value = 0.042).

For robustness, we also replicate our analysis using fund AUM as dependent variable, instead of fund flows; that is, we run our analysis in levels rather than in changes. Namely, we estimate the following regression:

$$\text{AUM}_{it} = \beta_1 2021\text{Q1}_t \times \text{SLR-Bank MMF}_i + \beta_2 \text{Post SLR}_t \times \text{SLR-Bank MMF}_i + \Gamma X_{i,t-1} + \alpha_i + \mu_t + \varepsilon_{it},$$

where AUM_{it} is fund i's AUM in billions of dollars on day t and all other variables are defined as in the main text.

Results are in Table 12 and are consistent with those in the main text. After the SLR relief ended, the AUM of MMFs affiliated with SLR banks increased by \$3 billion per fund relative to those of unaffiliated MMFs (p-value < 0.001). When we restrict the sample to government MMFs, the effect is even stronger: \$3.7 billion (p-value < 0.001). As in our results for fund flows, there is no effect on MMFs affiliated with banks that are not subject to the SLR.

In Table 13, we replicate Table 4 using fund AUM as dependent variable. Results are similar to those in the main text. After the end of the relief, the AUM of MMFs affiliated with

non-custodial SLR banks increase by $3.2 billion per fund ($p$-value < 0.001) and significantly more than those of MMFs affiliated with custodial banks subject to the SLR (by $634 million with p-value < 0.001); the effect when restricting the sample to government MMFs is even stronger. Similarly, the size of MMFs affiliated with SLR banks that had a lower buffer in 2019Q4 (i.e., before the introduction of the SLR relief) increases by $192 million more ($p$-value < 0.001) after the end of the relief.

B Banks' Balance-sheet Costs and MMF Portfolios

In this appendix, we replicate our results on the effect of banks' balance-sheet costs on MMF portfolios, and especially their decision to invest at the ON RRP (Section 5 of the paper).

Figure 7 replicates Panel (b) of Figure 5 in the main text, extending the sample until August 31, 2022. This figure shows that total private repos held by MMFs declined by $408 billion from the end of the SLR relief to August 2022, whereas the amount of sponsored repos in MMF portfolios remained roughly constant, around $120 billion.

Table 14 replicates the results of Table 5 of the main text, starting the sample on June 1, 2020, when the SLR relief became effective at the DI level. Results are almost identical. After the end of the relief, government MMFs increased the share of their portfolios invested at the ONRRP by 19 percentage points more than prime MMFs (p-value $=< 0.001$); Column (2) shows that the parallel trend assumption between government and prime MMFs is not violated. This evidence is consistent with government MMFs being more exposed to the negative shock to bank supply of wholesale short-term debt caused by the surge in balance-sheet costs triggered by the end of the SLR relief. Similarly, within government MMFs, funds that invested more in private repos in 2019Q4 (i.e., they relief more on bank debt to manage their portfolios) increased their portfolio share at the ON RRP more after the end of the SLR relief.

Table 15 replicates Table 7 of the main text, starting the sample on June 1, 2020. Results are again very similar. Even after controlling for the effects of interest rate risk and T-bill supply, the end of the SLR relief led government MMFs to increase their portfolio share invested at the ON RRP more than prime MMFs, by 12 percentage points (p-value < 0.001). Also consistent with the results in the paper, higher interest rate risk (as measured by the

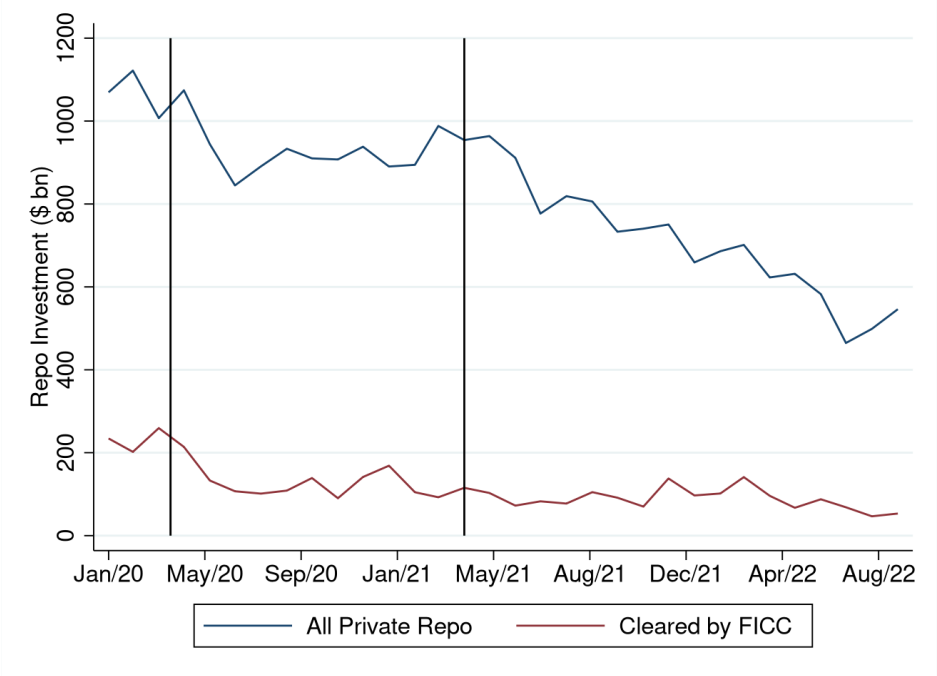

Figure 7: **Private Repos and Sponsored Repos held by MMFs.** This figure shows the total amount of private repos held by MMFs (blue line) and the amount of private repos held by MMFs that are cleared by the Fixed Income Clearing Corporation (FICC) in its sponsored repo platform (red line), from January 2020 to August 2022. MMF holdings are in billions of dollars; data are from the from the Office of Financial Research (OFR) US Money Market Fund Monitor. The vertical lines represent the start-date and end-date of the SLR relief at the BHC level: April 14, 2020, and March 31, 2021.

MOVE index) and lower T-bill supply lead government MMFs to increase their portfolio share at the ON RRP.

Finally, Table 16 replicates the results of Table 8 on MMFs' dollar investment at the ON RRP, starting the sample from June 1, 2020. Results are qualitatively and quantitatively similar to those in the main text.

	Flow$_{it}$				
	(1)	(2)	(3)	(4)	(5)
	MMF	MMF	MMF	Gov MMF	Gov MMF
2021Q1$_t$ × SLR-Bank MMF$_i$	0.030**	0.034*		0.040*	0.046*
	(2.007)	(1.894)		(1.888)	(1.817)
2021Q2$_t$ × SLR-Bank MMF$_i$	0.017	0.017		0.024	0.022
	(0.884)	(0.812)		(0.941)	(0.805)
2021Q1$_t$ × Bank MMF$_i$		-0.005			-0.007
		(-0.693)			(-0.784)
2021Q2$_t$ × Bank MMF$_i$		0.000			0.002
		(0.017)			(0.244)
Linear Trend$_t$ × SLR-Bank MMF$_i$			-0.000		
			(-0.207)		
Fund FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Apr 2020$_t$ × SLR-Bank MMF$_i$	Y	Y	Y	Y	Y
Apr 2020$_t$ × Bank MMF$_i$	N	Y	N	N	Y
R^2	0.02	0.02	0.03	0.03	0.03
Sample Period	4/20-12/21	4/20-12/21	4/20-12/20	4/20-12/21	4/20-12/21
Observations	85178	85178	37196	62870	62870

Table 9: **Banks' Balance-Sheet Costs and MMF Size.** Panel regressions at the fund-day level. In Columns (1)–(3), the sample includes all MMFs; in Columns (4) and (5), the sample is restricted to government MMFs. In Columns (1)–(2) and (4)–(5), the time period is April 14, 2020 (when the SLR relief was established for BHCs)-December 31, 2021; in Column (3), the time period is April 14, 2020–December 31, 2020 ("pre period"). Flow$_{it}$ is the fund's daily net flow in billions of dollars. 2021Q1$_t$ and 2021Q2$_t$ are two time dummies for the quarters immediately before and immediately after the end of the SLR relief (March 31, 2021). Apr 2020$_t$ is a time dummy for April 2020. SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR. Bank MMF$_i$ is a fund dummy for MMFs affiliated to any bank. Linear Trend is a linear time trend in days. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	Flow$_{it}$			
	(1) MMF	(2) Gov MMF	(3) MMF	(4) Gov MMF
2021Q1$_t$ × Non-Custodial SLR-Bank MMF$_i$	0.043**	0.058**		
	(2.176)	(2.024)		
2021Q2$_t$ × Non-Custodial SLR-Bank MMF$_i$	0.023	0.032		
	(0.912)	(0.923)		
2021Q1$_t$ × Custodial SLR-Bank MMF$_i$	0.009	0.012		
	(0.534)	(0.536)		
2021Q2$_t$ × Custodial SLR-Bank MMF$_i$	0.006	0.011		
	(0.299)	(0.414)		
2021Q1$_t$ × (SLR - SLR Req)$_{i2019Q4}$			-0.009*	-0.009
			(-1.935)	(-1.452)
2021Q2$_t$ × (SLR - SLR Req)$_{i2019Q4}$			-0.003	-0.003
			(-0.525)	(-0.322)
Fund FE	Y	Y	Y	Y
Date FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Apr 2020$_t$ × Non-Custodial SLR-Bank MMF$_i$	Y	Y	N	N
Apr 2020$_t$ × Custodial SLR-Bank MMF$_i$	Y	Y	N	N
Apr 2020$_t$ × (SLR - SLR Req)$_{i2019Q4}$	N	N	Y	Y
R^2	0.02	0.03	0.05	0.06
Sample Period	4/20-12/21	4/20-12/21	4/20-12/21	4/20-12/21
Observations	85178	62870	27354	19945

Table 10: **Banks' Balance-Sheet Costs and MMF Size: Identification through Custodial Banks and Banks' SLR Buffers.** Panel regressions at the fund-day level. In Columns (1) and (2), the sample includes all MMFs; in Columns (3) and (4), the sample is restricted to MMFs affiliated with banks subject to the SLR. The sample period is from April 14, 2020 (when the SLR relief was established for BHCs) to December 31, 2021. Flow$_{it}$ is the fund's daily net flow in billions of dollars. 2021Q1$_t$ and 2021Q2$_t$ are two time dummies for the quarters immediately before and immediately after the end of the SLR relief (March 31, 2021). Apr 2020$_t$ is a time dummy for April 2020. Non-custodial SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR that are not custodial banks. Custodial SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated to custodial banks subject to the SLR. (SLR-SLR Req)$_{i2019Q4}$ is the difference between the SLR of the bank to which MMF i is affiliated and its minimum SLR requirement in the last quarter of 2019. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	Flow_{it}	
	(1)	(2)
	MMF	Gov MMF
$2021Q1_t \times (\text{SLR - SLR Req})_{it-60}$	-0.006**	-0.007**
	(-2.353)	(-2.039)
$2021Q2_t \times (\text{SLR - SLR Req})_{it-60}$	-0.002	-0.002
	(-1.002)	(-0.668)
Fund FE	Y	Y
Date FE	Y	Y
Controls	Y	Y
R^2	0.05	0.06
Sample Period	6/20-12/21	6/20-12/21
Observations	24934	18229

Table 11: **Banks' Balance-Sheet Costs and MMF Size: Identification through Banks' Lagged SLR Buffers.** Panel regressions at the fund-day level. The sample period is from June 1, 2020 (when the SLR relief was established for DIs) to December 31, 2021. Flow_{it} is the fund's daily net flow in billions of dollars. $2021Q1_t$ and $2021Q2_t$ are two time dummies for the quarters immediately before and immediately after the end of the SLR relief (March 31, 2021). $(\text{SLR-SLR Req})_{it-60}$ is the difference between the SLR of the bank to which MMF i is affiliated and its minimum SLR requirement in the quarter before the quarter of day t. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	AUM_{it}				
	(1) MMF	(2) MMF	(3) MMF	(4) Gov MMF	(5) Gov MMF
Post SLR Relief$_t$ × SLR-Bank MMF$_i$	3.010***	2.657***		3.692***	4.071***
	(14.463)	(12.966)		(13.300)	(15.262)
2021Q1$_t$ × SLR-Bank MMF$_i$	0.267	0.044		0.261	0.351
	(1.397)	(0.225)		(0.976)	(1.286)
Post SLR Relief$_t$ × Bank MMF$_i$		0.393***			-0.431***
		(7.100)			(-8.749)
2021Q1$_t$ × Bank MMF$_i$		0.249***			-0.102**
		(6.523)			(-2.015)
Linear Trend$_t$ × SLR-Bank MMF$_i$			-0.020***		
			(-11.581)		
Fund FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
R^2	0.99	0.99	0.99	0.99	0.99
Sample Period	6/20-12/21	6/20-12/21	6/20-12/20	6/20-12/21	6/20-12/21
Observations	78237	78237	30255	57895	57895

Table 12: **Banks' Balance-Sheet Costs and MMF Size: Analysis of Fund AUM.** Panel regressions at the fund-day level. In Columns (1)–(3), the sample includes all MMFs; in Columns (4) and (5), the sample is restricted to government MMFs. In Columns (1)–(2) and (4)–(5), the time period is June 1, 2020 (when the SLR relief was established for DIs)-December 31, 2021; in Column (3), the time period is June 1, 2020–December 31, 2020 ("pre period"). AUM_{it} is the fund's daily AUM in billions of dollars. 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the SLR relief (March 31, 2021); Post SLR$_t$ is a time dummy for the period after the end of the relief. SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR. Bank MMF$_i$ is a fund dummy for MMFs affiliated to any bank. Linear Trend is a linear time trend in days. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	AUM_{it}			
	(1) MMF	(2) Gov MMF	(3) MMF	(4) Gov MMF
Post SLR Relief$_t$ × Non-Custodial SLR-Bank MMF$_i$	3.230***	4.503***		
	(15.822)	(15.353)		
2021Q1$_t$ × Non-Custodial SLR-Bank MMF$_i$	0.303	0.533		
	(1.254)	(1.533)		
Post SLR Relief$_t$ × Custodial SLR-Bank MMF$_i$	2.596***	2.340***		
	(11.047)	(8.482)		
2021Q1$_t$ × Custodial SLR-Bank MMF$_i$	0.212	-0.130		
	(1.441)	(-0.625)		
Post SLR Relief$_t$ × (SLR - SLR Req)$_{i2019Q4}$			-0.192***	-0.237***
			(-7.447)	(-6.698)
2021Q1$_t$ × (SLR - SLR Req)$_{i2019Q4}$			-0.021	0.017
			(-0.789)	(0.450)
Post SLR Relief$_t$ × (Non-Custodial SLR-Bank MMF$_i$ - Custodial SLR-Bank MMF$_i$)	0.634***	2.163***		
(F-statistic)	(27.352)	(193.253)		
2021Q1$_t$ × (Non-Custodial SLR-Bank MMF$_i$ - Custodial SLR-Bank MMF$_i$)	0.091	0.663**		
(F-statistic)	(0.27)	(6.026)		
Fund FE	Y	Y	Y	Y
Date FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
R^2	0.99	0.99	0.98	0.98
Sample Period	6/20-12/21	6/20-12/21	6/20-12/21	6/20-12/21
Observations	78237	57895	25110	18361

Table 13: **Banks' Balance-Sheet Costs and MMF Size: Identification through Custodial Banks and Banks' SLR Buffers: Analysis of Fund AUM.** Panel regressions at the fund-day level. In Columns (1) and (2), the sample includes all MMFs; in Columns (3) and (4), the sample is restricted to MMFs affiliated with banks subject to the SLR. The sample period is from June 1, 2020 (when the SLR relief was established for DIs) to December 31, 2021. AUM_{it} is the fund's daily AUM in billions of dollars. 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the SLR relief (March 31, 2021); Post SLR$_t$ is a time dummy for the period after the end of the relief. Non-custodial SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR that are not custodial banks. Custodial SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated to custodial banks subject to the SLR. (SLR-SLR Req)$_{i2019Q4}$ is the difference between the SLR of the bank to which MMF i is affiliated and its minimum SLR requirement in the last quarter of 2019. All regressions include MMF and day fixed effects, as well as the fund's lagged net yield and net flow as controls. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	%ONRRP$_{it}$		
	(1)	(2)	(3)
	MMF	MMF	Gov MMF
Post SLR Relief$_t$ × Gov$_i$	19.358***		
	(11.762)		
2021Q1$_t$ × Gov$_i$	0.341		
	(1.319)		
Linear Trend$_t$ × Gov$_i$		0.000	
		(1.471)	
Post SLR Relief$_t$ × Private Repo Share$_{i2019Q4}$			0.238***
			(10.399)
2021Q1$_t$ × Private Repo Share$_{i2019Q4}$			0.007*
			(1.916)
Fund FE	Y	Y	Y
Date FE	Y	Y	Y
Controls	Y	Y	Y
$\sum_{m\in\{\text{Month ends}\}}$ Month End$_t^{(m)}$ × Gov$_i$	Y	Y	N
$\sum_{m\in\{\text{Month ends}\}}$ Month End$_t^{(m)}$ × Private Repo Share$_{i2019Q4}$	N	N	Y
R^2	0.75	0.09	0.81
Sample Period	6/20-12/21	6/20-12/20	6/20-12/21
Observations	30854	11673	22498

Table 14: **Banks' Balance-Sheet Costs and the Share of MMF Portfolio Invested at the ON RRP.** Panel regressions at the fund-day level. In Columns (1) and (2), the sample includes all MMFs eligible to invest in the ON RRP; in Column (3), the sample is restricted to government MMFs. In Columns (1) and (3), the time period is from June 1, 2020 (when the SLR relief was established for DIs) to December 31, 2021; in Column (3), the time period is from June 1, 2020 to December 2020 ("pre period"). %ONRRP$_{it}$ is the percentage of fund AUM invested at the ON RRP. Post SLR Relief$_t$ is a time dummy for the period after the end of the SLR relief (March 31, 2021); 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the relief. Gov$_i$ is a fund dummy for government MMFs; Private Repo Share$_{i,2019Q4}$ is the percentage of private repo investment in the fund portfolio in 2019Q4. Linear Trend is a linear time trend in days. Columns (1) and (2) also include the interactions of month-end dummies (one for each month) with the government-MMF dummy; Column (3) includes the interactions of month-end dummies (one for each month) with the the percentage of private repo investment in the fund portfolio in 2019Q4. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	$\%\text{ONRRP}_{it}$	
	(1)	(2)
	MMF	MMF
Post SLR Relief$_t$ × Gov$_i$	11.709***	9.417***
	(5.498)	(4.285)
2021Q1$_t$ × Gov$_i$	-3.568***	-1.130
	(-2.625)	(-1.065)
MOVE$_{t-1}$ × Gov$_i$	0.328***	0.349***
	(5.922)	(7.571)
T-bill Issuance$_{t-30}$ × Gov$_i$	-8.338***	
	(-4.909)	
$\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ × Gov$_i$		-25.726***
		(-6.758)
Fund FE	Y	Y
Date FE	Y	Y
Controls	Y	Y
$\sum_{m\in\{\text{Month ends}\}} \text{Month End}_t^{(m)} \times \text{Gov}_i$	Y	Y
R^2	0.76	0.77
Sample Period	6/20-12/21	6/20-12/21
Observations	30854	30854

Table 15: **Banks' Balance-Sheet Costs and the Share of MMF Portfolio Invested at the ON RRP: Controlling for the Effect of Interest Rate Risk and T-bill Supply.** Panel regressions at the fund-day level. The sample includes all MMFs eligible to invest in the ON RRP. The sample period is from June 1, 2020 (when the SLR relief was established for DIs) to December 31, 2021. $\%\text{ONRRP}_{it}$ is the percentage of fund AUM invested at the ON RRP. Post SLR Relief$_t$ is a time dummy for the period after the end of the SLR relief (March 31, 2021); 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the relief. Gov$_i$ is a fund dummy for government MMFs. T-bill Issuance$_{t-30}$ is the total T-bill issuance in the calendar month before the month of day t in trillions of dollars. $\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ is the share of T-bills outstanding relative to the average total AUM of MMFs in the previous calendar month. All regressions include MMF and day fixed effects, the fund's lagged net yield and net flows as controls, and the interactions of month-end dummies (one for each month) with the government-MMF dummy. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.

	$\$\text{ONRRP}_{it}$			
	(1) MMF	(2) MMF	(3) MMF	(4) MMF
Post SLR Relief$_t$ × SLR-Bank MMF$_i$	1.215***	1.150***	3.079***	2.997***
	(6.600)	(6.202)	(9.431)	(9.026)
2021Q1$_t$ × SLR-Bank MMF$_i$	-0.035	-0.132***	-0.018	-0.139***
	(-1.340)	(-4.058)	(-0.474)	(-3.332)
Post SLR Relief$_t$ × SLR-Bank MMF$_i$ × (SLR - SLR Req)$_{i2019Q4}$			-0.717***	-0.710***
			(-11.186)	(-10.944)
2021Q1$_t$ × SLR-Bank MMF$_i$ × (SLR - SLR Req)$_{i2019Q4}$			-0.008	0.002
			(-1.101)	(0.201)
Post SLR Relief$_t$ × Gov$_i$	7.684***	6.490***	8.176***	6.998***
	(6.081)	(4.758)	(6.410)	(5.062)
2021Q1$_t$ × Gov$_i$	-2.325**	-0.849	-2.288**	-0.810
	(-2.532)	(-1.160)	(-2.498)	(-1.115)
MOVE$_{t-1}$ × Gov$_i$	0.246***	0.255***	0.245***	0.254***
	(6.673)	(8.117)	(6.665)	(8.073)
T-bill Issuance$_{t-30}$ × Gov$_i$	-5.179***		-5.228***	
	(-4.684)		(-4.723)	
$\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ × Gov$_i$		-14.917***		-14.904***
		(-5.842)		(-5.824)
Fund FE	Y	Y	Y	Y
Date FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
$\sum_{m\in\{\text{Month ends}\}} \text{Month End}_t^{(m)} \times \text{Gov}_i$	Y	Y	Y	Y
R^2	0.54	0.54	0.54	0.54
Sample Period	6/20-12/21	6/20-12/21	6/20-12/21	6/20-12/21
Observations	30854	30854	30854	30854

Table 16: **Banks' Balance-Sheet Costs, Interest Rate Risk, T-bill Supply, and MMFs' Investment at the ON RRP.** Panel regressions at the fund-day level. The sample includes all MMFs eligible to invest in the ON RRP. The sample period is from June 1, 2020 (when the SLR relief was established for DIs) to December 31, 2021. $\$\text{ONRRP}_{it}$ is the fund's dollar investment at the ON RRP in billions of dollars. Post SLR Relief$_t$ is a time dummy for the period after the end of the SLR relief (March 31, 2021); 2021Q1$_t$ is a time dummy for the quarter immediately before the end of the relief. SLR-Bank MMF$_i$ is a fund dummy for MMFs affiliated with banks subject to the SLR. (SLR-SLR Req)$_{i2019Q4}$ is the difference between the SLR of the bank to which MMF i is affiliated and its minimum SLR requirement in the last quarter of 2019. Gov$_i$ is a fund dummy for government MMFs. MOVE$_{t-1}$ is the MOVE index, lagged by one day. T-bill Issuance$_{t-30}$ is the total T-bill issuance in the calendar month before the month of day t in trillion dollars. $\frac{\text{T-bill Outstanding}_{t-30}}{\text{Avg Total AUM}_{t-30}}$ is the share of T-bills outstanding relative to the average total AUM of MMFs in the previous calendar month. All regressions include MMF and day fixed effects, the fund's lagged net yield and net flows as controls, and the interactions of month-end dummies (one for each month) with the government-MMF dummy. t-statistics, in parentheses, are calculated using Driscoll-Kraay standard errors with 5 lags.