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Supervisory Research and Analysis Unit

Working Paper | SRA 21-03 | September 27, 2021

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The Money Market Mutual Fund Liquidity Facility[1]

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September 24, 2021

Abstract

In this article, we discuss the run on prime money market funds (MMFs) that occurred in March 2020, at the onset of the COVID-19 pandemic, and describe the Money Market Mutual Fund Liquidity Facility (MMLF), which the Federal Reserve established in response to it. We show that the MMLF, like a similarly structured Federal Reserve facility established during the 2008 financial crisis, was an important tool in stemming investor outflows from MMFs and restoring calm in short-term funding markets. The usage of the facility was higher by funds that suffered larger outflows. After the facility's introduction, outflows from prime MMFs decreased more for those funds that had a larger share of illiquid securities. Importantly, following the introduction of the MMLF, interest rates on MMLF-ineligible securities decreased at a slower rate than those on MMLF-eligible securities, even after controlling for credit risk.

Keywords: COVID-19, money market funds, runs, Federal Reserve lending facilities

JEL classifications: G23, G28, G11

[1] We thank Catherine Huang, Abduel Hussein, and Reed Orchinik for excellent research assistance. We thank Jie Chen, Christine Docherty, Lei Li, Marco Macchiavelli, and Patrick McCabe for useful comments. The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of Boston, the Federal Reserve Bank of New York, or the Federal Reserve System. Any errors or omissions are the responsibility of the authors.

1. Introduction

In March 2020, at the onset of the Covid-19 pandemic, investors redeemed their shares en masse from dollar-denominated prime money market funds (MMFs). The large redemptions occurred both in U.S. MMFs registered with the Securities and Exchange Commission (SEC) and governed by its Rule 2a-7 ("domestic" funds) and in dollar-denominated MMFs domiciled in Europe and governed by European rules ("offshore" funds). In percentage terms relative to the size of the industry, the run was remarkably similar to that experienced by MMFs in September 2008, during the Global Financial Crisis, notwithstanding the starkly different natures of the shocks that precipitated the runs. As was the case in 2008, the 2020 run amplified strains in the short-term funding markets, a key source of liquidity for businesses, as rates on several money market securities increased steeply.

In mid-March, the Federal Reserve, with approval of the Secretary of the Treasury, established the Money Market Mutual Fund Liquidity Facility (MMLF) to assist MMFs in meeting heightened investor redemptions, stabilize the U.S. short-term funding markets, and support credit provision to the real economy. Under the facility, which was similar in its structure and purpose to the Asset Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) established in 2008, the Board of Governors authorized the Federal Reserve Bank of Boston to make non-recourse loans to eligible banks to facilitate the purchase of eligible assets from domestic prime, single state, or other tax-exempt MMFs.

In this paper, we discuss the March 2020 run on MMFs, describe the MMLF's design and operations, and assess its effectiveness in stemming fund outflows and calming money market rates. First, we discuss the different reasons that led investors to run and document the dislocations in money market rates that accompanied the run. As shown in Cipriani and La Spada (2020) and Li et al. (2020), institutional investors ran more from funds for which the imposition of redemption gates and liquidity fees—introduced by the 2014 SEC reform—was more likely due to lower levels of "weekly liquid assets" (WLA) in their portfolios. The outflows of retail investors, in contrast, were unrelated to fund-level liquidity and reflected other factors, including contagion from the behavior of institutional investors within the same fund family.

Second, we describe the MMLF's structure and compare it with that of the AMLF, highlighting similarities and differences. Both facilities used banks as a conduit to provide liquidity to domestic prime (and, for the MMLF, also tax-exempt) MMFs. A material difference, however, is that the AMLF only facilitated banks' purchases of ABCP from MMFs, whereas the MMLF made loans against a broader set of assets.

Third, we describe the usage of the facility. We show that the MMLF was used more by funds that suffered larger outflows, and that funds sold securities with longer maturities, consistent with their incentive to boost their liquidity positions and especially their WLA.[2]

Finally, we identify the effect of the MMLF on investor flows by showing that, after the facility's introduction, outflows from prime MMFs decreased more for those funds that were eligible to participate in the MMLF program (i.e., domestic ones), that had a larger share of illiquid securities, and whose investors were more concerned about the funds' liquidity (i.e., institutional ones). Moreover, we show that, after the introduction of the MMLF, the rates of MMLF-ineligible securities declined more slowly than those of MMLF-eligible securities, even after controlling for credit risk.

Overall, our analysis shows that, as the AMLF had been in 2008, the MMLF was an important tool in stabilizing prime-MMF flows and short-term funding markets at large.

2. Background on Money Market Funds

a. U.S.-domiciled, USD-denominated Money Market Funds ("Domestic Funds")

Domestic MMFs are open-end mutual funds that invest primarily in U.S. dollar-denominated money market instruments with short maturity and high credit quality. There are two main types of domestic MMFs: (1) "government" funds, which invest almost all their assets in U.S. government and agency securities and repurchase agreements (repos) backed by those securities; and (2) "prime" funds, which can also buy private unsecured debt such as certificates

[2] As explained above and in Section 4.a, through the MMLF, the Federal Reserve Bank of Boston made loans available to eligible banks secured by assets purchased from MMFs. Therefore, MMFs did not directly "use" or "participate" in the facility. Nevertheless, throughout the paper, we will employ those terms to reflect the fact that the MMLF was setup to "assist […] money market funds in meeting demands for redemptions by households and other investors, enhancing overall market functioning and credit provision to the broader economy" (FRS Press Release, 3/18/2020).

of deposit (CDs), commercial paper (CP), and variable rate demand notes (VRDNs), in addition to asset-backed commercial paper (ABCP).[3] Domestic MMFs can also be divided by investor type: "retail" fund shares can only be sold to "natural persons," whereas "institutional funds" are also available to institutions, such as businesses and governments. At the end of 2019, domestic MMFs had $4.3 trillion in total net assets, 69% held by government funds and 28% by prime funds.[4]

Domestic MMFs are regulated by the SEC under Rule 2a-7 of the Investment Company Act of 1940; this rule places limits on the credit risk, liquidity risk, maturity, and concentration of the funds' portfolios. In response to the 2008 run on prime MMFs, the SEC adopted a set of reforms in 2014 to improve the resilience of prime MMFs and reduce the likelihood of runs.[5]

The 2014 reform changed how prime MMFs sell and redeem shares, thereby directly impacting their runnability. The SEC required that all prime MMFs adopt a system of redemption gates and liquidity fees contingent on the level of weekly liquid assets (WLA) in their portfolios: if a fund's WLA falls below 30% of its total assets, the fund is allowed (but not required) to impose a liquidity fee of up to 2 percent on all redemptions or to temporarily suspend redemptions for up to ten business days; if a fund's WLA fall below 10%, the fund must impose a fee of 1% unless its board determines that doing so is not in the interests of the fund's shareholders.[6]

Additionally, the SEC required that institutional prime MMFs sell and redeem their shares at a price that reflects the market value of the fund's underlying securities (floating net asset value, or floating NAV); that is, institutional investors could no longer buy and redeem their shares at a stable NAV (typically $1 per share) as they had previously done and as retail prime investors can still do. Government MMFs were largely unaffected by the 2014 reform.

[3] A third type of MMFs are single state and other tax-exempt MMFs, which mainly invest in debt issued by state and local governments. They represent a very small fraction of the industry and are not the focus of this paper. All our analyses, with the exception of the statistics on MMLF usage, focus on prime funds only.
[4] The remaining 3% was held by single state and other tax-exempt funds (see footnote 3).
[5] The SEC adopted an initial, more limited, set of regulatory changes of the MMF industry in 2010.
[6] WLA include cash, U.S. Treasury securities, certain other government securities that mature within 60 days, and securities that mature or are puttable within five business days. For more details, see https://www.sec.gov/news/press-release/2014-143

b. EU-domiciled, USD-denominated MMFs ("Offshore Funds")

Offshore MMFs are European-domiciled open-end funds that, like domestic MMFs, invest in U.S. dollar-denominated money market instruments and can be divided into government and prime funds based on their portfolio holdings.[7] Unlike domestic MMFs, however, offshore MMFs are almost exclusively held by institutional investors.[8]

Offshore MMFs are regulated under Regulation (EU) 2017/1131 of the European Parliament and of the Council of the EU, which was also adopted in response to the run experienced by offshore MMFs in 2008. For the subset of offshore prime funds that are allowed to transact at a stable NAV (low volatility NAV funds), similarly to the 2014 SEC reform, this new rule introduced a system of redemption gates and liquidity fees contingent on the level of liquidity in the fund's portfolio.[9]

3. The March 2020 Run

a. Fund flows

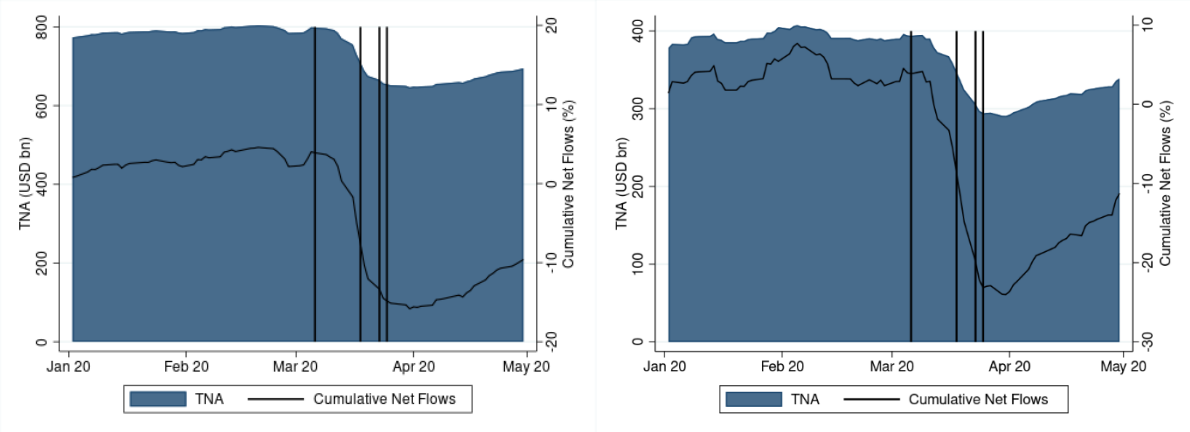
Starting on March 6, 2020, when the Covid-19 pandemic became of increasing concern in the U.S. and Europe, domestic and offshore prime MMFs began experiencing outflows that quickly accelerated over the next several days.[10] These outflows slowed significantly after the Federal Reserve established the MMLF in mid-March. As shown in the left panel of Figure 1, domestic funds lost $143 billion (bn) between March 6 and March 26, that is, 19% of the industry's assets in December 2019. These outflows are comparable to those suffered by domestic prime MMFs during the September 2008 run, when their assets dropped by 18% relative to August (see Figure 2). As shown in the right panel of Figure 1, the experience for offshore prime MMFs was similar: they lost $100 bn over the March 6-26 period, corresponding to 27% of their assets in December 2019.

[7] In the EU, offshore government MMFs are referred to as "public debt" funds; offshore prime MMFs are divided in three sub-groups: low volatility NAV funds (the largest group), short-term variable (i.e., floating) NAV funds, and standard variable NAV funds.
[8] See, https://www.immfa.org/market-statistics/immfa-aum.html
[9] For more details, see https://eur-lex.europa.eu/eli/reg/2017/1131/oj.
[10] In this paper, we use daily data on MMF flows from iMoneyNet, which, at the end of 2019, covered 82% of the industry.

The March 2020 and the September 2008 runs share two other important similarities. First, in both cases, outflows from prime MMFs were accompanied by large inflows into government MMFs, which represent a safe haven for investors. The assets of domestic government MMFs increased by $827bn (i.e., by 31%) in March 2020 and by $334bn (36%) in September 2008. Similar inflows were observed into offshore government funds, both in March 2020 (70%) and in September 2008 (65%).

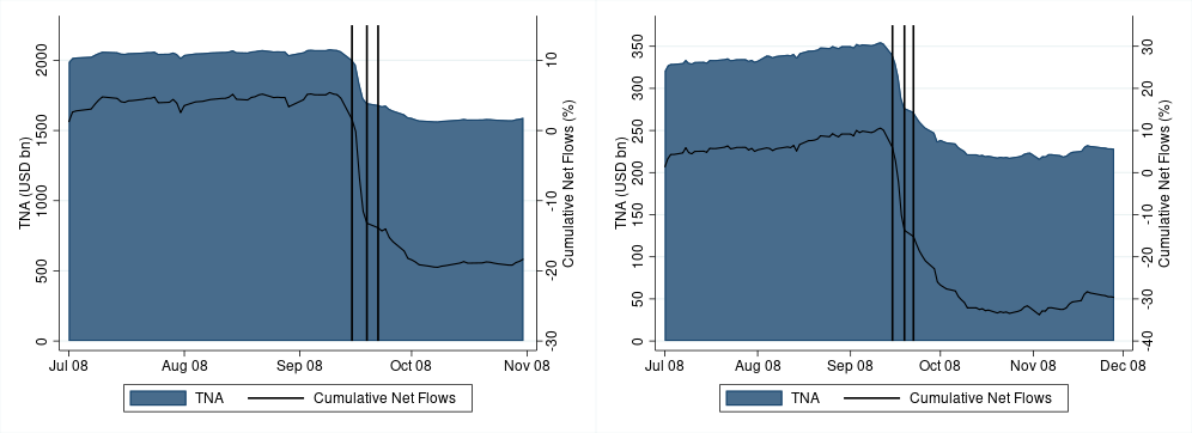
Second, during both runs, institutional prime funds experienced larger outflows than retail prime funds. Between March 6 and March 26, 2020, outflows from domestic institutional funds had reached 33% of their assets in December 2019; outflows from domestic retail funds were only 10% of their December 2019 assets. In other words, institutional investors seem to be quicker to move their money in times of uncertainty.

Figure 1. Prime-MMF Outflows in 2020. Left: Domestic. Right: Offshore.



Sources: iMoneyNet and staff calculations.
Notes: The figure shows the Total Net Assets (TNA) in billions of USD (left axis) and the cumulative net flow relative to December 2019 in percent (right axis) for domestic prime funds (left panel) and offshore prime funds (right panel) from January to April 2020. Vertical lines show March 6 (beginning of the 2020 run), 18 (MMLF announcement), 23 (MMLF opening), and 25 (when the MMLF started accepting CDs and VRDNs as collateral).

Figure 2. Prime-MMF Outflows in 2008.



Sources: iMoneyNet and staff calculations.
Notes: The figure shows the Total Net Assets (TNA) in billions of USD (left axis) and the cumulative net flow relative to June 2008 in percent (right axis) for domestic prime funds from July to October 2008. Vertical lines show September 15 (beginning of the 2008 run), 19 (AMLF announcement), and 22 (AMLF opening).

b. Money market rates

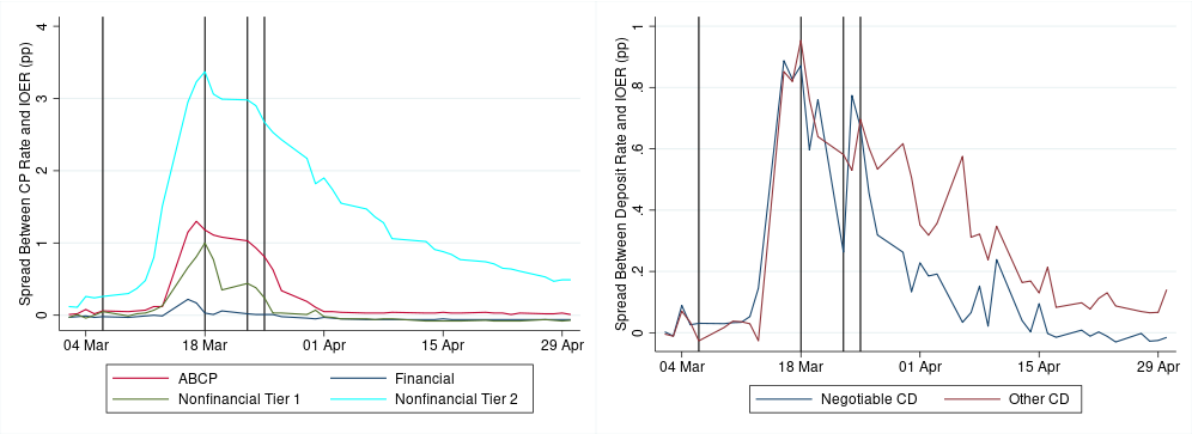
Large outflows from prime MMFs were accompanied by price dislocations in money market rates. Figure 3 shows the spreads between several secondary market rates and the interest rate on excess reserves (IOER) in March and April 2020. Before the announcement of the MMLF, between March 6 and March 18, the spreads of overnight AA ABCP and nonfinancial CP increased by 1.1 and 1.0 percentage points (pp), respectively. The effect on second-tier nonfinancial CP was even stronger, with the spread reaching 3.2 pp on March 17. Not all money market rates increased by the same amount: for instance, the increase in the spread of overnight AA financial CP was modest (0.05 pp).

These price dislocations were very large by historical standards and comparable to those observed during the 2008 crisis. On September 16, 2008, the day the Reserve Primary Fund "broke the buck," the spreads between the rates of overnight AA ABCP and second-tier nonfinancial CP and the target effective federal funds rate surged to 3.6 and 3.8 percentage points.[11] A similar, although smaller, rate spike occurred also for AA financial and nonfinancial CP.

[11] The Reserve Primary Fund was a large prime MMF that suspended redemptions and faced a lengthy liquidation due to losses on its holdings of Lehman Brothers' debt. "Breaking the buck" means that a stable-NAV fund reprices

CD rates also increased sharply in March 2020 to then retrace their paths after the MMLF was introduced. The right panel of Figure 3 shows rates on negotiable CDs and non-negotiable deposits with remaining maturity within 7 days. In both cases, rates spiked in the week ahead of the MMLF introduction, when MMFs suffered the largest outflows.

Figure 3. Dislocation in Money Market Rates in 2020. Left: Overnight CP. Right: Wholesale Deposits with Maturity within 7 Days.



Sources: Federal Reserve Board of Governors, FRED, FR2420, and staff calculations.
Notes: The left panel shows the daily average spread between several overnight CP rates (AA ABCP, AA financial CP, AA nonfinancial CP, and second-tier nonfinancial CP) and the IOER in percentage points from March to April 2020. The right panel shows the daily average spread relative to the IOER for negotiable CDs and non-negotiable deposits (CDs and TDs) with maturity within 7 days. Vertical lines show March 6 (beginning of the 2020 run), 18 (MMLF announcement), 23 (MMLF opening), and 25 (when the MMLF started accepting CDs and VRDNs as collateral).

c. The Role of WLA

Several recent papers have suggested that one of the reasons why investors ran from prime MMFs in March 2020 was the possible imposition of redemption gates and liquidity fees, introduced by the 2014 SEC reform.[12] Cipriani and La Spada (2020) and Li et al. (2020) find that institutional funds with lower WLA—and therefore, for which the imposition of gates and fees was more likely—experienced significantly larger outflows. For domestic institutional funds, Cipriani and La Spada (2020) find that a 10 pp decrease in a fund's WLA at the end of 2019 (i.e.,

its shares at an NAV that reflects the market-based value of its portfolio; this can happen if the market value of its portfolio drops below $0.995 per share.

[12] Concerns about fees and gates and the possibility that they might trigger preemptive runs were raised at the time the SEC adopted the new regulation (see Rosengren et al., 2013, and Cipriani et al., 2014).

before the run started) increases daily outflows during the Covid-19 run by 1.1 pp. Results from Li et al. (2020) are similar.

Investor concerns around the imposition of gates or fees were not the only cause behind the large outflows observed in March 2020. MMFs are vulnerable to runs because they perform liquidity transformation and cater to investors with low risk tolerance. Among offshore MMFs, Cipriani and La Spada (2020) show that contagion within fund families also played a role: outflows from offshore prime MMFs were larger for those funds in families also offering domestic institutional prime funds; in other words, there was a cross-border spillover of outflows from U.S. to European prime MMFs within the same family. Outflows from other types of mutual funds *without* fees and gates, such as ultrashort bond funds, were also very large in March.

Importantly, outflows from retail prime MMFs were not affected by funds' WLA (and the likelihood of gates and fees) but likely reflected other vulnerabilities. For instance, Cipriani and La Spada (2020) show that retail funds suffered larger outflows if they belonged to families also offering domestic institutional prime funds. This evidence of within-family contagion is consistent with less sophisticated retail investors using the actions of more sophisticated institutional investors in their own family as a signal.

4. The Money Market Mutual Fund Liquidity Facility (MMLF)

a. The facility

On March 18, 2020, the Federal Reserve, with approval of the Secretary of the Treasury and $10 bn of credit protection from the Exchange Stabilization Fund, announced the introduction of the MMLF to provide liquidity to MMFs.[13] To do this, the Federal Reserve had to address two challenges. First, the Federal Reserve needed to protect itself from credit risk, for example by offering loans only against high-quality collateral. Second, lending to MMFs is problematic, as it would have increased their leverage, amplifying any losses for the shareholders and increasing their incentive to run.

[13] See, https://www.federalreserve.gov/newsevents/pressreleases/monetary20200318a.htm

The Federal Reserve faced the same challenges in 2008, when it set up the AMLF in response to the MMF run triggered by Lehman Brothers' default. Although the type of shock was different, it was natural to design the 2020 facility based on its 2008 predecessor.

Through the MMLF, which was established under the authority of Section 13(3) of the Federal Reserve Act, the Federal Reserve Bank of Boston made non-recourse loans to eligible borrowers, taking as collateral eligible assets purchased by the borrowers from eligible MMFs. The eligible borrowers were U.S. depository institutions, U.S. bank holding companies (parent companies incorporated in the U.S. or their U.S. broker-dealer subsidiaries), and U.S. branches and agencies of foreign banks. Eligible collateral was limited to U.S. Treasuries and fully-guaranteed agencies, Government Sponsored Enterprise (GSE) securities, highly-rated CP (including ABCP), negotiable CDs, and short-term municipal debt (including VRDNs that met certain criteria).[14] Eligible funds were limited to domestic prime, single state, or other tax-exempt MMFs. Table 1 describes the evolution of the MMLF.

Table 1: Evolution of the MMLF

Date	Eligible Funds	Eligible Collateral
March 18 (facility is announced)	Domestic Prime MMFs	U.S. Treasuries and fully-guaranteed agencies; securities issued by GSEs; certain ABCP; certain CP
March 20 (eligible funds and eligible collateral are expanded)	Domestic Prime and Tax-exempt MMFs	U.S. Treasuries and fully-guaranteed agencies; securities issued by U.S. GSEs; certain ABCP; certain CP; certain U.S. municipal short-term debt
March 23 (facility opens; further expansion of eligible collateral is announced)	Domestic Prime and Tax-exempt MMFs	U.S. Treasuries and fully-guaranteed agencies; securities issued by U.S. GSEs; certain ABCP; certain CP; certain U.S. municipal short-term debt; certain CDs; certain VRDNs

The MMLF lending rate was equal to the primary credit rate (PCR) offered by the Federal Reserve Bank of Boston at the time the loan was made plus a spread based on the collateral type. Specifically, the rate for loans secured by U.S. Treasuries, fully guaranteed

[14] Eligible collateral was valued at either amortized cost or fair value, depending on the collateral type; CP, ABCP, CDs, and US municipal short-term debt, including VRDNs, were valued at amortized cost. For more information on eligible borrowers, eligible assets, and eligible lenders, see MMLF term sheet: https://www.federalreserve.gov/monetarypolicy/mmlf.htm

agencies, and GSE debt was equal to the PCR. Loans secured by municipal short-term debt, including VRDNs, were made at the PCR *plus* 25 bps. The rates on all other MMLF loans were equal to the primary credit rate *plus* 100 bps.[15] The maturity of each MMLF loan was equal to the remaining maturity of the collateral pledged under the facility, up to a maximum of 12 months. There was no haircut on the collateral.

Importantly, the Federal Reserve, the Office of the Comptroller of the Currency, and the Federal Deposit Insurance Corporation allowed banks to neutralize the effects of participating in the MMLF on their risk-based and leverage capital ratios by excluding the effects of buying assets through the MMLF from the calculation of regulatory capital requirements.[16] Moreover, on May 5, the same agencies collectively issued an interim final rule that neutralized the impact of the non-recourse funding provided by the MMLF on the calculation of banks' Liquidity Coverage Ratios.

b. Comparison with the ABCP Money Market Mutual Fund Lending Facility (AMLF)

The core structure and design of the MMLF was based on the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF), which was established in response to the run on MMFs of September 2008. Accordingly, the AMLF and MMLF were very similar, both in terms of institutional set-up and intentions. First, as with the MMLF, the AMLF was created by the Federal Reserve under the authority of Section 13(3) of the Federal Reserve Act.[17] Second, the AMLF was administered by the Federal Reserve Bank of Boston, which made non-recourse loans to eligible borrowers, taking as collateral eligible assets purchased by the borrowers from prime MMFs. Finally, each AMLF loan was also fully collateralized by the security purchased by the AMLF borrower: the collateral was purchased at

[15] In extending emergency credit, the Federal Reserve Board's practice is to set the interest rate at a penalty rate that is designed to encourage borrowers to repay the loans quickly. See, https://www.federalreserve.gov/newsevents/pressreleases/bcreg20151130a.htm

[16] See: https://www.federalregister.gov/documents/2020/03/23/2020-06156/regulatory-capital-rule-money-market-mutual-fund-liquidity-facility

[17] In 2010, the Dodd-Frank Act modified Section 13(3) of the Federal Reserve Act. Among other things, the amendments mandated that any emergency lending facilities authorized by the Federal Reserve under Section 13(3) must be approved by the Secretary of the Treasury. See https://www.federalreserve.gov/monetarypolicy/bsd-appendex_201508.htm#:~:text=The%20Dodd%2DFrank%20Act%20modified,failing%2C%20systemically%20important%20nonbank%20financial

amortized cost and had to be top-rated, with the maturity of the loan matching the remaining maturity of the collateral.[18]

There are, however, some important differences. First, as its name implies, eligible collateral under the AMLF was limited to certain ABCP, as the ABCP market was much larger in 2008 and had been under particularly severe stress during the Global Financial Crisis. In contrast, the MMLF accepted a broader slate of collateral as previously discussed. Second, given the improvements in financial conditions that followed the establishment of the AMLF, the Federal Reserve amended the AMLF in June 2009 to require that, in order to be eligible to participate, MMFs must have experienced single-day or multiple-day net redemptions that exceeded set thresholds;[19] there was no such requirement under the MMLF.

The AMLF was announced on September 19, 2008, began operations on September 22, and was closed on February 1, 2010.

c. MMLF Usage

Figure 4 shows daily and cumulative asset pledges to the MMLF, from its opening (March 23, 2020) to the last transaction (April 23, 2020). The MMLF extended loans to nine banks and bank holding companies, which purchased $58 bn of securities from MMFs.[20] For comparison, the value of the ABCP pledged to the AMLF in 2008 was much larger, about $200 bn, but its usage relative to the industry's assets was only slightly higher than the MMLF's.[21] As had happened with the AMLF, all loans made under MMLF were repaid in full, with interest, in accordance with the terms of the facility.

[18] One difference relative to the MMLF is that the maturity of an AMLF loan (and the remaining term of the collateral) was capped at 120 days for depository institutions and 270 for non-depository institutions. A second difference is that the rate on an AMLF loan was equal to the PCR offered by the Federal Reserve Bank of Boston at the time the loan was made, without any premium.

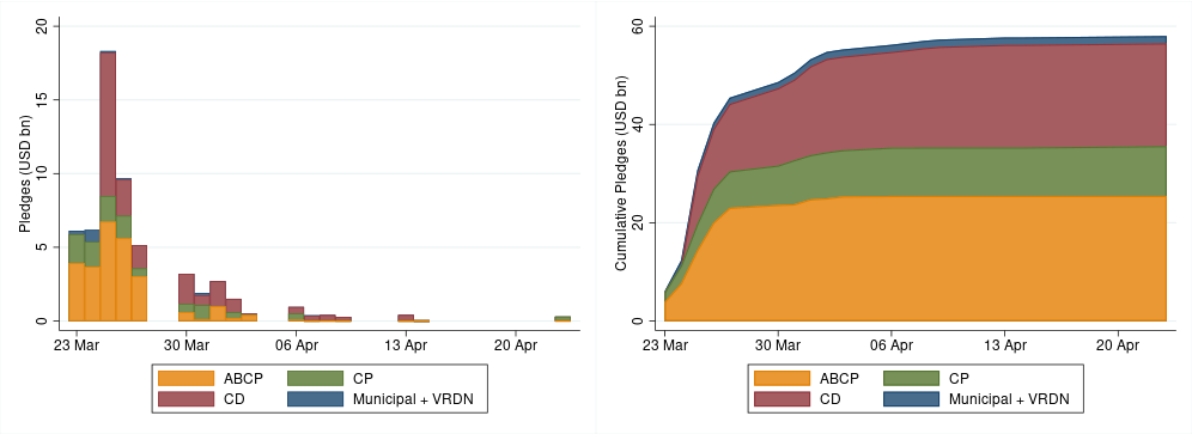
[19] Specifically, the fund must have experienced either: (1) a single-day net redemption that exceeded at least 5% of the fund's net assets on any given day during the 5 business days preceding AMLF usage, or (2) multiple-day net redemptions over 5 business days or less that exceeded at least 10% of the fund's net assets.

[20] The statistics on usage in Figure 4 include asset pledged by both prime and single state and other tax-exempt funds.

[21] The facility usage relative to total assets was about 10% under the AMLF and slightly below 8% under the MMLF (Anadu and Sanders, 2021). In dollar terms, MMLF pledges in 2020 were significantly smaller than AMLF pledges in 2008 because the size of the prime-MMF industry shrank by more than $1 trillion from November 2015 to October 2016 in response to the 2014 SEC reform (Cipriani and La Spada, 2021).

Of the securities pledged to the MMLF, 44% were ABCP, 36% were CDs, 18% unsecured CP, and the rest VRDNs and municipal debt, consistent with funds using the MMLF mainly to sell their illiquid assets to meet redemptions and stem future ones. Daily sales were the highest ($18 bn) on March 25, two days after it was announced that negotiable CDs and VRDNs were MMLF-eligible; 53% of the March 25 sales were indeed CDs.[22]

Figure 4. MMLF Pledges by Asset Category. Left: Daily Pledges. Right: Cumulative Pledges



Source: Federal Reserve Bank of Boston and staff calculations.
Notes: The left panel shows the daily value of the assets pledged to the MMLF in USD bn, by asset category; the right panel shows their cumulative value in USD bn.

The facility was used by 47 domestic prime MMFs out of a total of 95. Table 2 shows average portfolio characteristics of domestic prime MMFs at the end of February 2020, separating funds that participated in the MMLF from those that did not.[23] Sixty-three percent of participating funds were institutional funds. Funds that participated in the MMLF held more ABCP and repos and less Treasuries and unsecured CP. The most important differences, however, are that funds that participated in the MMLF experienced significantly larger outflows

[22] Although their eligibility was announced on March 23, CDs and VRDNs could only be pledged at the MMLF on March 25 or after.
[23] From this point on, we merge the data on the MMLF with iMoneyNet data on MMFs. Sixty-seven transactions (out of 1,507), accounting for $4.4 billion of MMLF loans (7.5% of the total), are with funds that are not listed in iMoneyNet and are dropped from the empirical analysis.

during the run (the difference is 22 pp from March 6 to March 20) and were more likely to be institutional funds.[24]

Table 2: Characteristics of Domestic Prime MMFs that Did and Did Not Participate in the MMLF.

	Participants	Not Participants	Difference
TNA [USD bn]	10.3	18.0	-7.7
	(21.1)	(36.3)	(-1.0)
WAM [days]	31.7	28.3	3.3
	(8.8)	(6.6)	(1.4)
WLA [%]	41.7	43.6	-2.0
	(5.2)	(7.4)	(-1.2)
ABCP [%]	12.5	6.8	5.6*
	(9.7)	(10.9)	(2.0)
CD [%]	25.9	21.4	4.5
	(13.8)	(14.8)	(1.1)
CP [%]	35.4	43.9	-8.5*
	(14.2)	(23.2)	(1.8)
Treasury [%]	1.3	3.5	-2.2*
	(2.3)	(7.3)	(-1.8)
Agency [%]	1.4	3.5	-2.1
	(3.9)	(7.3)	(-1.5)
Repos [%]	21.1	15.3	5.8*
	(10.3)	(11.3)	(2.0)
Flows [%]	-19.1	2.6	-21.7***
	(19.3)	(12.6)	(-4.4)
Institutional [%]	62.8	22.2	40.6***
			(3.1)

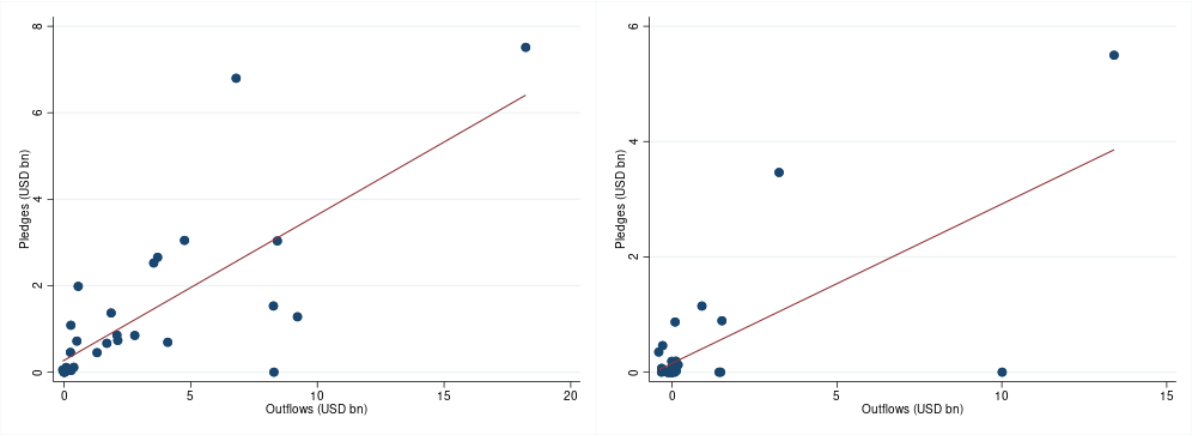
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Sources: Federal Reserve Bank of Boston, iMoneyNet, SEC, and staff calculations.
Notes: The first two columns show the average and standard deviation (in parentheses) of funds' characteristics at the end of February 2020. The third column presents the difference in the means and the t-statistic for the null that the means are equal. TNA is the fund's total net assets in USD billions; WAM is the weighted average maturity of the fund's portfolio in days; WLA is the percent of weekly liquid assets in the fund's portfolio; ABCP, CD, CP, Treasury, Agency, and Repos are the percent of the fund's portfolio invested in those asset types; Flows is the net flow between March 6 and March 20 (last business day before the MMLF opened) relative to the fund's TNA at the end of February in percent; Institutional is the percentage of institutional funds.

[24] Participating funds also had slightly lower WLA, but the difference is not statistically significant because retail funds, which suffered smaller outflows and had fewer incentives to use the facility, tend to have lower WLA (see Figure 6).

Funds that experienced larger outflows were more likely to use the facility and pledged more assets to it. Figure 5 shows the scatterplot of fund-level MMLF pledges against fund-level outflows during March 6-20 (i.e., during the run and before the MMLF opened). For both institutional and retail funds, there is a positive relationship between the outflows suffered by a fund during the run and the fund's usage of the MMLF. We estimate the magnitude of this relationship through regression analysis: a $1 billion dollar increase in outflows during the run (March 6-20, 2020) leads to an increase in MMLF asset pledges by $337 million in institutional funds and $275 million in retail funds; these effects are not only statistically significant but also economically important (see Box 1).

Figure 5. Fund-level MMLF Pledges vs Outflows during the March 2020 Run (3/6-20). Left: Institutional. Right: Retail.



Sources: Federal Reserve Bank of Boston, iMoneyNet, and staff calculations.
Notes: Both panels show a scatterplot of fund-level pledges to the MMLF in billions of USD against the fund-level outflows from March 6-20 in billions of USD. Institutional funds are shown in the left panel; retail funds are shown in the right panel.

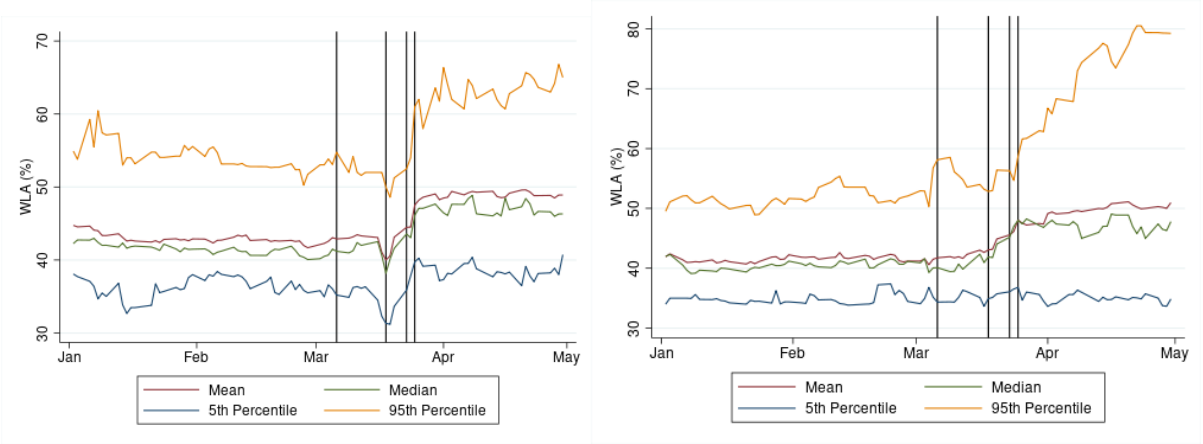
Through the MMLF, domestic prime funds sold their more illiquid assets and boosted their liquidity positions.[25] After the run was over, funds' WLA were actually greater than before the run started. Figure 6 shows the daily share of WLA in the portfolio of prime MMFs from January to April 2020, separately for institutional and retail funds; the figure shows the average and median, as well as the 5th and 95th percentiles, of WLA within each group. The WLA of

[25] The MMLF improved funds' liquidity position through two channels: a direct channel, whereby by pledging assets into the MMLF, MMFs replaced illiquid assets with cash; and an indirect one, whereby by slowing the run on the MMF industry, the MMLF gave funds time for their assets to mature so that they could use the proceeds to buy more liquid assets.

institutional funds dropped in the week ahead of the introduction of the MMLF, when outflows were the highest and MMFs struggled to meet investors' redemptions with their liquid assets. Their WLA, however, bounced back after the MMLF began its operations and, starting from early April, funds' WLA exceeded their February 2020 levels. The average WLA of institutional prime MMFs went from 42% at the end of February to 49% at the end of April. The fund on the 95th percentile of the WLA distribution increased its WLA even more, from 52% to 65%.

Although the WLA of retail funds did not drop materially during the run, likely because they suffered smaller redemption pressure, retail funds also significantly increased their WLA positions after the introduction of the MMLF. The average fund went from 41% at the end of February to 51% by the end of April, and the fund at the 95th percentile of the distribution boosted its WLA by more than 20 percentage points, from 52% to 79%.

Figure 6. WLA of Prime MMFs during January-April 2020. Left: Institutional. Right: Retail.



Sources: iMoneyNet and staff calculations.
Notes: The figure shows the average and median shares of WLA, together with the 5th and 95th percentiles, in the portfolios of institutional (left panel) and retail (right panel) prime MMFs from January to April 2020. Data are in percent and at the daily frequency. Vertical lines show March 6 (beginning of the 2020 run), 18 (MMLF announcement), 23 (MMLF opening), and 25 (when the MMLF started accepting CDs and VRDNs as collateral).

Table 3 shows the average remaining maturities, computed as of the end of February 2020, of the ABCP, CP, and CDs pledged to the MMLF and compares them with the average remaining maturities of the same security types held by prime MMFs at the end of February.[26]

[26] To calculate the remaining maturity of the securities held by prime MMFs at the end of February 2020, we use security-level data from SEC's Form N-MFP.

For all asset classes, the average maturity of the securities pledged is significantly greater than the average maturity of the securities held: the difference ranges from 16 (CDs) to 34 (CP) days. Li et al. (2020) obtains similar results in a regression setting. This evidence shows that prime funds boosted their liquidity by selling assets with longer maturities, which were more likely to be illiquid.[27]

Table 3: Maturity of the Securities Sold to the MMLF and of Those in the Portfolio of Prime MMFs at the End of February 2020

	ABCP			CP			CD		
	Feb	Sold	Diff	Feb	Sold	Diff	Feb	Sold	Diff
Feb 2020 Maturity [days]	74	93	19.3***	100	134	33.8***	117	133	15.6***
	(65)	(46)	(6.8)	(87)	(76)	(5.7)	(90)	(96)	(2.9)

Sources: Federal Reserve Bank of Boston, iMoneyNet, SEC, and staff calculations.
Notes: The table shows the mean and standard deviation (in parentheses) of the remaining maturities of the ABCP, CP, and CDs held in MMF portfolios at the end of February 2020 and of the ABCP, CP, and CDs pledged by MMFs to the MMLF. The third column of each security-type grouping shows the difference between the means and the *t*-statistics for the null that the means are the same. Remaining maturities are calculated in days relative to February 28.

d. Effect of the MMLF on Investor Flows

Outflows from prime MMFs began to abate shortly after the MMLF was announced on March 18. Between March 23 (the day of the MMLF inception) and the end of March, domestic prime MMFs only suffered outflows of $28 billion, more than half of which occurred over the first two days after the inception, i.e., before CDs and VRDNs could be pledged at the MMLF. At the beginning of April, domestic prime MMFs started to experience moderate inflows, and by the end of April, they received net inflows for $47 bn (33% of what they lost during the run). The rebound for offshore prime MMFs was similar, as they suffered outflows until April 1, when their assets reached their minimum level in 2020. From April 1 onward, however, offshore prime MMFs experienced net inflows for 12 consecutive days, for a total of $28 bn (28% of what they lost during the run).

[27] Illiquid assets such as CDs and CP only enter the calculation of a fund's WLA when their remaining maturity is five days or less.

One could wonder whether such a massive reduction in outflows was due to the MMLF or rather to changing market conditions. The task of identifying the impact of the MMLF is made harder by the fact that other Federal Reserve facilities, such as the Commercial Paper Funding Facility and the Primary Dealer Credit Facility, were established at the same time.[28]

In order to identify the effect of the MMLF on fund flows and measure its effectiveness in stemming the run, we follow a methodology similar to that developed by Duygan-Bump et al. (2013) to estimate the impact of the AMLF. They propose to identify the impact of the AMLF on outflows by assuming that it should be stronger for funds that have relatively more ABCP to sell to the AMLF.[29]

Similarly, we estimate the impact of the MMLF through regression analysis, by assuming that it should be stronger on those funds that hold relatively more illiquid assets in their portfolios (which therefore benefit more from the MMLF's liquidity provision) and whose investors are more concerned about the funds' liquidity (see Box 2).[30] For domestic institutional prime MMFs, a 10 percentage-point increase in the share of illiquid securities in the fund's portfolio leads to an increase in daily flows of 0.4 pp after the introduction of the MMLF. This effect is not only statistically significant but also economically important: over the 20 business days (i.e., roughly a month) following the opening of the facility, it amounts to an increase in cumulative flows of 8 pp.

For retail funds, in contrast, the share of illiquid securities in the fund portfolio does not have a material effect on their post-MMLF flows, consistent the fact that retail outflows during the run were unrelated to funds' liquidity positions; as discussed above, retail fund outflows were driven by other factors, including, in particular, a contagion spillover from the outflows in the institutional prime funds in the same family (Cipriani and La Spada, 2020). The results are also insignificant for offshore prime MMFs, consistent with the fact that offshore funds were not eligible to participate in the MMLF. This evidence, however, should not be read as implying that the MMLF did not have an impact on retail or offshore funds; indeed, as mentioned above,

[28] A description of Federal Reserve's policy tools, including 2020 liquidity and credit facilities, can be found here: https://www.federalreserve.gov/monetarypolicy/policytools.htm

[29] Li et al. (2020) find evidence that the MMLF slowed down the run by comparing the post-MMLF flows of domestic MMFs, which were eligible to use the MMLF, with those of offshore funds, which were not.

outflows from those funds also abated after the inception of the facility. Arguably, the reduction in retail and offshore outflows was not a direct result of the funds' usage of the facility; rather, outflows from retail and offshore funds likely subsided because of the overall improvement in secondary market conditions and the reduction of contagion spillovers from institutional funds.

e. Effect of the MMLF on Secondary-Market Rates

As Figure 3 shows, money market rates declined after the introduction of the MMLF. The spreads between top-rated CP rates (both secured and unsecured) and the IOER went back to their pre-crisis levels by April 1, that is, roughly within a week after the MMLF began operations. The reduction in second-tier nonfinancial CP was also visible but more gradual: at the end of April 2020, their spread relative to the IOER was still around 0.5%, up from 0.1% at the end of February.

As with flows, it is difficult to attribute the improvement in market rates to the MMLF because market conditions were changing dramatically over the run period. To identify the effect of the MMLF on money market rates, we exploit the fact that second-tier CP are not eligible collateral under the MMLF. Therefore, we expect that across maturity buckets, if the MMLF had an impact, rates on second-tier CP should revert more slowly than other CP rates. Regression analysis shows that, in the month following the introduction of the MMLF, the rates of second-tier CP declined less than those of top-rated ones by 0.9 pp; this result holds across all maturity buckets considered, from overnight to 30 days (see Box 3).

Roughly at the same time as the MMLF, the Federal Reserve also established the Commercial Paper Funding Facility (CPFF), to provide liquidity to the issuers of commercial paper. The CPFF supported primary issuance and not the secondary market; nevertheless, since the CPFF also did not accept second-tier CP, the above results could be driven by the impact of the Federal Reserve's support of CP issuance on secondary markets. To address this concern, we repeat a similar regression analysis for CDs, whose issuance was not supported by the CPFF. To identify the effect of the MMLF on CD rates, we exploit the fact that only negotiable CDs could be pledged to the facility. Results are similar to those for CP: after the introduction of the MMLF, the rates of non-negotiable deposits maturing within seven days decline less than those

of negotiable CDs with the same maturity by 0.2 pp. The result is weaker for CDs with maturity between 15 and 30 days but still statistically significant (see Box 4).

5. Conclusions

In March 2020, as the Covid-19 pandemic hit the U.S. and Europe, prime MMFs suffered very large investor outflows, of similar percentage magnitude to those experienced in 2008 during the Great Financial Crisis. The Federal Reserve established the MMLF in order to assist "money market funds in meeting demands for redemptions by households and other investors, enhancing overall market functioning and credit provision to the broader economy" (Federal Reserve Press Release, 3/18/2020).

Through the MMLF, the Federal Reserve Bank of Boston made non-recourse loans to eligible borrowers, taking as collateral eligible assets purchased by the borrowers from eligible MMFs. The facility, which was similar to the AMLF established in 2008, absorbed $58 billion of prime-MMF assets. With the facility's assistance, MMFs sold their most illiquid securities, thereby boosting their liquidity positions while meeting redemptions. In the aftermath of the MMLF's inception, outflows from prime funds abated, and the strains in the broader short-term funding markets subsided.

Because the MMLF was established in the midst of a financial crisis and a rapidly changing economic outlook, it is difficult to directly estimate its impact. Nonetheless, we provide evidence that the facility directly helped stem the outflows from prime MMFs and contributed to the easing in money market rates. Because of its positive effect on secondary markets, the facility also had a beneficial impact on offshore prime MMFs, which it did not directly target. By helping prime MMFs meet redemptions and reducing their outflows, the facility improved overall market functioning and supported credit provision to the real economy.

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Boxes

Box 1: MMLF Usage as a Function of Funds' Outflows.

We run the following fund-level cross sectional regression:

$$MMLF\ Pledges_i = \alpha + \beta_0\ Inst_i + \beta_1\ Run\ Flows_i\ + \beta_2\ Inst_i * Run\ Flows_i + \epsilon_i, \qquad (1)$$

where $MMLF\ Pledges_i$ is the pledge of fund i's assets to the MMLF in billions of USD; $Inst_i$ is a dummy variable for institutional funds; and $Run\ Flows_i$ is fund i's cumulative net flows for the run period in billions of USD. The model is estimated for three run periods: 3/6-3/18; 3/6-3/20; and 3/6-3/26. Results are in columns (1), (2), and (3) of the table below. *t* statistics, in parentheses, are robust to heteroskedasticity. The regression is run on prime-MMF data from iMoneyNet.

	MMLF Pledges (USD bn)		
	(1)	(2)	(3)
Inst	0.057	0.107	0.047
	(0.35)	(0.66)	(0.28)
Run Flows (USD bn)	-0.410*	-0.275**	-0.188**
	(-1.98)	(-2.11)	(-2.08)
Inst*Run Flows (USD bn)	-0.055	-0.062	-0.140
	(-0.25)	(-0.42)	(-1.28)
Observations	61	61	61
Run Period	3/6-3/18	3/6-3/20	3/6-3/26

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Sources: Federal Reserve Bank of Boston, iMoneyNet, and staff calculations.

Box 2: Effect of the MMLF on the Flows in Prime MMFs.

We run the following fund-level panel regression at the daily frequency on January-April 2020:

$$Flows_{it} = \alpha_i + \mu_t + \beta\ MMLF_t \times Illiquid\ Securities_i + \epsilon_{it}, \qquad (2)$$

where $Flows_{it}$ is the net flow in fund i on day t as a percent of its total net assets (TNA) on the previous business day; $MMLF_t$ is a dummy equal to one after the MMLF became operational (March 23); and $Illiquid\ Securities_i$ is the share of illiquid securities in the portfolio of fund i. $Illiquid\ Securities_i$ includes ABCP, unsecured CP, CDs, and VRDNs; we measure the share of illiquid securities in a fund's portfolio in December 2019 to mitigate endogeneity issues. We include fund fixed effects (α_i) to control for unobservable fund-specific characteristics and time

fixed effects (μ_t) to control for unobservable macro factors. Standard errors are robust to heteroskedasticity and both serial and cross correlation (Driscoll-Kraay standard errors with 10 lags).

The model is estimated separately on domestic institutional, domestic retail, and offshore prime funds. The regression is run on prime-MMF data from iMoneyNet. Results are in Columns (1), (2), and (3) of the table below.

	Flows (%)		
	(1)	(2)	(3)
MMLF * Illiquid Securities (%)	0.043***	-0.006	-0.001
	(2.72)	(-1.17)	(-0.17)
Observations	2573	2560	2295
Sample	Institutional	Retail	Offshore
Date FE	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Sources: iMoneyNet and staff calculations

For robustness, we also estimated regression (2) changing the definition of the MMLF dummy to when the facility was announced (March 18) and when it started accepting CDs and VRDNs (March 25); results are largely similar.

Box 3: Effect of the MMLF on CP Rates

We run the following regression on a panel of daily rates for various CP types and maturity buckets:

$$Rate_{it} = \alpha_i + \mu_t + \beta\ MMLF_t \times Second\ Tier_i + \epsilon_{it}, \quad (3)$$

where $Rate_{it}$ is the spread between the rate of CP of type i and the IOER on day t; $MMLF_t$ is defined as in Box 2; $Second\ Tier_i$ is a dummy for second-tier CP, which were not eligible for the MMLF. The types of CP included are AA ABCP, AA financial unsecured CP, AA nonfinancial unsecured CP, and second-tier nonfinancial CP. We include security-type fixed effects (α_i) to control for unobservable security-type characteristics and time fixed effects (μ_t) to control for macro factors. Data on CP rates are from the Federal Reserve Board. The model is estimated on January – April 2020, and standard errors are Driscoll-Kraay with 10 lags.

The model is estimated separately on overnight, 7-day, 30-day maturities. Results are presented in the table below, Columns (1) to (3).

Since the slower normalization of second-tier CP rates after the MMLF introduction could be at least partially driven by their higher credit risk—rather than their ineligibility under the MMLF—for robustness, we estimate regression (2) including as regressor the interaction of the VIX index, which captures changes in market volatility, with the dummy for second-tier CP; although smaller in magnitude, results are qualitatively similar (see columns (4)-(6) of the table below).

Table

	Rate (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
MMLF*Tier 2	0.894***	0.873***	0.952***	0.315	0.417**	0.587***
	(2.71)	(3.55)	(6.42)	(1.26)	(2.29)	(4.13)
VIX*Tier2				0.031***	0.024***	0.019***
				(4.53)	(4.74)	(4.69)
Observations	332	314	289	332	314	289
Maturity	Overnight	7 Day	30 Day	Overnight	7 Day	30 Day
Security Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Sources: FRED and staff calculations

Box 4: Effect of the MMLF on CD Rates

The table below reports the estimates of the regressions described in Box 3 run on CD rates (instead of CP rates, which could also be affected by the CPFF); data are from Form FR2420. In order to identify the impact of the MMLF, we interact the MMLF dummy with a dummy for non-negotiable CDs, which, similarly to second-tier CP, were also not eligible for the MMLF. The model is estimated separately for deposits with remaining maturities within 7 days and 15-

30 days; results are in Columns (1) and (2), respectively. Standard errors are Driscoll-Kraay with 10 lags. The sample period is January-April 2020.

Table

	Rate (%)			
	(1)	(2)	(3)	(4)
MMLF*Non-negotiable	0.176***	0.098***	0.171***	0.127***
	(5.97)	(3.28)	(5.55)	(3.03)
VIX*Non-negotiable			0.000	-0.001
			(1.02)	(-1.15)
Observations	164	160	162	158
Maturity	Within 7 Days	15-30 Days	Within 7 Days	15-30 Days
Security Type FE	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Sources: FR2420 and staff calculations

As with CP, we also estimate the regression on CD rates including as regressor the interaction of the VIX with the dummy for non-negotiable deposits, to control for the effect of a possible difference in credit risk. Results are in Columns (3) and (4) and similar to the baseline ones.