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Sophisticated and Unsophisticated Runs

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Abstract

This paper characterizes the run behavior of sophisticated (institutional) and unsophisticated (retail) investors by studying the runs on prime money market funds (MMFs) of March 2020, at the beginning of the Covid-19 pandemic. For both US and European institutional prime MMFs, the runs were more severe in funds for which the imposition of redemption gates and fees was a material possibility because of their lower liquidity positions. In contrast, although US retail prime MMFs are also required to adopt the same system of gates and fees, their outflows did not depend on fund liquidity; unsophisticated (retail) investors ran more often if their funds belonged to a family offering institutional prime MMFs and suffering larger institutional redemptions. Finally, across investor types, MMFs belonging to families with a larger share of government MMFs experienced larger outflows; this result is consistent with lower switching costs in fund families that offer both prime and government funds.
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1. Introduction

In March 2020, at the beginning of the Covid-19 pandemic, investors redeemed en mass from prime money market funds (MMFs). At the height of the run, cumulative redemptions from US-dollar prime MMFs, both onshore and offshore, were 22% of industry's total net assets (TNA) as of the end of 2019. Outflows were significant for both institutional (32%) and retail investors (11%). This is the second time the industry has suffered a run over the last 20 years: in 2008, after Lehman bankruptcy, redemption pressures of similar magnitude buffeted the industry. In both cases, the Federal Reserve intervened to stem the outflows with the establishment of emergency lending facilities.

In this paper, we use the 2020 run to characterize the behavior of sophisticated and unsophisticated MMF investors. The 2014 SEC reform separated prime MMFs by investor type, separating funds catering only to retail (unsophisticated) investors from those catering to institutional (sophisticated) ones. We show that the behavior of these two classes of investors were dramatically different during the crisis, which we view as a result of their different level of sophistication.

Institutional investors left those prime funds that were more likely to gate or charge a fee on redemptions. Therefore, their decision to run was based on an assessment of the likelihood that their access to liquidity might be impaired. This is true both for institutional onshore funds and for institutional offshore funds.

We identify the impact of gates and fees in two ways. First, since gates and fees can be imposed only if a fund's weekly liquid assets (WLA) drop below a threshold, we instrument funds' WLA with their average values in 2019Q4; our instrument allows us to control for reverse causality issues due to a fund's liquidity management during the run. We find that a 10 percentage-point decrease in 2019Q4 WLA leads to an increase in daily outflows of 1.1 percentage points in onshore institutional prime MMFs and of 0.6 percentage points in offshore prime LVNAV MMFs.

Second, we exploit the fact that some offshore institutional prime MMFs are exempt from the imposition of gates or fees. During the run, such funds experienced daily outflows that were 1.3 percentage points smaller than those suffered by offshore institutional funds that can impose gates and fees.

No such relationship between the likelihood of gates or fees and investor flows exists in retail funds. Instead, retail investors left those prime MMFs belonging to families that also catered to institutional prime investors and suffered heavier institutional redemptions. For example, during the run, retail prime MMFs in families also offering institutional funds experienced daily outflows that were 1.7 percentage points larger. In other words, (unsophisticated) retail investors seem to base their decision by following the behavior of (sophisticated) institutional investors within the same fund family.

The imposition of gates or fees is one of the main regulatory changes of the prime MMF industry introduced by the SEC in its 2014 reform. At that time, some practitioners, policy makers, and academics feared that the new regulation would make runs more likely by giving an incentive for investors to leave a fund preemptively ahead of a gate or fee being imposed. For instance, Cipriani *et al.* (2014) show in a simple Diamond and Dybvig (1983) model that such an incentive is present and that preemptive runs would occur. In this paper, we show that such a theoretical mechanism is indeed consistent with investors' behavior; however, it does require some level of sophistication for investors to run preemptively, and, as a result, we do not observe preemptive runs in retail prime MMFs. The unintended consequence of redemption gates and fees, however, can still propagate to retail funds via within-family spillovers from institutional to retail investors.

Finally, investors who left the prime MMF sector largely moved their money to government funds, consistently with past episodes of industry dislocation. This is true both of retail and of institutional investors. Prime MMFs belonging to families more specialized in government MMFs experienced larger outflows. For example, a 10 percentage-point increase in the share of government MMFs in a family's MMF business in 2019Q4 leads to daily outflows during the run that are larger by 0.24 percentage points in onshore institutional prime funds and 0.20 percentage points in onshore retail prime funds. This result suggests that, for both institutional and retail investors, there are lower switching costs in fund families that offer both products, which could lead to higher flow volatility during periods of stress.

Several recent papers have studied episodes of severe dislocation in the MMF industry. The 2008 run on prime MMFs was described in Baba *et al.* (2009), Brady *et al.* (2012), and Kacperczyk and Schnabl (2013), among others. Cipriani and La Spada (2017) analyze investors' behavior in response to the 2014 SEC reform of the MMF industry; they show that the imposition of a system of gates and fees on onshore prime MMFs (along with the floating NAV requirement for institutional ones) led to outflows of more than a trillion dollars from prime MMFs. Schmidt *et al.* (2016) study the relationship between fund flows during the 2008 run and investor sophistication, focusing on the externalities caused by the presence of investors with different levels of sophistication (e.g., institutional and retail ones) within the same fund. We follow their interpretation of the differences in institutional versus retail behavior as reflecting different levels of investor sophistication.[1]

The 2020 Covid-19 run is also studied by Li et al. (2020). They provide similar evidence to ours on the impact of gates and fees on investor flows in US institutional prime MMFs, while differing in the identification strategy; we discuss the difference in our empirical analysis. Casavecchia *et al.* (2020) document the March 2020 run

[1]For instance, several papers have shown that institutional investors respond strongly to fund performance such as Kacperczyk and Schnabl (2013), Chernenko and Sunderam (2014), and La Spada (2018).

focusing on institutional prime MMFs and their floating NAV feature.

The remainder of the paper is as follows: Section 2 describes onshore and offshore MMFs and our dataset; Section 4 describes the run by (sophisticated) institutional investors; Section 5 describes the run by (unsophisticated) retail investors; and Section 6 shows the effect of family specialization in government funds on run behavior.

2. Institutional Background

2.1. Onshore Money Market Funds

Onshore MMFs are open-end mutual funds, based in the Unites States, that invest in USD money-market instruments with short maturity and high credit quality. MMFs can be divided in two main types: government funds, which can only buy treasuries, GSE debt, and repurchase agreements (repos) backed by either Treasury or agency debt; and prime funds, which can also buy private unsecured debt such as certificates of deposit (CD), commercial paper (CP), asset-backed commercial paper (ABCP), and variable rate demand notes (VRDN).[2]

MMFs are important providers of liquidity to banks and other financial and non-financial institutions. At the end of 2019, prime and government MMFs had a total of roughly $3.43 trillion in TNA, of which roughly 78% was in government funds and 22% was in prime funds.

Prime MMFs can be further divided in two types: retail funds, catering to (unsophisticated) retail investors, and institutional funds, catering to (sophisticated) institutional investors. Retail funds are forbidden from offering their shares to institutional investors (defined by the regulation as all non natural persons); although in-

[2]In our analysis, we disregard tax-exempt municipal (muni) funds, which mainly invest in short-term bonds and VRDNs issued by state and local governments. As of the end of 2019, muni funds only amounted to 4% of the onshore MMF industry. Most of the discussion of prime MMFs in this section also applies to muni MMFs.

stitutional funds can sell their shares to retail investors (natural persons), in practice they do not. Government MMFs are not subject to the same regulatory distinction.

MMFs are regulated by the SEC under Rule 2a-7 of the 1940 Investment Company Act, which imposes tight limits on the credit risk, maturity, and concentration of the funds' portfolios.[3] Until October 2016, when the 2014 SEC MMF reform was implemented, all MMFs were allowed to keep their net asset value (NAV) at $1 per share by valuing assets at amortized cost. Fixed-NAV MMFs shares are money-like assets similar to bank deposits. Since MMF shares are not insured by the government and are daily redeemable, however, the stable-NAV feature makes MMFs susceptible to runs.

In 2008, the prime-MMF industry experienced a widely-known run. On September 16, 2008, the Reserve Primary Fund, the oldest MMF, was forced to reprice its share (it "broke the buck") after writing off Lehman Brothers debt; the run on the Reserve Primary Fund quickly spread to other prime MMFs, triggering investors' redemptions of more than $300 billion within a few days of Lehman's default (Kacperczyk and Schnabl, 2013).[4] Only prime MMFs suffered outflows; government MMFs actually received inflows as they were perceived as a safe haven. Moreover, within the prime sector, redemptions from institutional investors were much larger and faster than those of retail ones.

In July 2014, the SEC approved a new set of rules for prime MMFs in order to reduce the risk of runs (see SEC Release No. IC-31166).[5] The regulatory change, which took effect in October 2016, has two main pillars. First, institutional prime

[3]For example, MMFs can only purchase securities with remaining maturity of 397 days or less.

[4]In the summer of 2011, a "slow-motion run" hit the prime MMF sector as fears about European sovereign debt problems mounted, causing redemptions of more than $170 billion in approximately two months and disrupting the ability of both European and non-European firms to raise financing in the money markets (Chernenko and Sunderam, 2014). Differently from the 2008 and 2020 runs, the 2011 run was a slow-moving event, not limited to few days or weeks.

[5]The SEC had adopted a first set of reforms in 2010; see SEC Release No. IC-29132. For a discussion of reform option, see McCabe *et al.* (2013).

MMFs must price their shares based on the market value of the securities in their portfolios (floating NAV). Second, all prime MMFs may temporarily suspend (or "gate") redemptions for up to 10 business days in a 90-day period or impose a liquidity fee of up to 2%, if the fund's weekly liquid assets (WLA) fall below 30% of its total assets.[6] Additionally, prime MMFs are required to impose a liquidity fee of 1% on all redemptions if the fund's share of WLA falls below 10%.[7]

2.2. Offshore Money Market Funds

Offshore USD MMFs are funds domiciled abroad that, similarly to onshore MMFs, invest in dollar-denominated money-market instruments with short maturity and high credit quality. Similarly to onshore MMFs, they can be broadly classified into "government" and "prime" funds. Differently from onshore funds, however, all offshore MMFs cater to institutional investors.

Offshore USD MMFs are not regulated by the SEC and therefore were unaffected by the 2014 MMF reform. Most offshore USD MMFs are domiciled in Ireland and Luxembourg and are regulated by the European Union. In June 2017, the European Parliament approved a regulatory reform of the European MMF industry, which was implemented in March 2019. Under this reform, European "prime" MMFs are classified into three sub-categories: short-term low-volatility NAV (LVNAV) funds, short-term variable NAV (VNAV) funds, and standard VNAV funds.[8] The regulation of LVNAV MMFs differs significantly from that of short-term and standard VNAV MMFs (from now on, non-LVNAV funds).

[6]The 2014 MMF reform defines WLA as cash, US Treasuries, government agency discount notes with remaining maturities of 60 days or less, securities that mature or are subject to a demand feature exercisable and payable within five business days, and amounts receivable and due unconditionally within five business days on pending sales of portfolio securities.

[7]This requirement can be overridden if the fund's board determines that it is not in the best interest of the shareholders.

[8]Short-term MMFs have a maximum of WAM of 60 days and a maximum WAL of 120 days, whereas standard MMFs have maximum limits of 180 and 365 days respectively.

LVNAV funds can price their shares at a constant NAV by using amortized cost valuation.[9] In contrast, non-LVNAV funds can only use mark-to-market pricing, which results in a variable daily NAV.

Offshore LVNAV funds are required to impose a liquidity fee or a gate if the liquidity of their portfolios deteriorates below given thresholds; in contrast, offshore non-LVNAV MMFs are not required to do so.[10]

LVNAV funds have stricter liquidity requirements than non-LVNAV funds. Similarly to onshore prime MMFs, LVNAV funds must invest at least 30% of their portfolios in weekly liquid assets, including 10% in daily liquid assets. The minimum requirements for non-LVNAV funds, in contrast, are 15% for weekly liquid assets and 7.5% for daily ones.[11]

European government MMFs, called "public debt funds," are funds that invest at least 99.5% of their portfolios in public debt securities or repos backed by them. They can price their shares at a constant NAV using amortized cost.[12]. Similarly to LVNAV funds, they are allowed impose gates and fees if their WLA are too low.

2.3. Data

Daily data on fund flows, both onshore and offshore, are from iMoneyNet. For US MMFs, weekly data on fund WLA are from the regulatory Form N-MFP, filed

[9] Specifically, LVNAV funds can use amortised cost provided that the marked-to-market value of their portfolio does not deviate by more than 20 basis points from par. Funds must use mark-to-market valuation for assets with remaining maturity above 75 days; securities that are more than 10 basis points away from market values must be marked to market.

[10] LVNAV can apply gates and fees only if i) their weekly liquid assets (WLA) fall below 30 percent and ii) daily net redemptions exceed 10 percent. Moreover, LVNAV funds are required to either apply a liquidity fee or gate redemptions if their WLA fall below 10%. Under the EU regulation, WLA include cash and securities maturing within a week. For LVNAV funds, it can include up to 17.5% government securities with maturity up to 190 days; for non-LVNAV funds, instead, it can include up to 7.5% of other MMFs' shares.

[11] Moreover, the weekly liquid assets of LVNAV funds must include a minimum of 12.5% of the portfolio in cash, repos, or deposits, whereas the minimum requirement for VNAV funds is 7.5%.

[12] They can do so as long as the difference with respect mark-to-market pricing does not exceed 50 basis points

monthly with the SEC, and reflect a fund's WLA as of every Friday in a month; these regulatory data have a better coverage of the US MMF industry than the daily WLA data available through iMoneyNet. For the WLA of offshore MMFs, which do not submit regulatory filings with the SEC, we use iMoneyNet data.

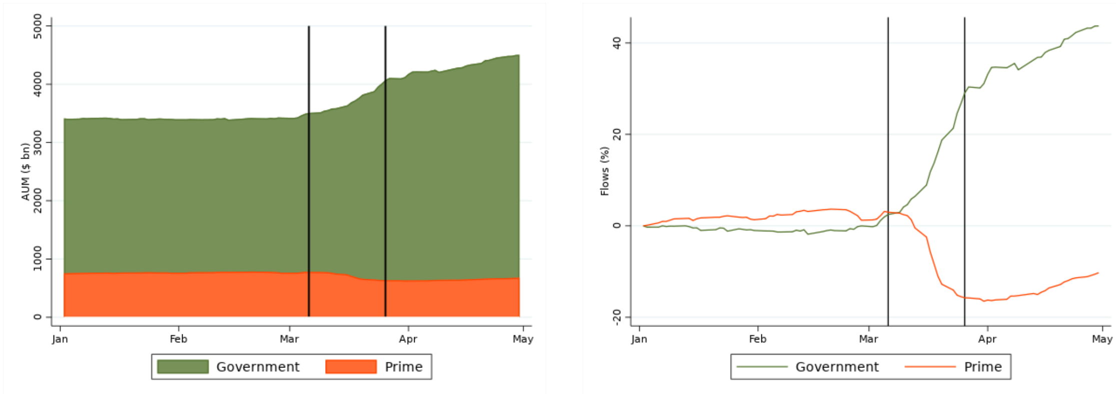
In our analysis, we drop feeder funds, which we identify through the regulatory Form N-MFP (onshore funds) or their portfolio holdings (offshore funds).

3. The March 2020 runs on prime MMFs

Over the first three weeks of March 2020, as uncertainty surrounding the COVID-19 pandemic increased, prime MMFs faced large redemption pressures, both in the US and abroad.[13] As in past episodes of industry dislocation, outflows from prime funds were accompanied by large inflows into government MMFs.

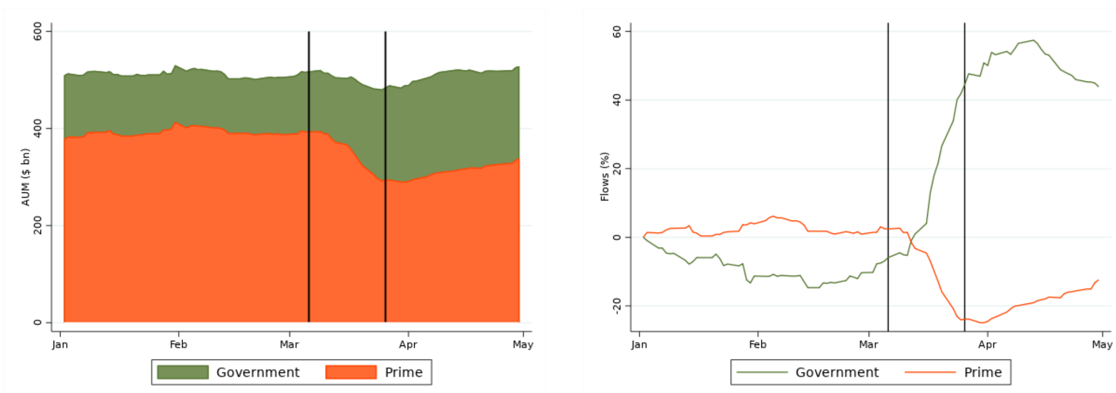
The left panel of Figure 1 shows the TNA of US prime and government MMFs from January to April 2020; the right panel shows the cumulative percentage flows in both groups. Figure 2 reports the same data for offshore MMFs.

[13]Muni MMFs experienced similar redemption pressures, as documented in Cipriani *et al.* (2020a) and (2020b).



(a) TNA **(b)** Cumulative % flows

Fig. 1. Total net assets (TNA) and cumulative percentage flows in onshore MMFs by fund type during January-April 2020. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the run).



(a) TNA **(b)** Cumulative % flows

Fig. 2. Total net assets (TNA) and cumulative percentage flows in offshore MMFs by fund type during January-April 2020. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the run).

Outflows from the prime-fund industry started on March 6 and continued for 20 consecutive days. Onshore funds lost \$143 billion (bn) over March 6-26, corresponding to a cumulative outflow of 19% relative to the industry's TNA as of the end of 2019; offshore funds lost \$100 bn, which corresponds to 27% of their TNA at the end of 2019. At the same time, by March 26, onshore government MMFs had received inflows for 27% of their 2019 size, and offshore government MMFs for 52%.

Outflows from prime (and inflows in government) MMFs abated after the introduction of the Money Market Funds Liquidity Facility (MMLF). The MMLF was announced on March 18, began operations on March 23, and on March 25 expanded the pool of eligible collateral to include CDs and VRDNs (in addition to CP, ABCP, and some municipal securities which were accepted since inception).

Throughout our paper, we use March 6 (the first day of consecutive aggregate outflows) as the beginning of the Covid-19 runs on prime MMFs and March 26 (the day when aggregate outflows ceased) as the end. For robustness's sake, we consider two alternative end dates: March 20 (the last business date before the inception of the MMLF) and March 24 (the last business day before the MMLF started accepting CDs and VRDNs).

4. The sophisticated run: institutional investors and the role of gates and fees

4.1. Onshore funds

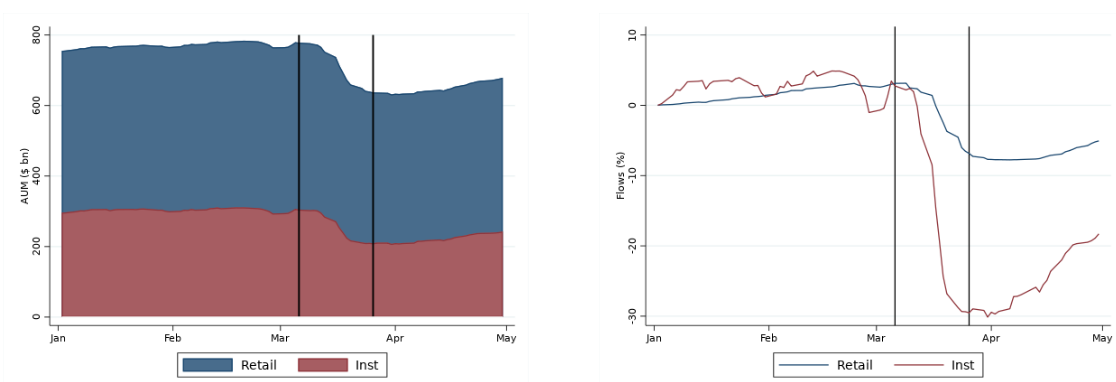
The left panel of Figure 3 shows the TNA of retail and institutional prime funds from January to April 2020; the right panel shows their cumulative percentage outflows. As a share of the sector's TNA at the end of 2019, cumulative percentage outflows from institutional prime funds reached 31% on March 26; cumulative percentage outflows from retail prime funds were smaller, reaching 10% percent on March 26.[14] In percentage terms, these outflows were greater than those suffered by institutional and retail prime MMFs during the 2008 financial crisis.[15]

[14]Outflows from retail prime MMFs, although smaller in magnitude, persisted until April 6, reaching 11%.

[15]In dollar terms, outflows were smaller than in 2008 due to the shrinkage of the prime MMF industry caused by the 2014 SEC reform, documented in Cipriani and La Spada (2017).

The larger outflows from institutional funds are consistent with past episodes of industry dislocation (see Cipriani and La Spada, 2017) and can be attributed to the higher sophistication of institutional investors relative to retail ones. Indeed, this will be the focus of much of our analysis in the rest of the paper. It is also interesting to notice that larger institutional outflows occurred notwithstanding the fact that institutional prime funds (but not retail ones) were forced to adopt a floating NAV (whose main objective was to make runs less likely).

Table 1 shows a series of statistics on the distribution of flows across funds during the run, separately for institutional and retail prime funds. Between March 6 and March 26, the median institutional fund experienced cumulative outflows of 29%; for the top 25 percent of funds, cumulative outflows were as large as 40%, whereas, for the bottom 25 percent, they were only 5%. Similarly, the median retail prime fund experienced no material change in TNA, whereas the top 25 percent experienced cumulative outflows of 11%, and the bottom 25 percent cumulative inflows of 8%. In other words, not only outflows were larger in institutional funds than in retail ones, but there was also a significant degree of heterogeneity within both types of funds.



(a) Total net assets **(b)** Cumulative percentage flows

Fig. 3. Total net assets (TNA) and cumulative percentage flows in onshore prime MMFs by investors type during January-April 2020. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the run).

	Outflows (%)			
	Retail	Institutional	Retail	Institutional
Min	-18	-58	-23	-66
P25	-7	-35	-11	-40
P50	0	-17	0	-29
P75	6	-4	8	-5
Max	22	12	45	6
Period	3/6-3/20	3/6-3/20	3/6-3/26	3/6-3/26

Table 1. Fund-level summary statistics of flows in institutional and retail onshore prime MMFs during the March 2020 run.

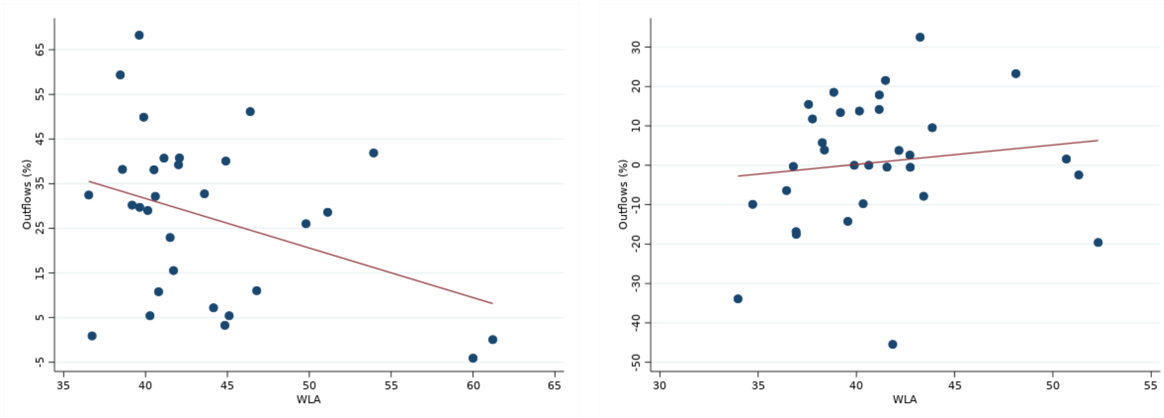
4.2. The role of WLA

The 2014 SEC reform has required all prime MMFs to adopt a system of gates and fees. Under this system, when a fund's WLA drop below 30% of the portfolio, the fund is allowed to impose either gates or fees.[16] At the time the regulation was adopted, there was the fear that the new system of gates and fees could trigger preemptive runs as a fund's WLA approached the 30 percent threshold (see Cipriani *et al.*, 2014, for a theoretical argument); the fear was that the threshold would become a focal point, acting as a coordination device for MMF investors. Of course, the Covid-19 run offers a clear opportunity to test such hypothesis.

To do so, we study fund outflows as a function of fund WLA. Figure 4 shows a scatter plot of funds' cumulative outflows over the run period March 6-26 against their average WLA in January-February, i.e., before the run started, separately for institutional and retail prime funds. For institutional funds, there is a clear negative relationship between WLA and outflows: funds with lower WLA experienced higher outflows during the Covid-19 run ($\beta = -1.1$ with p-value $= 0.08$). In contrast, for retail funds, there is no visible relationship between a fund's outflows and its WLA

[16] When the fund's WLA drop below 10%, the fund is required to impose a liquidity fee of 1% on all redemptions.

before the run started ($\beta = 0.4$ with p-value $= 0.52$).



(a) Institutional prime MMFs **(b)** Retail prime MMFs

Fig. 4. Scatterplot of cumulative percentage outflows from onshore prime MMFs during the March 2020 run (March 6-March 26) against a fund's average WLA in January-February 2020.

We study the relationship between a fund's WLA and outflow through a regression analysis from January 2020 until the end of the run. One needs to be mindful, however, that investor flows affect fund liquidity, as funds have to sell their assets to meet redemption. Such reverse-causality effect can persist over several days, especially if outflows are correlated in time as is likely to happen during a run.

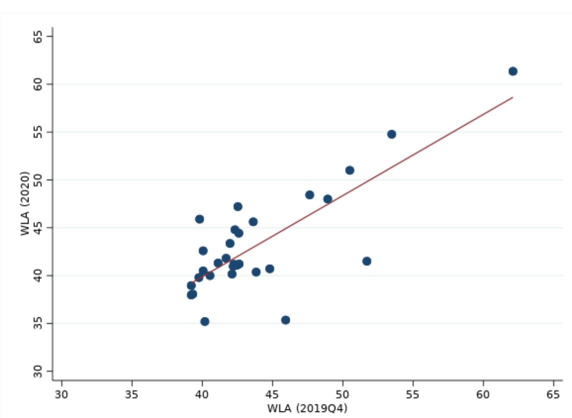
To address this reverse-causality issue, we instrument a fund's WLA with their average level over 2019Q4, a period of relative calm in the industry.[17] This instrument is relevant because different funds tend to target different WLA levels. In fact, WLA are quite widely distributed across funds, and, in good times, a fund's WLA are very stable. For example, Table 2 shows that, over September 2019-February 2020, average WLA ranged from 37% to 99% of the fund portfolio in the cross-section of institutional prime MMFs. The median week-to-week standard deviation of a fund's WLA, in contrast, was just 2 percentage points. Similar results hold for retail funds.

[17] Our identification strategy for the effect of the WLA differs from that of Li *et al.* (2020), who use the share of assets maturing during the crisis period in a fund's portfolio as of the end of February.

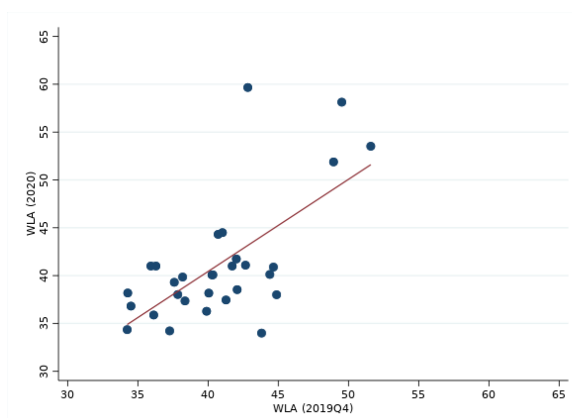
	Retail WLA[%]	Institutional WLA[%]
	Within-fund Average	
Min	34	37
P25	37	40
P50	40	42
P75	42	45
Max	51	99
	Within-fund Standard Deviation	
Min	1	0
P25	2	2
P50	2	2
P75	3	3
Max	6	12
Period	September 2019-February 2020	

Table 2. Summary statistics of the within-fund average and standard deviation of WLA over September 2019-February 2020 in onshore prime MMFs, by investor type.

Moreover, as shown in Figure 5, a fund's average WLA in 2019Q4 are good predictors of its WLA on March 6 (the day the runs started), for both institutional and retail prime MMFs. In fact, the slope coefficient from a simple OLS cross-sectional regression is 0.85 (p-value < 0.001) for institutional prime funds, with an $R^2 = 0.61$, and 0.96 (p-value < 0.001) for retail prime funds, with an $R^2 = 0.43$.



(a) Institutional prime MMFs



(b) Retail prime MMFs

Fig. 5. Scatterplot of WLA on March 6,2020 (beginning of the Covid-19 run) against average WLA in 2019Q4 for onshore prime MMFs.

To quantify the effect of WLA on investor flows, we estimate the following fund-level regression at the daily frequency from January 2020 until the end of the run:

$$\text{Outflow}_{it} = \alpha_i + \mu_t + \beta\, \text{Run}_t * \text{WLA}_i + \varepsilon_{it}\,, \tag{1}$$

where Outflow_{it} is the percentage outflow (i.e., negative net flow) in fund i on day t, α_i are fund fixed effects, μ_t are day fixed effects, and WLA_i is fund i's average WLA in 2019Q4.[18] Run_t is a dummy equal to one from March 6 onward. Standard errors are heteroskedasticity robust and clustered at the fund and date level to control for both autocorrelation and cross-correlation. Results are in Table 3 for institutional prime MMFs and in Table 4 for retail prime MMFs. Each column corresponds to a different end date for the run (March 20, 24, and 26, respectively).

	Outflows (%)		
	(1)	(2)	(3)
Run × WLA	-0.15**	-0.13*	-0.11*
	(-2.19)	(-1.78)	(-1.71)
Observations	1620	1680	1740
R^2	0.17	0.17	0.17
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

t statistics in parentheses

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

Table 3. Fund-level regression of daily percentage outflows from onshore institutional prime MMFs against fund WLA in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

[18] Daily net flows are calculated as $(\text{TNA}_{it} - (1 + r_{it})\text{TNA}_{it-1})/\text{TNA}_{it-1}$, where r is the fund's daily yield.

	Outflows (%)		
	(1)	(2)	(3)
Run × WLA	0.06	0.06	0.06
	(1.30)	(1.17)	(1.23)
Observations	1688	1748	1808
R^2	0.09	0.10	0.10
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

t statistics in parentheses

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

Table 4. Fund-level regression of daily percentage outflows from onshore retail prime MMFs against fund WLA in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

As the third column of Table 3 shows, during the Covid-19 run over March 6-26, a 10 percentage-point increase in 2019Q4 WLA decreases the expected daily outflows of institutional prime MMFs by 1.1 percentage points, an effect which is both statistically significant and economically meaningful. We obtain even stronger results when considering a shorter run period, up to March 20 or March 24 (see the first and second column).

Note that as Figure 4 shows, the negative relationship between WLA and outflows is not present in retail funds (for which the slow of fitted line is, if anything, positive). This is confirmed by the regression results in Table 4: the coefficient on WLA is not significant and positive.

The results suggest that only institutional investors were sophisticated enough to monitor their funds' WLA level and respond to the new regulatory regime by preemptively running when a fund's WLA approached the regulatory thresholds,

4.3. Offshore funds

In principle, funds with lower WLA may suffer larger outflows not because of the possible imposition of gates or fees but simply because their portfolios are less liquid, which strengthens the first-mover advantage and hence the likelihood of a run (Goldstein *et al.*, 2017). To disentangle the general effect of portfolio illiquidity from the specific effect of the possible imposition of gates and fees (triggered if portfolio WLA fall below 30%), we exploit the differential regulatory treatment of LVNAV and non-LVNAV offshore prime MMFs.

As discussed in Section 2, offshore LVNAV funds are allowed (and sometimes required) to impose either gates or fees if their WLA deteriorates; in contrast, this regulation does not apply to non-LVNAV prime funds. Figure 6 shows cumulative percentage flows in offshore LVNAV and non-LVNAV funds, along with those in onshore institutional funds. If gates and fees cause investors to run preemptively, we should expect to observe higher outflows from LVNAV funds (which are subject to them) than from non-LVNAV funds (which are not). This is indeed the case.

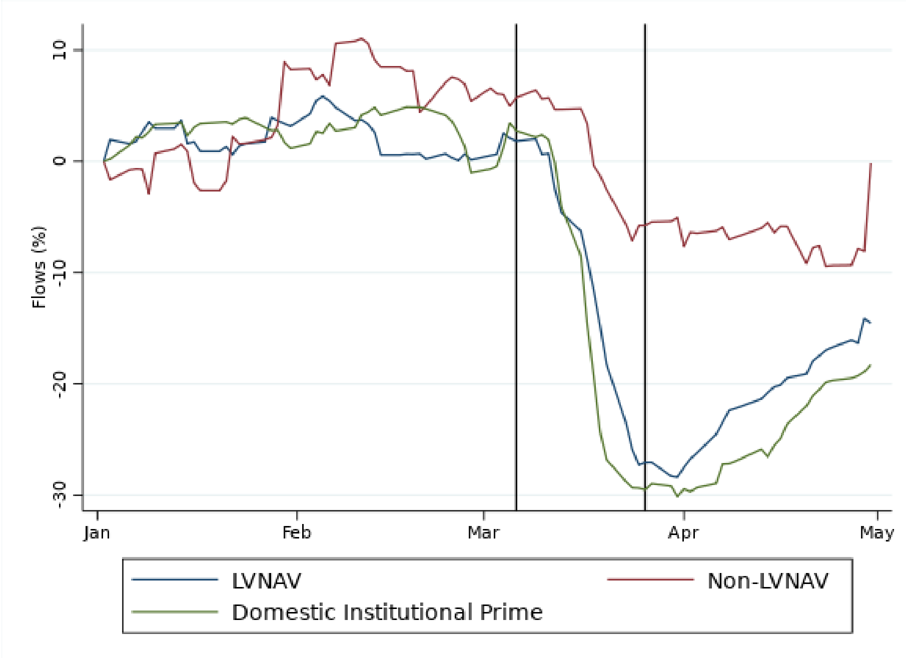


Fig. 6. Cumulative percentage flows in offshore prime MMFs and onshore institutional prime MMFs during January-April 2020. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the run).

The difference in outflows between LVNAV and non-LVNAV funds could also be due to the fact that LVNAV operate with a fixed NAV, whereas non-LVNAV funds do not. A floating NAV is supposed to mitigate run incentives. If the fixed NAV feature were the relevant trigger for the March 2020 run (and not fees or gates), we would expect outflows from offshore non-LVNAV funds to track those from onshore institutional prime funds, which also operate under a floating NAV. This is not the case. Outflows from non-LVNAV offshore funds were significantly smaller than those from onshore institutional funds, which instead were similar to those suffered by offshore LVNAV funds.

Note that the difference between offshore non-LVNAV funds and onshore institutional prime MMFs is unlikely to be due to a different clientele, since offshore MMFs also cater to institutional investors. Indeed, offshore LVNAV and onshore institutional prime MMFs, both subject to gates and fees, experienced similar flows during the run.

In order to better understand the role of gates and fees in offshore funds, we estimate the following daily regression on the panel of offshore prime MMFs:

$$\text{Outflow}_{it} = \alpha_i + \mu_t + \beta\,\text{Run}_t * \text{Non-LVNAV}_i + \varepsilon_{it} \tag{2}$$

where Non-LVNAV is a dummy equal to one for non-LVNAV offshore prime MMFs, and all other variables are defined as in regression (1). Results are in Columns (1)-(3) of Table 5; standard errors are clustered at the fund and date level. During the run period, non-LVNAV funds experienced daily outflows that were, on average, 1.3 percentage points lower than those of offshore LVNAV funds. Columns (4)-(6) report the result of regression (2) when, instead of using offshore LVNAV funds as a control group, we use onshore institutional prime MMFs. Both onshore institutional prime and offshore non-LVNAV MMFs have a floating NAV, but only the onshore ones are subject to gates or fees if their liquidity deteriorates. Results are similar: during the run, non-LVNAV funds experience average daily outflows that are 2.1 percentage points lower than those of onshore institutional prime funds.

It is unlikely that offshore non-LVNAV prime funds experienced smaller outflows because of a higher portfolio liquidity. As discussed in Section 2, offshore non-LVNAV funds have looser regulatory liquidity requirements than both offshore LVNAV funds and onshore institutional prime funds.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Non-LVNAV	-1.31**	-1.22**	-1.32**	-2.50***	-2.19**	-2.11***
	(-2.16)	(-2.12)	(-2.44)	(-2.80)	(-2.64)	(-2.83)
Observations	1660	1720	1780	2376	2464	2552
R^2	0.06	0.07	0.07	0.12	0.12	0.12
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26	1/2-3/20	1/2-3/24	1/2-3/26
Control Group	Offshore LVNAV			Onshore Institutional		

t statistics in parentheses

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

Table 5. Fund-level regression of daily percentage outflows in institutional prime MMFs (offshore and onshore) as a function of the possible imposition of gates and fees. Non-LVNAV is a dummy equal to one for offshore non-LVNAV MMFs. In columns (1)-(3), the sample is all offshore prime MMFs (LVNAV and non-LVNAV); in columns (4)-(6), the sample is offshore non-LVNAV and onshore institutional prime funds (both of which operate under a floating NAV). Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

In Table 6, we report the results of regression (1) estimated on the panel of offshore LVNAV funds. Similarly to the case of onshore institutional prime funds, a 10 percentage-point decrease in the fund's average WLA in 2019Q4 leads to an increase in daily outflows by 0.6 percentage point during the Covid-19 run.[19]

[19]Unfortunately, for offshore non-LVNAV funds, the coverage of WLA data is quite sparse; for 2019Q4, for example, iMoneyNet only has WLA data for two non-LVNAV funds. For this reason, we cannot estimate regression 1 separately on the sample of non-LVNAV funds.

	Outflows (%)		
	(1)	(2)	(3)
Run × WLA	-0.11***	-0.10***	-0.06**
	(-5.01)	(-3.04)	(-2.46)
Observations	840	870	900
R^2	0.08	0.11	0.10
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

t statistics in parentheses

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

Table 6. Fund-level regression of daily percentage outflows from offshore LVNAV MMFs against fund WLA in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

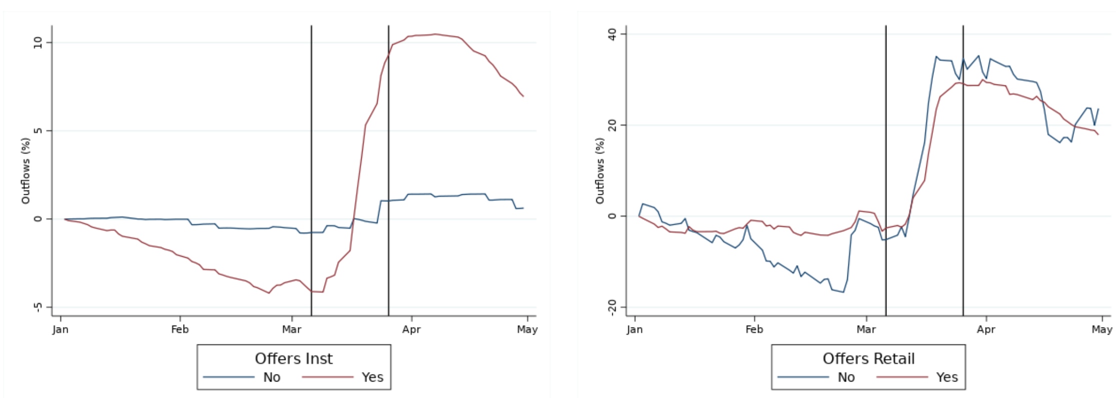
5. The unsophisticated run: retail investors and the role of institutional flows

In contrast to what happened in institutional funds, outflows from onshore retail prime MMFs during March 2020 were not driven by lower levels of WLA, as discussed in Section 4 and shown by Panel (b) of Figure 4. In this section, we show that outflows from retail prime MMFs were driven by the presence of institutional prime MMFs within the same family.

Table 7 shows that, as of the end of 2019, there were seven retail prime MMFs belonging to (seven) families that did not offer any institutional prime MMF. These funds represented 21% of the industry in terms of number of funds and 29% of the industry in terms of dollar value. Panel (a) of Figure 7 shows cumulative outflows in 2020 separately for retail prime MMFs belonging to families with and without institutional prime funds. During the Covid-19 run, the first group experienced much larger outflows, which on March 26 reached 13% of the group's TNA as of the end of 2019; the outflow of the second group were only 2% of their 2019 size.

	US Retail Prime MMFs	
	Family Offers Institutional Prime MMFs	
	No	Yes
AUM [$ billion]	137	335
Funds	7	26
Families	7	18
Median Share of Institutional Prime MMFs	0.20	
	US Institutional Prime MMFs	
	Family Offers Retail Prime MMFs	
	No	Yes
AUM [$ billion]	22	285
Funds	1	33
Families	1	18
Median Share of Retail Prime MMFs	0.41	

Table 7. Summary statistics of retail (institutional) prime MMFs and MMF families by the family's offering of institutional (retail) prime MMFs in 2019Q4.



(a) Retail Prime MMFs

(b) Institutional Prime MMFs

Fig. 7. Left (right) panel: cumulative percentage flows in US retail (institutional) prime MMFs during January-April 2020 as a function of the fund family's offering of institutional (retail) prime MMFs. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the run).

To quantify the effect of the presence of institutional prime MMFs in the family on the outflows from retail funds during the Covid-19 run, we estimate the following daily regression at the family level on the panel of MMF families that offer retail prime funds during our time period:

$$\text{Outflow}_{it} = \alpha_i + \mu_t + \beta\,\text{Run}_t \times \text{Offers Inst}_i + \varepsilon_{it} \tag{3}$$

where $\text{Outflow}_i t$ is the percentage outflow from the retail prime MMFs of family i on day t, α_i are family fixed effects, Offers Inst is a dummy equal to one if the family offers institutional prime MMFs as of the end of 2019, and all other variables are defined as in regression (1). We run regression (3) at the family level because the treatment variable (i.e., whether the family also offers institutional prime funds) is a family characteristic.[20] In Appendix B, however, we report the results of regression (3) estimated at the fund level; results are very similar (see Table 14).

The results of regression (3) are in Table 8. Standard errors are clustered at the family and date level. During the run period, retail prime MMFs in families that also offered institutional prime MMFs experienced daily outflows that were, on average, larger by 1.7 percentage points than those experienced by retail funds in families only offering prime MMFs to retail investors. This effect holds over different definitions of the run period (Columns (1), (3), and (5)). Since total outflows from the retail prime industry reached roughly 10% over a period of 20 business days, the effect of a family's institutional offering is quantitatively relevant.

[20]By family-level regression, we mean that we aggregate (dollar) flows across all funds that belong to the same family.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Inst	1.54***		1.75***		1.69***	
	(3.16)		(3.37)		(3.60)	
Run × Inst Share		1.70***		1.93***		1.98***
		(3.47)		(3.67)		(4.01)
Observations	1350	1350	1400	1400	1450	1450
R^2	0.13	0.13	0.15	0.15	0.14	0.14
Family FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 8. Family-level regression of daily percentage outflows from a family's retail prime MMFs as a function of the fund family's offering of institutional prime funds. Offers Inst is a dummy equal to one if the family also offer institutional prime MMFs in 2019Q4. Inst Share is the average share of institutional prime MMFs in the family's total prime-MMF business over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the family and date level.

In principle, the results in Columns (1), (3), and (5) of Table 8 could be due to the cutoff (presence or not of institutional prime funds) we chose to separate funds into two groups. For robustness, we repeat regression (3) using a continuous treatment variable, the share of institutional prime funds in the family's total prime MMF business (Inst Share). We measure this variable as of the end of 2019 to control for endogeneity. Results are in Columns (2), (4), and (6) of the same table and are very similar: on average, a 10-percentage-point increase of the share of institutional funds in a family's prime MMF business in 2019 increases daily outflows from the family's retail prime funds by 0.2 percentage points during the run.

Note that this spillover effect only works in one direction, from institutional to retail funds. The presence or share of retail prime MMFs in a family do not increase the outflows from the family's institutional prime funds (see panel (b) in Figure 7 and Appendix B, where we repeat the analysis for institutional fund outflows as a function of the family's retail offering).

Not only the presence of institutional prime funds leads to higher outflows from the retail prime funds in the same family, but, in those families offering prime funds to both institutional and retail investors, larger institutional outflows are associated with larger retail outflows, as shown by Figure 8. A simple OLS shows that a 10-percentage-point increase in outflows from institutional prime MMFs is associated with 2.9 percentage points larger outflows from the retail funds within the same family, although the effect is not statistically significant (p-value = 0.15).

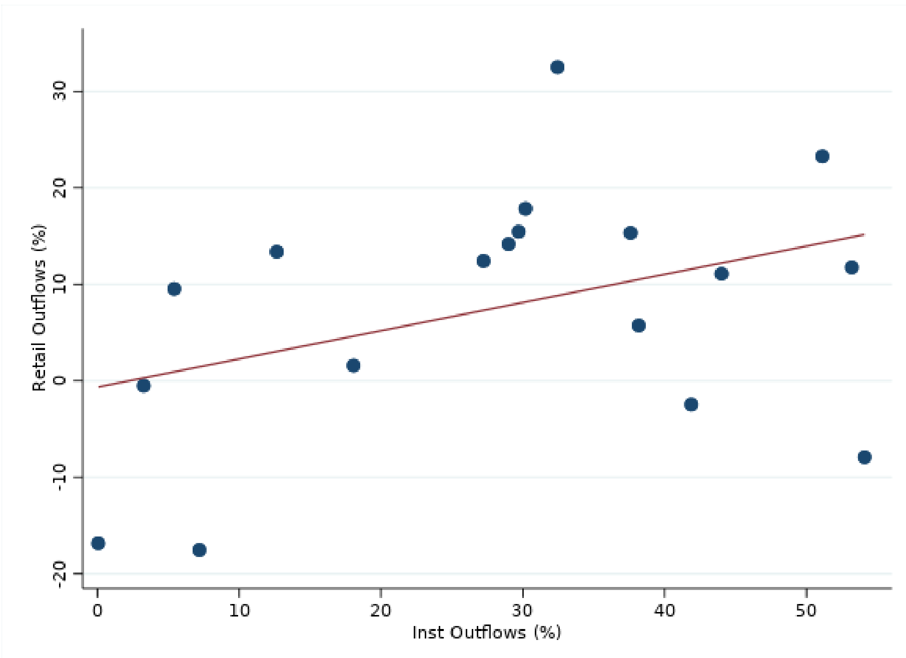


Fig. 8. Family-level scatterplot of percentage outflows from a family's retail prime MMFs over March 6-26 against the outflows in the family's institutional prime MMFs over the same period.

Table 9 shows the results of the following family-level panel regression:

$$\text{Retail Flow}_{it} = \alpha_i + \mu_t + \sum_{s=0}^{4} \beta_s \,\text{Inst Flow}_{it-s} + \varepsilon_{it} \tag{4}$$

where Retail Flow$_{it}$ are the percentage flows in family i's retail prime MMFs on day

t, Inst Flow are the percentage flows in the family's institutional prime funds, and α_i and μ_t are family and day fixed effects. That is, we regress daily flows from a family's retail prime MMFS against the contemporaneous and lagged (up to 4 business days) flows in the family's institutional funds. Standard errors are clustered at the family and date level.

An increase of 10 percentage points in outflows from a family's institutional prime MMFs over 5 days leads to a 3.2 percentage-point increase in daily outflows from the family's retail prime funds (a quantitatively significant effect compared to an overall 10% cumulative retail outflow over the whole run period). Such relationship is significant only for outflows (p-value = 0.015) and not for inflows, does not occur before the run, and weakens significantly after March 26.

	Retail Flow$_{it}$ (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Inst Flow$_{it}$ (%)	0.01		0.02		-0.00	
	(1.00)		(0.43)		(-0.22)	
Inst Flow$_{it-1}$ (%)	-0.03		0.12		0.00	
	(-0.78)		(1.71)		(0.01)	
Inst Flow$_{it-2}$ (%)	-0.02		0.09*		-0.00	
	(-1.67)		(1.99)		(-0.15)	
Inst Flow$_{it-3}$ (%)	-0.02		0.06		-0.01	
	(-1.09)		(1.51)		(-1.48)	
Inst Flow$_{it-4}$ (%)	0.01		0.07		-0.01	
	(0.71)		(1.72)		(-0.96)	
Inst Flow$_{it} > 0$ (%)		0.03		-0.01		-0.00
		(1.07)		(-0.07)		(-0.48)
Inst Flow$_{it} > 0$ (%)		0.00		0.05		0.01
		(0.02)		(0.74)		(0.58)
Inst Flow$_{it-1} > 0$ (%)		-0.06		0.38		-0.01
		(-1.48)		(1.35)		(-1.01)
Inst Flow$_{it-2} > 0$ (%)		-0.07		0.19		-0.01
		(-1.47)		(1.50)		(-0.59)
Inst Flow$_{it-3} > 0$ (%)		-0.05		0.17		-0.03*
		(-1.08)		(1.54)		(-1.77)
Inst Flow$_{it-4} > 0$ (%)		0.00		0.07		-0.02
		(0.11)		(0.79)		(-1.13)
Inst Flow$_{it-1} < 0$ (%)		-0.03		0.07		0.02
		(-0.65)		(1.11)		(0.83)
Inst Flow$_{it-2} < 0$ (%)		-0.01***		0.07		0.01
		(-3.81)		(1.66)		(0.99)
Inst Flow$_{it-3} < 0$ (%)		-0.01		0.05		0.01
		(-1.21)		(0.72)		(0.22)
Inst Flow$_{it-4} < 0$ (%)		0.01		0.08		0.01
		(0.59)		(1.47)		(0.48)
Observations	663	663	187	187	680	680
R^2	0.14	0.14	0.41	0.43	0.17	0.17
$\sum \beta$	-0.05		0.36*		-0.03	
p-value	0.40		0.05		0.29	
$\sum \beta > 0$		-0.14		0.80		-0.08
p-value		0.34		0.17		0.14
$\sum \beta < 0$		-0.04		0.32**		0.06*
p-value		0.40		0.01		0.07
Family FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/5	1/2-3/5	3/6-3/26	3/6-3/26	3/27-5/27	3/27-5/27

t statistics in parentheses

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

Table 9. Family-level regression of daily net percentage flows in a family's retail prime MMFs against contemporaneous and lagged (four business days) net percentage flows in the family's institutional prime MMFs. Standard errors are clustered at the family and date level.

Finally, one may object that outflows from retail prime MMFs (which are allowed to offer a fixed NAV) were due to investors' concerns that funds could "break the buck" as their NAV deteriorated during the run. It is not the case. Figure 9 is a scatterplot of cumulative outflows from retail prime MMFs over the run period against the minimum of their shadow NAV during the same time. The relationship is flat (the p-value of the slope coefficient is 0.61, and the R^2 is 0.01.);[21] if anything, funds with lower NAV minima experienced smaller outflows.

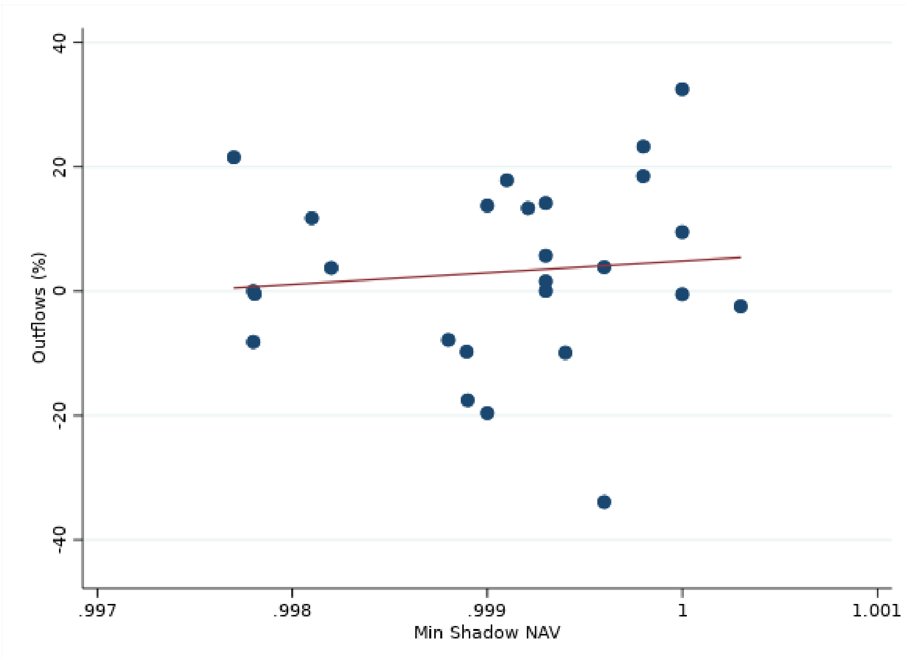


Fig. 9. Scatterplot of percentage outflows in onshore retail prime MMFs over March 6-26 against the minimum of their shadow NAV over the same period.

[21]Note that any reverse causality by which outflow cause a decrease of a fund's NAV would make the negative relationship between NAV and outflow stronger.

6. Switching costs and the presence of government MMFs in the family

As during past episodes of industry dislocation, outflows from prime MMFs in March 2020 were accompanied by large inflows in government MMFs, and a sizable share of this intra-industry flows happened within the MMF families.

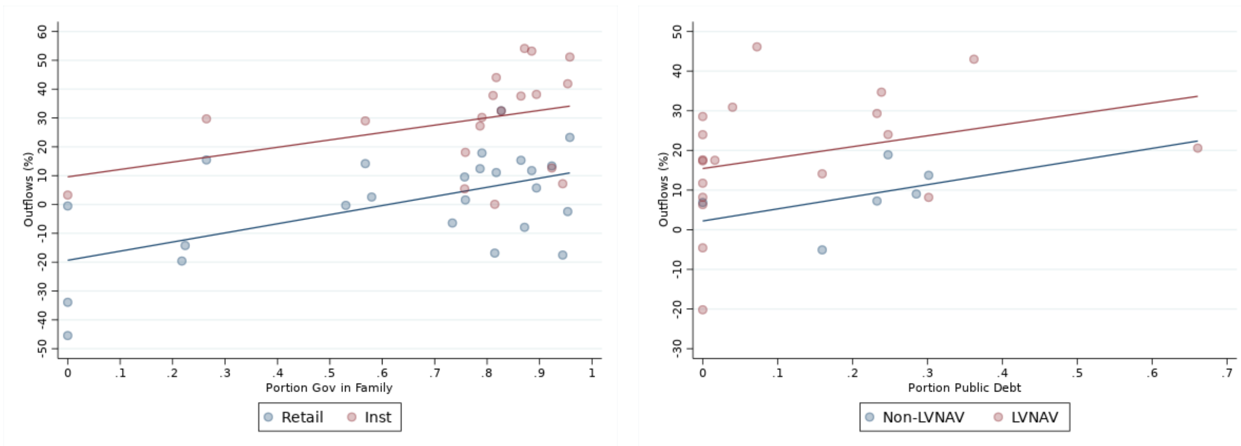
An important factor in an investor's decision to withdraw from an investment, such as a MMF, is the cost of switching to the outside option. For funds belonging to families that specialize in government MMFs, investors' cost of redeeming from prime MMFs should be lower. As shown in Table 10, only few domestic prime MMFs belong to families that do not offer government MMFs (one institutional and three retail funds). For this reason, we use the average share of government funds in the family's total MMF business in 2019Q4 as proxy for the family's relative specialization in government funds. We use the 2019Q4 share of government funds to avoid endogeneity issues, similarly to what we did for the analysis of the effect of WLA on investor flows. For robustness, we also show results using a dummy for whether the MMF family offers government funds.

	Offers Gov MMFs	
	No	Yes
Onshore Institutional		
AUM [$ billion]	.37	307
Funds	1	33
Families	1	18
Median Share of Government MMFs	0.82	
Onshore Retail		
AUM [$ billion]	.97	472
Funds	3	30
Families	3	22
Median Share of Government MMFs	0.79	
Offshore LVNAV		
AUM [$ billion]	35	302
Funds	9	11
Families	9	10
Median Share of Government MMFs	0.01	
Offshore non-LVNAV		
AUM [$ billion]	15	43
Funds	4	7
Families	1	5
Median Share of Government MMFs	0.24	
Offshore		
AUM [$ billion]	49	345
Funds	13	18
Families	10	11
Median Share of Government MMFs	0.09	

Table 10. Summary statistics of onshore and offshore prime MMFs and MMF families depending on the family's specialization government MMFs in 2019Q4.

Figure 10 shows scatterplots of the cumulative outflows from a family's prime MMFs during the March 2020 run against the share of government MMFs in the family's total MMF business in 2019Q4. Panel (a) is for onshore funds (both institutional and retail), whereas panel (b) is for offshore funds (LVNAV and non-LVNAV).

For all fund types, there is a positive relation between a family's specialization in government MMFs and the outflows from its prime MMFs during the March 2020 run.



(a) Onshore **(b)** Offshore

Fig. 10. Family-level scatterplot of outflows from prime MMFs (both onshore and offshore) over March 6-26 against the average share of government MMFs in the family's total MMF business in 2019Q4.

To quantify the effect of the presence of government MMFs on the outflows from prime funds in the same family, we estimate the following family-level regression at daily frequency:[22]

$$\text{Outflow}_{it} = \alpha_i + \mu_t + \beta\,\text{Run}_t \times \text{Govt\_Share}_i + \varepsilon_{it} \qquad (5)$$

where Outflow_{it} is the outflow from family i's prime MMFs on day t, α_i are family fixed effects, and Govt_Share is the average share of government MMFs in the family's total MMF business over 2019Q4. All other variables are defined as in regression (1). Results are in Table 11 for onshore institutional funds and in Table 12 for retail ones; standard errors are clustered at the family and date level.

An increase of 10 percentage points in the share of government MMFs in a fam-

[22]See footnote 20.

ily's MMF business in 2019Q4 leads, during the run, to higher daily outflows by 0.24 percentage points in institutional prime MMFs (p-value = 0.03) and by 0.20 percentage points in retail ones (p-value = 0.02). We obtain comparable results when using a dummy for the presence of government MMFs in the family instead of their share (see Columns (1), (3), and (5)).

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Govt	2.94***		2.77***		2.29***	
	(4.85)		(4.98)		(4.45)	
Run × Govt Share		3.03**		2.93**		2.41**
		(2.40)		(2.41)		(2.15)
Observations	1026	1026	1064	1064	1102	1102
R^2	0.17	0.17	0.17	0.17	0.17	0.17
Family FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 11. Family-level regression of daily percentage outflows from onshore institutional prime MMFs as a function of the family's specialization in government MMFs. Offers Govt is a dummy equal to one if the fund family offers government MMFs in 2019Q4. Govt Share is the average share of government MMFs in the family's total MMF business in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the family and date level.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Govt	1.86***		2.08**		1.93**	
	(2.80)		(2.69)		(2.77)	
Run × Govt Share		1.84**		2.10**		2.01**
		(2.54)		(2.61)		(2.73)
Observations	1350	1350	1400	1400	1450	1450
R^2	0.12	0.12	0.14	0.14	0.13	0.13
Family FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 12. Family-level regression of daily percentage outflows from onshore retail prime MMFs as a function of the family's specialization in government MMFs. Offers Govt is a dummy equal to one if the fund family offers government MMFs in 2019Q4. Govt Share is the average share of government MMFs in the family's total MMF business during 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the family and date level.

We also estimate regression (5) on the panel of offshore MMF families offering either LVNAV or non-LVNAV (prime) funds; results are in Table 13 and consistent with those for onshore funds. Offshore prime MMFs belonging to families that also offer offshore government MMFs experienced larger daily outflows by 1.3 percentage points.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Govt	0.77		1.19*		1.33**	
	(1.10)		(1.79)		(2.15)	
Run × Govt Share		0.73		1.34		2.14
		(0.47)		(0.78)		(1.41)
Observations	1176	1176	1218	1218	1260	1260
R^2	0.11	0.11	0.12	0.11	0.12	0.11
Family FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

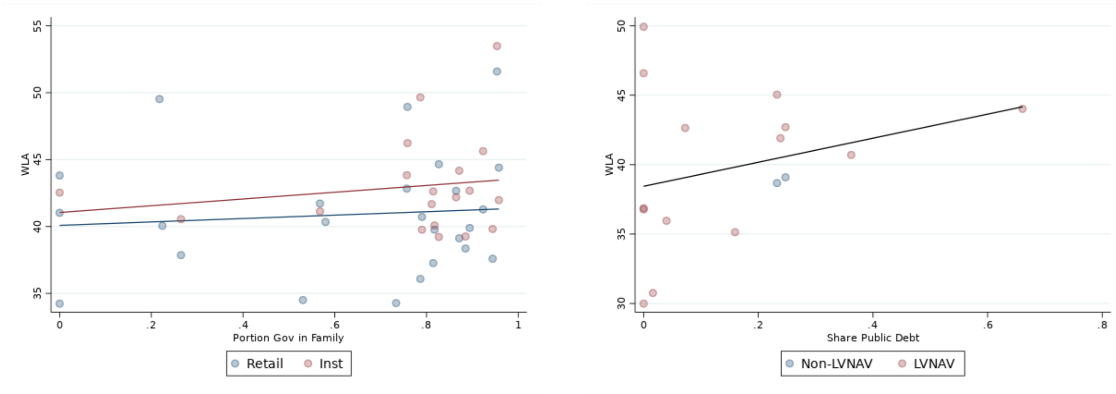
t statistics in parentheses

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

Table 13. Family-level regression of daily percentage outflows from offshore prime MMFs (both LVNAV and non-LVNAV) as a function of the family's specialization in government MMFs. Offers Govt is a dummy equal to one if the fund family offers government MMFs in 2019Q4. Govt Share is the average share of government MMFs in the family's total MMF business during 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the family and date level.

Although our main treatment variable is a family-level characteristic, we repeat the analysis of the effect of family's specialization in government MMFs on outflows from prime MMFs at the fund level. Results are in Tables 17–19 in Appendix C and are largely similar to those reported here.

Finally, for institutional and offshore prime MMFs, if funds in families with a larger share of government MMFs had lower WLA (and therefore higher outflows), the relationship between outflows and share of government MMFs in the family would be spurious. However, as shown by Figure 11, this is not the case. If anything, prime funds in families with a larger government-MMF share have slightly higher WLA.



(a) Onshore **(b)** Offshore

Fig. 11. Scatterplot of the average WLA of a family's prime MMFs during 2019Q4 against the average share of government MMFs in the family's total MMF business in 2019Q4.

References

Brady, S., Anadu, K., Cooper, N., 2012. The Stability of Prime Money Market Mutual Funds: Sponsor Support from 2007 to 2011. Working Paper, Federal Reserve Bank of Boston.

Casavecchia, L., Ge, G., Li, W., and Tiwari, A., 2020. Prime Time for Prime Funds: Floating NAV, Intraday Redemptions and Liquidity Risk During Crises. Working Paper.

Chernenko, S., Sunderam, A., 2014. Frictions in shadow banking: evidence from the lending behavior of money market mutual funds. Review of Financial Studies 27, 1717–1750.

Cipriani, M., Haughwout, A., Hyman, B., Kovner, A., La Spada, G., Lieber, M., and Nee, S., 2020a. Municipal Debt Markets and the COVID-19 Pandemic. Federal Reserve Bank of New York *Liberty Street Economics*, June 29, 2020. `https://libertystreeteconomics.newyorkfed.org/2020/06/municipal-debt-markets-and-the-covid-19-pandemic.html`.

Cipriani, M., La Spada, G., 2017. Investors' Appetite for Money-like Assets: the Money Market Fund Industry After the 2014 Regulatory Reform. Journal of Financial Economics (forthcoming).

Cipriani, M., La Spada, G., Orchinik R., and Plesset, A., 2020b. The Money Market Mutual Fund Liquidity Facility. Federal Reserve Bank of New York *Liberty Street Economics*, May 8, 2020. `https://libertystreeteconomics.newyorkfed.org/2020/05/the-money-market-mutual-fund-liquidity-facility.html`.

Cipriani, M., Martin, A., McCabe, P., and Parigi, B. M., 2014. Gates, Fees, and Preemptive Runs. Staff Report No. 670, Federal Reserve Bank of New York.

Diamond, D., and Dybvig, P., 1983. Bank Runs, Deposit Insurance, and Liquidity.

The Journal of Political Economy 91, 401–419.

Goldstein, I., Jiang, H., and Ng, D., 2017. Investor flows and fragility in corporate bond funds. Journal of Financial Economics 126, 592–613.

Kacperczyk, M., Schnabl, P., 2013. How safe are money market funds? The Quarterly Journal of Economics 128, 1073–1122.

La Spada, G., 2018. Competition, reach for yield, and money market funds. Journal of Financial Economics 129, 87–110.

Li, L., Li, Y., Macchiavelli, M., and Zhou, X., 2020. Runs and Interventions in the Time of Covid-19: Evidence from Money Funds.

McCabe, P., Cipriani, M., Holscher, M., Martin, A., 2013. The minimum balance at risk: a proposal to mitigate systemic risks posed by money market funds. Brookings Papers on Economic Activity, Spring 2013, 211–256.

Schmidt, L., Timmermann, A., and Wermers, R., 2016. Runs on Money Market Mutual Funds. American Economic Review 106, 2625–57.

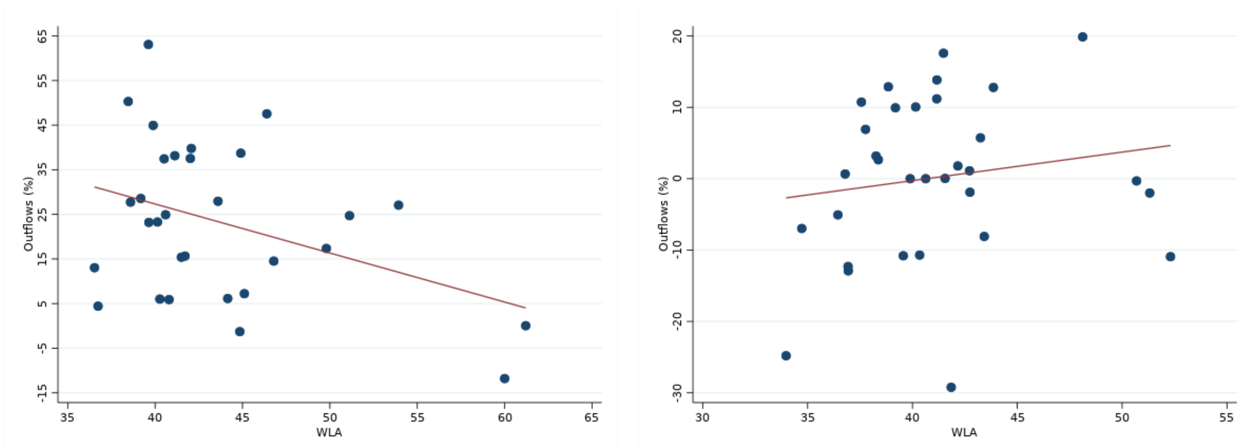
SEC, 2010. Money market fund reform, Release No. IC-29132, `https://www.sec.gov/rules/final/2010/ic-29132.pdf`.

SEC, 2014. Money market fund reform; Amendments to Form PF, Release No. IC-31166, `https://www.sec.gov/rules/final/2014/33-9616.pdf`.

Appendices

A. *The sophisticated run*

In this appendix, we report robustness checks on the sophisticated run of retail prime-MMF investors (Section 4 of the paper). Figure 12 shows scatterplots of the outflows from onshore prime MMFs over March 6-20 against the funds' average WLA over January-February 2020, separately for institutional and retail funds. The results are consistent with those of Figure 4 in the paper: there is a clear negative relationship between run outflows and pre-run WLA in institutional funds ($\beta = -1.1$ with p-value $= 0.02$ and $R^2 = 0.15$) and no relationship for retail ones ($\beta = 0.4$ with p-value $= 0.42$ and $R^2 = 0.02$).



(a) Institutional prime MMFs

(b) Retail prime MMFs

Fig. 12. Scatterplot of percentage outflows from onshore prime MMFs over March 6-20 against funds' average WLA over January-February 2020.

B. *The unsophisticated run*

In this section, we report robustness results on the unsophisticated run of retail investors (Section 5 of the paper).

Tables 14 reports the results of regression 3 estimated at the fund level, rather than at the family level. That is, retail prime MMFs within the same MMF family will have same treatment, i.e., the family's offering of institutional prime funds. Results are largely consistent with those of Table 8 in the paper; retail prime funds in families also offering institutional prime funds suffered daily outflows that were larger by 1.5 percentage points.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Inst	1.31***		1.52***		1.45***	
	(2.98)		(3.15)		(3.33)	
Run × Inst Share		1.12**		1.31***		1.34***
		(2.70)		(2.79)		(2.98)
Observations	1850	1850	1916	1916	1982	1982
R^2	0.11	0.10	0.12	0.11	0.12	0.11
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 14. Fund-level regression of daily percentage outflows from onshore retail prime MMFs as a function of the fund family's offering of institutional prime funds. Offers Inst is a dummy equal to one if the family also offer institutional prime MMFs in 2019Q4. Inst Share is the average share of institutional prime MMFs in the family's total prime-MMF business over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

We re-estimate regression (3) using outflows from a family's institutional prime MMFs as dependent variable and the family's offering of retail prime MMFs as treatment. Results are in Table 15 for the family-level estimation and in Table 16 for the fund-level one. In both cases, they show that there is no relationship between the outflows from a family's institutional prime MMFs and the presence of retail prime MMFs in the the same family. If anything, institutional funds belonging to families that also offer retail funds experienced smaller outflows during the run.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Retail	-1.79***		-0.76		-0.92	
	(-3.09)		(-1.29)		(-1.67)	
Run × Retail Share		-2.27		-1.92		-1.87
		(-1.33)		(-1.16)		(-1.23)
Observations	1026	1026	1064	1064	1102	1102
R^2	0.17	0.17	0.17	0.17	0.17	0.17
Family FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 15. Family-level regression of daily percentage outflows from a family's institutional prime MMFs as a function of the fund family's offering of retail prime funds. Offers Retail is a dummy equal to one if the family also offer retail prime MMFs in 2019Q4. Retail Share is the average share of retail prime MMFs in the family's total prime-MMF business over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the family and date level.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Retail	-1.83***		-0.87*		-1.04**	
	(-4.14)		(-1.99)		(-2.55)	
Run × Retail Share		-1.80		-1.38		-1.46
		(-1.56)		(-1.18)		(-1.34)
Observations	1836	1836	1904	1904	1972	1972
R^2	0.15	0.15	0.15	0.15	0.15	0.15
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 16. Fund-level regression of daily percentage outflows from onshore institutional prime MMFs as a function of the fund family's offering of retail prime funds. Offers Retail is a dummy equal to one if the family also offer retail prime MMFs in 2019Q4. Retail Share is the average share of retail prime MMFs in the family's total prime-MMF business over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

C. Switching Costs and the Role of Government MMFs

In this section, we report robustness results on the relationship between outflows from a family's prime MMFs during the March 2020 run and the family's specialization in government MMFs (Section 6 in the paper).

Tables 17-19 report the results of regression 5 estimated at the fund level for onshore institutional, retail, and offshore prime MMFs. Results are largely consisted with those in the paper; for example, an increase of 10 percentage points in the share of government MMFs in a family's total MMF business in 2019Q4 (i.e., a measure of the family's specialization in government-MMF products) leads to larger daily outflows by 0.22 percentage points in onshore institutional funds and 0.17 percentage points in onshore retail funds. Similarly, outflows from offshore prime MMFs that belong to families offering government funds are larger by 1.4 percentage points.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Govt	2.78***		2.58***		2.14***	
	(6.15)		(6.25)		(5.68)	
Run × Govt Share		2.58*		2.58**		2.21*
		(1.98)		(2.09)		(1.99)
Observations	1836	1836	1904	1904	1972	1972
R^2	0.15	0.15	0.15	0.15	0.15	0.15
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 17. Fund-level regression of daily percentage outflows from onshore institutional prime MMFs as a function of the fund family's specialization in government MMFs. Offers Govt is a dummy equal to one if the fund family offers government MMFs in 2019Q4. Govt Share is the average share of government MMFs in the family's total MMF business in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Govt	1.72**		1.95**		1.78**	
	(2.69)		(2.58)		(2.64)	
Run × Govt Share		1.51**		1.77**		1.67**
		(2.32)		(2.37)		(2.47)
Observations	1850	1850	1916	1916	1982	1982
R^2	0.10	0.10	0.12	0.11	0.11	0.11
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 18. Fund-level regression of daily percentage outflows from onshore retail prime MMFs as a function of the fund family's specialization government MMFs. Offers Govt is a dummy equal to one if the fund family offers government MMFs in 2019Q4. Govt Share is the average share of government MMFs in the family's total MMF business in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run × Offers Govt	0.84		1.23		1.38*	
	(0.96)		(1.53)		(1.92)	
Run × Govt Share		1.34		2.01		2.77
		(0.63)		(0.98)		(1.52)
Observations	1660	1660	1720	1720	1780	1780
R^2	0.06	0.06	0.07	0.06	0.07	0.06
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/20	1/2-3/24	1/2-3/24	1/2-3/26	1/2-3/26

t statistics in parentheses

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

Table 19. Fund-level regression of daily percentage outflows from offshore prime MMFs (both LVNAV and non-LVNAV) as a function of the fund family's specialization in government MMFs. Offers Govt is a dummy equal to one if the fund family offers government MMFs in 2019Q4. Govt Share is the average share of government MMFs in the family's total MMF business during 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are clustered at the fund and date level.