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# Sophisticated and Unsophisticated Runs

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## **Sophisticated and Unsophisticated Runs**

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### **Abstract**

What makes investors run? We show that during the March 2020 run on prime money market funds, institutional and retail investors behaved in dramatically different ways: sophisticated institutional investors ran preemptively based on fundamentals; unsophisticated retail investors ran based on herd-like informational spillovers, leaving funds belonging to families with large institutional outflows. We show that based on website traffic, institutional investors acquired more information on fund portfolios; furthermore, we show that within-family institutional outflows were informative to retail investors. Both investor types ran more if switching to a safer investment was cheaper, suggesting that safe-haven availability exacerbates runs.

Key words: runs, COVID-19, money market funds, sophisticated investors, regulation

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# 1. Introduction

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

In this paper, we use the 2020 prime-MMF run to characterize the behaviors of sophisticated and unsophisticated investors in stress periods. In 2014, the SEC reformed the US MMF industry and separated prime MMFs by investor type, dividing funds catering only to retail (unsophisticated) investors from those catering to institutional (sophisticated) ones.

We show that institutional and retail investors behaved in dramatically different ways during the March 2020 run. The differences in behavior are consistent with different levels of sophistication: institutional investors are more sophisticated and run based on fundamentals, whereas retail investors are less sophisticated and run based on herd-like informational spillovers.

In particular, we show that: (1) redemption-restriction rules based on portfolio fundamentals introduced by the SEC in 2014 led to preemptive runs by sophisticated investors, (2) run dynamics can propagate from sophisticated to unsophisticated investors due to informational contagion. These results are not driven by investors’ self-selection in funds based on unobserved investor heterogeneity.

Finally, we show that the behavior of both classes of investors was influenced by the cost of switching to a safe investment option, with lower costs associated with higher outflows from prime MMFs; this finding speaks to an important debate among policymakers and academics on the financial stability impact of providing investors with safe havens in times of turmoil (Frost et al., 2015).

## 1.1. Institutional Investors

For both institutional and retail prime MMFs, the 2014 reform introduced a system of redemption gates and fees that would be activated if a fund’s weekly liquid assets (WLA)—a regulatory definition that includes cash, government debt, and securities maturing within a week—dropped below a certain threshold. We show that during the 2020 run, institutional investors left those prime funds whose WLA were closer to the regulatory threshold that could trigger the imposition of redemption gates or fees; this is true for both onshore and offshore funds. In other words, their decision to run was based on an assessment of the likelihood that unfettered access to liquidity—the main driver of investors’ investment in MMFs—might be impaired.

WLA levels close to the regulatory threshold may be the result as much as the cause of investors’

outflows, as funds usually sell their most liquid assets to meet redemptions. To causally identify their impact, we employ two strategies. First, we instrument funds' WLA with their average values in 2019Q4. 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 during the March 2020 run. Second, we exploit a differential regulatory treatment among offshore institutional prime MMFs: some of these funds, but not all, are exempt from the imposition of gates or fees, while sharing the same investor base. Consistent with the causal role of WLA-based redemption restrictions, we find that such funds experienced daily outflows that were 1.3 percentage points smaller than those suffered by offshore funds subject to gates and fees. Furthermore, we show that our results are not driven by ex ante heterogeneity in investor sophistication—and therefore their propensity to flee—across funds.

When the SEC reformed the MMF industry in 2014, practitioners, policymakers, and academics feared that the new regulation would make runs more likely by giving investors an incentive to leave funds preemptively ahead of gates or fees being imposed. Cipriani et al. (2014) formalized the argument in a Diamond and Dybvig (1983) model. In this paper, we show that preemptive runs are not only a theoretical possibility but did actually occur in March 2020. Our results are consistent with the motivation of the 2023 SEC decision to eliminate liquidity-contingent gates and fees (SEC, 2023).

## 1.2. *Retail Investors*

In contrast to previous periods of industry instability, in March 2020, retail prime funds also suffered significant outflows. Consistent with their lower levels of sophistication and information acquisition, however, retail investors did not seem to pay attention to their funds' WLA. In particular, retail funds closer to the WLA regulatory threshold for the imposition of redemption restrictions did not experience heavier outflows; in other words, we did not observe preemptive runs in the retail industry.

We did however observe contagion. Fund families, such as those sponsored by bank holding companies or large investment companies, often offer both retail and institutional funds to their clients. Retail investors ran on prime MMFs belonging to families that also catered to institutional prime-MMF investors; additionally, when institutional redemptions were higher, so were retail ones in the same family. In other words, (unsophisticated) retail investors based their decision to run on the behavior of (sophisticated) institutional investors within the same fund family, in a sort of herd-like fashion through shared news access or word of mouth.<sup>1</sup> Similar to what we did for institutional investors, we show that our results are not driven by heterogeneity in the sophistication of retail investors across fund families.

We provide evidence that such intra-family contagion is due to informational spillovers on the fund's investment strategy. In particular, we show that institutional outflows have information value for retail investors in the same family by computing measures of portfolio similarity across

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<sup>1</sup>See, e.g., Bikhchandani et al. (1992) and Cipriani and Guarino (2008).

funds: portfolio holdings of retail and institutional funds within the same family have much more similar credit-risk exposures than across families;<sup>2</sup> Moreover, retail and institutional prime MMFs in the same fund family are often managed by the same portfolio managers. Additionally, we show that investors left prime MMFs for government MMFs—which can only hold government securities and repos backed by them—within the same family; this suggests that retail investors did not follow institutional ones out of fear for the stability of the fund family. Our finding is consistent with the SEC decisions—both in 2014 and more recently in 2023—to concentrate the regulatory reform effort on institutional prime funds (SEC, 2014, 2023).

To confirm that institutional investors are more sophisticated than retail ones—and therefore their outflows are informative—we study information acquisition on fund portfolios by both investor types during the 2020 run. Using a novel dataset on internet access to MMF websites, we show that information gathering on institutional prime MMFs was significantly higher than on retail ones.

Our results are related to Schmidt et al. (2016), who study the relationship between fund outflows during the 2008 run and investor sophistication, focusing on the strategic interactions across investors of different sophistication within the same fund. Similar to us, they identify investors’ sophistication by using the distinction between retail and institutional investors; in contrast to us, however, they compare investors within the same fund as the SEC had not yet required retail and institutional prime MMFs to be segregated in different funds.<sup>3</sup> Schmidt et al. (2016) find that after the failure of Lehman Brothers, sophisticated investors’ outflows were larger than those of unsophisticated investors and increasing in the fraction of sophisticated investors within the fund. Our results show that a different type of complementarity has emerged after the 2014 SEC decision to segregate retail from institutional investors; such complementarity occurs at the fund-family level rather than at the fund level. This happens because the interaction between retail and institutional investors is now different: while in Schmidt et al. (2016) the interaction comes from externality due to the illiquidity of a fund’s portfolio, in our paper—after the SEC segregation—it stems from information contagion within the family. For this reason, in our sample, institutional investors do not respond to retail presence in the fund family (as they do in Schmidt et al. (2016)), whereas retail investors respond to institutional presence and to the informational content of institutional flows.

Our results are also consistent with recent empirical work on bank runs, pointing to the heterogeneity of depositor responses to shocks. Iyer et al. (2016) find that bank fragility depends on the composition of its depositor’s base; similar to us, they find that, after a liquidity shock, sophisticated (uninsured) depositors are more likely to run, as are depositors who are bank staff. Moreover, consistent with the idea that contagion due to word of mouth is important for retail investors, Iyer and Puri (2012) find that social networks matter, and if “other people in a depositor’s network run, the depositor is more likely to run.”

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<sup>2</sup>This is particularly important as both the 2008 and 2011 runs were mainly driven by credit-risk concerns (Kacperczyk and Schnabl, 2013; Chernenko and Sunderam, 2014).

<sup>3</sup>Consistent with a higher sophistication, Kacperczyk and Schnabl (2013) and Chernenko and Sunderam (2014) also show that institutional investors respond more strongly to fund performance than retail investors.

### *1.3. Government MMFs, Switching Costs, and the Availability of a Safe Option*

The fact that investors largely moved their money from prime to government funds within the same family is consistent with past episodes of industry dislocation; this is true of both retail and institutional investors. The reason is that switching across funds within the same family is less costly to investors than moving across families (e.g., due to lower search costs).

If switching costs are important, we would expect that prime-MMF investors in families with a more robust offering of government MMFs would run more easily. Since the relative offering of government and prime funds within a family’s MMF business varies across families—with some families mostly offering government funds and some families mostly offering prime funds—we can study whether lower switching costs cause higher outflows.

We find that prime MMFs belonging to families more specialized in government MMFs indeed experienced larger outflows: a 10 percentage-point increase in the 2019Q4 share of government-MMF share classes in a family’s total number of MMF share classes leads to larger daily outflows during the March 2020 run—by 0.3 percentage points in both institutional and retail funds (6 percentage points over the 20-day run period). We also obtain similar results when we consider offshore prime MMFs. Importantly, our results are not driven by heterogeneity in investors’ risk aversion or sophistication across fund families.

The impact of a family’s government-MMF offering on prime-MMF outflows creates an externality: the family has an incentive to provide both prime and government MMFs because this increases the likelihood that investors remain within the family in times of stress; offering both prime and government MMFs, however, increases the likelihood of runs from prime funds, which have a destabilizing impact on the industry due to contagion and fire sales.

By showing that a family’s offering of government MMFs increases its prime-MMF outflows during a run, we are the first to present evidence that providing investors with easy access to a safer alternative may adversely affect financial stability. This is an important argument, recently made by both policymakers and academics when assessing the financial stability implications of providing access to the central bank’s balance sheet to non-traditional counterparties. Examples are Central Bank Digital Currencies (CBDCs); the overnight reverse repo facility (ON RRP), which allows MMFs to invest at the Federal Reserve (Cipriani and La Spada, 2022); and narrow banks, i.e., banks that would not make loans but only invest in reserves. Our findings suggest that these concerns may not be unfounded.

### *1.4. Relation with the Literature*

Several recent papers have studied episodes of severe dislocation in the MMF industry. The 2008 run on prime MMFs was studied by Baba et al. (2009), McCabe (2010), Anadu et al. (2012), and Kacperczyk and Schnabl (2013), in addition to Schmidt et al. (2016); the 2011 “slow-motion run” was studied by Chernenko and Sunderam (2014); Parlato (2016) studies the impact of sponsor support on MMF fragility and its implications for regulation.

Cipriani and La Spada (2021) analyze investors’ behavior in response to the 2014 SEC reform of the MMF industry; they show that the imposition of a system of redemption gates and fees on onshore prime MMFs (along with the requirement of a floating NAV for institutional ones) led to outflows of more than a trillion dollars, with inflows of a similar magnitude in government MMFs.

The 2020 MMF run is also studied by Li et al. (2021). They provide similar evidence to ours on the impact of gates and fees on investor flows in onshore institutional prime MMFs. They identify the impact of gates and fees by comparing the 2020 run with the 2008 run, before the SEC reform; we discuss their approach in greater detail in our empirical analysis. Casavecchia et al. (2020) document the March 2020 run focusing on institutional prime MMFs and their floating NAV feature.

Finally, our paper speaks to the recent and growing literature on the financial-stability effects of safe assets’ provision by the public sector. Greenwood et al. (2016) broadly discuss how the central bank can use its balance-sheet to provide safe assets, increasing financial stability by reducing runnable private money provision. In contrast, other papers have raised the concern that the provision of a safe option may impair financial stability as it allows investors to run more easily in times of stress; Frost et al. (2015) discuss such concerns for the ON RRP, whereas Williamson (2022a), Williamson (2022b), Fernandez-Villaverde et al. (2021), and Keister and Monnet (2022) focus on CBDCs. We are the first to investigate whether the availability of a safe option increases run risk empirically, by studying the behavior of MMF investors.

The remainder of the paper is as follows: Section 2 describes onshore and offshore MMFs and our dataset; Section 3 describes the March 2020 MMF run; Section 4 describes the run by (sophisticated) institutional investors; Section 5 describes the run by (unsophisticated) retail investors; Section 6 shows the effect of family specialization in government funds on run behavior; and Section 7 concludes.

## 2. Institutional Background

### 2.1. Onshore Money Market Funds

Onshore MMFs are open-end mutual funds, based in the United States, that invest in USD money-market instruments with short maturity and high credit quality. MMFs can be divided into 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).<sup>4</sup>

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

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<sup>4</sup>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.

TNA, of which roughly 78% was in government funds and 22% was in prime funds.

Prime MMFs can be further divided into 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 institutional 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.<sup>5</sup> Until October 2016, when the 2014 SEC 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, 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).<sup>6</sup> Only prime MMFs suffered outflows; government MMFs actually received inflows as they were perceived as a safe haven. Moreover, within the prime sector, the redemptions of 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 (SEC, 2014).<sup>7</sup> The regulatory change, which took effect in October 2016, has two main pillars. First, institutional prime 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.<sup>8</sup> 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%.<sup>9</sup>

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<sup>5</sup>For example, MMFs can only purchase securities with remaining maturities of 397 days or less.

<sup>6</sup>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 a few days or weeks.

<sup>7</sup>The SEC had adopted a first set of reforms in 2010 (SEC, 2010). For a discussion of reform options, see McCabe et al. (2013).

<sup>8</sup>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.

<sup>9</sup>This requirement can be overridden if the fund's board determines that it is not in the best interest of the

## 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 (EU, 2017).

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.<sup>10</sup> The regulation of LVNAV MMFs differs significantly from that of short-term and standard VNAV MMFs (non-LVNAV funds from now on).

LVNAV funds can price their shares at a constant NAV by using amortized cost valuation.<sup>11</sup> In contrast, non-LVNAV funds can only use mark-to-market pricing, which results in a variable daily NAV. LVNAV funds are allowed to impose a liquidity fee or a gate if the liquidity of their portfolios deteriorates below given thresholds; in contrast, offshore non-LVNAV MMFs cannot do so.<sup>12</sup> 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 WLA, including 10% in daily liquid assets. The minimum requirements for non-LVNAV funds, in contrast, are 15% and 7.5%.

Finally, 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.<sup>13</sup>

## 2.3. Data

Daily data on fund flows, both onshore and offshore, are from iMoneyNet. For onshore MMFs, weekly data on fund WLA are from the regulatory Form N-MFP, filed monthly with the SEC, and reflect a fund’s WLA as of every Friday in a month; these regulatory data have better coverage of

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shareholders.

<sup>10</sup>The portfolios of short-term MMFs have a maximum weighted average maturity (WAM) of 60 days and a maximum weighted average life (WAL) of 120 days, whereas standard MMFs have maximum limits of 180 and 365 days.

<sup>11</sup>Specifically, LVNAV funds can use amortized 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.

<sup>12</sup>LVNAV MMFs can apply gates and fees only if i) their 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 a maturity of up to 190 days; for non-LVNAV funds, instead, it can include up to 7.5% of other MMFs’ shares.

<sup>13</sup>They can do so only if the difference relative to mark-to-market pricing does not exceed 50 basis points.

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.

From iMoneyNet, we also obtain daily data on fund TNA, portfolio maturity (WAM), and shadow NAV (i.e., the share price of the fund portfolio based on the market value of the portfolio securities), weekly data on the composition of fund portfolios by asset class (e.g., the share of bank obligations in a fund’s portfolio), and monthly data on share-class expense ratios. Data on minimum investment and portfolio managers also come from iMoneyNet. Data on the CDS spreads of the issuers of the securities in onshore MMFs’ portfolios are from Markit.<sup>14</sup> Data on estimated monthly visits to fund websites come from Semrush Inc., a search engine marketing company.

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.<sup>15</sup> As in past episodes of industry dislocation, outflows from prime funds were accompanied by large inflows into government MMFs.

Panel (a) of Figure 1 shows the TNA of onshore prime and government MMFs from January to April 2020; panel (b) shows the cumulative percentage flows in both groups. Panels (c) and (d) report the same data for offshore MMFs.

Outflows from prime MMFs started on March 6 and continued for 20 consecutive days. Onshore prime funds lost \$143 billion (bn) over March 6-26, corresponding to a cumulative outflow of 19% relative to the industry’s TNA in 2019Q4; offshore prime 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 of 27% of their size in 2019Q4, and offshore government MMFs of 52%.

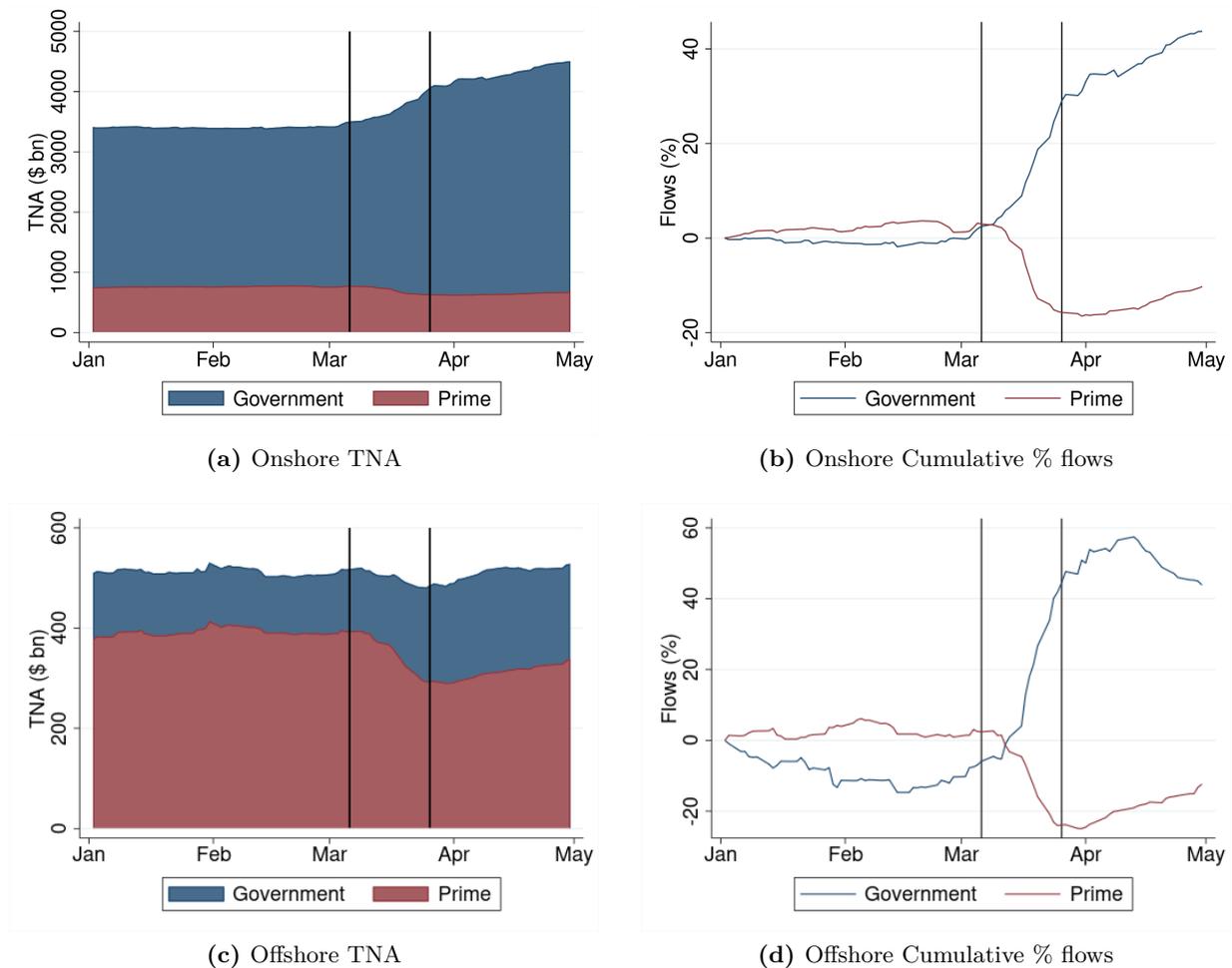
As documented in Anadu et al. (2022), outflows from prime MMFs abated after the introduction of the Money Market Funds Liquidity Facility (MMLF). The MMLF was announced on March 18, began operations on March 23, and on March 25 expanded the pool of eligible collateral to include CDs and VRDNs (in addition 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, 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).

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<sup>14</sup>For onshore MMFs, since we have security-level data on their portfolios from Form N-MFP filings, we can match their portfolio securities with the security issuers’ CDS spreads from Markit; for offshore MMFs, we cannot do this as we do not have security-level data on their portfolios.

<sup>15</sup>Muni MMFs experienced similar redemption pressures, as documented in Cipriani et al. (2020a) and Cipriani et al. (2020b).



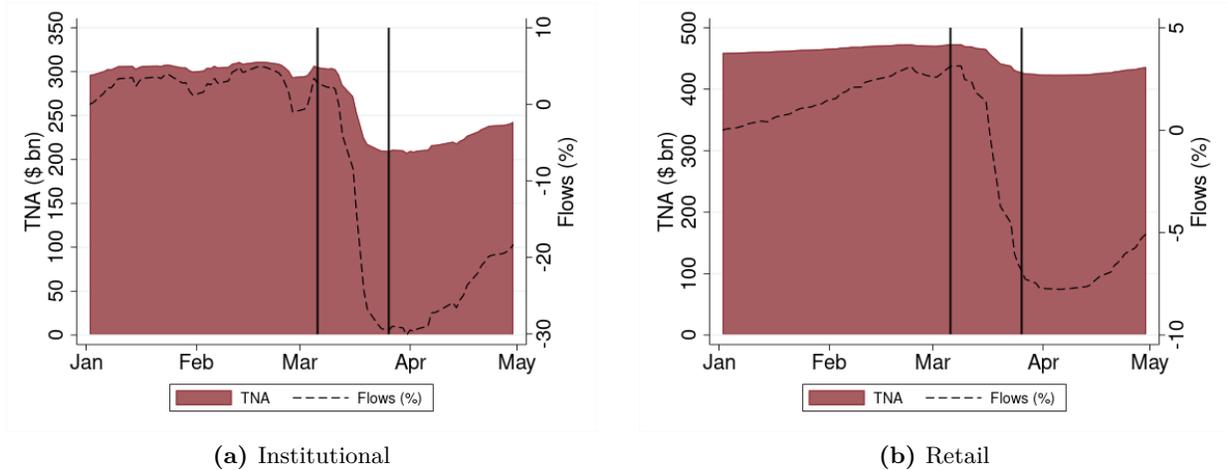
**Figure 1.** Total net assets (TNA) and cumulative percentage flows in onshore and offshore MMFs during January-April 2020. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the Covid-19 run).

Panel (a) of Figure 2 shows the TNA and cumulative percentage flows of institutional prime MMFs from January to April 2020; panel (b) shows the same data for retail ones. As a share of the sector’s TNA in 2019Q4, cumulative percentage outflows from institutional prime funds reached 31% on March 26; cumulative percentage outflows from retail prime funds were smaller but still significant, reaching 10% of 2019Q4 TNA on March 26.<sup>16</sup> Notably, these percentage outflows were greater than those suffered by institutional and retail prime MMFs during the 2008 financial crisis.<sup>17</sup>

The larger outflows from institutional funds are consistent with past episodes of industry dislocation (Cipriani and La Spada, 2021) 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. It is also interesting to notice that larger institutional outflows occurred notwithstanding the fact that

<sup>16</sup>Outflows from retail prime MMFs, although smaller, persisted until April 6, reaching 11%.

<sup>17</sup>In dollar terms, outflows were smaller because, in 2016, the prime-MMF industry shrank by more than \$1 trillion due to the 2014 SEC reform, as documented in Cipriani and La Spada (2021).



**Figure 2.** 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).

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 summary statistics on the distribution of flows across funds during the run, separately for institutional and retail prime MMFs. Between March 6 and March 26, the median institutional fund experienced cumulative outflows of 29%; for the bottom 25 percent of funds, cumulative outflows were as large as 40%, whereas, for the top 25 percent, they were only 11%. A similar heterogeneity is visible in retail flows: the median retail prime fund experienced outflows of 2%, whereas the bottom 25 percent experienced cumulative outflows of 13%, and the top 25 percent actually received cumulative inflows of 9%. In other words, not only were outflows larger in institutional funds than in retail ones, but there was also a significant degree of heterogeneity within both types of funds. Outflows from offshore funds, which only cater to institutional investors, were similar to those of onshore institutional funds and also highly heterogeneous. Results are similar when considering the shorter run period March 6-20, before the introduction of the MMLF (Table 26 in Appendix A).

	Prime MMF Cumulative Flows over 3/6-3/26 (%)				
	Min	P25	P50	P75	Max
Onshore Retail	-32	-13	-2	9	45
Onshore Institutional	-68	-40	-29	-11	4
Offshore	-46	-25	-14	-4	49

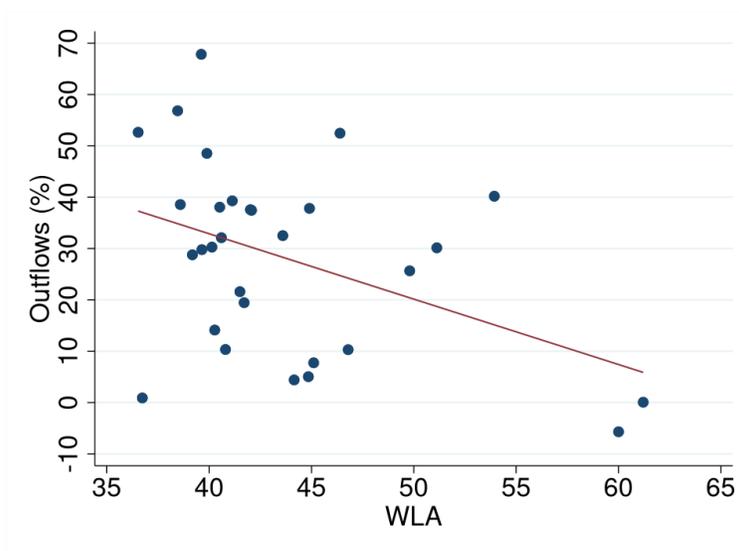
**Table 1.** Fund-level summary statistics of cumulative percentage flows in onshore and offshore prime MMFs during the March 2020 run. Our baseline definition of the run period is March 6-26; flows are relative to funds' TNA on March 5.

## 4. The sophisticated run of institutional investors

### 4.1. WLA and the role of gates and fees

The 2014 SEC reform has required all (onshore) 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.<sup>18</sup> 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. 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 3 shows a scatter plot of cumulative outflows from institutional prime funds over the run period March 6-26 against their average WLA in January and February, i.e., before the run started.<sup>19</sup> The scatterplot shows 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).



**Figure 3.** Scatterplot of cumulative percentage outflows from onshore institutional prime MMFs during the March 2020 run (March 6-March 26) against a fund’s average WLA in January-February 2020.

Building on the visual evidence in Figure 3, we study the relationship between a fund’s WLA and outflows 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 can persist over several days, especially if outflows are correlated in time as is likely to happen during a run.

<sup>18</sup>When the fund’s WLA drop below 10%, the fund is required to impose a liquidity fee of 1% on all redemptions.

<sup>19</sup>In Appendix A, we report the same figure calculating cumulative outflows over March 6-20 (i.e., up to the last business day before MMLF began operations); results are similar (see Figure 11).

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.<sup>20</sup> 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, in 2019Q4, average WLA ranged from 38% to 99% of fund portfolios 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.

	WLA of Institutional Prime MMFs (%)				
	Min	P25	P50	P75	Max
Within-fund Average	38	40	42	44	99
Within-fund Standard Deviation	0	2	2	3	6
Period	2019Q4				

**Table 2.** Summary statistics of the within-fund average and standard deviation of WLA, at the weekly frequency, over 2019Q4 in onshore institutional prime MMFs.

Consistent with the evidence in Table 2, Figure 12 in Appendix A shows that a fund’s average WLA in 2019Q4 is a good predictor of its WLA on March 6 (the day the runs started). In fact, the slope coefficient from a simple OLS cross-sectional regression is 0.85 ( $p$ -value  $< 0.001$ ) with an  $R^2 = 0.61$ .

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:

$$\text{Outflow}_{it} = \alpha_i + \mu_t + \beta \text{Run}_t * \text{WLA}_{i2019Q4} + \varepsilon_{it}, \quad (1)$$

where  $\text{Outflow}_{it}$  is the percentage outflow (i.e., negative net flow) in fund  $i$  on day  $t$ ,  $\alpha_i$  are fund fixed effects,  $\mu_t$  are day fixed effects, and  $\text{WLA}_{i2019Q4}$  is fund  $i$ ’s average WLA in 2019Q4.<sup>21</sup>  $\text{Run}_t$  is a dummy equal to one from March 6 onward. Standard errors are robust to heteroskedasticity, serial correlation, and cross-sectional correlation.<sup>22</sup> Results are in Table 3; each column corresponds to a different end date for the run (March 20, 24, and 26, respectively).

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

Our results hinge on the assumption that 2019Q4 heterogeneity in fund WLA reflects the

<sup>20</sup>Our identification strategy differs from that of Li et al. (2021), who use the share of assets in a fund’s portfolio at the end of February that mature during the crisis period.

<sup>21</sup>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.

<sup>22</sup>Unless otherwise specified, for all regressions, we use Driscoll-Kraay standard errors with 20 lags.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	-0.15*** (-2.87)	-0.13*** (-3.08)	-0.11*** (-2.99)
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

**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.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

likelihood of redemption restrictions. One concern is that, instead, it may reflect heterogeneity in investor sophistication: more sophisticated, and therefore attentive and flighty, investors may rationally self-select into more aggressive funds with lower WLA as they are faster in getting out; in a crisis, these investors may redeem more quickly not because of the possible imposition of redemption restriction, but because they are more reactive to negative shocks (e.g., a credit event, heightened uncertainty due to the Covid pandemic).

To rule out this possibility, we repeat our analysis by adding the interaction of the run dummy with two proxies of investor sophistication widely used in the literature (Schmidt et al., 2016; Gallagher et al., 2020): a fund’s average expense ratio and minimum investment (measured in 2019Q4, as we did for WLA). Results are in Table 4 and show that, while relatively more sophisticated institutional investors (that is, investors in funds with lower expense ratios and higher minimum investments) do withdraw more from their prime funds, the effect of WLA on fund outflows is unchanged, in both economic and statistical terms.

Additionally, in Section 4.2, we show that investors in offshore funds—which are subject to a different regulatory regime—only left those funds in which gates and fees could be imposed, although these funds have higher liquidity requirements; this provides additional evidence that investors’ self-selection does not drive our results, and institutional investors ran preemptively before the imposition of redemption restrictions.

Another concern is that our results may be driven by the fact that funds with lower WLA also take more risk and as a result, during the Covid crisis, they may experience larger outflows not because investors fear gates or fees but because they respond to higher uncertainty. To control for this, we estimate regression (1) adding the interaction of the run dummy with proxies for funds’ risk-taking behavior. We include the weighted average maturity (WAM) of the portfolio securities (a proxy for the fund’s exposure to interest-rate risk), the weighted average CDS spread of the securities’ issuers (a proxy for the fund’s exposure to credit risk), and the portfolio share of bank

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run $\times$ WLA	-0.22*** (-3.57)	-0.19*** (-4.04)	-0.18*** (-4.13)	-0.15** (-2.66)	-0.12*** (-2.88)	-0.10*** (-2.83)
Run $\times$ Expense Ratio	-0.24*** (-6.78)	-0.23*** (-7.81)	-0.23*** (-8.58)			
Run $\times$ Log Min Investment				0.06 (1.60)	0.07** (2.15)	0.06* (2.00)
Observations	1620	1680	1740	1620	1680	1740
$R^2$	0.18	0.18	0.18	0.17	0.17	0.17
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

**Table 4.** Fund-level regression of daily percentage outflows from onshore institutional prime MMFs against fund WLA in 2019Q4, controlling for investor sophistication. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Expense Ratio is in basis points, and Log Min Investment is in millions; both are fund-level averages in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

obligations (the riskiest asset class available to MMFs; see La Spada, 2018).<sup>23</sup> Similarly to what we did with WLA, we take the 2019Q4 average for each of these risk-taking proxies. Results are in Table 5, and the estimated impact of WLA on funds' outflows is largely similar. Note that neither of our measures of credit risk has an impact on outflows; outflows, however, are stronger from funds with higher WAM and therefore higher exposure to interest-rate risk.

Finally, we run several other robustness checks. First, one may worry that our results could be driven by outliers, specifically by the two institutional funds with WLA above 60% in Figure 3. We estimate regression (1) dropping those funds, and the results are similar to our baseline ones (see Table 6). Another strategy to control for outliers, which does not require dropping observations, is to use the least absolute deviation (LAD) estimator. Results are similar and can be found in Table 27 in the appendix.

A second concern is that our diff-in-diff setting may not satisfy the parallel trend assumption. For robustness, we re-estimate our regressions including the interaction of a linear time trend with  $WLA_{i2019Q4}$ . Results are in Table 7 and are similar to our baseline results: a 10-pp drop in 2019Q4 WLA leads to additional daily outflows of 0.9 pp, which amount to additional outflows of 18 pp over the 20-day run period.

The results in this section suggest that 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.

<sup>23</sup>Weighted average CDS spread is calculated using the issuers' 5-year CDS spreads from Markit and security values as weights.

	Outflows (%)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Run $\times$ WLA	-0.12** (-2.55)	-0.09** (-2.32)	-0.07* (-2.00)	-0.15** (-2.65)	-0.13*** (-2.86)	-0.12*** (-2.95)	-0.15*** (-2.92)	-0.12*** (-3.04)	-0.11*** (-2.96)
Run $\times$ WAM	0.06*** (2.67)	0.07*** (2.90)	0.07*** (3.12)						
Run $\times$ CDS Spread				0.02 (0.49)	-0.00 (-0.05)	-0.02 (-0.45)			
Run $\times$ Bank Oblig Share							0.64 (0.52)	1.57 (1.12)	1.03 (0.88)
Observations	1620	1680	1740	1620	1680	1740	1620	1680	1740
$R^2$	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	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	1/2-3/20	1/2-3/24	1/2-3/26

**Table 5.** Fund-level regression of daily percentage outflows from onshore institutional prime MMFs against fund WLA in 2019Q4, controlling for fund risk-taking. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WAM is the weighted average maturity of the fund's portfolio in days. Bank Oblig is the share of bank obligations in the fund's portfolio in percent. CDS Spread is the weighted average 5-year CDS spread of the issuers of the securities in the fund's portfolio. WAM, Bank Oblig, and CDS Spread are calculated as averages over 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	-0.11*	-0.09*	-0.08*
	(-1.71)	(-1.76)	(-1.95)
Observations	1512	1568	1624
$R^2$	0.26	0.26	0.26
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

**Table 6.** 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. Two funds with 2019Q4 WLA near 60% are dropped to control for outliers.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	-0.11**	-0.09**	-0.09*
	(-2.58)	(-2.28)	(-1.97)
Time $\times$ WLA	-0.00	-0.00	-0.00
	(-1.27)	(-1.05)	(-0.82)
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

**Table 7.** 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; Time is a linear time trend.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

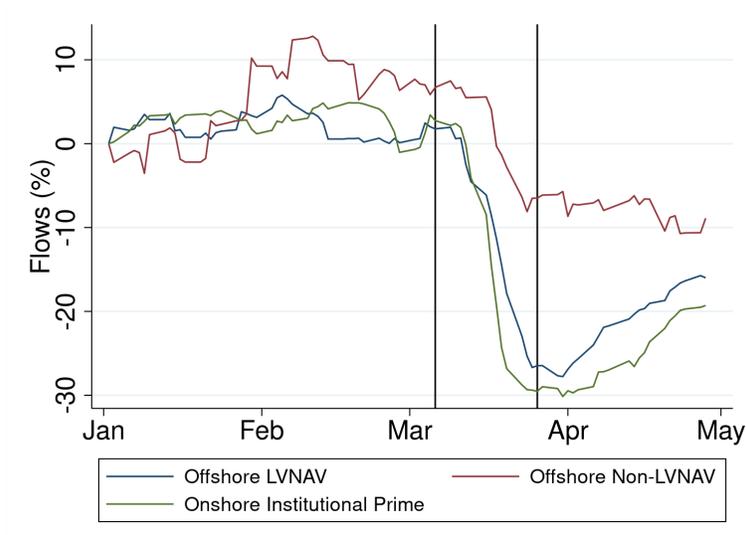
#### 4.2. Identification via offshore funds' regulation

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; lower portfolio liquidity strengthens the first-mover advantage for fund investors and hence the likelihood of a run (Goldstein et al., 2017). To disentangle this effect from that of liquidity-contingent gates and fees, 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.<sup>24</sup> Figure 4 shows cumulative percentage flows in offshore LVNAV and

<sup>24</sup>LVNAV MMFs can impose fees or gates if their WLA falls below 30% and daily outflows are above 10%. They are subject to mandatory fees and gates if their WLA fall below 10%. In our sample, we observe 9 Non-LVNAV funds

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.



**Figure 4.** Cumulative percentage flows in offshore prime MMFs (LVNAV and non-LVNAV) 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 funds 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—and not fees and gates—were the relevant trigger for the March 2020 run, 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.

The difference between offshore non-LVNAV 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:

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

where  $\text{Non-LVNAV}$  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 8; standard and 20 LVNAV funds. The Non-LVNAV funds had altogether, on average across 2019Q4, \$49 billion in TNA, while the LVNAV funds had \$318 billion. We observe 21 families of offshore funds.

errors are robust to heteroskedasticity, serial correlation, and cross-sectional correlation. 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 2.2 percentage points lower than those of onshore institutional prime funds.<sup>25</sup>

Similar to the case of onshore funds, one concern is investors’ self-selection: more sophisticated investors—who are more prone to flee a fund—may rationally choose more aggressive funds with lower portfolio liquidity; outflows, then, would not be due to the possibility of redemption restrictions but to ex ante investor heterogeneity. If that were the case for offshore funds, however, this would imply that our findings underestimate (as opposed to overestimate) the importance of redemption restrictions: offshore non-LVNAV funds should have more sophisticated and flighty investors because, as discussed in Section 2, they have lower liquidity requirements than both offshore LVNAV funds and onshore institutional prime funds; as a result, everything else being equal—and in particular, if liquidity restrictions did not drive investors’ behavior—they should experience larger, not smaller, outflows. For the same reason, it is unlikely that offshore non-LVNAV prime funds experienced smaller outflows because of higher portfolio liquidity (regardless of heterogeneity in investor sophistication).

For robustness, in Appendix A, we re-estimate regression (2) including the interaction of a linear time trend with the non-LVNAV dummy, to allow for different time trends across groups; results are in Table 28 and are largely similar to the baseline ones.

Finally, to strengthen our identification of the impact of liquidity-based gates and fees on investor flows, in Table 9, we report the results of regression (1) estimated on offshore LVNAV funds.<sup>26</sup> 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 points during the Covid-19 run.

## 5. The unsophisticated run of retail investors

### 5.1. *Within-family contagion from institutional investors*

In contrast to outflows from institutional funds, outflows from onshore retail prime MMFs during March 2020 were not driven by lower WLA levels. Figure 5 is the equivalent of Figure 3 for onshore

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<sup>25</sup>Additionally, in Appendix A, we re-estimate regression (2) comparing outflows in offshore LVNAV and in onshore institutional prime MMFs—both of which are subject to gates and fees, but only the former operates under a fixed NAV; our results show that offshore LVNAV funds experienced slightly lower outflows, which indicates that credit concerns were unlikely to be a factor.

<sup>26</sup>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 do not estimate regression (1) separately on the sample of non-LVNAV funds.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run $\times$ Non-LVNAV	-1.31*** (-2.88)	-1.22*** (-3.49)	-1.32*** (-4.02)	-2.56*** (-2.73)	-2.27*** (-3.26)	-2.18*** (-3.68)
Observations	1660	1720	1780	2160	2240	2320
$R^2$	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
Sample	Non-LVNAV and LVNAV			Non-LVNAV and Institutional		

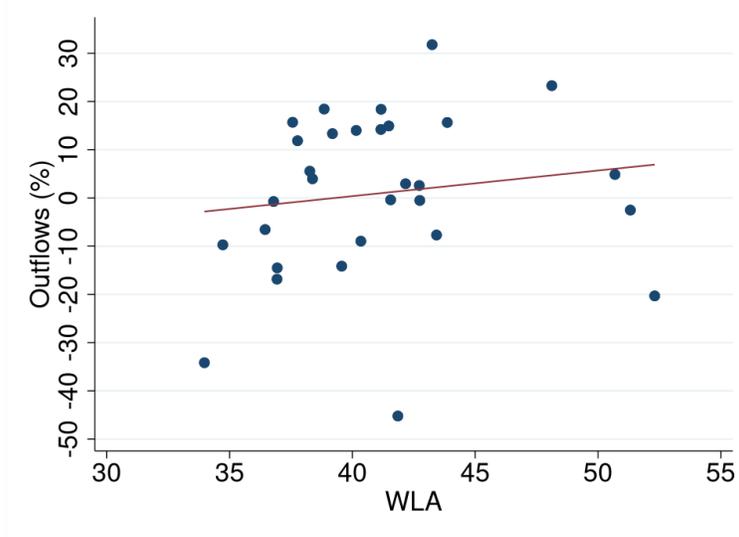
**Table 8.** Fund-level regression of daily percentage outflows in institutional prime MMFs (offshore and onshore) as a function of the possible imposition of gates and fees. Non-LVNAV is a dummy equal to one for offshore non-LVNAV MMFs. In columns (1)-(3), the sample is all offshore prime MMFs (LVNAV 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.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	-0.11*** (-3.95)	-0.10*** (-4.12)	-0.06* (-1.74)
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

**Table 9.** 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.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

retail prime funds: it shows their cumulative outflows during the March 2020 run against their WLA in January and February. There is no visible relationship between a fund's outflows and its WLA before the run started ( $\beta = 0.4$  with  $p$ -value = 0.52); this evidence suggests that retail investors were not sophisticated enough to constantly monitor their funds' WLA and run preemptively when their level approached the regulatory thresholds. The mechanism that led retail investors to run from prime MMFs was different, and in this section, we show that their outflows were driven by the presence of institutional prime MMFs within the same fund family.

Table 10 shows that, at the end of 2019, there were seven retail prime MMFs belonging to (seven) families that did not offer any onshore institutional prime MMFs. These funds represented 23% of the industry in terms of the number of funds and 29% of the industry in terms of dollar



**Figure 5.** Scatterplot of cumulative percentage outflows from onshore retail prime MMFs during the March 2020 run (March 6-March 26) against a fund’s average WLA in January-February 2020.

value. Overall, the share of institutional offering in a family prime-MMF business ranged from zero (family offers only retail funds) to one (family offers only institutional funds), with a median across families of 0.40, and the 25<sup>th</sup> and 75<sup>th</sup> percentiles equal to 0 and 0.87.

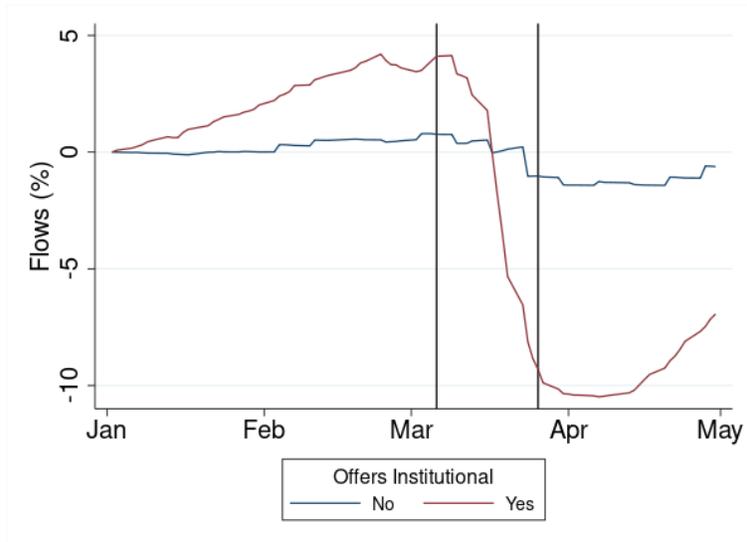
US Retail Prime MMFs							
Family Offers Institutional Prime MMFs		No	Yes				
TNA (\$ billion)		137	335				
Funds		7	23				
Families		7	18				
TNA Share of Institutional Funds in a Family’s Prime MMFs							
Min	P10	P25	P50	P75	P90	Max	Std Dev
0	0	0	0.40	0.87	0.95	1.00	0.41

**Table 10.** Summary statistics of retail prime MMFs and MMF families by the family’s offering of institutional prime MMFs in 2019Q4.

Figure 6 shows cumulative flows in 2020 separately for retail prime MMFs belonging to families with and without institutional prime funds. During the run, the first group experienced much larger outflows, which on March 26 reached 13% of the group’s TNA at the end of 2019; the outflows from the second group were only 2% of its 2019 size.

To quantify the effect of the presence of institutional prime MMFs in the family on retail outflows during the Covid-19 run, we estimate the following daily regression on the panel of retail prime MMFs:

$$\text{Outflow}_{it} = \alpha_i + \mu_t + \beta \text{Run}_t \times \text{Inst Share}_{i2019Q4} + \gamma \text{Run}_t \times \text{WLA}_{i2019Q4} + \varepsilon_{it}, \quad (3)$$



**Figure 6.** Cumulative percentage flows in US retail prime MMFs during January-April 2020 as a function of the fund family’s offering of institutional prime MMFs. The black vertical lines represent March 6 (beginning of the Covid-19 run) and March 26 (end of the run).

where Inst Share is the average share of institutional prime-MMF TNA in the family’s total prime-MMF TNA over 2019Q4 (to control for endogeneity), and all other variables are defined as in regression (1). The variable Inst Share proxies the informativeness of institutional investors’ behavior in the family.

The results of regression (3) are in Table 11. Standard errors are robust to heteroskedasticity, serial correlation, and cross-sectional correlation. A 10-pp increase in the share of institutional funds in a family’s prime-MMF business at the end of 2019 increases daily outflows from the family’s retail prime funds during the March 2020 run by 0.2 pp ( $p$ -value  $< 0.01$ ), for a total of 4 pp over the 20-day stress period.

Since the cross-sectional standard deviation of Inst Share is 41 pp, and total outflows from retail prime MMFs reached roughly 10%, the effect of a family’s institutional offering is quantitatively important. In contrast, consistent with the visual evidence in Figure 5, the effect of WLA on retail flows is practically zero and statistically insignificant.

Our results could be driven by the possibility that retail investors in fund families offering institutional funds are more sophisticated, i.e., more similar to institutional investors, and therefore more attentive and prone to flee from a fund. To control for this confounding factor, we re-estimate regression (3) controlling for the fund’s average expense ratio and minimum investment, as we do for institutional funds in Section 4. Results are in Table 12 and show that although retail prime funds with more sophisticated investors (lower expense ratios and higher minimum investment) did experience moderately larger outflows, the presence of institutional prime funds in the family still causes larger outflows during the March 2020 run.

As we did for institutional funds, we re-estimate regression (3) controlling for retail funds’ risk-taking. Results are in Table 13; although higher interest-rate risk (proxied by WAM) and higher

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	0.00 (0.02)	-0.01 (-0.48)	-0.01 (-0.37)
Run $\times$ Inst Share	1.39*** (3.64)	1.66*** (3.52)	1.69*** (3.94)
Observations	1682	1742	1802
$R^2$	0.12	0.13	0.13
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

**Table 11.** Fund-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. Inst Share is the average share of institutional prime-MMF TNA in the family’s total prime-MMF TNA over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WLA is a fund’s average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run $\times$ WLA	-0.00 (-0.12)	-0.01 (-0.59)	-0.01 (-0.49)	0.02 (1.47)	0.01 (0.55)	0.01 (0.48)
Run $\times$ Inst Share	1.05*** (3.36)	1.30*** (3.20)	1.38*** (3.45)	0.91*** (2.73)	1.19** (2.64)	1.34*** (2.73)
Run $\times$ Expense Ratio	-0.02*** (-4.73)	-0.02*** (-5.23)	-0.02*** (-6.15)			
Run $\times$ Log Min Investment				0.11*** (5.48)	0.11*** (6.24)	0.08*** (2.90)
Observations	1682	1742	1802	1651	1711	1771
$R^2$	0.14	0.15	0.14	0.13	0.14	0.13
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

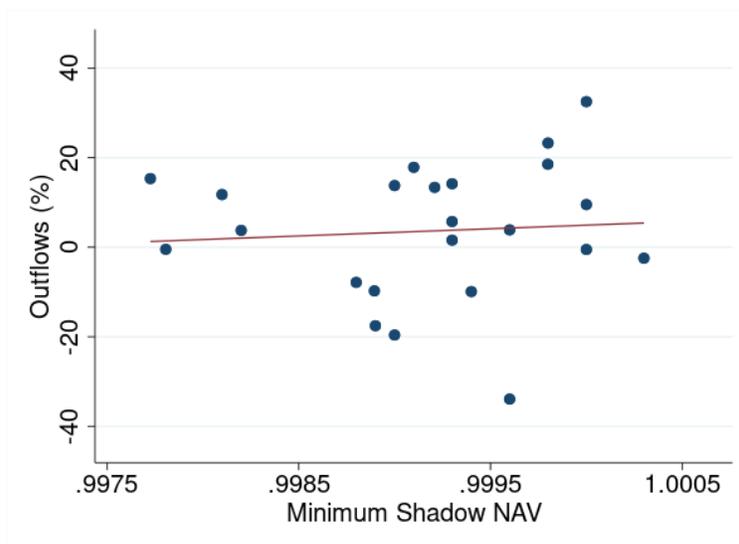
**Table 12.** Fund-level regression of daily percentage outflows from a family’s retail prime MMFs as a function of the fund family’s offering of institutional prime funds, controlling for investor sophistication. Inst Share is the average share of institutional prime-MMF TNA in the family’s total prime-MMF TNA over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Expense Ratio is in basis points and Log Min Investment is in millions; both are fund-level averages in 2019Q4. WLA is a fund’s average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

credit risk (proxied by either CDS spreads or the portfolio share invested in bank obligations) are associated with higher outflows, the effect due to the presence of institutional prime MMFs within the same family is almost unchanged: a 10-pp increase in the institutional share of a family’s prime

MMF business leads to 0.1-0.2 pp ( $p$ -value  $< 0.01$ ) increase in daily outflows from the family’s retail prime MMFs during the run.

To make sure that our results are not driven by a violation of the parallel trend assumption, we re-estimate regression (3) including the interaction of a linear time trend with Inst Share. Results are in Table 14 and are very close to our baseline results.

Finally, one may believe that outflows from retail prime MMFs—which are allowed to offer a fixed NAV—were due to investors’ concerns that these funds could “break the buck” as their NAV deteriorated during the run. This is not the case. Figure 7 is a scatterplot of cumulative outflows from retail prime MMFs over the run period against the minimum of their shadow NAV (i.e., the fund’s share price based on the market value of its portfolio securities) during the same time. The relationship between cumulative outflows and NAV is flat (the  $p$ -value of the slope coefficient is 0.61, and the  $R^2$  is 0.01);<sup>27</sup> if anything, funds with lower NAV minima experienced smaller outflows.<sup>28</sup>



**Figure 7.** Scatterplot of cumulative percentage outflows from onshore retail prime MMFs over March 6-26 against the minimum of their shadow NAV over the same period.

Not only does the presence of institutional prime funds in a family lead to higher outflows from the family’s retail prime funds, but the size of the institutional outflows also matters. As shown in Figure 8, larger institutional outflows are associated with larger retail outflows in the same family.

To estimate the effect of institutional outflows on retail ones, we run the following family-level

<sup>27</sup>Note that any reverse causality such that outflows cause a decrease of a fund’s NAV due to liquidation costs would make the negative relationship between NAV and outflow stronger.

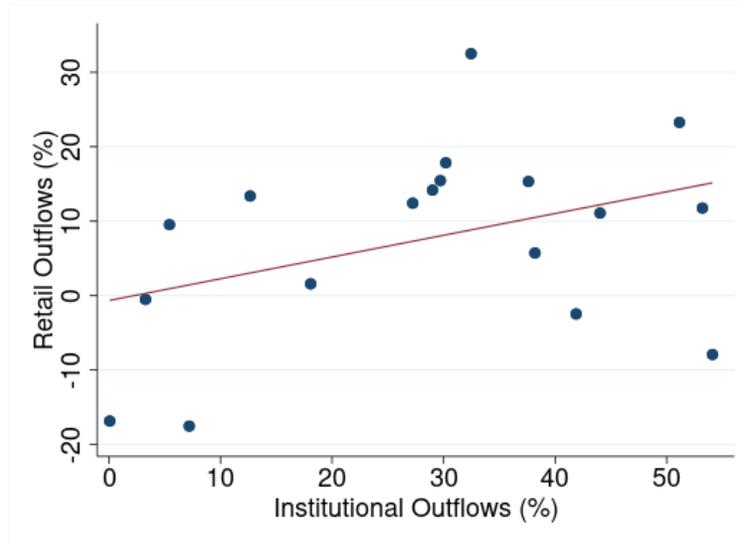
<sup>28</sup>Although institutional prime MMFs have a floating NAV, which means that they do not face the risk of “breaking the buck,” we repeat the same analysis for their case. As shown in Figure 13 in Appendix A, the relationship between outflows from institutional prime MMFs during the run period and their minimum NAV over the same period is also insignificant, suggesting that a deteriorating NAV was not the cause of the outflows.

	Outflows (%)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Run $\times$ WLA	0.01 (1.45)	0.01 (0.53)	0.01 (0.62)	0.05** (2.45)	0.03 (1.33)	0.03 (1.46)	-0.00 (-0.15)	-0.01 (-0.60)	-0.01 (-0.54)
Run $\times$ Inst Share	1.27*** (3.91)	1.51*** (3.73)	1.57*** (4.07)	0.89** (2.52)	1.19** (2.47)	1.25*** (2.70)	1.34*** (3.76)	1.60*** (3.60)	1.63*** (4.05)
Run $\times$ WAM	0.03* (1.91)	0.04** (2.10)	0.03** (2.39)						
Run $\times$ CDS Spread				0.08*** (5.18)	0.07*** (5.18)	0.07*** (4.51)			
Run $\times$ Bank Oblig Share							3.77* (1.76)	4.55* (1.95)	4.86** (2.13)
Observations	1682	1742	1802	1682	1742	1802	1682	1742	1802
$R^2$	0.12	0.14	0.13	0.12	0.14	0.13	0.13	0.15	0.15
Fund FE	Yes								
Date FE	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	1/2-3/20	1/2-3/24	1/2-3/26

**Table 13.** Fund-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, controlling for fund risk-taking. Inst Share is the average share of institutional prime-MMF TNA in the family's total prime-MMF TNA over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WAM is the weighted average maturity of the fund's portfolio in days. Bank Oblig is the share of bank obligations in the fund's portfolio in percent. CDS is the weighted average 5-year CDS spread of the issuers in the fund's portfolio. WAM, Bank Oblig, and CDS are calculated as averages over 2019Q4. WLA is a fund's average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	0.00 (0.02)	-0.01 (-0.48)	-0.01 (-0.37)
Run $\times$ Inst Share	1.25*** (3.80)	1.45*** (3.65)	1.45*** (4.02)
Time $\times$ Inst Share	0.01* (1.77)	0.01* (1.73)	0.01* (1.84)
Observations	1682	1742	1802
$R^2$	0.12	0.13	0.13
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

**Table 14.** Fund-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, controlling for linear trends across groups. Inst Share is the average share of institutional prime-MMF TNA in the family’s total prime-MMF TNA over 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward; and Time is a linear time trend. WLA is a fund’s average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.



**Figure 8.** Family-level scatterplot of cumulative 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.

panel regression:

$$\text{Retail Flow}_{it} = \alpha_i + \mu_t + \sum_{s=0}^4 \beta_s \text{Run}_t \times \text{Inst Flow}_{it-s} + \sum_{s=0}^4 \gamma_s \text{Inst Flow}_{it-s} + \varepsilon_{it}, \quad (4)$$

where  $\text{Retail Flow}_{it}$  are the percentage flows in family  $i$ ’s retail prime MMFs on day  $t$ ,  $\text{Inst Flow}$  are the percentage flows in the family’s institutional prime MMFs, and  $\alpha_i$  and  $\mu_t$  are family and

day fixed effects. That is, we regress daily flows in a family’s retail prime funds against the contemporaneous and lagged (up to 4 business days) flows in the family’s institutional prime funds and allow the impact of institutional flows to be different during the run period. The regression is estimated from January 2020 to the end of the run. Results are in Table 15. Standard errors are robust to heteroskedasticity, serial correlation, and cross-sectional correlation.

	Retail Flow <sub>it</sub> (%)	
	(1)	(2)
$\sum_{s=0}^4 \beta_s(\text{Run}_t \times \text{Inst Flow}_{it-s})$	0.34***	
p-value	0.00	
$\sum_{s=0}^4 \beta_s(\text{Run}_t \times \text{Positive Inst Flow}_{it-s})$		0.80***
p-value		0.00
$\sum_{s=0}^4 \beta_s(\text{Run}_t \times \text{Negative Inst Flow}_{it-s})$		0.28***
p-value		0.00
Observations	900	900
$R^2$	0.18	0.19
Family FE	Yes	Yes
Date FE	Yes	Yes
Period	1/2-3/26	1/2-3/26

**Table 15.** 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 and their interactions with a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Standard errors are Driscoll-Kraay with 20 lags.

As Column (1) shows, relative to the pre-run period, a 10-pp increase in daily outflows from a family’s institutional prime MMFs leads to a cumulative 3-pp increase in outflows from the family’s retail funds over the next 5 days during the run; this effect is quantitatively significant compared to the 10% total retail outflow over the 20-day run period. The fact that the size of retail outflows depends on that of institutional outflows supports the hypothesis that they are driven by informational reason (and not by a self-selection of more run-prone retail investors in families with higher shares of institutional clients).

In Column (2) of Table 15, we estimate regression (4) splitting institutional flows into inflows and outflows; during the March 2020 run, spillovers from institutional to retail prime MMFs within the same family occur both with inflows and outflows, but the impact of inflows is stronger; this result is consistent with an information story because, during a time of generalized outflows, inflows are likely to be a more informative signal than outflows.

One concern with regression (4) is reverse causality: retail outflows could be causing institutional outflows, and not vice versa. However, this is not the case. In Appendix B, in fact, we show that the flow spillover is only from institutional to retail funds, and not the other way around. Specifically, if we replicate regression (4) using a family’s institutional prime-MMF flows as the dependent variable and retail flows as the explanatory variable, the results are non significant (see Table 30 in Appendix B).

## 5.2. *Information and portfolio choice*

Even if unsophisticated retail investors are not aware of the workings of the SEC rules regarding gates or fees, they may follow the behavior of the institutional investors in their family through word of mouth because they view them as better informed. This interpretation is reminiscent of the information-based theories of contagion in bank runs, such as Chari and Jagannathan (1988) and Chen (1999): during episodes of heightened uncertainty, investors use other investors' actions as signals about the quality of their own investment.

For the redemptions of institutional investors to be informative, managers of institutional and retail funds belonging to the same family must have similar investment strategies. To test whether this is the case, we construct a measure of portfolio similarity and compare retail and institutional funds within and across families. In particular, for each pair of funds, we construct a cosine similarity measure of their portfolios based on the share of investment in any given security type and issuer, using security-level month-end data for October, November, and December 2019.<sup>29</sup> Since our similarity measure is based on a fund's investment share in each given security and issuer, it captures the similarity of credit-risk exposure between fund portfolios, which is particularly salient for retail investors as both the 2008 and 2011 runs were mainly driven by credit-risk concerns (Kacperczyk and Schnabl, 2013; Chernenko and Sunderam, 2014). The portfolio cosine similarity ranges from zero, when funds have orthogonal investment strategies, to one, when funds share the same investment strategy (all investment shares are the same).

Table 16 shows the average portfolio similarity between funds for different types of fund pairs (institutional-institutional, retail-retail, institutional-retail) within and across fund families, during 2019Q4. As the table shows, all fund pairs belonging to the same family—and specifically for our purposes, retail-institutional pairs—have stronger portfolio similarity than pairs belonging to different families. Because of this, the behavior of institutional investors within the same fund family conveys useful information to retail investors.

Additionally, the same team often manages both institutional and retail prime MMFs in a fund family. Table 17 shows that, in our sample, a portfolio manager manages on average two funds, with 66% of the managers managing more than one fund and 59% of them managing both institutional and retail portfolios. In particular, 66% of retail prime MMFs—corresponding to 69% of the retail industry's TNA—have at least one portfolio manager who is also on the management team of an institutional prime fund in the same fund family; for 50% of retail prime MMFs, the whole management team is also managing some institutional prime MMFs in the same family. This evidence suggests that the actions of institutional investors within the same fund family may convey information to retail investors not only because the portfolio of retail and institutional funds in a given family are similar, but also because the management team of the funds is often the same.

Finally, retail investors may have left prime funds in families also offering institutional funds

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<sup>29</sup>For each fund, we construct a vector of portfolio shares of length  $N$ , where  $N$  is the total number of combinations of security type and issuer (e.g., CDs issued by Bank of America is one element of the vector); for each fund, the vector contains the share of each security type-issuer combination in the fund's portfolio. For every pair of funds, we then calculate the dot product of their portfolio-share vectors divided by their norms.

	Family		
	Different	Same	Same – Different
Institutional Pair	0.24 (0.18)	0.53 (0.32)	0.29*** (6.6)
Retail Pair	0.22 (0.15)	0.64 (0.26)	0.42*** (10.9)
Institutional-Retail Pair	0.23 (0.17)	0.62 (0.26)	0.39*** (17.4)

**Table 16.** Average portfolio similarity between pairs of onshore prime MMFs by investor type during 2019Q4, within and across fund families. In Columns (1) and (2), standard deviations are in parentheses. In Column (3), the  $t$ -statistics for the difference between the means in Columns (2) and (1) are presented in parentheses; for each sample of fund pairs, the  $t$ -statistics are computed by regressing the portfolio similarity measure against a “Same Family” dummy, together with month and fund fixed effects.

Portfolio Manager (PM) Allocation Within Fund Family	
Average Number of PMs per Family	2.19
Average Number of Funds Managed by a PM	2.11
PMs that Advise More than One Fund	66%
PMs that Advise Both Retail and Institutional Funds	59%
Retail Funds with at Least One PM Also Advising Institutional Funds	66%
Retail Funds with the Same PM Team as an Institutional Fund	50%
TNA of Retail Funds With at Least One PM Also Advising Institutional Funds	69%

**Table 17.** Summary statistics on the allocation of portfolio managers (PMs) across onshore institutional and retail prime MMFs of the same family in 2019Q4. To identify a fund’s portfolio managers, we use the variable “Portfolio Manager” from iMoneyNet.

because they were concerned about the stability of the whole family or that of its sponsor, not because they were extracting information on their own investment from the actions of institutional investors. If this were the case, however, retail investors would switch to a different family when moving from prime to government MMFs; instead, as we show in Section 6, most flows from prime to government funds happen within the same fund family. This evidence suggests that the information content of institutional prime outflows is likely to be related to the investment decisions of individual funds and not to the stability of the fund family in general.

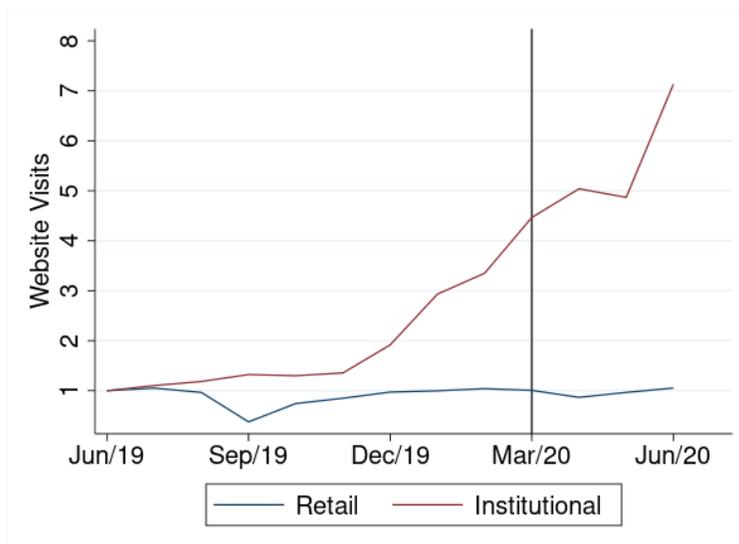
### 5.3. Information acquisition

We have argued that the reason why retail investors follow institutional ones is that they are less sophisticated. To buttress our hypothesis, we study the extent to which both investor types acquired information on their funds during the March 2020 run using data on website traffic. We use data from Semrush on the estimated monthly visits to prime-MMF websites, distinguishing between institutional and retail funds.

Since funds are mandated by SEC regulation to disclose their WLA levels daily on their websites,

website visits are a useful indicator of whether investors tried to acquire information on their funds, and specifically on their likelihood to impose gates or fees, which can be done when WLA drops below 30%.

Figure 9 shows the estimated monthly website visits for institutional and retail prime MMFs from June 2019 to June 2020, normalized by their June 2019 value. Around the run (vertical lines), the visits to the websites of institutional funds increased significantly more than those of the websites of retail funds. In March 2020, website visits for institutional prime MMFs increased by 346% relative to June 2019, whereas they remained roughly constant for retail ones. Website visits in institutional funds started to increase sharply in January 2020, as concerns about the Covid pandemic and its spread to the US mounted.<sup>30</sup>



**Figure 9.** Estimated monthly visits to onshore prime MMF websites by investor type, from June 2019-June 2020. Visits are normalized to 1 in June 2019 for each industry. The black vertical line represents March 2020, the beginning of the Covid-19 run. Data are from SEMrush

To quantify the differential information acquisition of institutional and retail investors, we run the following fund-level regression at the monthly frequency on the panel of onshore prime MMFs:

$$\text{Web Visits/TNA}_{it} = \alpha_i + \mu_t + \beta \text{Run}_t \times \text{Inst}_i + \varepsilon_{it}, \quad (5)$$

where Web Visits/TNA is the number of monthly visits to a fund’s website divided by the fund’s TNA to account for heterogeneity in fund size (and therefore in the number of investors), Run is a dummy equal to 1 from March 2020 onward, Inst is a dummy for institutional funds,  $\alpha_i$  are fund fixed effects, and  $\mu_t$  are time fixed effects. We use Driscoll-Kraay standard errors (robust to heteroskedasticity, serial correlation, and cross-correlation) with three lags. Results are in Columns (1) of Table 18. From March 2020 onward, website visits in institutional prime MMFs increased

<sup>30</sup>On December 31, 2019, the Chinese authorities alerted the World Health Organization (WHO) of a string of pneumonia-like cases in Wuhan, which the WHO confirmed on January 9, 2020. On January 2020, the CDC confirmed the first case in the US.

more than those for retail funds by 250 visits per billion dollars invested ( $p$ -value  $< 0.01$ ).

Moreover, institutional investors tend to have larger MMF shares; as a result, for the same fund size, the number of investors should be smaller in institutional funds than in retail ones. To control for this heterogeneity, we also construct another proxy for the number of investors in a fund using class-level information on minimum investment. Namely, for any given share class, we take its TNA and divide it by its minimum investment to estimate (an upper bound on) the number of investors at the class level; we then aggregate this estimate across classes in the same fund to obtain a fund-level measure. Results are similar: the estimated number of monthly visits per investor in institutional funds increased more than in retail funds by 0.2 visits per investor ( $p$ -value  $< 0.01$ ).

Finally, to control for possible violations of the parallel trend assumption, we re-estimate regression (5) allowing for a differential linear trend between institutional and retail funds. Results are in Columns (3) and (4) of Table 18. Although smaller in magnitude because, as discussed above, information acquisition and website monitoring started ahead of the March 2020 run, the results are qualitatively similar.

	(1)	(2)	(3)	(4)
	Web Visits/TNA	Web Visits/Investor	Web Visits/TNA	Web Visits/Investor
Run $\times$ Inst	252.62*** (5.41)	0.22*** (5.96)	128.01* (1.94)	0.14*** (3.74)
Time $\times$ Inst			19.17** (2.45)	0.01** (2.86)
Observations	377	377	377	377
$R^2$	0.074	0.087	0.084	0.093
Fund FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes

**Table 18.** Fund-level regression of estimated monthly visits to onshore prime-MMF websites (Web Visits) from June 2019-June 2020 as a function of a fund’s investor type, controlling for a differential linear trend between investor types. Fund TNA are in billions of dollars. Investor is a proxy for the number of investors in the fund; for each share class, we take the ratio between its TNA and minimum investment and then sum across classes in the fund. Inst is a dummy equal to one for institutional funds. Run is a dummy equal to one from March 2020 onward. Time is a linear time trend.  $t$ -statistics, based on Driscoll-Kraay standard errors with 3 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

Overall, these results show that the growth of information acquisition by retail investors did not match that of institutional investors during the Covid-19 run; rather, it remained substantially flat. The finding lends support to the fact the retail investors are less sophisticated, which affects their reaction to adverse events and makes the withdrawals of institutional investors a useful signal to them.

## 6. Switching costs and government MMFs

Financial institutions sponsoring MMFs often offer both government and prime funds. The relative importance of these two types of funds within the family’s MMF business, however, varies across families, with some families mostly offering government funds and some families mostly offering prime funds. In this section, we study whether a family’s offering of government funds makes it more likely for investors to run from the family’s prime funds in times of stress. This could be because switching from prime to government funds within the same family is less costly to investors (e.g., due to lower search costs) than moving across families. The cost of switching to a safer option is an important determinant of investors’ decision to run on their risky investments. The higher the cost, the lower the likelihood (or size) of a run.

To understand the role of switching costs in the March 2020 run, we first provide suggestive evidence that prime-MMF investors remained mainly within the fund family, flowing into the family’s government MMFs. We then show that a robust government-MMF offering in a fund family exacerbates runs from the family’s prime funds. To the first point, similarly to 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 these intra-industry flows happened within MMF families. To quantify the within-family flows from prime to government MMFs, we run the following family-level regression at the daily frequency:

$$\text{Govt-MMF USD Flow}_{it} = \alpha_i + \mu_t + \beta \text{Prime-MMF USD Flow}_{it} + \varepsilon_{it}, \quad (6)$$

where Govt-MMF USD Flow and Prime-MMF USD Flow are the daily dollar flows in a family’s government and prime MMFs. We include family and day fixed effects. Given the heterogeneity in size across fund families, we use the LAD estimator to mitigate the effect of extremely large flows in the largest families. We run regression (6) separately on the pre-run (January 2-March 5) and run (March 6-26) periods.

Results are in Tables 19 and 20 for onshore institutional and retail share classes. In the pre-run period, there is no relationship between prime-MMF and government-MMF flows (Columns 1 and 2); in contrast, in the run period, there is a significant, one-to-one negative relationship between prime-MMF outflows and government-MMF inflows in the same family (Column 4). In other words, for the median family, a one-dollar outflow from its prime MMFs corresponds to a one-dollar inflow into its government MMFs, for both institutional and retail investors (both  $p$ -values  $< 0.01$ ). In contrast, we observe no relationship between inflows in prime MMFs and flows in the family’s government MMFs. Although we cannot observe individual investors’ flows, these results strongly suggest that, when concerns about prime MMFs started to materialize, investors just moved their money from the prime to the government funds in the same family.<sup>31</sup>

As we mention in Section 5, our results also provide support for the idea that the relationship

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<sup>31</sup>Government funds accommodated the inflows by increasing their ON RRP investment; for a discussion of MMF investment at the ON RRP, see Afonso et al. (2022).

	Government Flow <sub>it</sub> (USD)			
	(1)	(2)	(3)	(4)
Prime Flow <sub>it</sub> (USD)	0.13 (0.32)		-0.78 (-1.50)	
Prime Flow <sub>it</sub> (USD) > 0		0.26 (0.74)		3.02 (1.21)
Prime Flow <sub>it</sub> (USD) < 0		0.06 (0.06)		-1.06*** (-3.72)
Observations	731	731	255	255
R <sup>2</sup>	0.13	0.13	0.37	0.38
Family FE	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes
Period	1/2-3/5	1/2-3/5	3/6-3/26	3/6-3/26

**Table 19.** Family-level daily regression of dollar flows in a family’s government MMFs (institutional share classes) against dollar flows in the family’s institutional prime MMFs. This regression uses a LAD estimation to control for outliers. *t*-statistics, based on heteroskedasticity-robust standard errors, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Government Flow <sub>it</sub> (USD)			
	(1)	(2)	(3)	(4)
Prime Flow <sub>it</sub> (USD)	0.03 (0.55)		-0.79*** (-33.46)	
Prime Flow <sub>it</sub> (USD) > 0		0.06 (1.48)		0.33 (0.31)
Prime Flow <sub>it</sub> (USD) < 0		-0.02 (-1.24)		-1.08*** (-5.87)
Observations	903	903	315	315
R <sup>2</sup>	0.01	0.01	0.43	0.47
Family FE	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes
Period	1/2-3/5	1/2-3/5	3/6-3/26	3/6-3/26

**Table 20.** Family-level daily regression of dollar flows in a family’s government MMFs (retail share classes) against dollar flows in the family’s retail prime MMFs. This regression uses a LAD estimation to control for outliers. *t*-statistics, based on heteroskedasticity-robust standard errors, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

between retail and institutional outflows from prime MMFs is not driven by concerns about the stability of the fund family, but rather by retail investors taking the actions of institutional investors as a signal about the quality of their investment: if retail investors left prime funds out of concerns about the families’ stability, they would be unlikely to keep their money with the government funds of the same family.

The evidence in Tables 19 and 20 suggests that during the March 2020 run on prime MMFs, investors considered government MMFs as a natural outside option and preferred to remain within

the same fund family if possible. This result implies that for investors in prime funds belonging to families with a wider offering of government MMFs, in particular, the cost of redeeming their prime-MMF shares should be lower: these shares can be easily transferred to the preferred government-MMF share class within the same family, with lower search costs. As a result, it is easier for investors in such families to run on their prime MMFs in times of stress.

To test this hypothesis, for each investor type, we measure the breadth of a family’s offering of government MMFs as the average proportion of government-MMF share classes in the family’s total number of MMF share classes offered in 2019Q4. The rationale is that a larger offering of government-MMF products increases the likelihood that investors are able to find a safe option within the family that matches their needs; as a result, the investor will save the search cost of looking elsewhere, therefore reducing the switching cost from prime to government funds.

As shown in Table 21, for the median family, retail government-MMF share classes constitute 53% of retail MMF share classes, whereas institutional government-MMF share classes constitute 72% of institutional MMF share classes. There is, however, a lot of heterogeneity in the industry: in the family at the 10<sup>th</sup> percentile, the fraction of government-MMF share classes is equal to zero for both retail and institutional investors; in the family at the 90<sup>th</sup> percentile, it is 67% for retail investors and 85% for institutional ones.

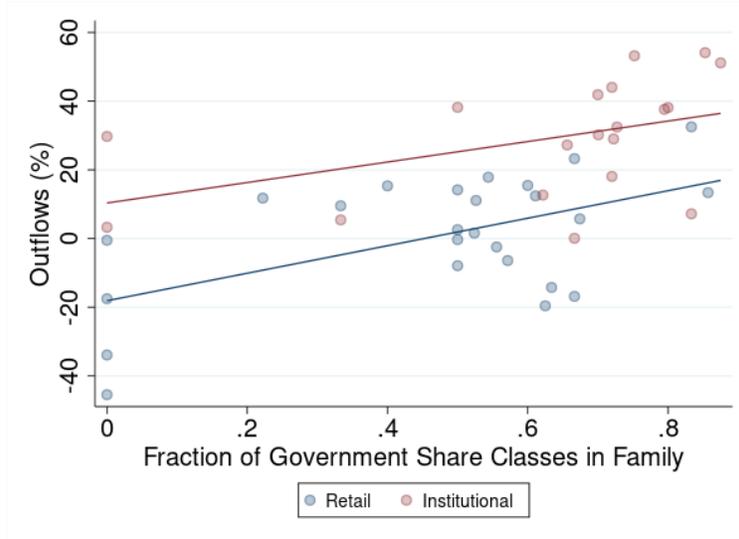
Fraction of Government-MMF Share Classes in an MMF Family by Investor Type								
	Min	P10	P25	P50	P75	P90	Max	Std Dev
Onshore Retail	0.00	0.00	0.40	0.53	0.62	0.67	0.86	0.25
Onshore Institutional	0.00	0.00	0.62	0.72	0.79	0.85	0.88	0.25
Offshore	0.00	0.00	0.00	0.15	0.33	0.43	0.61	0.20

**Table 21.** Summary statistics on the offering of government MMFs by fund families in 2019Q4, both onshore and offshore. For each investor category (onshore institutional, onshore retail, and offshore), a family’s offering of government MMFs is calculated as the fraction of government-MMF share classes in the family’s total number of MMF share classes (prime and government ones).

Figure 10 shows the scatterplot of the cumulative outflows from a family’s prime MMFs during the March 2020 run against the proportion of government-MMF share classes in the family’s total MMF share classes in 2019Q4. For both institutional and retail funds, there is a positive relation between a family’s offering of government MMFs and the outflows from its prime MMFs during the March 2020 run. That is, consistent with our hypothesis that lower switching costs can exacerbate the run, outflows are stronger in families with a broader offering of government MMFs.

To quantify this effect, we re-estimate regressions (1) and (3) including the interaction between the run dummy and the proportion of government-MMF share classes in the family’s total number of MMF share classes during 2019Q4 (Gov Class Share). Results are in Table 22 for onshore institutional funds and in Table 23 for retail ones; standard errors are Driscoll-Kraay with 20 lags.

Switching costs are an important determinant of investors’ run behavior: an increase of 10 pp in the share of government-MMF share classes in a family’s MMF business in 2019Q4 leads



**Figure 10.** Family-level scatterplot of outflows from onshore prime MMFs over March 6-26 against the proportion of government-MMF share classes in the family's total MMF share classes in 2019Q4.

to higher daily outflows during the run, by 0.3 pp in both institutional and retail prime MMFs ( $p$ -values  $< 0.01$ ). Over the 20-day run period, these effects amount to 6 pp of additional outflows, which is a substantial difference.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	-0.15*** (-2.87)	-0.13*** (-3.08)	-0.11*** (-2.98)
Run $\times$ Gov Class Share	3.50*** (3.69)	3.17*** (4.24)	2.90*** (4.31)
Observations	1620	1680	1740
$R^2$	0.17	0.18	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

**Table 22.** Fund-level regression of daily percentage outflows from onshore institutional prime MMFs as a function of the family's offering of government MMFs. Gov Class Share is the average share of government-MMF share classes in the family's total number of onshore institutional MMF share classes in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WLA is a fund's average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

Our results hinge on the assumption that heterogeneity in a family's offering of government-MMF share classes reflects heterogeneity in investors' switching costs. One may worry that, instead, it reflects heterogeneity in investors' risk aversion: more risk-averse investors invest in both prime and government MMFs and self-select into families that offer both fund types, whereas less risk-

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	0.02* (1.81)	0.01 (0.93)	0.02** (2.01)
Run $\times$ Inst Share	0.87*** (4.03)	1.12*** (3.62)	0.91*** (4.72)
Run $\times$ Gov Class Share	2.22*** (2.94)	2.58*** (3.03)	2.65*** (3.36)
Observations	1682	1742	1802
$R^2$	0.12	0.13	0.13
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

**Table 23.** Fund-level regression of daily percentage outflows from onshore retail prime MMFs as a function of the family’s offering of government MMFs. Inst Share is the average share of institutional prime-MMF TNA in the family’s total prime-MMF TNA over 2019Q4. Gov Class Share is the average share of government-MMF share classes in the family’s total number of onshore retail MMF share classes in 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WLA is a fund’s average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

averse ones would only invest in prime MMFs and be more likely to choose families with only prime MMFs. In a crisis, investors in families offering both prime and government MMFs redeem more quickly from prime funds not because of lower switching costs, but because they are more risk averse.

To rule out this possibility, we re-estimate the regressions in Tables 22 and 23 adding the interaction of the run dummy with our proxies for fund risk-taking. Results are in Tables 24 for institutional investors and in Table 25 for retail ones; results are similar and show that, while higher fund risk-taking tends to be associated with higher outflows, the effect of a family’s offering of government-MMF products on prime-MMF outflows remains significant in both economic and statistical terms.

Finally, for robustness, we control for ex-ante heterogeneity in investor sophistication by re-estimating our regressions adding the interactions between the run dummy and the proxies for fund-level investor sophistication that we describe above: the fund’s average expense ratio and minimum investment (Tables 31 and 32 in Appendix C); results are similar.

Finally, we repeat the same analysis on the panel of offshore prime MMFs (including both LVNAV and non-LVNAV funds); results are in Table 33 of Appendix C and are consistent with those for onshore funds. A 10-pp increase in the share of government-MMF share classes in the family in 2019Q4 leads, during the run, to outflows from the family’s prime MMFs that are larger by 0.4 pp per day ( $p$ -value  $< 0.01$ ); that is, 8 pp during the whole run period.

	Outflows (%)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Run $\times$ WLA	-0.13** (-2.63)	-0.10** (-2.45)	-0.08** (-2.13)	-0.13** (-2.47)	-0.11** (-2.62)	-0.10*** (-2.73)	-0.15*** (-2.93)	-0.12*** (-3.06)	-0.11*** (-2.97)
Run $\times$ Gov Class Share	3.31*** (3.56)	2.90*** (4.02)	2.62*** (3.92)	3.89*** (3.75)	3.44*** (4.31)	3.08*** (4.16)	3.50*** (3.72)	3.13*** (4.25)	2.89*** (4.30)
Run $\times$ WAM	0.03* (1.80)	0.05** (2.20)	0.05** (2.37)						
Run $\times$ CDS Spread				0.12** (2.19)	0.08* (1.68)	0.05 (1.00)			
Run $\times$ Bank Oblig Share							-0.09 (-0.07)	0.93 (0.67)	0.43 (0.37)
Observations	1620	1680	1740	1620	1680	1740	1620	1680	1740
$R^2$	0.18	0.18	0.17	0.18	0.18	0.17	0.17	0.18	0.17
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	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	1/2-3/20	1/2-3/24	1/2-3/26

**Table 24.** Fund-level regression of daily percentage outflows from institutional prime MMFs as a function of the family's offering of government MMFs, controlling for fund risk-taking. Gov Class Share is the average share of government-MMF share classes in the family's total number of onshore institutional MMF share classes. WAM is the weighted average maturity of the fund's portfolio in days. Bank Oblig is the share of bank obligations in the fund's portfolio in percent. CDS Spread is the weighted average 5-year CDS spread of the issuers of the securities in the fund's portfolio. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WAM, Bank Oblig, and CDS Spread are calculated as averages over 2019Q4. WLA is a fund's average WLA in 2019Q4. t-statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Run × WLA	-0.01 (-0.51)	-0.02 (-0.90)	-0.02 (-1.05)	0.03 (1.16)	0.01 (0.37)	0.01 (0.39)	-0.02 (-0.73)	-0.03 (-1.07)	-0.03 (-1.13)
Run × Inst Share	1.34*** (3.87)	1.59*** (3.71)	1.66*** (4.03)	0.92** (2.53)	1.22** (2.48)	1.29*** (2.71)	1.36*** (3.75)	1.63*** (3.60)	1.65*** (4.04)
Run × Gov Class Share	1.83*** (3.23)	2.07*** (3.35)	2.32*** (3.36)	2.02*** (2.81)	2.34*** (2.94)	2.45*** (3.19)	1.67*** (3.50)	1.90*** (3.58)	1.98*** (3.90)
Run × WAM	0.02 (1.30)	0.02 (1.55)	0.01 (1.28)						
Run × CDS Spread				0.07*** (5.06)	0.07*** (4.89)	0.06*** (4.16)			
Run × Bank Oblig Share							2.68 (1.44)	3.30 (1.65)	3.57* (1.80)
Observations	1682	1742	1802	1682	1742	1802	1682	1742	1802
R <sup>2</sup>	0.13	0.16	0.15	0.14	0.16	0.15	0.14	0.16	0.16
Fund FE	Yes								
Date FE	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	1/2-3/20	1/2-3/24	1/2-3/26

**Table 25.** Fund-level regression of daily percentage outflows from retail prime MMFs as a function of the family's offering of government MMFs and risk controls. Gov Class Share is the average share of government-MMF share classes in the family's total number of onshore retail MMF share classes. WAM is the weighted average maturity of the fund's portfolio in days. Bank Oblig is the share of bank obligations in the fund's portfolio in percent. CDS is the weighted average 5-year CDS spread of the issuers of the securities in the fund's portfolio. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Inst Share is the average share of institutional prime-MMF TNA in the family's total prime-MMF TNA over 2019Q4. WAM, Bank Oblig, and CDS Spread are calculated as averages over 2019Q4. WLA is a fund's average WLA in 2019Q4. t-statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

## 7. Conclusions

Both institutional and retail investors ran on prime MMFs in March 2020; their behaviors, however, were starkly different. Outflows by institutional investors were stronger for those funds for which the imposition of gates and fees was more likely, due to a deterioration in their liquidity provision. This is consistent with the concern that investors may flee preemptively if the redemption restrictions are allowed. In contrast, unsophisticated retail investors were not sensitive to their funds' liquidity positions but ran more often if their funds belonged to families also offering institutional prime MMFs; given the similarity in managers' decisions within a family, their behavior is consistent with learning from the actions of their institutional counterparts.

Switching costs also played an important role in exacerbating the run: both institutional and retail prime MMFs belonging to families with a larger offering of government MMFs experienced larger outflows. This creates an externality: families with prime MMFs have an incentive to also provide government MMFs, increasing both the likelihood that investors remain within the family in times of stress and the likelihood of a run on its prime MMFs that may destabilize the industry. Moreover, we are the first to present evidence that providing investors with easy access to a safer alternative may adversely affect financial stability.

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# For Online Publication

## Online Appendices

### A. *The sophisticated run*

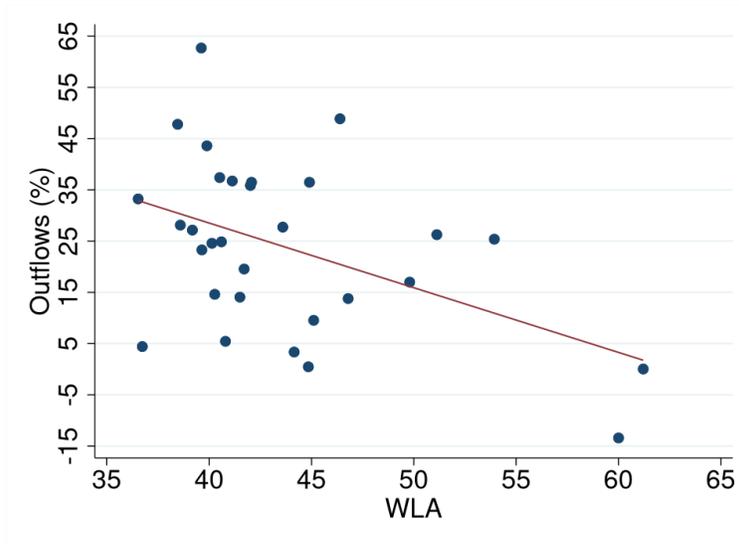
In this appendix, we report additional results and robustness checks on the run of institutional prime-MMF investors (Section 4 of the paper).

Table 26 shows summary statistics on the distribution of flows across prime MMFs during the Covid-19 run, between March 6 (beginning of the run) and March 20, i.e., up to the last business day before the introduction of the MMLF. The summary statistics are calculated separately for onshore institutional, onshore retail, and offshore funds. Results are consistent with those for the full run period March 6-26 reported in the paper (Table 1): institutional funds—both onshore and offshore ones—experienced larger outflows, but within all categories—including retail funds—there is significant heterogeneity.

	Prime MMF Cumulative Flows over 3/6-3/20 (%)				
	Min	P25	P50	P75	Max
Onshore Retail	-19	-10	0	8	29
Onshore Institutional	-63	-37	-24	-13	11
Offshore	-37	-18	-13	2	43

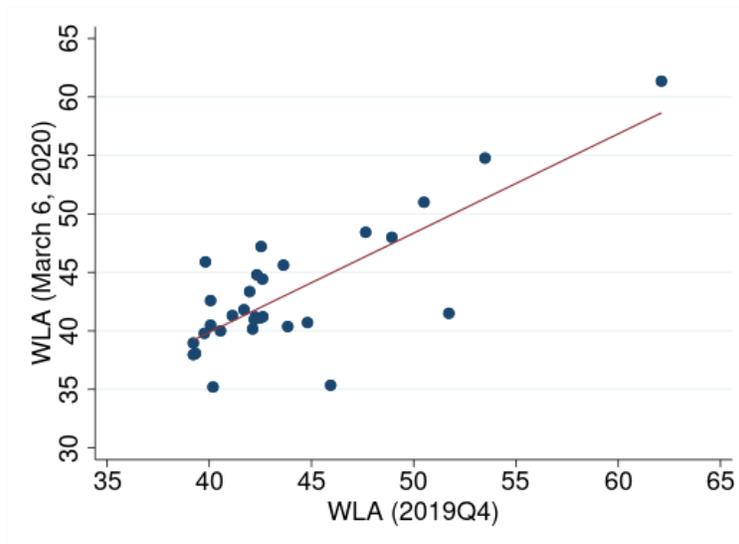
**Table 26.** Fund-level summary statistics of flows in onshore and offshore prime MMFs during the March 2020 run. The baseline definition of the run period in the paper is March 6-26; in this table, we report summary statistics on fund flows over March 6-20, i.e., up to the last business day before the introduction of the MMLF.

Figure 11 shows scatterplots of the outflows from onshore institutional prime MMFs over March 6-20 (i.e., before the introduction of the MMLF) against the funds' average WLA over January-February 2020. The results are consistent with those of Figure 3 in the paper, which considers outflows over the full length of the run (March 6-26): 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  $R^2 = 0.15$ ).



**Figure 11.** Scatterplot of cumulative percentage outflows from onshore institutional prime MMFs over March 6-20 against a fund's average WLA over January-February 2020.

Figure 12 shows the scatterplot of a fund's WLA on March 6 (the day the run started) against its average WLA in 2019Q4 (our instrument in the baseline regression (1)). A fund's WLA in 2019Q4 are a good predictor of its WLA right before the run. In fact, the slope coefficient from a simple OLS cross-sectional regression is 0.85 ( $p$ -value  $< 0.001$ ) with an  $R^2 = 0.61$ .



**Figure 12.** Scatterplot of WLA on March 6, 2020 (beginning of the Covid-19 run) against average WLA in 2019Q4 for onshore institutional prime MMFs.

In Table 27, we estimate regression (1) using the least absolute deviation (LAD) estimator to mitigate the effect of possible outliers. Results are similar to the baseline ones in the text, showing a significantly negative relationship between a fund's outflows during the March 2020 run and its average WLA in 2019Q4. Namely, a 10-pp decrease in WLA leads to additional daily outflows of

0.6 pp, which amount to total additional outflows of 12 pp over the 20-day run period.

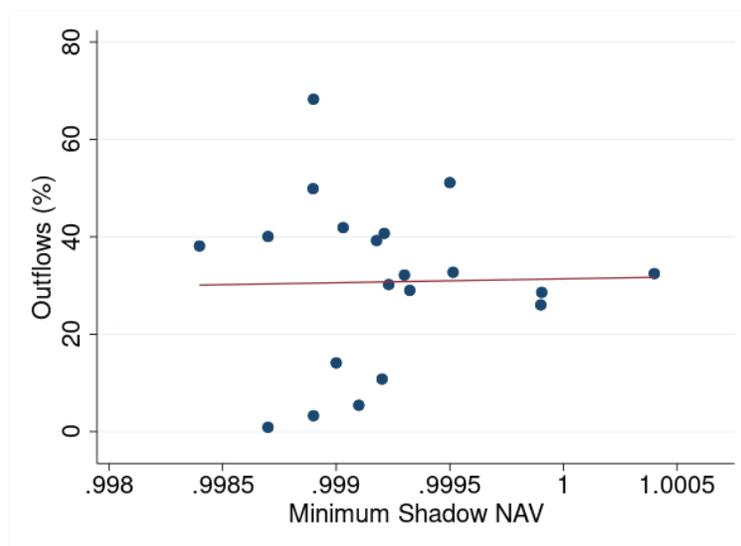
	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ WLA	-0.12** (-2.19)	-0.07 (-1.45)	-0.06 (-1.60)
Observations	1620	1680	1740
$R^2$	0.13	0.14	0.14
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

*t* statistics in parentheses

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

**Table 27.** 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. This regression uses a LAD estimation to control for outliers. *t*-statistics, based on heteroskedasticity-robust standard errors, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

Figure 13 plots outflows from onshore institutional prime MMFs during March 6-26 against the minimum of their shadow NAV over the same period; consistent with results for retail funds reported in the paper (Figure 7), outflows from institutional funds did not seem to depend on the funds' shadow NAV, which suggests that investors redemptions were not driven by concerns that the funds may incur capital losses (e.g., due to the default of the securities in their portfolios).



**Figure 13.** Scatterplot of percentage outflows in onshore institutional prime MMFs over March 6-26 against the minimum of their shadow NAV over the same period.

Table 28 shows the results of regression (2) in the paper, which compares the outflows from offshore non-LVNAV prime MMFs with those from offshore LVNAV and onshore institutional prime MMFs, allowing for a differential line trend between treatment (non-LVNAV funds) and control

groups (LVNAV and onshore institutional funds). Consistent with the results in the paper, offshore non-LVNAV funds experienced significantly smaller outflows (1-2 pp less per day) than the funds subject to the system of gates and fees based on portfolio liquidity.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run $\times$ Non-LVNAV	-1.41*** (-3.06)	-1.36*** (-3.23)	-1.44*** (-3.54)	-2.32*** (-2.74)	-2.12*** (-2.93)	-2.07*** (-3.01)
Time $\times$ Non-LVNAV	0.00 (0.35)	0.01 (0.53)	0.00 (0.43)	-0.01 (-0.92)	-0.01 (-0.59)	-0.00 (-0.38)
Observations	1660	1720	1780	2160	2240	2320
$R^2$	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
Sample	Non-LVNAV and LVNAV			Non-LVNAV and Institutional		

**Table 28.** 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, Time is a linear time trend, and Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. 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).  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

Table 29 shows the results of regression (2) estimated on the sample of offshore LVNAV and onshore institutional prime MMFs, substituting the dummy for non-LVNAV funds (which are now excluded from the sample) with a dummy for LVNAV funds. Results show that offshore LVNAV funds experienced smaller outflows than onshore institutional prime funds during the run (0.9-1.3 pp per day); as also discussed in the paper, this evidence suggests that investors did not run out of concerns that their funds could “break the buck.”

### B. *The unsophisticated run*

In this section, we report robustness results on the March 2020 run on prime MMFs by retail investors (Section 5 of the paper).

Table 30 replicates Table 15 in the paper using the daily flows from a family’s institutional prime MMFs as the dependent variable and the flows from the family’s retail prime MMFs (current and lagged up to 4 days) as the independent variable. As the table shows, relative to the pre-run period, there is no effect of retail flows on the institutional flows within the same fund family during the March 2020 run; this result holds both if retail funds experience outflows and if they experience inflows. As discussed in the paper, this result suggests that, while the redemptions of institutional investors triggered the redemptions of retail investors in the same family, the actions of retail investors had no impact on the behavior of institutional ones.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ LVNAV	-1.25** (-2.35)	-1.05** (-2.59)	-0.86** (-2.37)
Observations	2740	2840	2940
$R^2$	0.11	0.12	0.11
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26
Sample	LVNAV and Institutional		

**Table 29.** Fund-level regression of daily percentage outflows in institutional prime MMFs (offshore and onshore) as a function of NAV type (floating or non-floating). LVNAV is a dummy equal to one for offshore LVNAV MMFs. The sample is offshore LVNAV and onshore institutional prime funds (both of which allow the imposition of gates and fees). Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Institutional Flow $_{it}$ (%)	
	(1)	(2)
$\sum_{s=0}^4 \beta_s(\text{Run}_t \times \text{Retail Flows}_{it-s})$	0.13	
p-value	0.62	
$\sum_{s=0}^4 \beta_s(\text{Run}_t \times \text{Positive Retail Flows}_{it-s})$		0.27
p-value		0.73
$\sum_{s=0}^4 \beta_s(\text{Run}_t \times \text{Negative Retail Flows}_{it-s})$		-0.22
p-value		0.37
Observations	900	900
$R^2$	0.17	0.18
Family FE	Yes	Yes
Date FE	Yes	Yes
Period	1/2-3/26	1/2-3/26

**Table 30.** Family-level regression of daily net percentage flows in a family’s institutional prime MMFs against contemporaneous and lagged (four business days) net percentage flows in the family’s retail prime MMFs interacted with a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

### 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 offering of government MMFs (Section 6 in the paper).

First, we re-estimate the regressions in Tables 22 and 23 of the paper controlling for within-fund investor sophistication, proxied either by the weighted average expense ratio or by the weighted

average minimum investment in the fund during 2019Q4. Results are in Table 31 for onshore institutional prime MMFs and in Table 32 for retail ones. Results are similar to those in the paper: a wider offering of government-MMF share classes in 2019Q4 leads to higher prime-MMF outflows during the March 2020 run, for both institutional and retail investors.

Second, we run the same analysis on offshore funds; namely, we re-estimate regression (2) including the interaction of a family's offering of offshore government-MMF shares in 2019Q4 and the run dummy. Results are in Table 33 and are consistent with those of onshore funds presented in the paper: a 10-pp increase in the fraction of government-MMF shares offered by the fund family leads to additional daily outflows of 0.4 pp during the run period.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run $\times$ WLA	-0.22*** (-3.57)	-0.19*** (-4.04)	-0.17*** (-4.13)	-0.15*** (-2.67)	-0.12*** (-2.90)	-0.11*** (-2.85)
Run $\times$ Gov Class Share	2.86*** (3.21)	2.53*** (3.62)	2.27*** (3.57)	3.41*** (3.44)	3.05*** (4.02)	2.80*** (4.16)
Run $\times$ Expense Ratio	-0.22*** (-7.10)	-0.21*** (-8.06)	-0.21*** (-8.79)			
Run $\times$ Log Min Investment				0.04 (0.97)	0.05 (1.51)	0.05 (1.43)
Observations	1620	1680	1740	1620	1680	1740
$R^2$	0.18	0.18	0.18	0.18	0.18	0.17
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

**Table 31.** Fund-level regression of daily percentage outflows from onshore institutional prime MMFs as a function of the family's offering of government MMFs, controlling for investor sophistication. Gov Class Share is the average share of government-MMF share classes in the family's total number of onshore institutional MMF share classes in 2019Q4. Expense Ratio is a fund's average expense ratio in 2019Q4. Log Min Investment is the average minimum investment in a fund during 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. WLA is a fund's average WLA in 2019Q4. t-statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Run $\times$ WLA	-0.02 (-0.81)	-0.03 (-1.13)	-0.03 (-1.21)	0.01 (0.43)	-0.00 (-0.19)	-0.01 (-0.28)
Run $\times$ Inst Share	1.07*** (3.35)	1.33*** (3.19)	1.41*** (3.44)	0.81*** (2.67)	1.08** (2.58)	1.22** (2.66)
Run $\times$ Gov Class Share	1.94*** (2.77)	2.25*** (2.90)	2.37*** (3.13)	2.41*** (3.13)	2.72*** (3.27)	2.76*** (3.66)
Run $\times$ Expense Ratio	-0.02*** (-4.85)	-0.02*** (-5.40)	-0.02*** (-6.15)			
Run $\times$ Log Min Investment				0.14*** (5.31)	0.14*** (6.29)	0.11*** (4.36)
Observations	1682	1742	1802	1651	1711	1771
$R^2$	0.15	0.17	0.17	0.15	0.17	0.16
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

**Table 32.** Fund-level regression of daily percentage outflows from onshore retail prime MMFs as a function of the family’s offering of government MMFs, controlling for investor sophistication. Gov Class Share is the average share of government-MMF share classes in the family’s total number of onshore retail MMF share classes in 2019Q4. Expense Ratio is a fund’s average expense ratio in 2019Q4. Log Min Investment is the average minimum investment in a fund during 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward. Inst Share is the average share of institutional prime-MMF TNA in the family’s total prime-MMF TNA over 2019Q4. WLA is a fund’s average WLA in 2019Q4.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.

	Outflows (%)		
	(1)	(2)	(3)
Run $\times$ Non-LVNAV	-1.54*** (-2.96)	-1.52*** (-3.54)	-1.64*** (-3.98)
Run $\times$ Gov Class Share	3.11*** (2.93)	4.14*** (2.89)	4.39*** (3.17)
Observations	1660	1720	1780
$R^2$	0.06	0.07	0.08
Fund FE	Yes	Yes	Yes
Date FE	Yes	Yes	Yes
Period	1/2-3/20	1/2-3/24	1/2-3/26

**Table 33.** Fund-level regression of daily percentage outflows in offshore institutional prime MMFs as a function of the possible imposition of gates and fees. Non-LVNAV is a dummy equal to one for offshore non-LVNAV MMFs. Gov Class Share is the average share of government-MMF share classes in the family’s total number of offshore MMF share classes during 2019Q4. Run is a dummy equal to one from March 6, 2020 (first day of the Covid-19 run) onward.  $t$ -statistics, based on Driscoll-Kraay standard errors with 20 lags, are in parentheses. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance.