MONEY MARKET FUND FLOWS IN STRESSED MARKETS

Ananth Madhavan[†]

December 6, 2022

EXECUTIVE SUMMARY

There is renewed concern that investors in money market funds will withdraw funds if net asset value (NAV) falls below 1 because of a "first-mover" advantage, leading to further dilution of remaining fund investors. This research examines the impact of deviations from net asset value on daily money market fund flows across 11 large funds across three currencies from January 2, 2020-March 31, 2022. We find no evidence that fund flows are related to NAV deviations. Further, we find no empirical support for a non-linear (i.e., a "cliff") relation of NAV deviations and flows driven by a destabilizing rush to exit by investors who perceive a first mover advantage.

[†] The views expressed here are those of the author alone. This material is not intended to be relied upon as a forecast, research, or investment advice, and is not a recommendation, offer or solicitation to buy or sell any securities or to adopt any investment strategy.
© 2022 BlackRock® Inc. All rights reserved.

The idea that a large exogenous shock may trigger redemptions by fund investors leading to further security price declines in a negative feedback loop has seen renewed interest among academics and policymakers in the context of money market funds (MMFs). The specific concern is that investors in certain types of money market funds may rush to withdraw funds if net asset value (NAV) falls below 1 because of a perceived "first-mover" advantage; those who fail to exit may see dilution as fund redemptions puts further negative price pressure ("fire sale") that affects the net asset value for remaining shareholders.[1] If correct, then negative deviations from NAV should be associated with large outflows. The literature further hypothesizes that negative deviations beyond a certain level (or "cliff") matter as Low Volatility NAV (LVNAV) funds then begin to report a floating NAV highlighting the fact that NAV is below unity.

There is voluminous literature on fire sales but much of the recent evidence for "runs" in money market funds comes from one event, the collapse of Lehman Brothers in September 2008. Schmidt, Timmermann, and Wermers (2016) examine daily fund flows for money market mutual funds in the nine-month period prior to and including the Lehman crisis. They find that institutional investors moved their money simultaneously (or with a one-day delay) into or out of prime money funds, especially within the same fund family complex. Their analysis also suggests that prime retail flows lagged prime institutional flows. Gordon and Gandia (2014) also study this period and conclude that additional stability-enhancing reforms, beyond those put in place post the crisis, are necessary. More recently, Bouveret, Martin, and McCabe (2022) provide a global perspective and conclude that "The global pattern of runs and crises shows that MMF vulnerabilities are not unique to a particular set of governing arrangements, and that mitigating these vulnerabilities requires fundamental reforms that either place MMFs more clearly within the investment-fund sector or establish protections for MMFs similar to those for deposits."

Research looking more broadly at bond funds finds mixed evidence for the hypothesis. Collins and Plantier (2014) find outflows from bond funds are muted in the face of large economic

[1] See Zeng (2017) for a theory of MMF runs and Li et. al. (2021). These concerns also apply to bond funds. See, e.g., Chen, Goldstein, and Jiang (2010), Ellul, Jotikasthira, and Lundblad (2011), Goldstein, Jiang, and Ng (2017), Pagano, Serrano, and Zechner (2019), and Choi et. al (2020) among others. The European Central Bank (2018) argues that "in a stress scenario, this could result in increased redemption pressures in ETFs with feedback loops to the liquidity and volatility of underlying securities." Fricke, Jank, and Wilke (2022) use data on the sectoral ownership structure of euro area equity mutual funds to analyze how investor groups respond to the performance impact of large outflows. They find that investment funds react more strongly to past performance and are more procyclical compared to households and insurers.

shocks, focusing on the "taper tantrum" of summer of 2013. Hoseinzade (2016) concludes there is "little evidence that redemptions or resulting sell-offs push corporate bond prices below fundamental values." He further notes that "While bond fund investors demonstrate bank-run like behavior, bond fund managers hold a significant amount of liquid assets, allowing them to manage redemptions without excessively liquidating corporate bonds, even during the financial crisis." See, e.g., Choi, Hoseinzade, Shin, and Tehranian (2019) who show that bond mutual funds also do not trigger fire sale prices in the underlying bond markets. Antoniewicz and Stahel (2020) using daily ETF data from 2099-2017 find no evidence that extreme redemption implied bond selling pressure generates abnormal negative price impacts in individual bonds, i.e., that there is no evidence for fire sales.

This research examines the impact of deviations from net asset value on daily money market fund flows across 11 of the largest LVNAV funds in three currencies from 1/2/2020-4/12/2022 that experienced deviations from a unit price.[2] Guided by the previous literature, we are interested in whether there is evidence of a non-linearity in the relation between NAV and MMF flows. We also want to understand how much of the variation in flows is explained by NAV changes versus other factors. We find little evidence that fund flows are related to NAV deviations. Further, there is no empirical support for a "cliff" where there is a destabilizing rush to exit by investors who perceive a first mover advantage.

EMPIRICAL EVIDENCE

Data and Methodology

We selected 3 BlackRock LVNAV funds in three currency regimes (US dollars, Pound Sterling, and Euro) and augmented these data with the 8 largest peer LVNAV funds that BlackRock directly benchmarks to the performance of its own funds, for a total of 11 funds. Of the 11 funds, 4 are denominated in USD, 4 in GBP, and 3 in Euro.[3]

We focus on daily flows in the period 1/2/2020 to 4/12/2022, representing a total of 589 days. This period covers the Covid crisis period and several instances when some of these 11

[2] We used data to 12 April 2022 so that this included the Q1 2022 quarter end.

[3] These represented the largest LVNAV funds in each of the currencies with over $10bn in assets for which there was available data, with 8 fund families represented. For Euro denominated funds, we used the top 3 (in 2020 there were no other funds above $10bn) for which data was available from Money Fund Analyzer-iMoneyNet/EPFR.

funds had NAVs under 1 in the local currency. As institutions may move funds at a day's notice, it makes sense for us to examine flows at that granularity. Several factors go into selecting the proper peer funds for our money fund strategies, including:

- Investment objective;
- Fund currency and overall size (funds of scale);
- Fund pricing structure (e.g., Public Debt Constant Net Asset Value (PDCNAV), etc.);
- Share class fee structure (total charged management fee); Europe, Middle East, and Africa (EMEA) based funds.

The 11 sample funds are all large: Total AUM as of 1/2/2020 (the start of the period) was $226.3 billion for the USD funds, £121.7 billion for GBP funds, and €49.5 billion for the Euro funds.

All data sourced from this analysis comes from our external data provider Money Fund Analyzer-iMoneyNet/EPFR which is a discretionary data aggregator across the America and EMEA regions. We scaled the NAV of all the funds so that the base denomination is 1; flows are measured in the local currency to mitigate the effects of currency fluctuations. We filtered out days when NAV was missing due to holidays. For the three USD denominated funds, we have 571 trading days of data.

The Relation between NAV and Flows

From an econometric viewpoint, there are challenges with using standard regression techniques to estimate the relation between NAV and flows. NAV is stationary and exhibits strong autocorrelation while flows demonstrate extreme variation with weak autocorrelation beyond a day or so. Further, the literature suggests that the relation may be non-linear.

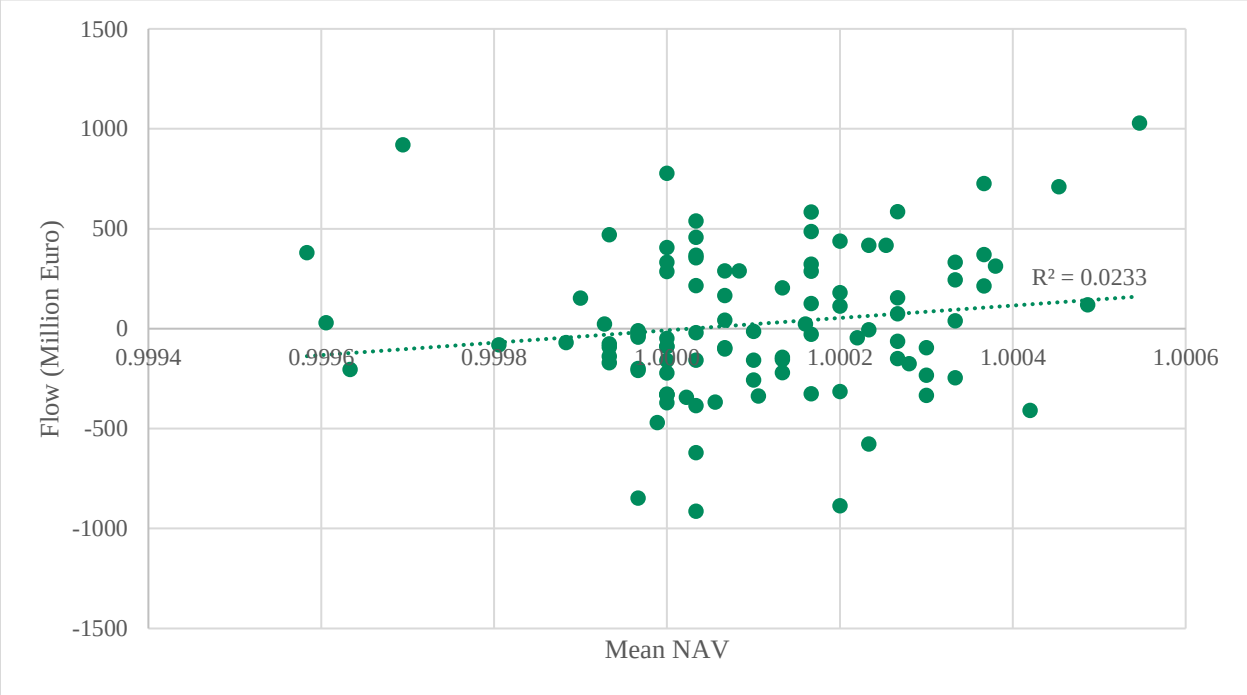
To handle the clustering of NAV observations, we sort the 589 days into percentiles based on NAV, so that each percentile has about 6 days of data. Exhibit 1 plots the data for the Euro-denominated funds with NAV on the horizontal axis and total fund flows (in millions of Euros) on the vertical axis over all six days in that percentile. For the Euro-denominated funds, we first exclude holidays and then compute, for each day, the total flows and corresponding average NAV over the six days in each percentile. We look at total flows[4] as the primary object of interest: The "cliff" observations are points furthest left on the horizontal axis. If the destabilization hypothesis

[4] We could also plot average flows against average NAV. Since the average flow in each percentile is the total flow divided by the number of days in that percentile (usually six), the two are equivalent.

was correct, we would see a strong positive relation between flows and NAV and a pronounced non-linearity when NAV was substantially under 1.[5]

However, we see that there is no pattern of flows as we move from left to right on the chart. The regression line (dotted) is positively sloped but the effect is economically and statistically insignificant. Even for the larger negative deviations on the left of the horizontal axis, the implied reduction in flows is very small and tiny as a fraction of the asset base. The R-squared is 2.3% meaning 97.7% of the variation in flows is unrelated to NAV. We get similar results for the other funds grouped by currency.

EXHIBIT 1
Euro Denominated Fund Flows (millions of Euros) Against Percentiles of NAV



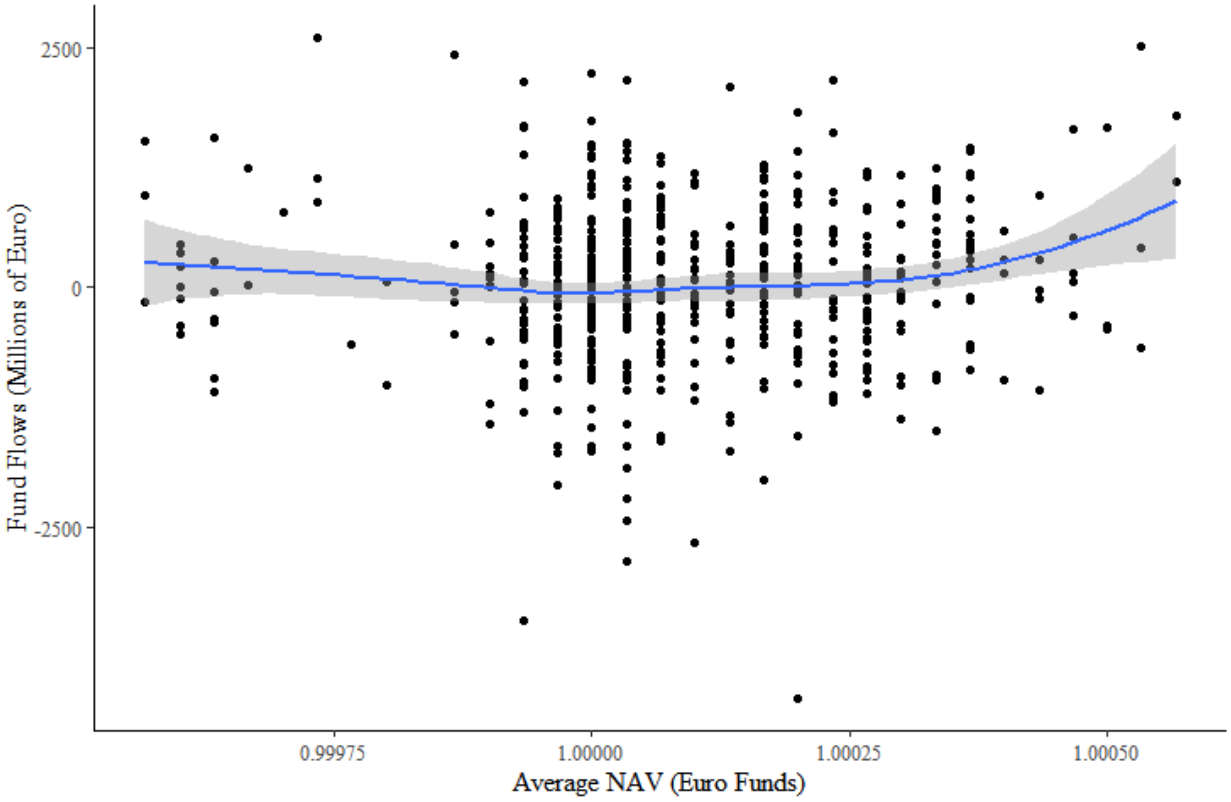
Source: Authors' estimates based on data for 3 Euro money market funds from 1/2/2020-3/31/2022. Each point in the chart represents a percentile of NAV and the corresponding average flow. The straight line plotted represents a linear regression line through the 100 data points.

[5] Due to the negative yield in Euro money market instruments, and the restrictions on distributing negative yield in the European regulatory framework, in this period, all Euro MMFs were required to let their NAVs fall in line with that yield. Therefore, the NAV distributions here do not represent solely underlying MTM deviations, but a combination of those deviations and the incorporating of negative yield. Rebased against a rounded share price of 1.00 with negative yield excluded, the range of MTM NAV deviations across the period of this data set was -10bps to +12 bps. This does not affect our conclusions on the lack of correlation between NAV deviations and redemptions.

Evidence for Non-linearities

To examine non-linearities, we utilize a more modern regression non-parametric technique known as the LOESS regression (for locally estimated scatterplot smoothing) where the estimate or best fit weights local observations more heavily than distant ones. This allows for the fitted line to be smooth but non-linear (without specifying a polynomial function) and thus pick up a potential "cliff" beyond which flows are sharply negative. For these 3 Euro-denominated funds, we compute the total flows for each day and the corresponding average NAV across the funds for that day. Exhibit 2 plots the data (589 days less holidays) and the local regression. We observe the fit is largely flat, and that there is no evidence of a cliff.

EXHIBIT 2
Euro Denominated Daily Fund Flows (millions of Euros) Against Average NAV



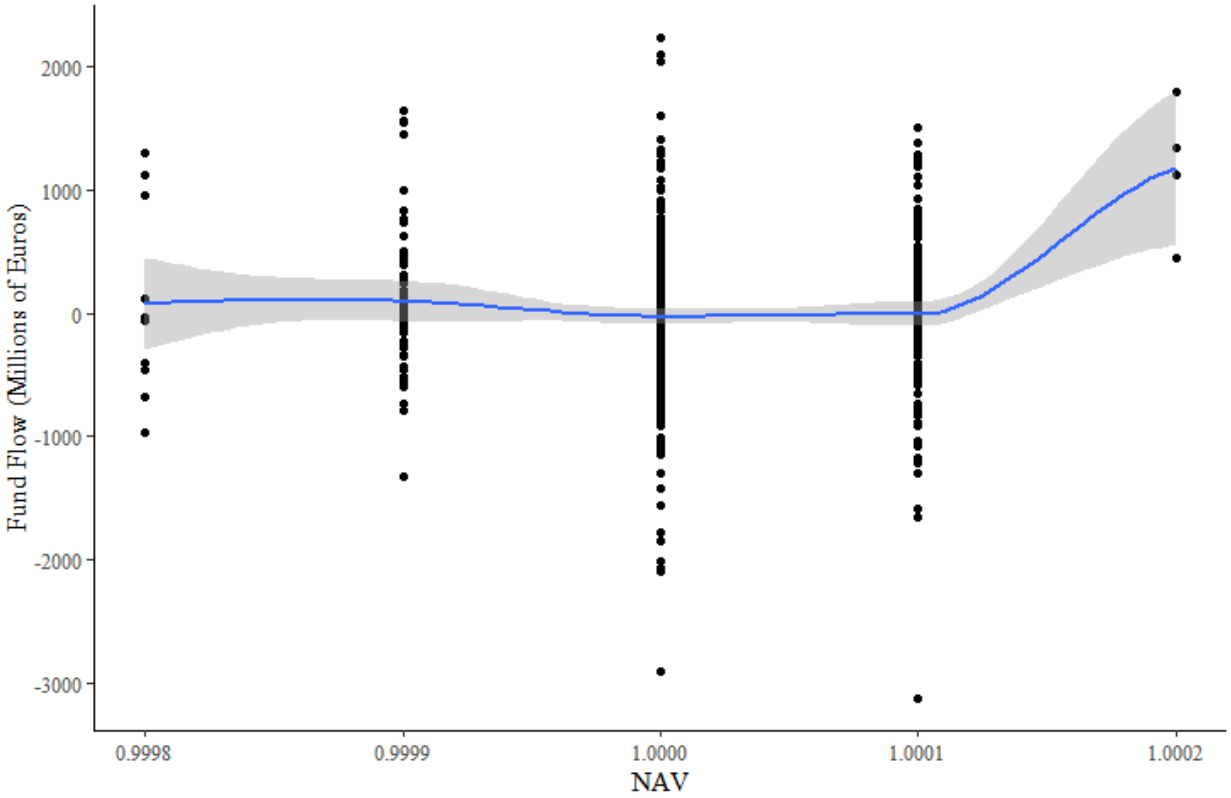
Source: Authors' estimates based on data for 3 Euro money market funds for 1/2/2020-3/31/2022. The LOESS regression line and associated confidence interval are also shown.

We see that at the extreme left, the lowest point in NAV, that the flows are negative but there are relatively few observations here. As a percentage of total AUM, these flows are not large. In other currencies (US dollar, Sterling), the pattern is like the Euro-denominated funds. For USD, it does appear that for the largest negative deviations, there are net outflows, but this is limited to a handful of days for one of the peer group funds. A more nuanced view can be provided by looking at the individual fund level data.

Individual Funds

We examine the 3 individual BlackRock LVNAV funds. For the Euro fund (BlackRock ICS Euro Liquidity Fund) we obtain Exhibit 3 based on all days in our sample period.

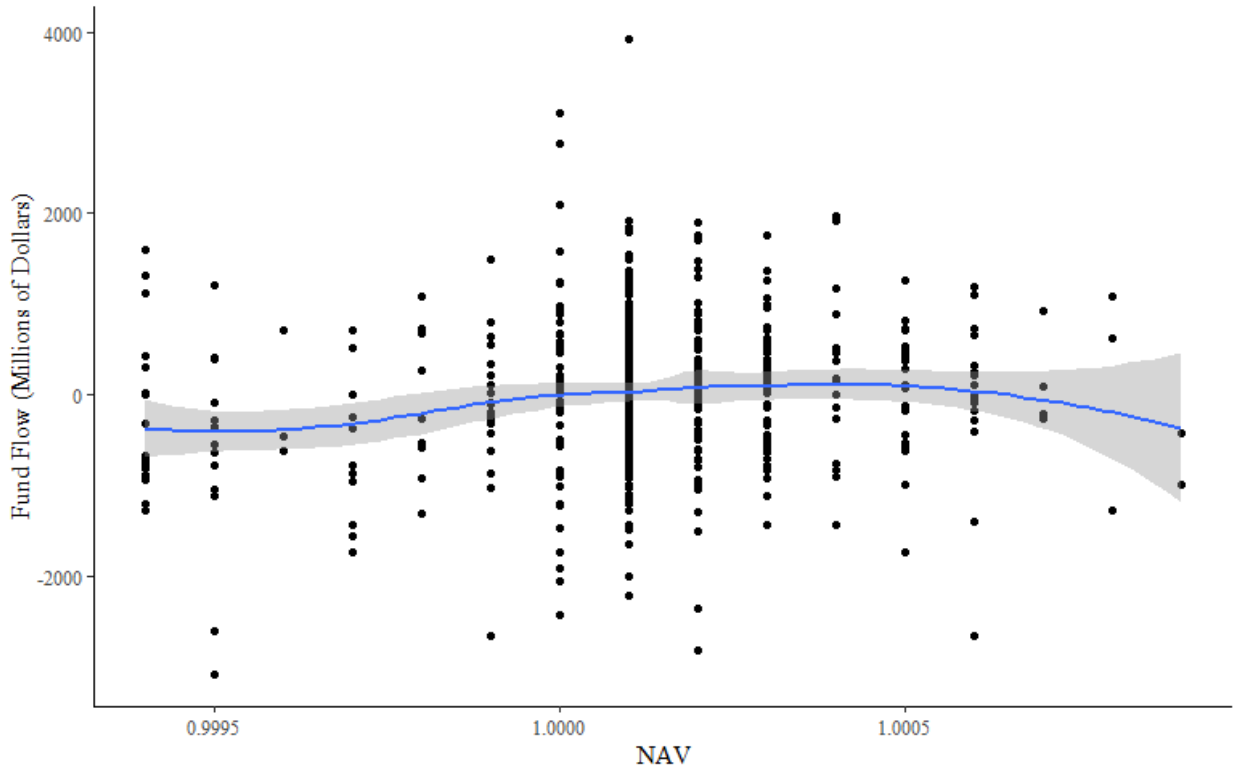
EXHIBIT 3
Euro Daily Fund Flows Against NAV for BlackRock ICS Euro Liquidity Fund



Source: Authors' estimates based on data for a BlackRock Euro-denominated money market fund for 1/2/2020-3/31/2022. The LOESS regression line and associated confidence interval are also shown.

Remarkably, even though the LOESS fit can be quite non-linear, the estimated relation is quite flat in the negative region and there is again, no evidence that beyond a certain NAV level that net flows are sharply negative. Similarly, for the BlackRock USD-denominated fund, we obtain the following LOESS fit, as shown in Exhibit 4.

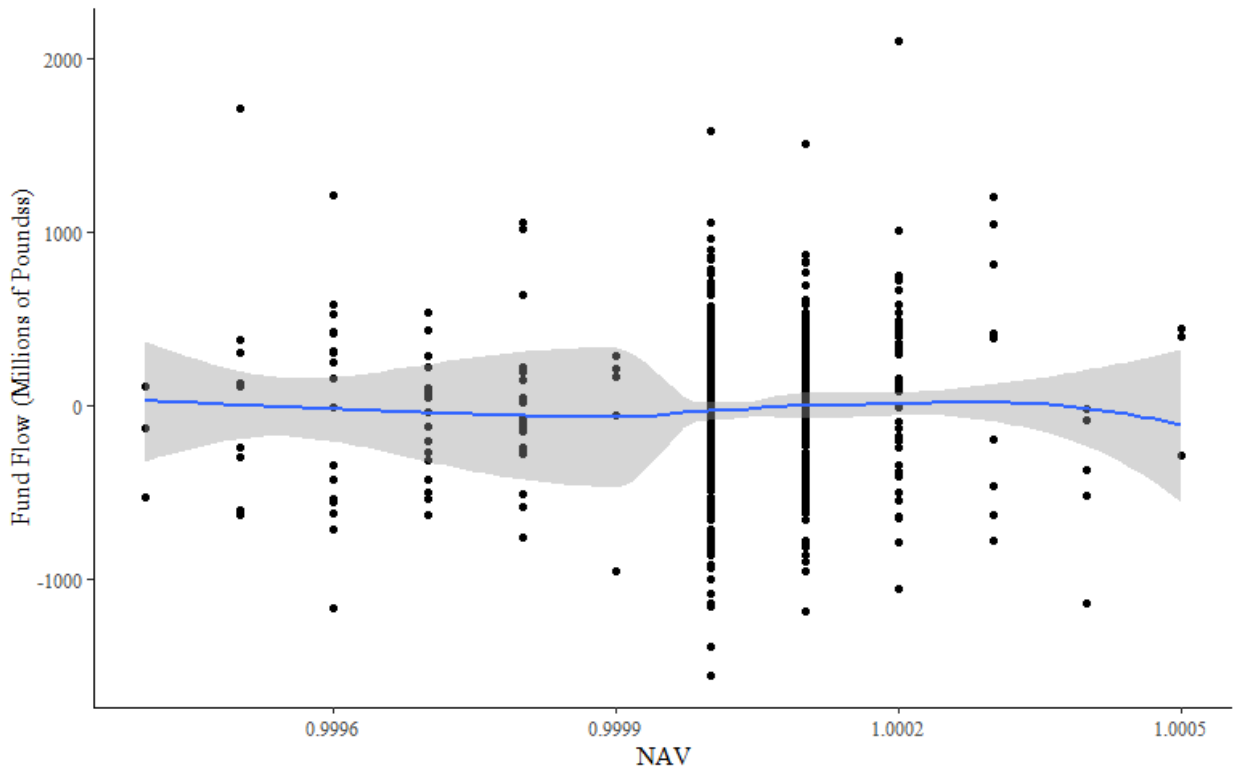
EXHIBIT 4
USD Daily Fund Flows Against NAV for BlackRock ICS US Dollar Liquidity Fund



Source: Authors' estimates based on data for a BlackRock USD money market fund for 1/2/2020-3/31/2022. The LOESS regression line and associated confidence interval are also shown.

Exhibit 5 shows the pattern for the BlackRock sterling denominated fund. Again, we see the clustering of NAV on certain days, but little or no evidence that the flows are negative as we move from right to left along the horizontal axis. Many days see net positive and net negative flows, even for values below 1.

EXHIBIT 5
Sterling Daily Fund Flows Against NAV for BlackRock ICS Sterling Liquidity Fund



Source: Authors' estimates based on data for a BlackRock Sterling denominated money market fund for 1/2/2020-3/31/2022. The LOESS regression line and associated confidence interval are also shown.

Time-Series Models of Flows

In this section, we estimate time-series models at the fund level where (USD) flows depend on past flows and past changes in NAV. We use changes in NAV because the variable is stationary. The basic model allows a fund's flows (denoted $f_{i,t}$ for fund *i* on day *t*) to depend on past flows and changes in NAV plus a cliff variable:

$$f_{i,t} = \beta_{i,0} + \sum_{j=1}^{n} \beta_{i,j} f_{i,t-j} + \sum_{j=1}^{m} \gamma_{i,j} x_{i,t-j} + \delta c_{i,t} + \varepsilon_{i,t} \quad (1)$$

Here, $c_{i,t}$ is the cliff which takes the value 1 if NAV is below \$0.9995 (e.g., a 5bps NAV deviation), $x_{i,t}$ is the change in NAV, $\varepsilon_{i,t}$ is the error term representing exogenous shocks to flows, and *n* and *m* are the number of lags. Using the Bayesian Information Criterion, we find that $n = m = 2$ fits the data well.

Rather than report the full regression estimates, we provide a summary of the key measures of interest in Exhibit 6. The bottom line is that even with 589 data points for the 4 USD-denominated funds, the fit of these time-series models even at the individual fund level is remarkably poor. For 3 of the 4 funds, almost 97% of the variation in fund flows is not explained by the 5 explanatory variables (2 lags of flows, 2 lags of changes in NAV, and the cliff), the sole exception being fund 9 which has the highest R-squared of 0.145. Fund 9 is also exceptional in that it is the only fund where the cliff variable is statistically significant (at the 5% level) and negative in sign as expected. It is possible that this fund experienced some drawdowns when NAV was below $0.9995 but there are only a few data points in this region. The F-statistic measures the overall goodness of fit. Again, we see that the time-series models struggle to capture flow dynamics.

EXHIBIT 6
Summary Statistics on Individual Fund Regressions for 4 USD-Denominated MMFs

	Fund 8	**Fund 9**	**Fund 10**	**Fund 11**
Cliff	0.023	-0.561*	0.062	-1.618
F-Statistic	4.538	19.84	3.055	3.275
Degrees of Freedom	562	562	562	532
R-Squared	0.039	0.143	0.027	0.029

Source: Authors' estimates based on time-series model estimates using equation (1) for 4 USD-denominated money market funds for 1/2/2020-3/31/2022. Cliff is an indicator variable that equals 1 if the fund's NAV is below $0.9995 on a given day and 0 otherwise. Cell values that are statistically significant at the 5% level are marked with an asterisk.

CONCLUSION

Although the notion that a first-mover advantage may trigger a run on a money market fund appears sound from a theoretic basis, the empirical evidence from the LVNAV's operational history (including the recent highly stressed period of March 2020) does not support this hypothesis. Looking at the highest degree of data granularity, that is daily flows, we find little evidence that investors respond by withdrawing funds if NAV falls below 1. Further, there is no

NM1222U-2627763-10/12

evidence of a non-linearity or cliff where outflows occur when the NAV deviation is sufficiently large and negative. We conclude that money market funds are operating as they are supposed to even in stressed periods. Further, less than 1% of the variation in flows is explained by current and lagged NAV deviations suggesting that investor inflows and outflows are largely determined by other factors beyond NAV discounts to par value such as yield.

REFERENCES

Antoniewicz, R. and C. Stahel. 2020. "Do Fund Flows Lead to Fire-sales and Pose Systemic Risk?" White paper, Investment Company Institute. Available at http://dx.doi.org/10.2139/ssrn.3630399

Bouveret, A., Martin, A., and P. McCabe, 2022. "Money Market Fund Vulnerabilities: A Global Perspective," Finance and Economics Discussion Series 2022-012. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2022.012.

Chen, Q., Goldstein, I. and W. Jiang, 2010. "Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows," *Journal of Financial Economics* 97: 239-262.

Choi, J., Hoseinzade, S, Shin, S., and H. Tehranian, 2020. "Corporate Bond Mutual Funds and Asset Fire Sales." *Journal of Financial Economics* 138(2): 432–457.

Collins, S. and L. C. Plantier, 2014. "Are Bond Mutual Fund Flows Destabilizing? Examining the Evidence from the Taper Tantrum" White paper, Investment Company Institute. Available at http://dx.doi.org/10.2139/ssrn.2510666

Ellul A, Jotikasthira C, and C. Lundblad, 2011. "Regulatory Pressure and Fire Sales in the Corporate Bond Market." *Journal of Financial Economics* 101(3):596–620.

European Central Bank, 2018, *Financial Stability Review*.

Fricke, D., Jank, S., and H. Wilke, 2022. "Who Creates and Who Bears Flow Externalities in Mutual Funds? Bundesbank Discussion Paper No 41/2022.

Goldstein, I., Jiang, H., and D. Ng, 2017 "Investor Flows and Fragility in Corporate Bond Funds." *Journal of Financial Economics* 126(3): 592-613.

Gordon, J. and C. Gandia, 2014. "Money Market Funds Run Risk: Will Floating Net Asset Value Fix the Problem?" *Columbia Business Law Review* 2014(2), 314–370.

Hoseinzade, S., 2016. "Do Bond Mutual Funds Destabilize the Corporate Bond Market?" Available at http://dx.doi.org/10.2139/ssrn.2638547

Li, L., Li, Y., Macchiavelli, M., and X. Zhou, 2021. Liquidity Restrictions, Runs, and Central Bank Interventions: Evidence from Money Market Funds (May 24, 2021). Available at SSRN: https://ssrn.com/abstract=3607593 or http://dx.doi.org/10.2139/ssrn.3607593

Pagano, M., Serrano, A. and J. Zechner, 2019. "Can ETFs Contribute to Systemic Risk?" Working paper, 9. Report of the Advisory Scientific Committee, European Systemic Risk Board.

Schmidt, L., Timmermann, A. and R. Wermers. 2016. "Runs on Money Market Mutual Funds." *American Economic Review* 106 (9): 2625-57.

Zeng, Y., 2017. "A Dynamic Theory of Mutual Fund Runs and Liquidity Management." Available at http://dx.doi.org/10.2139/ssrn.2907718