

Influences on Money Market Fund Price Variations During the March 2020 Market Dislocation

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Abstract

This white paper examines weekly fluctuations in money market fund (“MMF”) market prices surrounding the March 2020 market dislocation, which resulted from the economic disruptions caused by the COVID-19 pandemic (the “March 2020 market dislocation”). The analysis in this white paper identifies key factors influencing these price variations, including interest rates, redemptions, portfolio construction, and liquidity. This white paper aims to inform the Commission, investors, and other interested parties with insights into broader trends within the money market fund industry.²

¹ This white paper is provided in the author’s official capacity as an economist in the Commission’s Division of Economic and Risk Analysis but does not necessarily reflect the views of the Commission, the Commissioners, or other members of the staff. The author thanks Alex Schiller, Samantha Croffie, Oliver Richard, Angela Mokodean, and Amy Scully for helpful comments and suggestions.

² See, e.g., 17 CFR § 200.23a.

I. Introduction

There are three main categories of MMFs: i) government MMFs, which hold a mix of Treasury and government agency instruments (i.e., debt and repurchase agreements (“repos”)); ii) prime MMFs, which mainly hold repos, Treasury debt, government agency debt, commercial paper (“CP”) and certificates of deposit (“CDs”); and iii) tax-exempt MMFs, which primarily hold municipal debt.³ As of December 31, 2024, of \$7.2 trillion in total MMF net assets, 82% was invested in government MMFs, 16% in prime MMFs, and 2% in tax-exempt MMFs.⁴

By disrupting economic activity, the Covid-19 pandemic adversely affected U.S. funding markets, exacerbating financial stress that culminated in March 2020. MMFs, which previously acted as a conduit for contagion during the Great Recession in 2008,⁵ were similarly impacted during this period. Some MMFs experienced volatility in their net asset value per share (“NAV”) and faced substantial redemptions as institutional investors shifted capital from institutional prime and institutional tax-exempt MMFs into government MMFs, despite regulatory reform in 2010 and 2014 aimed at enhancing their resiliency.⁶ The 2010 reforms required funds to hold more liquid assets, shortened the weighted average maturity of their portfolios, and enhanced stress testing and disclosure requirements.⁷ The 2014 reforms, introduced floating NAV for institutional prime and institutional tax-exempt MMFs to mitigate first mover advantage and gave MMF boards for prime and tax-exempt MMFs the ability to implement fees and gates should MMF weekly liquid assets (“WLA”) drop below 30%, with the goal of reducing the risk of investor runs.⁸ Another reason for the reforms was that market price volatilities for prime and tax-exempt MMFs were much larger than for government funds.⁹

Commission staff and other stakeholders studied the impact of the Covid-19 pandemic and the resulting March 2020 market dislocation.¹⁰ The President’s Working Group on Financial Markets (“PWG”), for instance, published a report detailing key events – such as large institutional prime MMF redemptions – and outlined several policy reform options.¹¹ The Commission then issued a request for comment (“RFC”) on potential policy measures as described by the PWG report and any other topics relevant to

³ MMFs are a type of mutual fund registered under the Investment Company Act of 1940 (the “Act”). These funds are subject to rule 2a-7 under the Act, which limits the risk in a MMF’s portfolio by governing the maturity, diversification, and liquidity of the fund’s investments, among other requirements. See 17 CFR § 270.2a-7.

⁴ See Money Market Fund Statistics, Form N-MFP Data, period ending January 2025, available at <https://www.sec.gov/divisions/investment/mmf-statistics>.

⁵ The “Great Recession” was triggered by the subprime mortgage crisis, where risky home loans led to mass defaults and a collapse in housing prices. This instability caused major financial institutions like Lehman Brothers to fail, and because prime MMFs held Lehman’s debt along with other distressed assets, they suffered losses, prompting investors to rapidly withdraw their dollars. Consequently, short-term credit markets froze, restricting essential liquidity for businesses and exacerbating the economic downturn.

⁶ Government MMFs have seen a fivefold growth over the last decade. See D. Hiltgen, *Charting the Course: A Systematic Exploration of Influences Shaping Money Market Fund Growth* (U.S. Sec. & Exch. Comm’n, DERA Working Paper, 2024), available at https://www.sec.gov/files/dera_wp_will-mmfs-continue-grow.pdf.

⁷ Money Market Fund Reform, Investment Company Act Release No. 29132 (Feb. 23, 2010) [75 FR 10060 (Mar. 4, 2010)].

⁸ Money Market Fund Reform; Amendments to Form PF, Investment Company Act Release No. 31166 (July 23, 2014) [79 FR 47735 (Aug. 14, 2014)].

⁹ *Id.*

¹⁰ See, e.g., DERA Economic and Risk Outlook, Division of Economic and Risk Analysis, SEC (April 23, 2020), available at https://www.sec.gov/files/dera_economic-and-risk-outlook-report_apr2020.pdf.

¹¹ See Report of the President’s Working Group on Financial Markets, Overview of Recent Events and Potential Reform Options for Money Market Funds, (Dec. 2020), available at <https://home.treasury.gov/system/files/136/PWG-MMF-report-final-Dec-2020.pdf>.

any potential reforms.¹² Several of the comment letters received as a result are referenced below. The Commission then adopted reforms in 2023, which included a modified liquidity fee framework, increased liquidity thresholds, and the removal of the gate provision established in the 2014 reforms.¹³

The 2021 proposing release for the 2023 reforms described several empirical trends, including fluctuations in prime MMF market prices prior to and around March 2020.¹⁴ Analyses conducted by Commission staff and academics, as discussed in the 2021 proposing release, found no statistically significant correlation between institutional prime MMF redemptions and market prices amid the March 2020 market dislocation.¹⁵ This paper builds on the analyses presented in the 2021 proposing release to examine the key determinants of price variability during this period. Specifically, the report looks at the impact of the Covid-19 pandemic on market price fluctuations, identifying the factors that most significantly influenced market prices. These factors include interest rates, redemptions, portfolio construction, and liquidity.

Currently, MMFs can be broadly categorized into those with stable NAVs and those with floating NAVs. Stable NAV MMFs, such as government and retail MMFs, have two distinct prices: the stable NAV (net amortized cost divided by the number of outstanding shares) and the market price (i.e., mark-to-market NAV or shadow price).¹⁶ If the market price remained within \$0.0050 of \$1,¹⁷ the MMF could price their portfolio using their stable NAV. In contrast, floating NAV MMFs – typically institutional prime or institutional tax-free MMFs – must value their shares to four decimal points, reflecting real-time market fluctuations in their underlying assets. It was long assumed that the low-risk nature of institutional prime and institutional tax-free MMF assets would limit the potential to cause a deviation in market value from \$1 and ultimately material dilution or other unfair results to investors.¹⁸ However, this assumption had not proven to be correct; for example, the market stress of 2008, which resulted in the Reserve Primary Fund “breaking the buck”¹⁹ and significant numbers of institutional investors running from prime MMFs, triggered regulatory reform, resulting in institutional prime and institutional tax-free MMFs floating their

¹² See Request for Comment on Potential Money Market Fund Reform Measures in President’s Working Group Report, Investment Company Act Release No. IC-34188 (Feb. 4, 2021) [86 FR 8938 (Feb. 10, 2021)].

¹³ 17 CFR § 270.2a-7. See also Money Market Fund Reforms; Form PF Reporting Requirements for Large Liquidity Fund Advisers; Technical Amendments to Form N-CSR and Form N-1A, Investment Company Act Release No. IC-34959 (July 12, 2023) [88 FR 51404 (Aug. 3, 2023)]. While this white paper identifies trends within the data, it does not evaluate any correlation between the recent rulemaking and the trends observed.

¹⁴ See Money Market Fund Reforms, Investment Company Act Release No. 34441 (Dec. 15, 2021) [87 FR 7248 (Feb. 8, 2022)] (“2021 Proposing Release”).

¹⁵ See V. Baklanova, I. Kuznits, and T. Tatum, *Prime MMFs at the Onset of the Pandemic: Asset Flows, Liquidity Buffers, and NAVs*, SEC Staff Analysis (Apr. 15, 2021), available at <https://www.sec.gov/files/prime-mmfs-onset-pandemic.pdf>. L. Li, Y. Li, M. Macchiavelli, & X. Zhou, *Liquidity Restrictions, Runs, and Central Bank Interventions: Evidence from Money Market Funds* (May 24, 2021), available at SSRN: <https://ssrn.com/abstract=3607593> (retrieved from SSRN Elsevier database). The original title of this paper was *Runs and Interventions in the Time of COVID-19: Evidence from Money Funds*. This citation reflects the latest version.

¹⁶ Shadow price is the mark-to-market based price of the stable NAV fund’s portfolio, which shadows the stable \$1.00 NAV price, calculated using the amortized cost method. If the fund’s shadow price rises above \$1.0050 or below \$0.9950, then the fund generally would reprice the stable \$1.00 NAV price to the shadow price. The reprice is known as “breaking the buck”. If investors withdraw shares when the shadow price is less than \$1.00, the fund’s shadow price will drop lower since portfolio losses are spread across a smaller asset base.

¹⁷ MMFs are not required to use \$1 as a stable NAV, but only a small number of MMFs use a different stable value. To simplify the discussion, \$1 per share is used as the fund’s stable price.

¹⁸ See Valuation of Debt Instruments and Computation of Current Price Per Share by Certain Open-End Investment Companies (Money Market Funds), Investment Company Act Release No. 13380 (July 11, 1983) [48 FR 32555 (July 18, 1983)].

¹⁹ See *supra* note 16.

NAV.²⁰ In addition, it showed the importance of sponsor support in preventing significant deviations in MMF market prices.²¹

To reduce volatility in their market prices, MMFs invest in very short-term, high-credit-quality, well-diversified debt securities following the guidelines set forth in rule 2a-7. Although these guidelines attempt to control risks a MMF may face, they do not eliminate those risks. Risks that remain may cause the fund's market price to deviate from \$1. Changes in interest rates or a security's credit rating, for example, could put temporary downward pressure on an asset's price before it matures at par. In addition, if redemptions lead to fire sales or securities matured at less than the amortized cost, then the fund's market price could decrease below \$1. Various other factors (e.g., portfolio construction and liquidity) may also influence market price fluctuation of MMF shares. For example, MMFs may construct their portfolios with a small number of second-tier securities, to the extent the board can determine that those securities present minimal credit risk to the fund. During the March 2020 market dislocation, for instance, second-tier non-financial CP experienced a higher yield increase (higher price decrease) than first-tier securities. In response to the PWG's December 2020 report, one commenter noted that fund managers had difficulty selling their longer maturity assets, while some experienced losses when selling securities.²² Finally, an issuer may default on payments of principal or interest, generating losses for funds holding the issuer's securities. If the loss is big enough, a stable NAV fund could break the buck while a floating NAV fund could see a decline in its share price.

During the March 2020 market dislocation, MMFs faced the added complexity of liquidity constraints, as some managers had to contend with the possibility of implementing fees and gates when WLA amounts approached the 30% threshold following a wave of redemptions. The way MMF managers responded to redemption pressures – whether by selling assets or strategically managing their liquidity – had a direct impact on MMF market prices. This paper looks for patterns within this complex environment to better understand the factors driving MMF price movements.

The rest of the paper is organized as follows: Section II. describes the data and methodology, Section III. examines the distribution and standard deviation of MMF prices, and Section IV. documents the empirical findings.

II. Data and Methodology

This paper uses data from Form N-MFP submissions between December 2019 and December 2020 for all MMFs.²³ Unless otherwise noted, all dates refer to 2020. These filings provided reported portfolio

²⁰ See *supra* note 8.

²¹ See, e.g., Moody's Investor Service, Special Comment, Sponsor Support Key to Money Market Funds (Aug. 9, 2010), available at https://www.alston.com/files/docs/Moody's_report.pdf. ("The forms of support by fund sponsors have varied. These included capital contributions, purchases of the affected securities at par, execution of Letters of Credit (LOCs), capital support agreements, letters of indemnity or performance guarantees.")

²² See JPMorgan's comment letter to the RFC, available at <https://www.sec.gov/comments/s7-01-21/s70121-8662454-235280.pdf>.

²³ MMFs use Form N-MFP to report information to the Commission each month about their portfolio holdings under the Investment Company Act of 1940. Form N-MFP provides transparency on a MMF's security-level holdings, liquidity levels, and fund characteristics.

holdings and fund characteristics for each MMF,²⁴ including a fund’s weekly mark-to-market based price (“market price” here after). In addition, the data also identify whether a prime or tax-exempt MMF is a retail or institutional fund. Where appropriate, institutional MMFs are separated into public and private (e.g., an internal cash fund). For retail and government MMFs that do not float their net asset value, the market price and not the stable \$1 is assessed. In this way, we hope to quantify any changes in the distribution of market prices that resulted from the March 2020 market dislocation.

Although the market price, liquidity, and flow data is filed on the monthly Form N-MFP during the relevant period, it is reported weekly and therefore only provides a comprehensive snapshot of MMF characteristics as of the close of business on Friday of each week.²⁵ Nevertheless, the weekly snapshot may fail to capture intra-week market volatility. In contrast, third-party sources offer daily MMF characteristics, allowing for a more granular assessment of market dynamics. However, the daily data tends to differ in scope and coverage compared to the weekly Form N-MFP data, which is used in this paper. The daily data, for instance, suggests that on Friday, March 13, MMFs were starting to feel the stress of the market dislocation. The stress peaked around Wednesday, March 18. And by Friday, March 20, some MMFs started to recover.²⁶ Table 1 shows the daily characteristics of a MMF during the week of peak market volatility that experienced significant redemptions. The MMF’s amount of WLA dropped to 32.3% on Wednesday, March 18 only to recover to 36.8% by Friday, March 20. In contrast, the MMF’s market price continued to drop each day to a low of \$0.9989 on Friday, March 20, while the fund experienced the largest percentage outflow on Thursday, March 19.

Table 1. Daily Fund Characteristics for a MMF During the March 2020 Market Dislocation^a

Date	Fund Characteristics				Liquid Asset Bin		AUM		
	WAM ^b (Days)	WAL ^c (Days)	7Day Yield ^d (%)	NAV	DLA (%)	WLA ^e (%)	AUM (\$Billion)	Change ^f (\$Billion)	Change (%)
3/13/2020	42	90	1.10	1.0003	35.8%	36.9%	10.7	-1.0	-5.9%
3/16/2020	41	91	1.04	1.0002	38.1%	38.8%	9.7	-1.0	-9.5%
3/17/2020	45	98	0.99	1.0001	32.6%	34.7%	8.8	-1.0	-9.9%
3/18/2020	52	86	0.91	0.9999	29.0%	32.3%	7.1	-1.6	-18.6%
3/19/2020	60	80	0.86	0.9990	35.9%	35.9%	5.4	-1.7	-23.9%
3/20/2020	42	79	0.65	0.9989	36.8%	36.8%	4.8	-0.6	-10.8%

^a Source: CraneData’s MFI daily data, available at <https://cranedata.com/>.

^b WAM is the weighted average maturity.

^c WAL is the weighted average Life.

^d 7-Day Yield is the 7-Day Gross Yield.

^e Form N-MFP has WLA =34% for the fund on March 20, while CraneData has 36.8% for March 20 and 34% for March 23, suggesting the WLA values may reflect data from different days.

^f AUM change is calculated daily between March 13 and March 20.

²⁴ Although feeder funds generally have the same characteristics as their master fund, feeder funds have different investor redemption patterns, which can affect the fund’s market price. Consistent with this, we removed the master funds from our market price database and kept feeder funds to avoid duplicity. Advisers to unregistered feeder funds, which are located offshore, do not have to file Form N-MFP. In addition, some high-net-worth investors invest directly into a master fund, bypassing feeder funds.

²⁵ The 2023 amendments require daily reporting of market price, liquidity and flow data on monthly Form N-MFP. See *Supra* note 13.

²⁶ See *supra* note 11.

III. Distribution and Standard Deviation of MMFs' Market Prices

The distribution and variability of market prices play a crucial role in understanding financial market stability, as they often reflect underlying risk, liquidity conditions, and investor behavior. Periods of market stress often led to shifts in price dispersion and volatility. A common measure of volatility is the standard deviation, which is a measure of the variability of a value, such as market price, around its mean.²⁷ This section examines the empirical distribution and standard deviation of market prices, illustrating how these measures evolve in response to financial stress. The analysis below seeks to quantify changes in these metrics during the March 2020 market dislocation, highlighting how disruptions affected price behavior.

1. Distribution of Market Prices

The distribution of market prices represents the frequency with which specific market prices occur within a given week, typically displayed in graphical form. For instance, one metric of interest is when a MMF's market price falls below \$0.9975 from \$1.0000, a threshold indicating a material deviation that necessitates the filing of a current report (Form N-CR) for stable NAV MMFs.²⁸

Form N-MFP, introduced in 2010, provides the Commission with substantially more detailed data on prices than was available during the Great Recession. Consequently, comprehensive market price information was not readily accessible to investors in 2008. However, participation in the Treasury Guarantee Program during the Great Recession required MMFs to report their prices when they fell below \$0.9975.²⁹ This reporting requirement enabled regulators to monitor material deviations in market prices, despite the absence of systematic data collection at the time. Based on this data, 74 share classes had prices fall below \$0.9975 at least once between September 5 and October 17, 2008, while 29 of these share classes had prices below \$0.9950.³⁰ If it had not been for sponsor support, these funds with prices below \$0.9950 would have broken the buck.³¹ In contrast, during the March 2020 market dislocation only one MMF, a retail tax-exempt MMF with one share class, fell below \$0.9975 with a price of \$0.9968.³²

Additionally, instead of selling securities in an unfavorable market during the March 2020 market dislocation, which would have negatively impacted a MMF's market price, some MMFs sold assets to their sponsor or pledged them as collateral to the Federal Reserve's Money Market Liquidity Facility ("MMLF") for a non-recourse loan.³³ Sponsors to four MMFs purchased approximately \$4 billion of

²⁷ See, e.g., Standard Deviation, Fidelity, available at <https://www.fidelity.com/learning-center/trading-investing/technical-analysis/technical-indicator-guide/standard-deviation>.

²⁸ A MMF files form N-CR when its market price deviates downward from its intended stable price per share by more than ¼ of 1 percent. See Form N-CR available at <https://www.sec.gov/files/formn-cr.PDF>.

²⁹ As reported in the *Response to Questions Posed by Commissioners Aguilar, Paredes, and Gallagher*, which draws upon data from the Treasury Guarantee Program. See, *Response to Questions Posed by Commissioners Aguilar, Paredes, and Gallagher*, Division of Risk, Strategy, and Financial Innovation, SEC (Nov. 30, 2012), available at <https://www.sec.gov/news/studies/2012/money-market-funds-memo-2012.pdf>.

³⁰ *Id.*

³¹ See *supra* note 21.

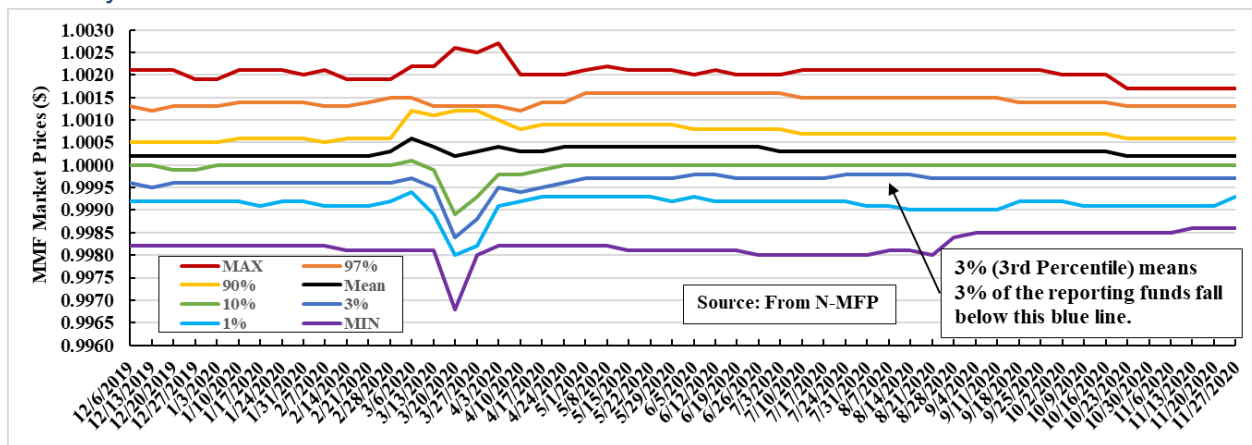
³² 2021 Proposing Release, See *supra* note 14.

³³ See, e.g., MONEY MARKET MUTUAL FUND LIQUIDITY FACILITY FAQs, Bd. of Governors of the Fed. Rsrv. Sys. (May 26, 2020), available at <https://www.federalreserve.gov/monetarypolicy/files/mmlf-faqs.pdf>.

assets in March 2020.³⁴ MMFs pledged \$58 billion to the MMLF.³⁵ For comparison, 62 MMFs received sponsor support during the Great Recession.³⁶ Also during the Great Recession, the U.S. Department of the Treasury guaranteed the \$2.4 trillion MMF industry, and the Federal Reserve authorized the Asset-Backed Commercial Paper MMF Liquidity Facility.³⁷

The distribution of weekly market prices for all MMFs is presented in Figure 1. The results show that 10% (green line) of MMFs prices dropped below \$0.9990 on March 20. There was only one MMF with a material deviation that had a market price below \$0.9975 at \$0.9968, thus requiring the filing of a current report (Form N-CR). The mean price (black line) stayed around \$1.0002. These results are in sharp contrast to the numerous MMFs that would have broken the buck in 2008 had it not been for sponsor support as discussed above. At first glance, this observation suggests that previous regulatory reforms enhanced the resilience of MMFs to significant price fluctuations during periods of short-term market inefficiencies. To what extent this may be true is hard to quantify. However, unlike in 2008, MMFs did not face issuer defaults (e.g., Lehman Brothers) or financially distressed institutions (e.g., Bear Sterns, Fannie Mae and Freddie Mac) in 2020, which may have contributed to the relative stability observed in 2020. Nonetheless, as previously discussed, institutional prime MMFs actively managed their portfolios to maintain their WLA above the 30% threshold. This strategic liquidity management likely played a crucial role in mitigating price deviations during the March 2020 market dislocation.

Figure 1. Distribution of weekly MMF market prices through the 2020 Covid-19 stress and recovery



2. Standard Deviation of Market Prices

Standard deviation is one measure of the dispersion of values of a variable within a dataset. A lower standard deviation indicates that values are tightly grouped, whereas a higher standard deviation signifies

³⁴ See *supra* note 13.

³⁵ See, e.g., A. Kenchukwu, M. Cipriani, R. Craver, and G. La Spada, *The Money Market Mutual Fund Liquidity Facility* (July 2022). Economic Policy Review, Vol. 28, No. 1, p. 139-160, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4155590 (retrieved from SSRN Elsevier database).

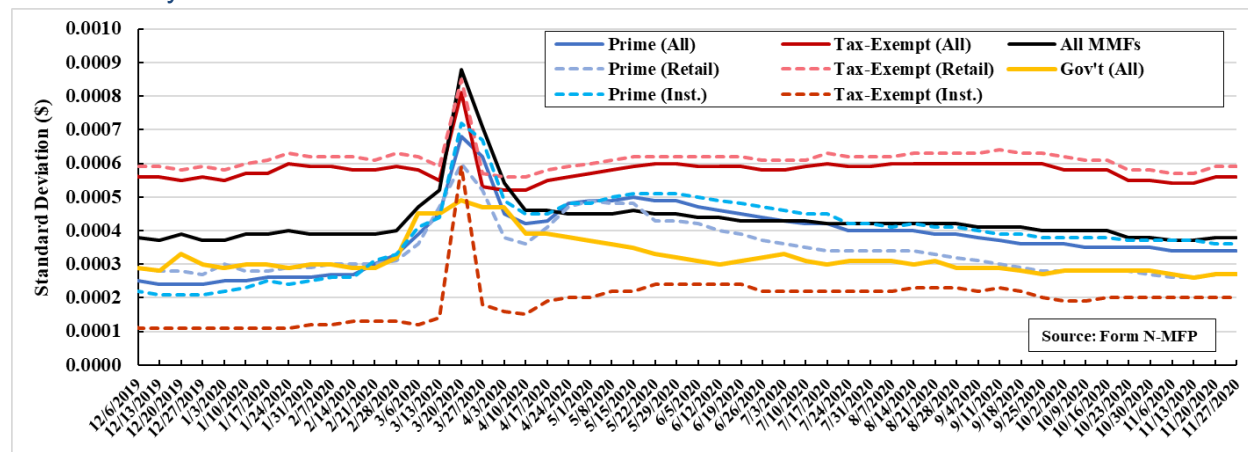
³⁶ See *supra* note 21.

³⁷ See, e.g., TREASURY ANNOUNCES TEMPORARY GUARANTEE PROGRAM FOR MONEY MARKET FUNDS, U.S. DEPT. OF THE TREASURY (Sept. 29, 2008), available at <https://home.treasury.gov/news/press-releases/hp1161>. REPORT PURSUANT TO SECTION 129 OF THE EMERGENCY ECONOMIC STABILIZATION ACT OF 2008: ASSET-BACKED COMMERCIAL PAPER MONEY MARKET FUND LIQUIDITY FACILITY, Fed. Rsrv. Bank N.Y. (Sept. 19, 2008), available at <https://www.federalreserve.gov/monetarypolicy/files/129amf.pdf>.

greater variability. If the distance of each market price from the mean doubles, for example, then the standard deviation doubles. In Figure 1, the spread in market price, measured as the difference between the MAX (red line) and MIN (purple line), widened during the week of March 20, corresponding to an increase in the standard deviation of these prices.

Figure 2 highlights the changes in the cross-sectional standard deviation of weekly market prices for MMFs during the Covid-19 pandemic. For all MMFs, the standard deviation (black line) more than doubled from \$0.0004 to almost \$0.0009. This reflected an increase in market prices for government MMFs and a decrease in market prices for prime and tax-exempt MMFs as discussed below. Retail tax-exempt MMFs (pink dashed line) had the highest standard deviation in absolute terms at \$0.0008, while institutional tax-exempt MMFs (red dashed line) saw the largest relative increase (by a factor of 6) in standard deviation from \$0.0001 to \$0.0006.

Figure 2. Standard deviation of weekly MMF market prices through the 2020 Covid-19 stress and recovery



IV. Trends in Market Price Variations

Several key factors influence a MMF’s market price. This section examines the effects of interest rate changes, redemptions, portfolio construction (specifically, the amount of CP and CDs held in their portfolios), and liquidity levels (specifically, the amount of WLA). Certain factors are not analyzed, including the gains or losses on portfolio holdings – due to unavailable data – and credit events (e.g., ratings downgrades or defaults) – no credit events occurred during the market dislocation in March 2020.³⁸

This analysis documents trends in price changes and their correlations with these factors. For example, large investor redemptions can impact a MMF’s market price. If a MMF lacks sufficient liquidity to meet redemption demands, it may be compelled to sell securities at discounted prices in illiquid market, thereby influencing its market price. Additionally, a correlation with specific securities may indicate

³⁸ However, that was not the case during other market stresses. For instance, prime MMFs held Lehman Brothers debt when it defaulted in 2008 and had exposure to Eurozone banks in 2011. See, e.g., *Supra* Note 29.

stress within that market. Similarly, a correlation with non-WLA percentages may suggest an association with securities of longer maturities.

1. Interest Rates

Market prices for fixed-income instruments and interest rates are inversely proportional, meaning that when one of them increases the other decreases. For example, during the March 2020 market dislocation, Treasury yields dropped, while CP yields and the Securities Industry and Financial Markets Association (“SIFMA”) Municipal Swap Index rates increased. Consequently, MMFs with a lot of Treasury holdings (e.g., government MMFs) would expect to see price increases for these holdings, while MMFs with significant amounts of CP (e.g., prime MMFs) and municipal securities (e.g., tax-exempt MMFs) would expect to see a drop in prices. However, the maturity of these securities also has a lot to do with how much of an effect interest rate changes have on their value. This is because, as the maturity date approaches, the market price of a security converges to its par value; conversely, the further away an instrument is from maturity, the larger the role of interest rates for determining the present value of future cash flows associated with the security. The sub-sections below document how changes in interest rates have impacted the market prices of government, prime and tax-exempt MMFs.

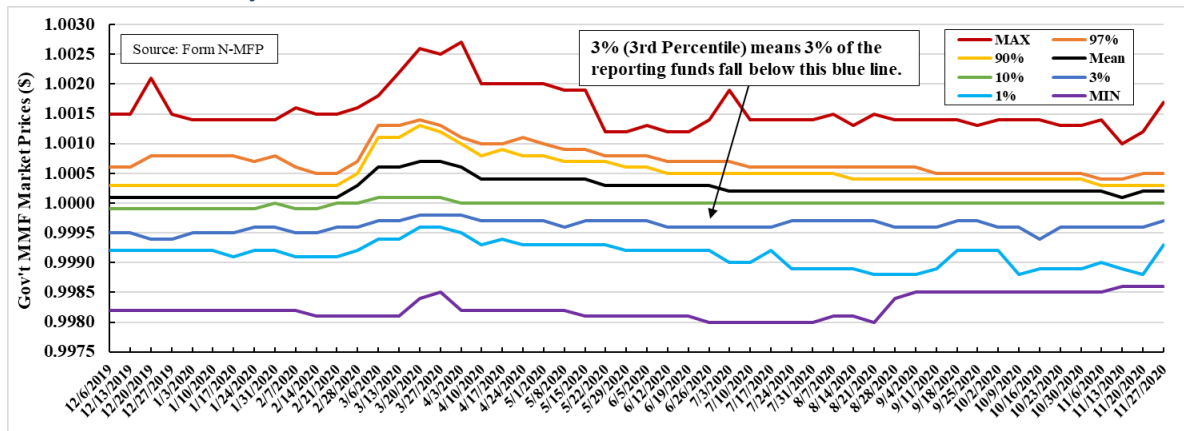
a. Government MMFs

Government MMFs hold mainly Treasury debt and repos, as well as government agency debt and repos from issuers like the Federal Home Loan Banks, Freddie Mac, and Fannie Mae. As fear and uncertainty surrounding the pandemic started to take root in mid-February, fear started to spread to the funding markets. In times of stress, investors turn to cash and cash-like securities (e.g., short-term Treasuries). As a result, one of the first markets affected by the Covid-19 pandemic was the Treasury market, which globally is the largest and most liquid government securities market. As the March 2020 market dislocation unfolded, the Federal Reserve cut interest rates and investors flocked to government MMFs and to short-term Treasuries, causing short-term Treasury yields to drop significantly. MMF yields followed suit and market prices increased. Consequently, a few MMF advisers temporarily closed their funds to new investors since cash received from new investors would be invested in lower yielding instruments, reducing further a fund’s yield. Similarly, all government MMF yields continued to drop as instruments held in their portfolio with higher yields were rolled over for ones with lower yields.

The distribution of market prices of government MMFs are given in Figure 3, which shows that prices for these types of MMFs increased during the March 2020 market dislocation. The mean market price (black line) went from \$1.0001 in February to a high of \$1.0007 at the end of March, an increase of 6 basis points (“bps”).³⁹ Over the following months, demand for government MMFs declined and their market prices mean-reverted as financial conditions stabilized, the appetite for safe assets diminished with the easing of the liquidity crisis, and investors began reallocating capital to higher-yielding assets.

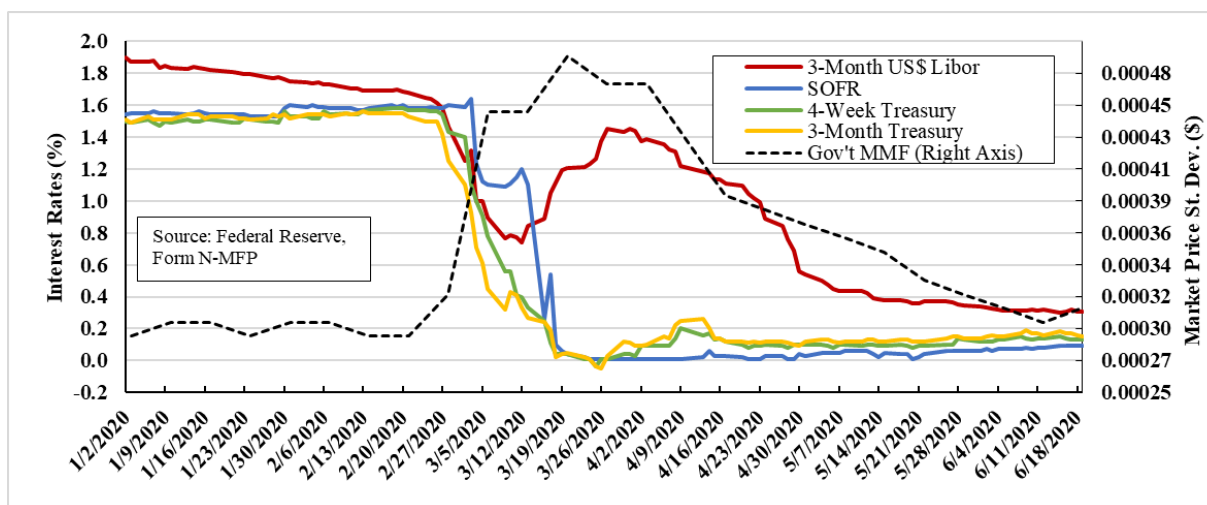
³⁹ 1 basis point equals \$0.0001. See Pricing of U.S. Money Market Funds, ICI Research Report (January 2011), available at https://www.ici.org/doc-server/pdf%3AAppr_11_mmf_pricing.pdf.

Figure 3. Distribution of weekly government MMF market prices through the 2020 Covid-19 stress and recovery



Economically, a decreasing federal funds rate leads to higher bond values, resulting in higher prices and, consequently greater standard deviations due to the upward pressure on bond prices. Figure 4 presents the standard deviation of the market price of government MMFs from Figure 3 (black dashed line) alongside several benchmark rates for comparison analysis. Figure 4 shows that as Treasury yields (green and yellow lines) fell, the standard deviation (black dashed line) of government MMF market price increased from \$0.00030 to \$0.00048. The peak occurred when Treasury yields dropped to about 0%. During this time the Federal Reserve cut the federal funds rate twice. The rate was cut to 1.00%-1.25% on March 3.⁴⁰ Twelve days later it was cut to 0.00%-0.25%.⁴¹

Figure 4. Several benchmark rates and the standard deviation of market prices for government MMFs⁴²



⁴⁰ Statement of the Federal Open Markets Committee, December 16, 2008, available at <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200303a.htm>.

⁴¹ Statement of the Federal Open Markets Committee, December 16, 2008, available at <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315a.htm>.

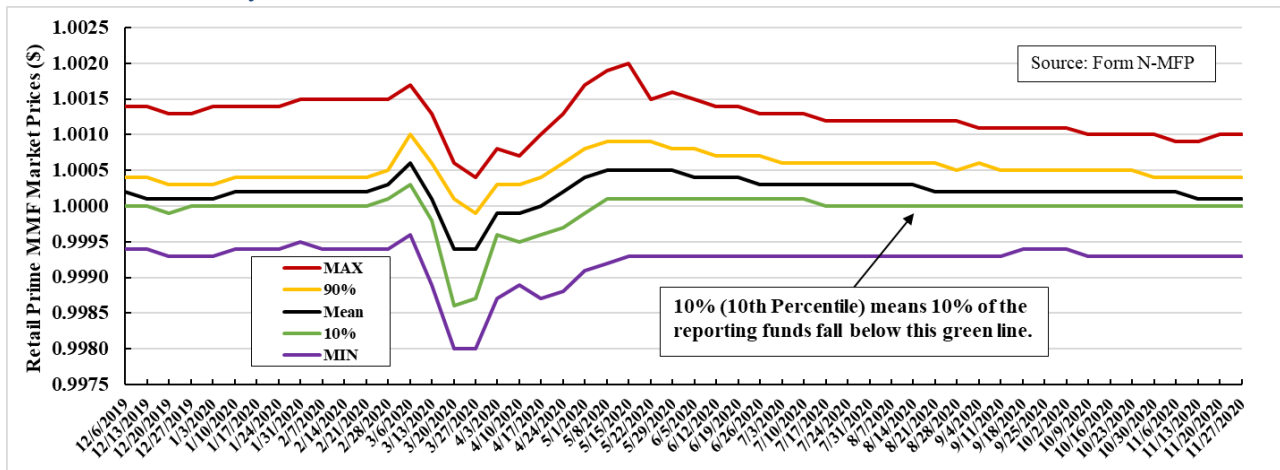
⁴² Sources: Bd. of Governors of the Fed. Rsrv. Sys. (US), Secured Overnight Financing Rate [SOFR], from FRED, Fed. Rsrv. Bank of St. Louis (Dec. 28, 2020), available at <https://fred.stlouisfed.org/series/SOFR>. Bd. of Governors of the Fed. Rsrv. Sys. (US), 3-

b. Prime MMFs

Prior to the March 2020 market dislocation, prime MMFs predominantly held CP and CDs in their portfolios. Specifically, retail prime MMFs allocated around 65% of their portfolio to CP and CDs, while institutional prime MMFs allocated around 55%. However, during the March 2020 market dislocation, sales of CP and CDs occurred, and a portion of the maturing CP and CDs were not rolled over to enhance liquidity. Consequently, by August, the proportion of CP and CDs in both retail and institutional prime MMF portfolios declined on average to 45% or lower. This shift reflects a strategic adjustment by MMF managers in response to heightened liquidity concerns and market volatility.

Figures 5 and 6 show the distribution of weekly retail and institutional prime MMF market prices during the Covid-19 pandemic, respectively. On average, retail prime MMF prices (black line Figure 5) dropped from \$1.0002 on February 21 to \$0.9994 on March 20 or by 8 bps because of the increase in CP and CD credit spread as discussed below.⁴³ Similarly, the average institutional prime MMF prices (black line Figure 6) dropped from \$1.0003 to \$0.9994 or by 9 bps.⁴⁴ The lowest market price (purple line Figure 5) for retail prime MMF prices dropped from \$0.9994 to \$0.9980 or by 14 bps.⁴⁵ Similarly, institutional prime MMF lowest NAV (purple line Figure 6) dropped from \$0.9999 to \$0.9976 or by 23 bps.⁴⁶ No prime MMF market price dropped below \$0.9975.⁴⁷

Figure 5. Distribution of weekly retail prime MMF market prices through the 2020 Covid-19 stress and recovery⁴⁸



Month London Interbank Offered Rate (“LIBOR”) [USD3MTD156N], from FRED, Fed. Rsrv. Bank of St. Louis (Dec. 28, 2020), Data is no longer available. Bd. of Governors of the Fed. Rsrv. Sys. (US), 3-Month Treasury Bill Secondary Market Rate [DTB3], from FRED, Fed. Rsrv. Bank of St. Louis (Dec. 28, 2020), available at <https://fred.stlouisfed.org/series/DTB3>. Bd. of Governors of the Fed. Rsrv. Sys. (US), 4-Week Treasury Bill Secondary Market Rate [DTB4WK], from FRED, Fed. Rsrv. Bank of St. Louis (Dec. 28, 2020), available at <https://fred.stlouisfed.org/series/DTB4WK>.

⁴³ 2021 Proposing Release, *supra* note 14.

⁴⁴ *Id.*

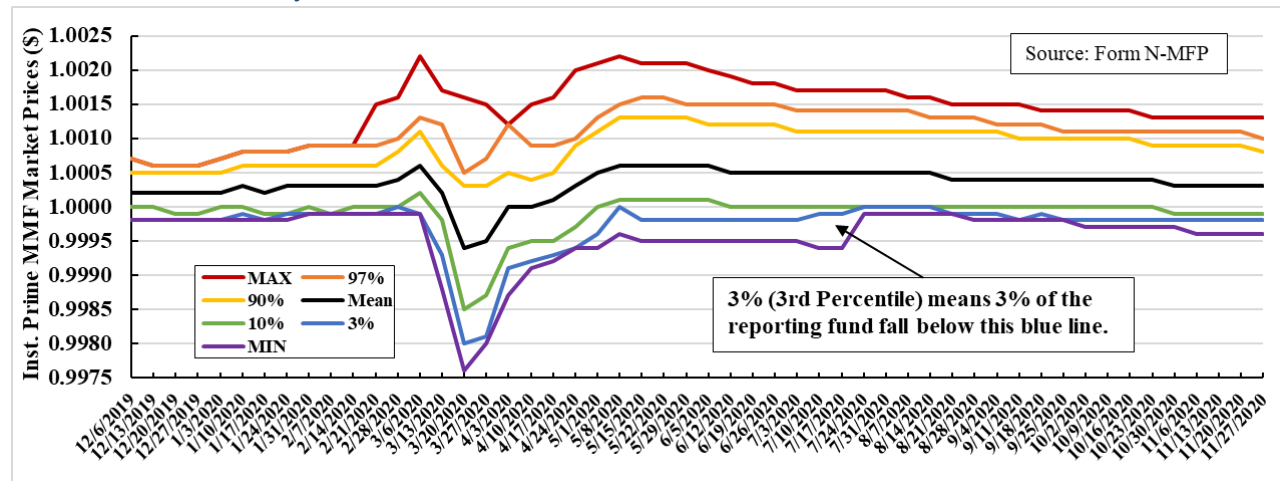
⁴⁵ *Id.*

⁴⁶ *Id.*

⁴⁷ *Id.*

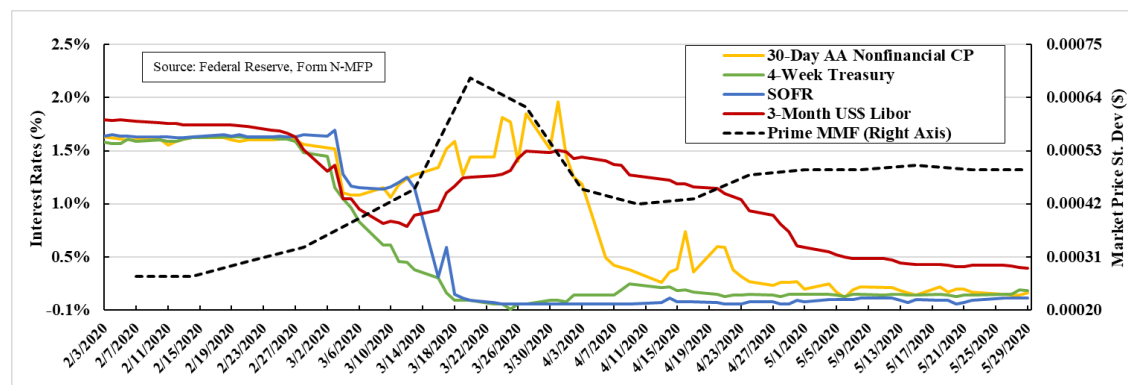
⁴⁸ *Id.* This graph was included in the 2021 Proposing Release.

Figure 6. Distribution of weekly institutional prime MMF market prices through the 2020 Covid-19 stress and recovery⁴⁹



Economically, an increase in the CP spread lowers CP values, resulting in lower prices and, consequently, greater standard deviations due to the downward pressure on CP prices. Figure 7 plots the standard deviation of the market price for all prime funds along with several benchmark rates for comparison. The standard deviation (black dashed line) more than doubled from \$0.00027 on February 15 to \$0.00068 on March 20. At the end of February and the start of the pandemic, both the market prices and the standard deviation of market prices for prime MMFs, which also held some government instruments (e.g., Treasuries), began to increase alongside government MMFs as the federal funds rate and Treasury yields (green line) fell, as previously discussed. However, this trend reversed about a week later around March 6 as CP rates (yellow line) increased and spreads relative to Treasuries (green line) widened, resulting in price drops and a more pronounced rise in the standard deviation (black dashed line).

Figure 7. Several benchmark rates and the standard deviation of market prices for Prime MMFs⁵⁰



⁴⁹ *Id.* This graph was included in the 2021 Proposing Release.

⁵⁰ Sources: Bd. of Governors of the Fed. Rsv. Sys. (US), Secured Overnight Financing Rate [SOFR], from FRED, Fed. Rsv. Bank of St. Louis (Dec. 28, 2020), available at <https://fred.stlouisfed.org/series/SOFR>. Bd. of Governors of the Fed. Rsv. Sys. (US), 3-Month London Interbank Offered Rate (LIBOR) [USD3MTD156N], from FRED, Fed. Rsv. Bank of St. Louis (Dec. 28, 2020), Data is no longer available. Bd. of Governors of the Fed. Rsv. Sys. (US), 4-Week Treasury Bill Secondary Market Rate [DTB4WK], from FRED, Fed. Rsv. Bank of St. Louis (Dec. 28, 2020), available at <https://fred.stlouisfed.org/series/DTB4WK>. Bd. of Governors of the Fed. Rsv. Sys. (US), 30-Day AA Nonfinancial Commercial Paper Interest Rate [H15/H15/RIFSPNNAAD30_N.B] (Dec. 28, 2020), available at <https://www.federalreserve.gov/releases/cp/>.

MMFs often invest in securities that are correlated with short-term interest rates like the 3-month US\$LIBOR,⁵¹ which reflects the rate that banks would lend to one another. MMFs also follow the Secured Overnight Financing Rate (“SOFR”) as MMFs are a major contributor to the overnight repo market (e.g., repos back by Treasuries) in which SOFR is calculated. However, this makes the 3-month US\$LIBOR more sensitive to credit compared with SOFR. Therefore, stress specific to the MMF space is reflected in the spread between 3-month US\$ LIBOR and the SOFR. This difference between the 3-month US\$LIBOR (red line) and SOFR (blue line) in Figure 7 is considered an indication of the short-term credit risk and the absence of cash within the banking system. The spread, which is routinely monitored by MMF managers, started increasing dramatically on March 13 and peaked on March 31. The increase in spread may, in part, have been the result of banks’ unwillingness to fund illiquid securities and pressures within the banking system as lines of credit were used by entities shut out of the CP market as demand for longer maturities CP fell. Banks were lending at low SOFR rates against safe assets like Treasuries, while demanding a higher risk premium for accepting CP as collateral. Increased purchases by the Federal Reserve through its different liquidity facilities helped in alleviating the market stress.

c. Tax-Exempt MMFs

Tax-exempt MMFs are a type of MMF that invest primarily in short-term municipal bonds issued by local and state governments. The income they generate is tax-exempt from federal taxes, making tax-exempt MMFs an option for investors seeking conservative returns with tax benefits. Most of the municipal securities held in their portfolios are variable-rate demand notes (“VRDNs”) where long-term municipal bonds, which usually have a maturity around 20 years, are converted into short-term securities by a periodic coupon reset, usually reset weekly, coupled with a demand feature or put. The demand feature of VRDNs allows MMFs and other investors to tender the note back to a remarketing agent or bank when the price is reset. The remarketing agent then looks for another buyer for the tendered VRDN. In short, a VRDN with a weekly reset is a municipal security which can be converted into cash within a week and counts as a WLA.⁵²

The difference in weekly distribution of market prices between retail (Figure 8) and institutional (Figure 9) tax-exempt MMFs during the Covid-19 pandemic is dramatic. Retail tax-exempt MMFs’ market prices were a lot more dispersed. On average, retail tax-exempt MMF prices (black line in Figure 8) dropped from \$1.0005 to \$0.9994 or 11 bps because of the March 2020 market dislocation. Whereas the average institutional tax-exempt MMF prices (black line in Figure 9) dropped from \$1.0001 to \$0.9997 or 4 bps because of the March 2020 market dislocation. The lowest market price (purple line in Figure 8) for retail tax-exempt MMFs dropped from \$0.9989 to \$0.9968 or 25 bps, resulting in one MMF with a price drop below \$0.9975. In contrast, institutional tax-exempt MMF lowest prices (purple line in Figure 9) dropped from \$1.0000 to \$0.9987 or 13 bps.

⁵¹ US\$ LIBOR was discontinued in September of 2023.

⁵² See 17 CFR § 270.2a-7(a)(28).

Figure 8. Distribution of weekly retail tax-exempt MMF market prices through the 2020 Covid-19 stress and recovery

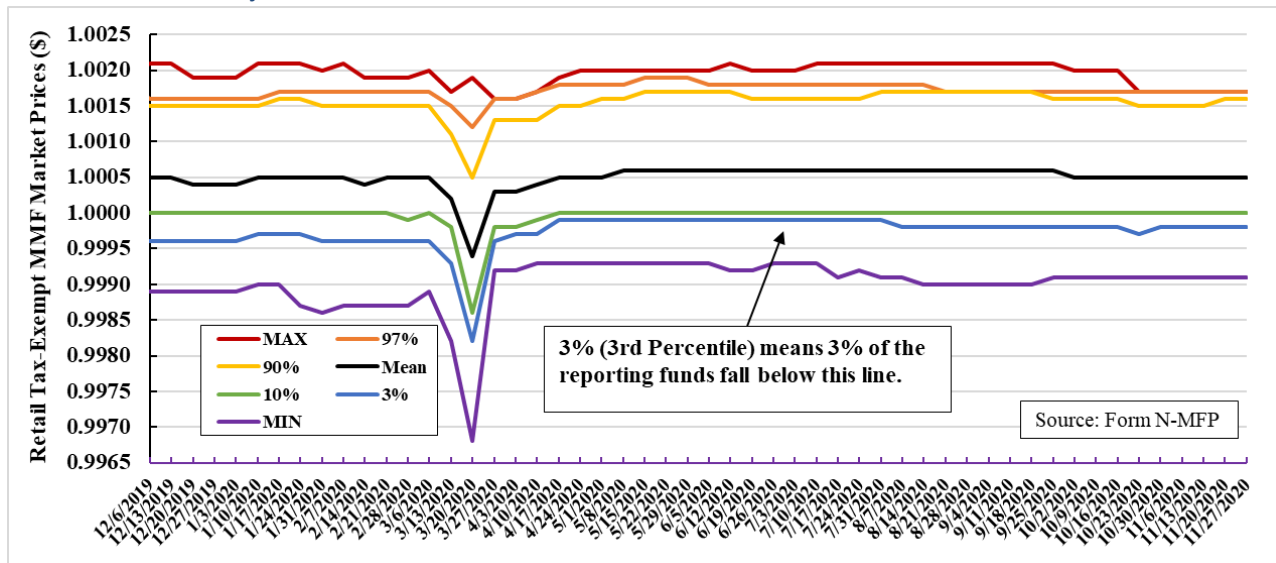
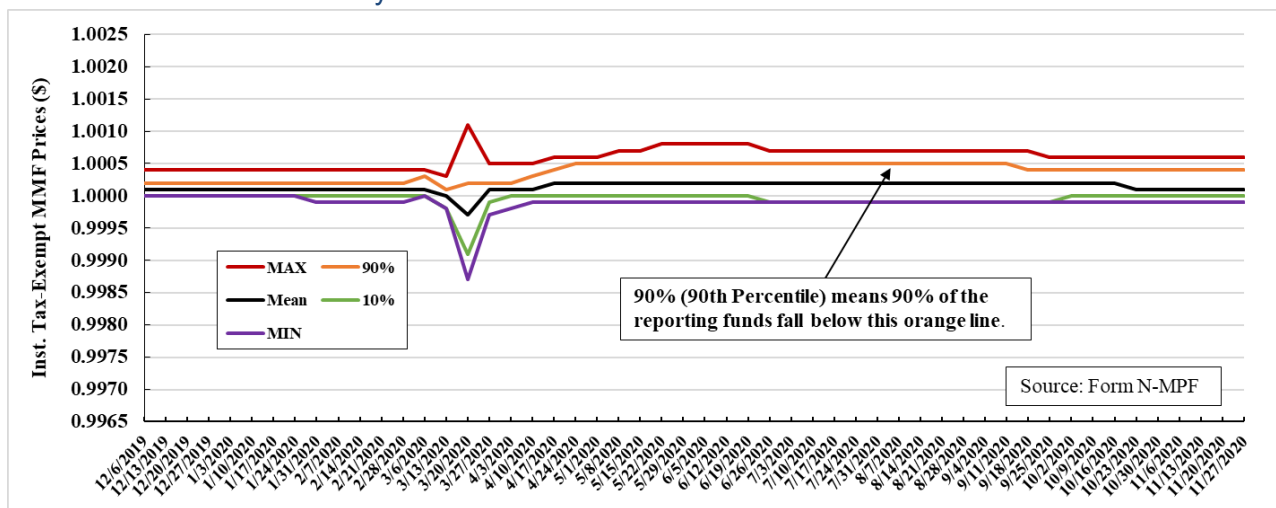


Figure 9. Distribution of weekly institutional tax-exempt MMF market prices through the 2020 Covid-19 stress and recovery

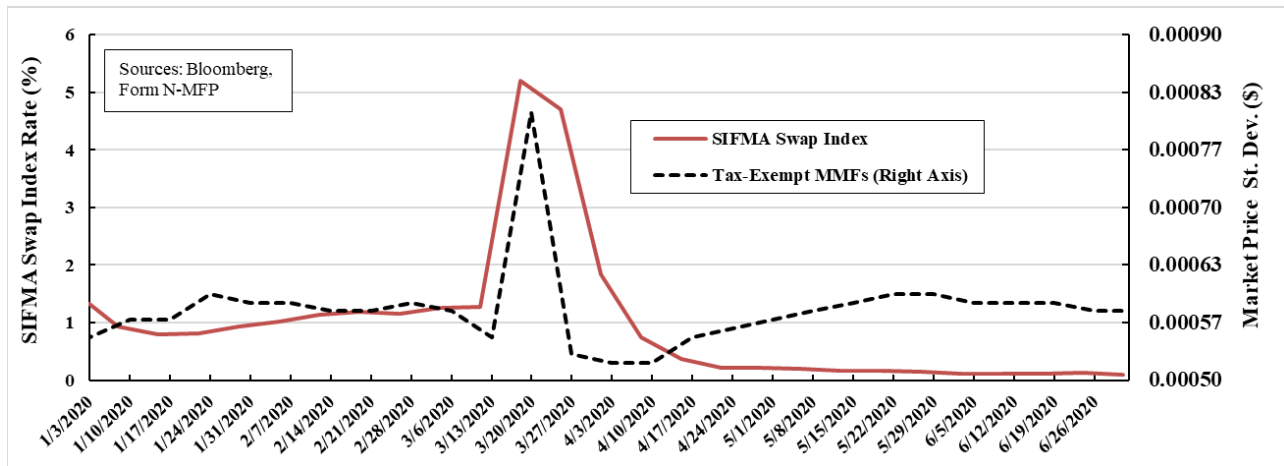


Because the short-term municipal bond market operates independently from the Treasury market, the SIFMA Municipal Swap Index (and not Treasuries) is a key municipal benchmark rate watched by MMF managers, which is a 7-day, high-grade market index for VRDNs.⁵³ Economically, similar to CP, an increase in the SIFMA Municipal Swap Index rate lowers municipal values, resulting in lower prices and, consequently, greater standard deviations due to the downward pressure on municipal prices. Figure 10 plots the standard deviation of the market price for all tax-exempt MMFs (black dashed line) along with the SIFMA swap index rate (red line). The standard deviation increased by 43% from \$0.00056 to \$0.00080. The price drops to tax-exempt MMFs came during the week of March 20 and occurred as the

⁵³ See SIFMA Municipal Swap Index, available at <https://www.sifma.org/resources/research/swap/> for a description. Historical data is available from Bloomberg starting in August 2014.

SIFMA Swap Index rate increased from 1.3% to 5.2%. By March 27, prices had returned to normal. Like prime money market funds, tax-exempt MMFs engaged in greater than normal selling activity during the week of March 20 as tax-exempt MMFs experience heightened redemptions of 9.2%,⁵⁴ suggesting tax-exempt MMFs may have had to exercise some of their VRDN's demand feature and tender back the notes they would normally keep in their portfolio.⁵⁵ Moreover, the amount of primary dealer holdings of VRDNs increased from \$3.1 billion to \$17.1 billion between February 26 and March 18.⁵⁶ However, tax-exempt MMFs hold a small portion of the outstanding VRDNs, and it remains unclear how much of the increase in primary dealer holdings can be attributed to MMFs.

Figure 10. SIFMA Swap Index Rate and the standard deviation of market prices for tax-exempt MMFs



2. Redemptions

Large investor redemptions can impact a MMF's market price. If a MMF lacks liquidity to meet investor redemptions, it may need to sell securities at a discounted price when the market is illiquid, impacting the MMF's market price. Analyses conducted by Commission staff and academics found no statistically significant correlation between institutional prime MMF redemptions and market price amid the March 2020 market dislocation.⁵⁷ More specifically, these studies did not find evidence that higher outflows led to lower market prices.⁵⁸ Figure 11 shows the result of the analyses conducted by Commission staff and academics in figure form, extended to include results for retail prime funds, showing no correlation between outflows and market prices in prime MMFs on March 20. For instance, on that day, the highest outflow from an institutional prime MMF had a market price of \$1.0000 while the highest outflow from a retail prime MMF had a market price of \$1.0001.

⁵⁴ 2021 Proposing Release, *supra* note 14.

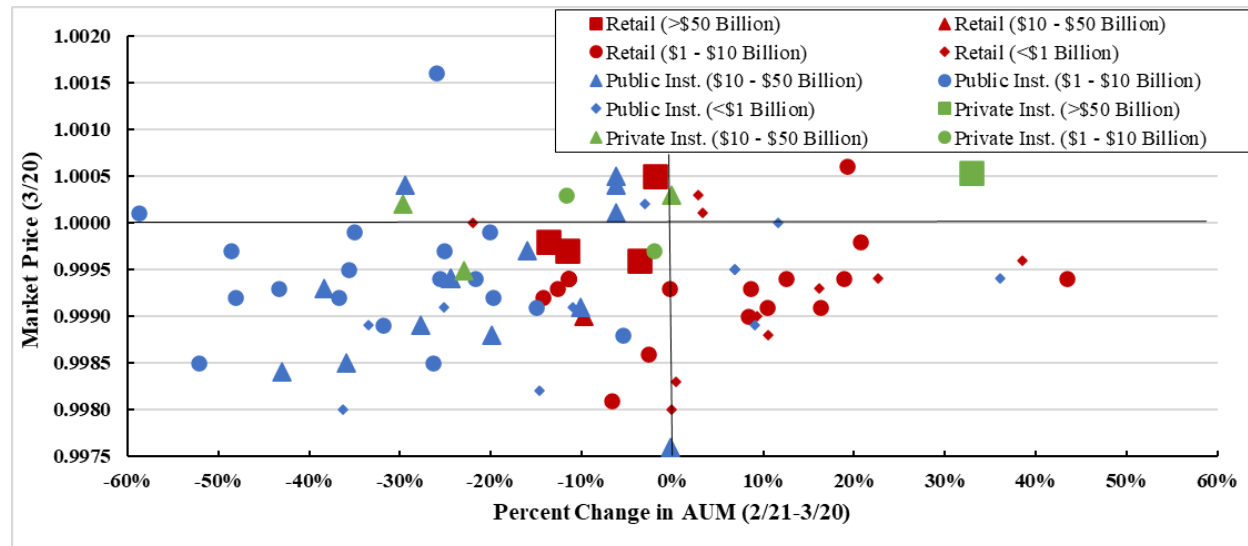
⁵⁵ See *The Impact of COVID-19 on Economies and Financial Markets*, ICI (October 2020), available at https://www.ici.org/doc-server/pdf%3A20_rpt_covid1.pdf.

⁵⁶ See PRIMARY DEALER STATISTICS, Fed. Rsrv. Bank N.Y., available at <https://www.newyorkfed.org/markets/counterparties/primary-dealers-statistics>.

⁵⁷ See *supra* note 15.

⁵⁸ These studies did not examine retail prime funds, as those funds experienced significantly lower redemptions.

Figure 11. Prime MMF market prices as a function of AUM changes, fund type and fund AUM on March 20.



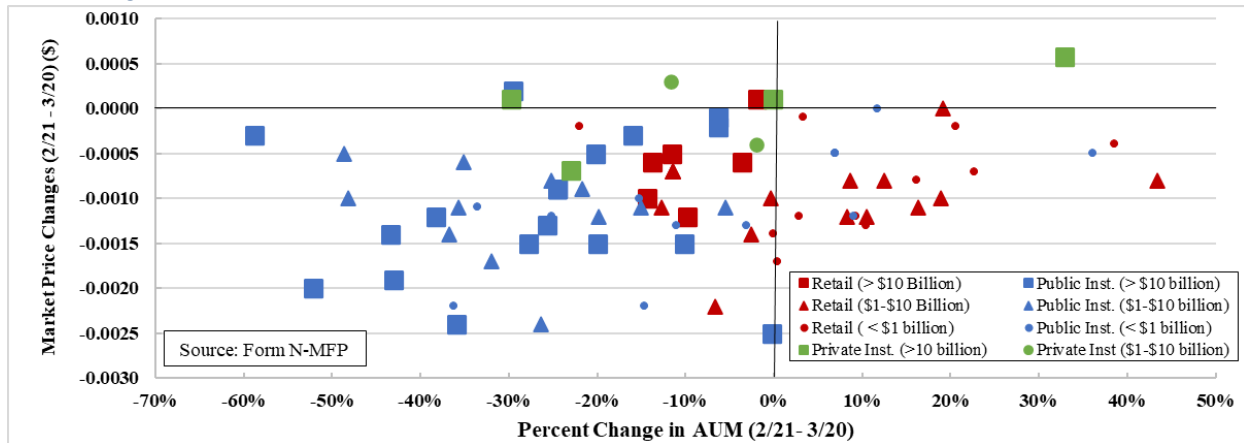
While these studies provided valuable insights by examining market prices at the peak of market stress, they did not explore whether changes in market prices were correlated with MMF outflows. This paper extends that line of inquiry by analyzing price changes from a month earlier. Such an analysis could have several implications. First it may signal heightened market uncertainty and liquidity stress as investors react to changing conditions. Second, larger price declines may reflect increased redemption activity, leading to forced asset sales and accumulating trading costs, which may further erode a MMF’s NAV. Lastly, significant fluctuations may reduce investor confidence, potentially triggering further outflows and exacerbating market stability.

Additionally, not all MMFs maintain a market price of \$1.0000 even during periods of market stability. On any given day, there is a range of market prices. For instance, in Figure 6 above, on February 21 – shortly before the March 2020 market dislocation – the low, average, and high market prices for institutional prime MMFs were \$0.9999, \$1.0003, and \$1.0015, respectively. Thus, if a MMF has a market price of \$0.9999 on February 21 and \$0.9980 on March 20 then its price change would -18 bps. Similarly, if the MMF’s market price had been \$1.0015 on February 21, the price change would double at -35 bps.

Figure 12 looks at the monthly price changes for prime MMFs from February 21 to March 20 as a function of AUM changes. Figure 12 shows that almost all prime MMFs had negative price changes. Retail prime MMFs changed by -9 bps on average, while public institutional prime funds changed by -11 bps on average. Figure 12 also suggests that there is a weak correlation between price changes and AUM changes. Prime MMFs with an AUM change of -40% or lower had a simple average price change of -12 bps, prime MMFs with an AUM change of -40% to -20% had a simple average price change of -11 bps, prime MMFs with an AUM change of -20% to 0% had a simple average price change of -9 bps, and prime MMFs with an AUM change of 0% or greater had a simple average price change of -7 bps.⁵⁹

⁵⁹ In contrast, a similar analysis for tax-exempt MMFs shows no observable correlation.

Figure 12. Prime MMF market prices changes as a function of AUM Changes in the Month Preceding March 20



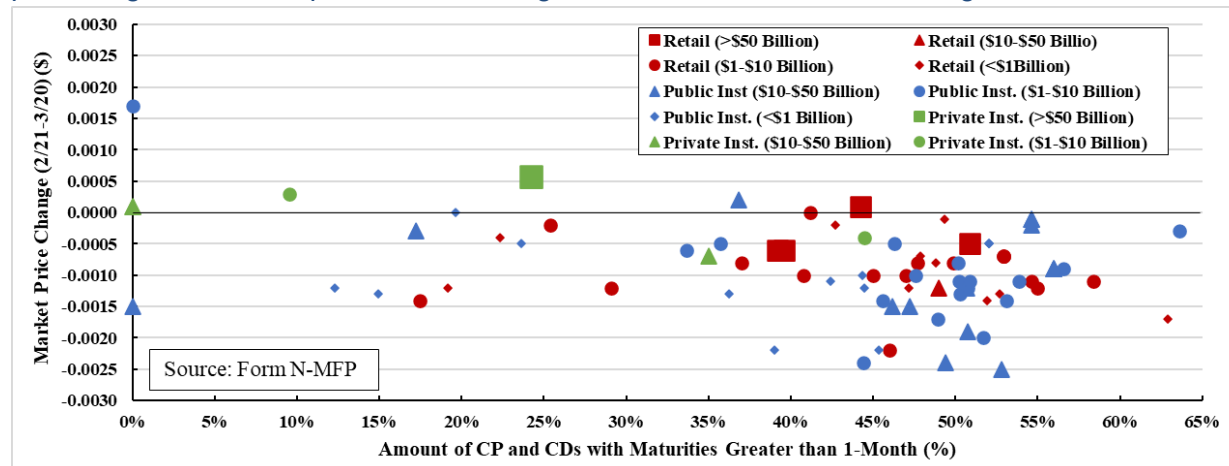
3. Commercial Paper and Certificates of Deposits

When the market is illiquid, large investor redemptions could require a MMF to sell its CP and CDs at a loss, which can impact a MMF’s market price. Indeed, MMFs sold an estimated combined \$80 billion in CP and CDs in March 2020 to fund sponsors (\$4 billion), in the secondary market (\$23 billion) and to the Money Market Mutual Fund Liquidity Facility (\$53 billion).⁶⁰ In response to the RFC, one commenter stated that they took significant losses selling longer dated CP and CDs.⁶¹ However, not all MMFs had to sell their longer dated CP and CDs. Figure 13 shows the percentage of a MMF’s portfolio consisting of CP and CDs holdings with maturities greater than a month and market price changes between February 21 and March 20. As illustrated in Figure 13, prime MMFs with a market price change of -15 bps or more had over 39% of their portfolio in CP and CDs with maturities greater than a month on March 20, suggesting those MMFs that construct their portfolio with a higher percentage of CP and CDs with maturities greater than a month are more likely to have to sell these securities for a loss in a liquidity crunch.

⁶⁰ 2021 Proposing Release, *See supra* note 14.

⁶¹ See JPMorgan comment letter to the RFC available at <https://www.sec.gov/comments/s7-01-21/s70121-8662454-235280.pdf>. (“We determined that under the circumstances it was in the best interests of these funds and their shareholders to maintain our WLA at or above 35 percent. To accomplish this while meeting investor redemptions, we sold longer dated (non-WLA) instruments such as CP and CDs... we took significant losses on many of our sales in the secondary market. This selling, together with similar activity from other market participants, created further downward pressure on the prices of these securities...”)

Figure 13. Prime MMF market prices changes as a function of AUM on March 20 and the percentage of a fund's portfolio consisting of CP and CDs with maturities greater than 1-month



4. Liquidity

WLA as a percentage of AUM is one measurement of liquidity in MMFs. The 2014 reforms allowed MMFs to impose redemption gates and liquidity fees once the amount of WLA fell below 30%. As mentioned above, MMFs during the March 2020 market dislocation, were actively managing their portfolios to avoid going below the 30% WLA threshold. As a result, MMFs did not rely solely on their WLA buffer to meet redemptions, but also sold longer maturity assets. Otherwise, WLAs would have changed more significantly.

Most tax-exempt MMF portfolios are constructed with VRDNs, which generally have a demand feature that allows their interest rates to be reset weekly. Most VRDNs count as WLA.⁶² According to one commenter responding to the RFC, the deviation in tax-exempt MMF market price changes resulted from a lack of market liquidity in longer dated fixed-rate tax-exempt securities, which did not count as WLA.⁶³ Indeed, Figure 14 below shows a strong correlation between tax-exempt MMF market price changes and WLA. More specifically, those tax-exempt MMFs with a lower WLA percentage (i.e., held more longer dated securities in their portfolio) had a greater market price change. However, not all tax-exempt MMF market prices changes are attributed to specific securities. For example, one MMF reported a material deviation of \$0.0032 to its market price on Form N-CR, during the March 2020 market dislocation, resulting from embedded realized losses from a prior period.⁶⁴ Also, in Figure 14, the data show no correlation between changes in market price and WLA for prime MMFs.

⁶² See 17 CFR § 270.2a-7(a)(28).

⁶³ See Vanguard comment letter to the RFC available at <https://www.sec.gov/comments/s7-01-21/s70121-8662453-235301.pdf>. (“Roughly three-quarters of the tax-exempt MMF universe is comprised of VRDNs, which provide contractual liquidity on a daily or weekly basis. ...The remaining one-quarter of available tax-exempt money market securities are fixed rate and are offered generally with tenors of 30 to 365 days, making them more comparable to the longer-dated commercial paper market. It was this latter security type that bore the brunt of the market stresses in March 2020”).

⁶⁴ Form N-CR is a current report to be filed by MMFs whenever there is material event impacting the fund under the Investment Company Act of 1940. See Form N-CR filing available at <https://www.sec.gov/Archives/edgar/data/831363/000083136320000053/formn-cr.htm>.

Figure 14. Market price changes from February 21 to March 20 as a function of weekly liquid assets from March 20 and fund type

