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Swing Pricing Calibration: A Simple Thought Exercise Using ETF Pricing Dynamics to Infer Swing Factors for Mutual Funds

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Swing Pricing Calibration: A Simple Thought Exercise Using ETF Pricing Dynamics to Infer Swing Factors for Mutual Funds

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1. Introduction

In March 2020, amid the onset of the COVID-19 pandemic, pooled investment funds that invest substantially in short-term debt instruments experienced large net redemptions and runs.[2] For example, in the two-week period ended March 24, 2020, net redemptions from publicly-offered institutional prime money market mutual funds (MMMFs) were about 30 percent (Presidents' Working Group on Financial Markets (PWG (2020)).[3] Ultra-short-term bond mutual funds (MFs), including those that invest substantially in short-term corporate debt instruments, experienced large monthly net outflows of about 15 percent of net assets in March 2020.[4] These outflows resulted in some funds liquidating their underlying assets at large discounts, which contributed to volatility in the prices of those assets and strains in broader financial markets.

Policy makers are assessing potential options to reduce the structural vulnerabilities in MFs and MMMFs, particularly those that invest in assets that can suddenly become illiquid during periods of stress.[5] One option under consideration is swing pricing, or the process of

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[2] To be sure, long-term MFs, such as corporate and municipal bond funds, also experienced large redemptions in March 2020. However, the focus of this note is on funds that invest primarily in short-term debt instruments.

[3] This compares to two-week-period outflows of about 26 percent experienced during the MMMF run in September 2008 (PWG (2020)).

[4] This was the largest monthly net outflows relative to net assets since 1993. Based on Morningstar, Inc. data.

[5] Policy makers and researchers have flagged fire sale externalities as a risk to financial stability posed by open-ended pooled investment vehicles, including MFs. Since the Global Financial Crisis, numerous reforms have been

adjusting a MF's net asset value per share (NAV) to pass on the costs arising from its net purchase or redemption activity to the investors responsible for that activity.[6] Swing pricing can disincentivize large redemptions; however, effective design and calibration require real-time estimates of liquidity costs. These liquidity costs can be difficult to measure for certain corporate debt instruments, such as commercial paper, which generally only have thin secondary markets, even during normal times.[7]

In this note, we use pricing dynamics for Exchange-Traded Funds (ETFs) that invest primarily in short-term debt to provide rough estimates of a *range* of swing-factor-proxies for MFs that invest in similar assets. The premise underlying this thought exercise is that MFs and ETFs that hold similar portfolios are comparable, except for the fund structure. Accordingly, the magnitude of ETF premiums and discounts could be a useful, albeit imprecise, proxy for liquidity costs for a MF that holds similar assets to the ETF.[8] Thus, for MFs that held at least 50 percent of their pre-COVID-19 net assets in short-term corporate debt, swing-factor-proxies (that is, the ETF price discount to the value of its underlying assets) ranged between 2 and 7 percent, on average, during the most stressful period in March 2020.[9]

This measure tended to be higher for MFs that held more short-term corporate debt than the median MF and those with a longer weighted average life (WAL) than the median MF. For

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adopted to reduce these risks. For example, the SEC adopted two sets of MMMF reforms, in 2010 and 2014, to improve the resilience of MMMFs and reduce run risk. *See* https://www.sec.gov/rules/final/2010/ic-29132.pdf and https://www.sec.gov/news/press-release/2014-143, respectively. Also, in 2016, the SEC adopted new liquidity risk management rules for MFs, including swing pricing. *See* https://www.sec.gov/rules/final/2016/33-10233.pdf

[6] As discussed further below, since 2016, U.S. MFs (not MMMFs) are permitted to use swing pricing, although none has chosen to implement it. On December 15, 2021, the SEC proposed amendments to rules that govern MMMFs, including a swing pricing requirement for certain types of MMMFs that would cause their NAVs to drop on days when the fund experiences net redemptions. *See* https://www.sec.gov/news/press-release/2021-258.

[7] Under the current CP structure, for example, sellers typically ask the bank from which they purchased the CP to buy it back in the secondary market (Blackrock (2021)). More broadly, investors tend to hold CP and CD to maturity. Accordingly, there is little to no secondary market transactions, even during non-stressed periods (Financial Stability Board (2021)).

[8] The ETF premium/discount is the difference between an ETF's closing price and its end-of-day net asset value. See sections 3.2 and 3.3, respectively, for more information on our methodology and its limitations. *See* Appendix A for high-level characteristics for ultra-short-term bond MFs and ETFs.

[9] The largest outflows began on March 13, 2020 and abated on March 26, 2020. Also, during this period, the weighted average discount for the *entire* ETF sample was 4 percent; discounts as large as 12 percent were observed during this period. Finally, the median corporate debt percentage and WAL for the entire ETF sample was 77 percent and 1.2 years, respectively.

MFs that invest at least 50 percent of their pre-COVID-19 net assets in government-related securities, the analogous range is only 0.01 percent to 0.11 percent, on average. These much lower ranges likely reflect the relatively low-risk and high liquidity of these funds' underlying assets.

Thus, during periods of stress in which funds experience large net redemptions, swing factors could range between 0.01 percent, for MFs that invest substantially in short-term government-related securities, to almost 7 percent for those that invest substantially in short-term corporate debt, on average. These proxies could be useful for benchmarking stress-period swing factors in which funds that invest substantially in money market instruments experience large net redemptions. Outside this cohort, the general framework could also be useful to benchmark swing-factor-proxies for other types of MFs that invest in less liquid assets, including municipal bonds, which also experienced unusually large net outflows in 2020.

The rest of this note is structured as follows: Section 2 briefly describes liquidity transformation risks in open-ended funds, the swing pricing mechanism, and ETF pricing dynamics. Section 3 discusses our approach and results. A conclusion follows.

2. Background

2.1. *Liquidity Transformation in Open-Ended Funds*

Policy makers and researchers have identified liquidity transformation as a salient risk to financial stability posed by open-ended, collective investment vehicles, including MFs.[10] These funds offer daily redemptions to their investors, but may hold assets that require more than a day to sell without significant price impact. The primary concern is that large redemptions and runs from these vehicles, particularly those that invest in relatively illiquid assets, could result in the funds liquidating their underlying assets at "fire sale" prices, which contributes to increased volatility in the prices of those assets and in broader financial markets (*see, generally,* Goldstein, Jiang, and Ng (2017), Chernenko and Sunderam (2020), Jiang, Li, Sun, and Wang (2020)).

[10] *See, e.g.,* Federal Reserve Board (2020), President's Working Group on Financial Markets (2020), Anadu and Cai (2019), Financial Stability Oversight Council (2016), International Monetary Fund (2015).

MF fire-sale dynamics were at play in Spring 2020, amid the onset of the COVID-19 pandemic, when several types of MMMFs and bond MFs experienced unusually large net redemptions. Particular attention was paid to funds that invest substantially in corporate money market instruments, given the importance of this source of funding to businesses. Redemption activity from these funds, including MMMFs, likely amplified strains in the short-term funding markets, which normalized after unprecedented official sector actions were taken to restore key markets.[11]

2.2. *The Swing Pricing Mechanism*

Swing pricing is one of several reform options under consideration for reducing liquidity transformation risks in MFs and MMMFs.[12] A properly designed swing pricing requirement could create a disincentive for investors to redeem during periods of stress, as it forces a fund's investors to internalize the liquidity costs (including transaction, bid-ask spread, and market-impact costs) of their redemption activity, at least partially.

Existing literature, which mostly focused on European MFs, is generally supportive of the efficacy of swing pricing. For example, an empirical study by Lewrick and Schanz (2017) finds that swing pricing dampens outflows in response to poor fund performance, but that it has a

[11] The Federal Reserve, with prior approval from the Secretary of the Treasury, established numerous emergency lending facilities to support the flow of credit to households and business. For example, the Money Market Mutual Fund Liquidity Facility (MMLF) was established on March 18, 2020 to assist eligible MMMFs meet heightened redemption pressures. Also, on March 23, 2020, the Federal Reserve established the Secondary Market Corporate Credit Facility to provide liquidity to the corporate bond market. *See* https://www.federalreserve.gov/monetarypolicy/policytools.htm. On the effectiveness of the MMLF, *see, e.g.,* Anadu, Cipriani, Craver, and La Spada (2021).

[12] In 2016, the SEC adopted new rules that permit MFs to use swing pricing, among other changes. Thus far, no U.S. MF has adopted swing pricing. In contrast, swing pricing is more widely used in Europe. That no U.S. MF has chosen to adopt swing pricing reveals the MF industry's preference for swing pricing. Although operational obstacles are often cited as an impediment to widespread adoption, some funds have argued that investors may prefer a fund without swing pricing to an otherwise similar fund with swing pricing; thus, the collective action problem likely creates a first-mover disadvantage. Therefore, a requirement that certain MFs use swing pricing would resolve this collective action problem.

As previously noted, the SEC recently proposed mandatory swing pricing for MMMFs. Also, the Securities and Exchange Board of India (SEBI) recently introduced swing pricing for certain debt MFs. SEBI's framework is only activated when in-scope debt funds experience net redemptions. The framework is hybrid, such that during "normal" times, a fund sponsor may elect to activate swing pricing. During periods of stress, however, swing pricing is mandatory for in-scope debt funds (SEBI (2021)). This framework goes into effect in March 2022.

limited effect on outflows during periods of stress.[13] However, a study with more detailed information on fund-level pricing practices by Jin, Kacpercyzk, Kahraman, and Suntheim (2021) finds evidence that swing pricing eliminates the first-mover advantage and reduces outflows during market stress in corporate bond funds. Also, a study based on survey data covering the COVID-19 pandemic period by the Bank of England (2021) finds preliminary evidence that swing pricing may have helped to reduce outflows.[14] Finally, a theoretical study by Capponi, Glasserman, and Weber (2020) illustrates that swing pricing could materially mitigate the first-mover advantage in MFs.

Although swing pricing could be a useful tool to reduce liquidity transformation risks, calibrating certain parameters, including the "swing factor," that is, the amount by which the fund "swings the NAV," may be difficult.[15] In principle, the swing factor should equal all the liquidity costs arising from net flows. Unfortunately, MF liquidity costs cannot be observed directly, which makes swing factors difficult to calibrate. To address this problem, we propose using ETF pricing dynamics to estimate a range of swing factors for MFs that have a similar investment strategy. Understanding this methodology requires an explanation of how ETF pricing works, which we discuss next.

[13] The lower effectiveness in certain instances may be due to challenges in calibrating swing pricing. Alas, the literature on appropriate calibration of swing factors is thin. A study by the Bank of England (2021) using survey data from December 2019 to June 2020 matched swing factors of corporate bond MFs to comparable corporate bond ETF bid-ask spreads and NAV discounts. It noted that swing factors may not fully reflect the cost of sales to meet redemptions and may not reflect the price uncertainty of the underlying bonds. Malik and Lindner (2017) demonstrate in a simulation that swing factors may need to be raised to a level higher than those justified by prevailing trading costs to deter the first-mover advantage. They also note that investors may lack awareness of swing pricing practices and that this lack of awareness may decrease effectiveness. They argue that increased communication may increase effectiveness. Also, in examining the efficacy of swing pricing in European bond MFs in March 2020, Claessens and Lewrick (2021) noted "[t]he swing factor might have been too modest to dissuade redemption in this episode."

[14] The evidence from this study draws an obvious conclusion: poorly calibrated swing pricing parameters, including too low swing factors, and full discretion in setting those parameters likely diminishes the efficacy of swing pricing.

[15] For example, Bank of England (2021) found "Fund managers also noted the challenges of calculating swing factors in a highly volatile market environment, during which spreads are hard to define… information on execution prices was limited, or prices quoted by vendors were not representative of the actual tradeable spreads, particularly for fixed-income assets."

2.3. *Exchange-Traded Funds and Related Pricing Dynamics*

In contrast to MFs and MMMFs, which largely satisfy investor redemptions in cash, liquidity transformation risks are less salient for most ETFs. This is because the main mechanism by which most ETF shares are redeemed (or created) in the primary market is in-kind; this "exchange" of ETF shares for a basket of the ETF's underlying securities minimizes liquidity transformation (Anadu, Kruttli, McCabe, and Osambela (2020)). ETFs, like other exchange-traded securities, have two prices in the secondary market: a bid price and an ask price. The bid and ask prices reflect the prices at which ETF shares can be bought or sold, respectively, and both are influenced by market forces. In addition to bid and ask prices, ETFs, like MFs, also compute a NAV once a day, which is the value of their underlying securities.

During normal times, the difference between an ETF's share price and its NAV is typically subdued for most ETFs, owing to arbitrage activities.[16] However, during periods of stress, this so-called share price *premium* or *discount* to NAV can widen notably, albeit typically briefly, as observed in certain bond ETFs in March 2020. This divergence between an ETF's share price and its NAV likely reflects widening bid-ask spreads and other liquidity costs that impede APs' ability to arbitrage the price-NAV gaps.[17] That is, during periods in which bond

[16] Only large institutional investors known as Authorized Participants (AP) can transact with ETFs in the primary market. This process is known as the creation and redemption mechanism: when an ETF's share price is higher than its NAV (i.e., trading at a premium to NAV), the AP has an incentive to buy the ETF's underlying basket, deliver the basket to the ETF in exchange for ETF shares ("creations"), and then sell the ETF shares on the secondary market, earning the spread. The opposite happens if the ETF is trading at a discount to its NAV (that is, APs have incentives to engage in "redemptions").

[17] Others have pointed to ETFs as a price discovery vehicle. For example, BlackRock (2020) suggests the ETF premiums and discounts to NAV are "…transmitting real-time information and providing price discovery for market participants," as the bonds underlying the ETF may trade infrequently and, therefore, not reflect current market information in their NAVs. Also, "ETFs acted as a price discovery tool, particularly in the fixed-income market, where market participants faced challenges in finding liquidity and establishing pricing for individual bonds." (Investment Company Institute (2020)). State Street Global Advisors (SSgA) notes "Fixed income liquidity became challenged and pricing more opaque than usual. Fixed income ETFs, however, tend to reflect more real-time sentiment and realistic pricing levels as to where the basket of bonds should trade. As a result, pricing on individual bonds can lag behind the real-time market sentiment and executable pricing levels reflected by the ETF, resulting in the appearance of large discounts to NAV. In some cases, the ETF price may have been a better representation of actionable trade prices of the underlying constituents, when some were not always quoted by dealers, and thus acting as an efficient price discovery venue." (SSgA (2020)).

markets are distressed, the ETF discount conveys information that could be useful in discerning the "true liquidation costs" of the ETF's underlying assets.[18]

3. Data and Approach, and Observations

3.1. *Data and Approach*

Our data are primarily from Morningstar, Inc., Bloomberg, and funds' SEC filings. We first identified a group of bond MFs and ETFs that Morningstar, Inc. classifies as "ultra-short-term." We limit this universe to those funds with inception dates on or before December 2019. Morningstar, Inc. also provides monthly and daily net assets, daily and monthly estimated net flows for MFs, and some portfolio-level information such as weighted-average life. Next, we obtained end-of-day premium and discount to NAV and other high-frequency data for ETFs from Bloomberg. Finally, we collected portfolio composition information for each MF and ETF from their SEC filings. We used these data to decompose holdings by broad categories, such as corporate and government.

Our methodology is quite intuitive: as previously noted, swing factors are difficult to calibrate because it is difficult to measure the liquidity costs generated by a MF's activities, particularly for funds investing in short-term corporate debt, which trade infrequently. The magnitude of an ETF's premium and discount to NAV could serve as a useful, albeit rough, proxy for these liquidity costs: a large discount represents the amount by which a MF's NAV might need to be swung downward when it experiences net redemptions. Conversely, a large premium could represent the amount by which a MF's NAV is swung upward when it experiences net purchases.[19]

[18] Another potential means of measuring ETF liquidity costs might be to use the ETFs' bid-ask spreads instead of their discounts to NAV. A challenge, however, is that the ETFs' bid-ask spread measures the liquidity of the ETF, not necessarily those of its underlying assets. For example, in the case of corporate bond ETFs, the ETF shares trade on a stock exchange and are likely more liquid than the underlying corporate bond it holds. So, using the ETFs' bid-ask spreads could understate bonds' transaction costs.

[19] We are primarily concerned about the downward NAV adjustments required when there are net outflows, however, swing pricing could be symmetrical, requiring upward NAV adjustments when there are inflows to reduce dilution of the value of the fund's shares. Of course, this approach is of course not without caveats and limitations, which we will discuss in a later section. Nonetheless, we think this is a useful first step in the direction to a proper calibration.

3.2. *Observations*

Our general conjecture: during periods in which a MF experiences unusually large net redemptions, a similarly positioned ETF would experience large discounts to its NAV insofar as the MF-redemption is driven by broad market stress. There are at least two potential interpretations of this. First, MF redemptions increase the liquidity costs of their underlying assets (focusing on non-government debt), on balance, which are then reflected in ETF pricing dynamics. Second, broad market stress induces redemptions from MFs through the flow-performance relationship (*see, e.g.,* Chernenko and Sunderam (2020)), which is then reflected in ETF pricing dynamics.[20] Nevertheless, we make no claims of causality and simply observe the relationship between MF net flows and ETF premiums and discounts for funds that hold similar portfolios.

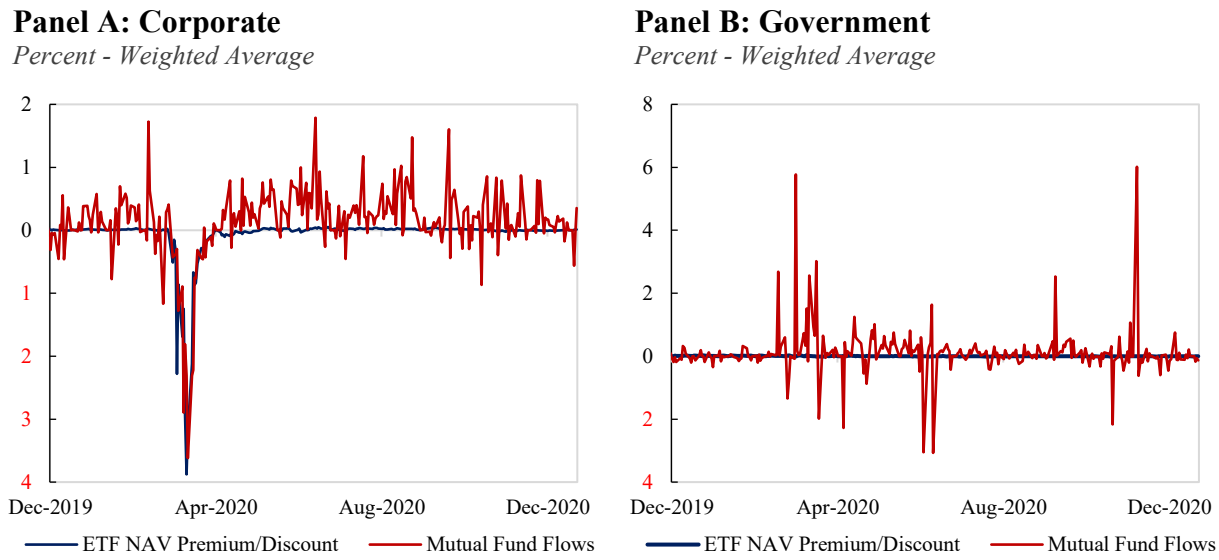
Figure 1 reports daily ETF premium and discount to NAV and MF net flows for funds classified as ultra-short-term bond funds. Figure 1, Panel A shows that in March 2020, corporate bond ETFs experienced large discounts-to-NAV of almost four percent, on average, while MFs experienced contemporaneous net outflows of a similar magnitude.[21] In contrast, the premium/discount for government ETFs was relatively muted (Panel B), even though net flows (both in and out) were quite volatile.

[20] Another is that the ETF AP's reluctance to arbitrage the price-NAV (described in footnote 14) gap may be a function of the AP's risk aversion. To the extent dealers' balance sheet costs or risk aversion cause the ETF arbitrage mechanism to break down and cause ETFs' prices to have a large discount to NAV, this could also be consistent with high transaction costs for the underlying bonds.

[21] Although corporate bond ETFs experienced large NAV discounts in March 2020, it is likely that discounts could have been even larger had the Federal Reserve not intervened with emergency lending facilities to provide backstops to the corporate bond primary and secondary markets. *See* Boyarchenko, Kovner, and Shachar (2020).

Also, it is worth noting that this phenomenon is not limited to ultra-short-term bond ETFs, for example, municipal bond ETFs also experienced sharp discounts of about 8 percent, on average, in March 2020, a month in which municipal bond MFs experienced record net outflows of about 5 percent (*see* Appendix C). Nor is it limited to March 2020, for example, some corporate bond ETFs experienced large discounts during the 2013 "taper tantrum."

Figure 1: ETF Premium/Discount and MF Net Flows for Ultra-Short Bond Funds

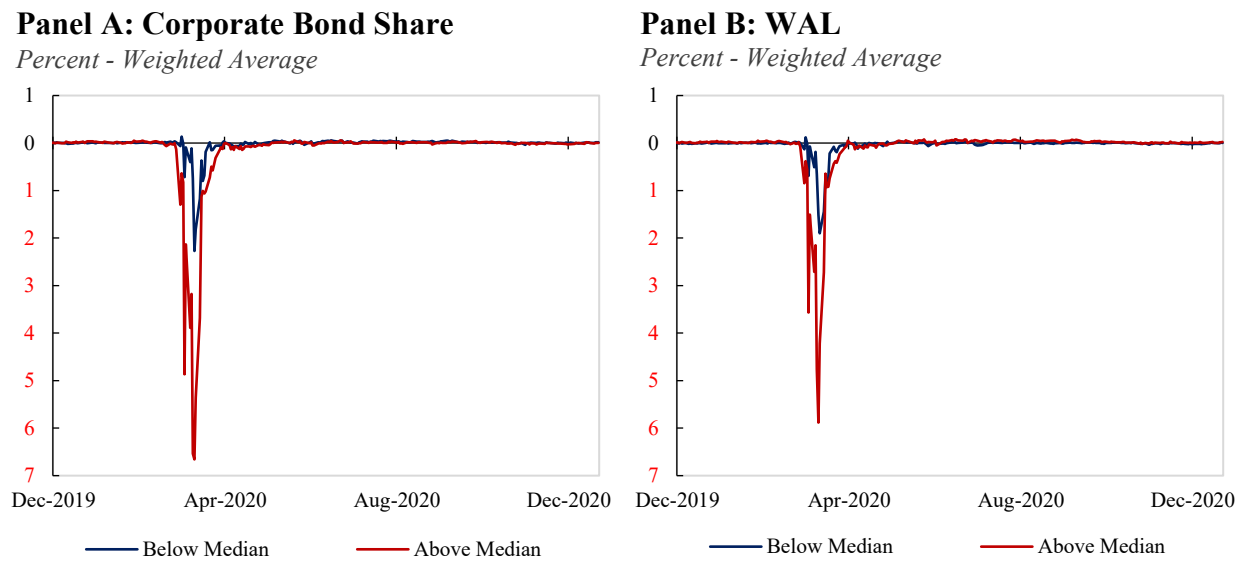


Notes: "Corporate" are MFs and ETFs that held at least 50 percent of their pre-COVID-19 net assets in short-term corporate debt. "Government" are those that held at least 50 percent of their pre-COVID-19 net assets in government-related securities. The data are daily, and those for MFs are limited to funds with daily reported net flow data.
Sources: Authors' calculations based on Morningstar, Inc., and Bloomberg data.

Next, we divided our ETF sample by broad portfolio-composition levels and WAL to see how such factors generally relate to ETF premiums and discounts. Figure 2, Panel A shows that ETFs that held more corporate debt than the median corporate debt ETF tended to have larger discounts in March 2020 (about 7 percent) than those that held a below-median share of corporate debt (2 percent). Moreover, as reported in Figure 2, Panel B, ETFs with an above median WAL tended to experience larger discounts than those with below average WALs. Figure 3 reports an analogous exercise for government ETFs: premiums and discounts for those with above median holdings of government securities and WAL tended to be more volatile than the below median ETFs.[22]

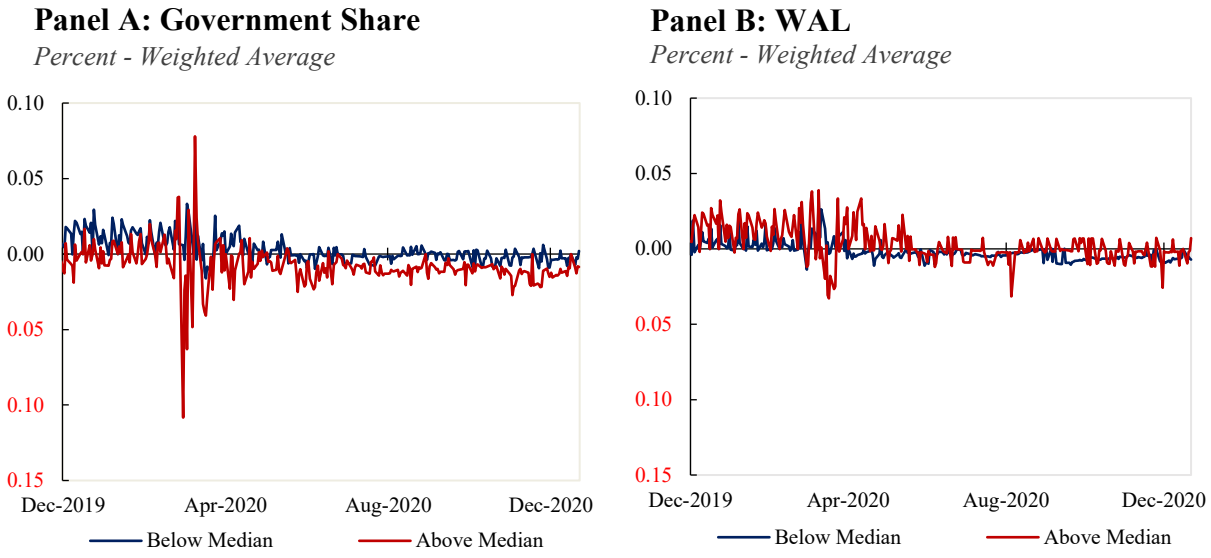
[22] See Appendix B for the minimum, maximum, and median ETF premiums and discounts for the entire sample.

Figure 2: ETF Premium/Discount for Select Corporate Ultra-Short Bond Funds



Notes: "Corporate" are ETFs that held at least 50 percent of their pre-COVID-19 net assets in short-term corporate debt. The data are daily.
Sources: Authors' calculations based on Morningstar, Inc., and Bloomberg data.

Figure 3: ETF Premium/Discount for Select Government Ultra-Short Bond Funds

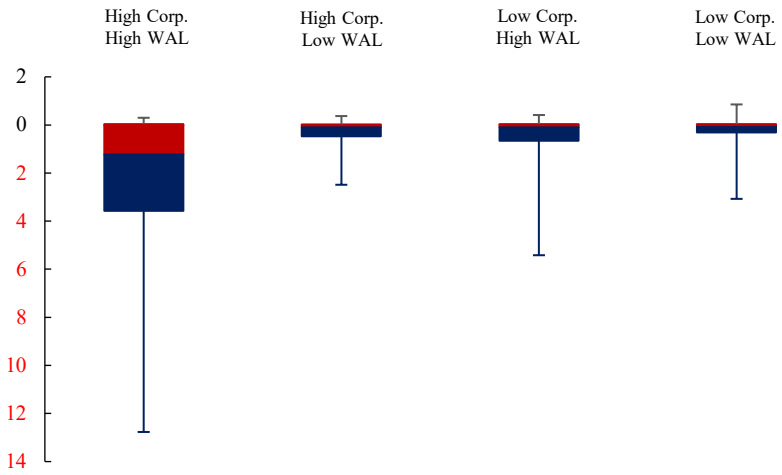


Notes: "Government" are ETFs that held at least 50 percent of their pre-COVID-19 net assets in government-related securities. The data are daily
Sources: Authors' calculations based on Morningstar, Inc., and Bloomberg data.

Finally, to understand how portfolio composition interacted with WAL during the worst days in March 2020, we divided our corporate bond ETF sample into four quadrants: High Corporate Holdings-High WAL; High Corporate Holdings-Low WAL; Low Corporate Holdings-High WAL; and Low Corporate Holdings-Low WAL. Figure 4 shows that, in March

2020, corporate bond ETFs that had both an above-median fraction of corporate bonds and above-median WAL experienced a median and maximum discount of approximately one and a half percent and 12 percent, respectively (first box). In contrast, ETFs with both below-median holdings of corporate debt and below-median WAL (fourth box) had a median discount of about half of a percent, and a maximum of four percent.[23]

Figure 4: Distribution of Premium/Discount for Ultra-Short ETFs in March 2020



Notes: Figures are in percentage point. The first box, High Corp-High WAL, shows distribution of premiums and discounts for ETFs with a larger fraction of corporate debt and higher weighted average life than the median corporate debt ETF. The last box, Low Corp-Low WAL, shows the distribution of premiums and discounts for ETFs with a lower fraction of corporate debt and lower WAL than the average corporate debt ETF. These distributions are based on daily ETF premium and discount to NAV, and the period is March 2020.
Source: Authors' calculations based on Morningstar, Inc., and Bloomberg data.

To sum up this section, during periods in which short-term corporate bond MFs are experiencing large net redemptions, average swing-factor-proxies could range between approximately 2 percent and 7 percent, depending on portfolio composition and WAL. For MFs that invest primarily in government-related securities, the range is substantially lower: 0.01 to 0.11 percent.

[23] We ran discovery regression analysis on six pairs of ultra-short corporate bond ETFs and MFs spanning February to May 2020. Pairs are matched based on portfolio characteristics such as share of corporate holding, weighted-average life, and fund size. For each pair i of ETF and MF, regression specification is as follows:

$$ETF\ NAV Discount/Premium_{i,t} = \beta_0 + \beta_1 * MF\ Flow_{i,t} + \beta_2 * MF\ Outflow_t + \beta_3 * \left(MF\ Flow_{i,t} * MF\ Outflow_{i,t}\right) + \alpha_i + \epsilon_{i,t}$$

where *MF Outflow*$_t$ is a dummy variable indicating whether there is MF net outflow on day *t*. Regression results suggest that one percent MF outflow correlates with an additional 20 basis point ETF NAV discount. Results are statistically significant at ten percent level. There are a few caveats worth cautioning. In addition to those in section 3.4, the six pairs matched on portfolio characteristics are not guaranteed to have identical underlying positions.

3.3. *Caveats and Limitations*

A few caveats are in order. First, our analysis generally assumes that MFs and ETFs with similar investment strategies are comparable, except for the investment vehicle (MF or ETF). This assumption is difficult to examine empirically due to data limitations. That said, we provide *ranges* for swing-factor-proxies, which somewhat relaxes the "similar portfolios" constraint. Second, ETF premiums and discounts likely reflect other factors, such as non-price-related incentives of APs.[24] These additional unobserved factors may muddy the degree to which premiums and discounts reflect just liquidity costs. Third, while ETFs and MFs might inherently have different clientele due to their structural differences, our analysis is agnostic on "clientele effects" that may be contributing to pricing dynamics.[25]

Finally, our framework does not estimate swing-factor-proxies for different levels of net investor activity. Thus, it could be useful to think of the averages as lower bounds, during periods of stress, depending on a fund's net redemptions and portfolio composition.

4. Conclusion

Open-ended collective investment vehicles, particularly those that invest in non-government debt, engage in liquidity transformation. Large redemptions and runs from these vehicles can negatively impact financial markets, as was observed in March 2020. One potential policy option for dampening large redemptions and destabilizing runs on funds is swing pricing, particularly if it is designed so that redeeming shareholders bear the full costs of their redemption activity. Despite swing pricing's potential benefits, calibrating swing factors is difficult, particularly for assets with thin secondary markets, such as commercial paper.

In this note, we provide a framework that can be used to benchmark swing factors for different fund types. For example, for MFs that invest primarily in short-term corporate debt, the discount-to-NAV could fall between 2 percent to 7 percent, on average, during periods of stress in which the funds experience large net redemptions. Our analysis could be useful to policy

[24] Other factors such as commissions, taxes, and fees from the creation and redemption process and higher hedging costs during periods of stress (International Organization of Securities Commissions (2021)).

[25] For example, we note that there could be selection biases that reflect MF investors' and ETF investors' different redemption behavior during stressed markets.

makers that are examining methods to calibrate swing factors that reasonably approximate transaction costs, while preserving the benefits of the fund to investors.

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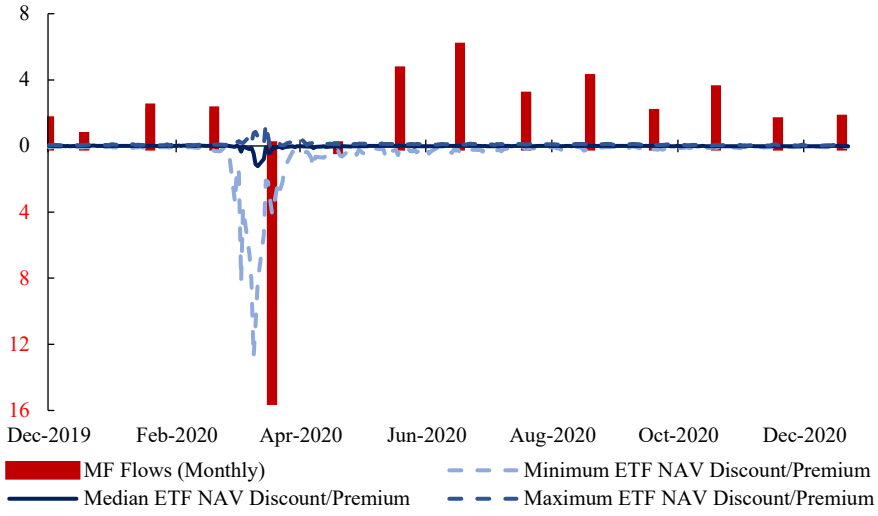
Appendices

Appendix A: Ultrashort Bond Funds - Weighted Average and Dispersion

	Corporate Bond Funds		Government Bond Funds	
	Mutual Funds	ETFs	Mutual Funds	ETFs
Number of Funds	21	14	9	6
Size - *USD Billions*	5.7	4.3	0.3	6.0
	(7.5)	(4.8)	(0.3)	(7.8)
Corp. Share - *Percent*	78.3	75.8	3.2	0.0
	(13.6)	(11.7)	(14.5)	-
Gov. Share - *Percent*	4.5	6.6	86.3	97.7
	(12.7)	(7.7)	(16.7)	(1.4)
WAL - *Years*	0.8	1.1	2.7	0.4
	(0.6)	(0.7)	(1.0)	(0.5)

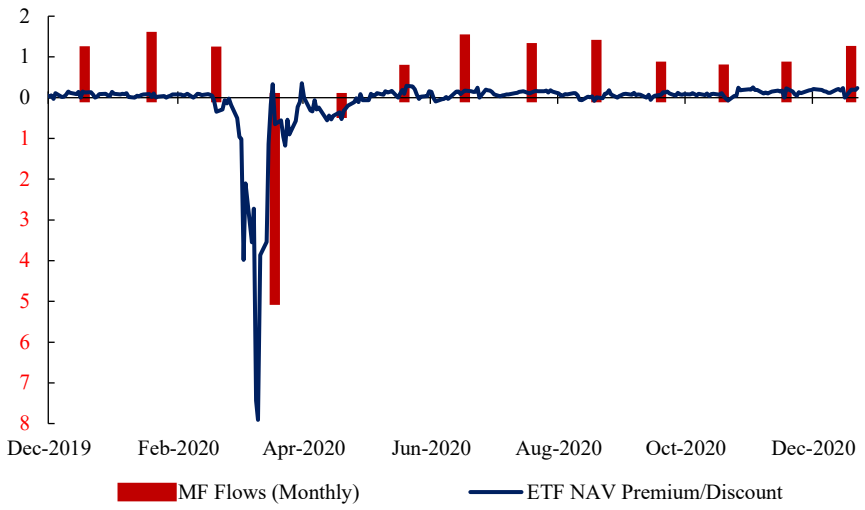
Notes: Appendix A reports some asset-weighted characteristics of MFs and ETFs in our sample. "Corporate Bond Funds" are MFs and ETFs that invested at least 50 percent of their pre-COVID-19 event net assets in short-term corporate debt. "Government Bond Funds" are those for which government-related securities comprised at least one half of their pre-COVID-19 net assets. The top numbers are weighted averages; The numbers in parentheses are standard deviations. The total assets of the 30 corporate and government MFs with data on their portfolios is $123 billion, or approximately 56 percent of the ultrashort bond MF industry. Total assets of the 20 ETFs in our sample is $95.7 billion, or approximately 97 percent of the ultrashort bond ETF industry.

Appendix B: Ultra-Short Bond ETF NAV Premium/Discount and MF Flows



Notes: Series are presented as asset-weighted averages. Authors' calculations based on Morningstar, Inc., and Bloomberg data.
Sources: ETF data are daily, while MF data are monthly.

Appendix C: Municipal Bond ETF NAV Premium/Discount and MF Flows



Notes: Series are presented as asset-weighted averages.
Sources: Authors' calculations based on Morningstar, Inc., and Bloomberg data. ETF data are daily, while MF data are monthly.

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