BOND MUTUAL FUND AND EXCHANGE-TRADED FUND FLOWS IN STRESSED MARKETS: EMPIRICAL EVIDENCE ON THE DESTABILIZATION HYPOTHESIS

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ABSTRACT

The proposed mechanism for what we term the *destabilization hypothesis* is that an exogenous shock triggers large redemptions by fund investors, requiring fund managers to sell securities to raise cash, leading to further drops in security prices and increased systemic risk. Although a large body of literature finds little evidence of fund-driven fire sales in bond markets, the destabilization hypothesis has seen renewed interest among academics and policymakers in the context of bond funds. We examine the impact of shocks on U.S. bond fund flows by sub-asset class and by type of investment vehicle. The time-series analysis we conduct shows that a risk-off shock to markets does not necessarily result in large bond fund outflows. Accordingly, we conclude that there is little evidence that bond funds are a source of systemic risk, particularly bond ETFs. We also find no evidence of a non-linear response of flows to large shocks.

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The hypothesis that correlated redemptions from mutual funds might destabilize financial markets via a negative feedback loop dates back to the late 1920s. The proposed mechanism for what we term the *destabilization hypothesis* is that a large exogenous shock triggers large redemptions by fund investors, requiring that fund managers sell securities to raise cash, further exacerbating the decline in security prices.[1] Although the past literature finds little evidence of fire sales in bond markets, the destabilization hypothesis has seen renewed interest among academics and policymakers in the context of bond funds.

There are several reasons for the new interest in bond fund flows: First, traditional open-end bond funds engage in what some observers believe is liquidity transformation, raising concerns about the mismatch between the liquidity of the fund and the underlying assets (i.e., investors are able to redeem at closing net asset value for following day settlement, while the underlying security execution has a longer settlement period such as T+2 for corporate bonds).[2] The growth in assets of open-end bond funds, particularly exchange-traded funds (ETFs), have added to these concerns (Bhattacharya and O'Hara, 2019), although this growth in nominal bond fund assets under management should also be viewed relative to the overall growth of the underlying bond markets. Both the European Central Bank (2018) and the European Systemic Risk Board (see Pagano, Serrano, and Zechner, 2019) have raised concerns that ETFs also pose a systemic risk. The European Central Bank (2018) notes 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." Finally, there is interest in how monetary policy might affect bond flows and hence valuations (Fang, 2022).

Other studies find that evidence on bond fund flows does not provide support for the destabilization hypothesis. Specifically, Collins and Plantier (2014) find outflows from bond funds are muted in the face of large economic shocks, focusing on the "taper tantrum" of summer of 2013. Their conclusions are consistent with much of the literature, which finds that aggregate fund flows respond to lagged market returns but finds little evidence of a feedback effect in the opposite direction. Hoseinzade (2016) concludes there is "little evidence that redemptions or resulting sell-offs push corporate bond prices below fundamental values." Choi, Hoseinzade, Shin, and

[1] See Ellul, Zeng Jotikasthira, and Lundblad (2011) among others.
[2] See, e.g., Pan and (2021).

Tehranian (2019) also show that bond mutual funds do not trigger fire sale prices in the underlying bond markets. Antoniewicz and Stahel (2020) using daily ETF data from 2009-2017 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 of fire sales).

Bond ETFs represent a special case of open-end mutual fund by virtue of two attributes: exchange trading and in-kind creation/redemption. Exchange trading allows buyers and sellers to transact ETF shares directly on exchange at a market clearing level without the requirement of a physical creation or redemption, though creations and redemptions do occur in certain market and regulatory conditions.[3] The relationship between the exchange market price, the NAV and creation/redemption activity is driven by an arbitrage mechanism. If there is a large degree of asymmetric buying or selling, the exchange price may deviate sufficiently away from the tradeable value ofthe underlying securities (which is not necessarily equivalent to the end of day NAV) such that a market maker could be incentivized to buy/sell the underlying bonds to create/redeem shares. In such a transaction, the ETF shares are then transacted on exchange at a profit relative to the primary bond execution. As an example, if the exchange price is sufficiently above the bond portfolio execution price (i.e., high enough to cover transaction costs and other frictions), the market maker could sell ETF shares on exchange while simultaneously buying the required bonds in primary markets at lower levels thereby locking in a profit. The bonds are then delivered to the ETF provider in exchange for the receipt of shares which are used to cover the exchange sale. The opposite dynamic happens in a redemption. Such activity brings share prices and underlying bond prices back into relative alignment.

Mounting evidence, most recently during the severe bout of market volatility that occurred at the onset of the COVID-19 pandemic, suggests that the exchange trading layer of bond ETFs is both significant in size and tends to behave as a sort of shock absorber for the underlying market.[4] Laipply and Madhavan (2020) find the ratio of exchange activity to underlying primary (creation/redemption activity) for corporate bond funds widened during the stress period of March 2020 (implying that exchange trading increased while creation/redemption activity simultaneously decreased), as opposed to contracting as has been suggested by proponents of the destabilization

[3] See ESMA Guidelines on ETFs and other UCITS issues updated in 2014 which provides for direct redemptions for example in the event of market disruption such as the absence of a market maker.
[4] See, for example, Bank of England (2020) or Shim and Todorov (2021).

hypothesis.

Open-ended bond funds (excluding money market funds) meet end-investors' demand for liquidity by selling portfolio assets.[5] To uphold the principle of treating all investors fairly, many fund managers aim to sell a representative (or pro-rata) slice of fund assets to meet redemptions, rather than relying solely on liquid asset buffers. Analysis of the worst of the Covid crisis of March 2020 (see Laipply and Madhavan, 2020) when open-ended funds saw heightened outflows (although low as a percentage of AUM) suggests that this principle is broadly upheld, even during periods of market turbulence.[6]

Fund managers' ability to satisfy the dual objectives of meeting redemptions in a timely manner, while also ensuring remaining investors are not adversely impacted by their doing so, is a function of ex-ante liquidity risk management. Specifically, these objectives should be satisfied if a funds' portfolio has been structured such that a basket large and diverse enough to satisfy a redemption can be sold in a timely manner without causing adverse market dislocations that would negatively impact remaining investors' holdings. With this in mind, regulators in both the US and EU have recently introduced liquidity management rules for open-ended funds. In the US, SEC Rule 22-e-4 requires fund managers to categorize portfolio holdings according to expected time take to liquidate a holding without changing the market value. In the EU, ESMA guidelines require stress testing of fund assets (dynamics in securities markets) and liabilities (redemptions and counterparty exposures) to ensure redemptions can be met in a range of scenarios.

In traditional open-ended mutual funds, execution risk is borne by the fund's investors. While investors are assured of receiving end of day NAV, the fund has uncertain execution in both price and certainty relative to NAV intraday. This uncertainty varies with redemption size and market conditions, and if not managed correctly can lead to 'dilution' of remaining investors' holdings. This has led some commentators to suggest that there is a 'first-mover advantage' risk

[5] Unlike most mutual funds, which generally sell a representative selection of assets from their portfolio to pay redemptions, MMFs are designed to meet redemptions using cash on hand. This is recognized in the Daily Liquid Assets (DLA) and Weekly Liquid Assets (WLA) minimums set out in regulation around the world, which aim to ensure MMF portfolios have large amounts of cash on hand and are able to organically replenish these levels throughout a weekly period.

[6] Regarding funds' outflow management, see ESMA (2020), which notes: *"When analysing the portfolio composition of corporate debt funds between mid-February and the end of June 2020 the main conclusion is that funds experiencing outflows managed to maintain the composition of their portfolio broadly stable. This analysis suggests a liquidity management approach consistent with the "vertical slicing" of their portfolio, i.e. selling assets proportional to their investment allocation. A vertical slicing approach reduces the risk of unfair treatment for remaining or redeeming investors. From a financial stability perspective, being able to sell less liquid portfolio assets also reduces the risk of creating a first-mover advantage for investors redeeming their fund shares early".*

embedded in the open-ended fund structure.

Swing pricing and other anti-dilution mechanisms, where available, are designed to manage this risk by externalizing execution risk onto investors transacting in or out of a fund.[7] There is evidence to suggest that it is effective in doing so (Jin et al., 2019).

EMPIRICAL EVIDENCE

Data and Methodology

To test the destabilization hypothesis, we obtain monthly data from Morningstar on the assets and flows of US-domiciled, US-focused open-ended bond funds including mutual funds and ETFs for the period April 2007 to March 2022. For a given fund *i* in month *t*, the net flow is defined as:

$$Net\ Flow_{i,t} = [Shares\ Outstanding_{i,t} - Shares\ Outstanding_{i,t-1}] \times NAV_{i,t}. \qquad (1)$$

We group fund flows by sub-asset class, focusing on intermediate government, investment grade, and high yield corporate bond funds, and by investment vehicle. These fund categories are defined by Morningstar as follows:

Government (**GOV**) portfolios have at least 90% of their bond holdings in bonds backed by the U.S. government or by government-linked agencies; intermediate bond portfolios have durations typically between 3.5 and 6.0 years.

Investment-grade (IG) bonds issued by corporations in U.S. dollars, which may have more credit risk than government or agency-backed bonds. These portfolios hold more than 65% of their assets in corporate debt, less than 40% of their assets in non-U.S. debt, less than 35% in below-investment-grade debt.

High-yield (HY) bond portfolios concentrate on lower-quality bonds that are more vulnerable to economic and credit risk than investment grade bond portfolios. These portfolios primarily invest in U.S. high yield debt securities where at least 65% or more of bond assets are not rated or are rated by a major agency such as Standard & Poor's or Moody's at the level of BB (considered speculative for taxable bonds) and below.

We analyze monthly US bond ETF and mutual fund flows across three different proxies for risk on / risk off including month-on-month changes in 10-year Treasury yields, returns on the

[7] In the United States, while the SEC has permitted swing pricing to be used by open-ended funds since 2018, eligible funds have yet to implement swing pricing, largely because implementation would require substantial reconfiguration of current distribution and order-processing practices.

S&P 500, and changes in HY spreads from April 2007 to March 2022, sourced from Bloomberg. For a subset of our analyses, we will use scaled flows defined as follows: First, we add up all the monthly flows across the individual bond funds in our sample cut by asset class c (where $c \in \{GOV, IG, HY\}$) in investment vehicle v (where $v \in \{MF, ETF\}$). In month t, denote this flow by $Net\ Flow_{c,v,t}$ and correspondingly define the starting AUM. Then, we define the scaled flow fora particular asset class c in investment vehicle v as the total flows across all three asset classes divided by the total AUM in that investment vehicle at the start of the month:

$$f_{c,v,t} = Net\ Flow_{c,v,t} / AUM_{c,v,t-1} \quad (2)$$

We first turn to some descriptive statistics and then to a more formal model for flow dynamics.

Descriptive Statistics on Flows and Risk Metrics

Exhibit 1 shows the month-end AUM in millions of dollars at the startof the sample on March 31, 2007 versus the end of the sample on March 31, 2022. The size of AUM and growth of particularly ETFs over time should, however, be viewed relative to the wider market: for example, Bond ETFs are estimated to account for 5% of the US bond market, and just 2% of the $124 trillion global fixed income marketplace[8]. Mutual funds account for a larger share, but are still in a minority: according to the Federal Reserve, as of June 2020, US mutual funds (excluding MMFs) accounted for 9.5% of the $103 billion US Commercial Paper market, 6% of the $1.2 trillion Treasury Bond market, 6% of the $585 billion Agency- and Government-Sponsored Entity-backed securities market, 16% of the $2.2 trillion corporate and foreign bond market, and 20% of the $800billion Municipal Bond Market.[9]

EXHIBIT 1
Assets under Management (AUM) by Investment Vehicle and Sub-Asset Class

	ETF AUM ($M)			**Mutual Fund AUM ($M)**		
Date	**Corp**	**Govt**	**HY**	**Corp**	**Govt**	**HY**
Mar-07	2,883	81	-	20,166	88,123	132,395
Mar-22	110,420	86,576	67,254	91,493	120,440	283,741

Source: Bloomberg, Morningstar as of 3/31/22.

[8] Sources: US bond market size: Bank for International Settlements, Simfund/Broadridge, McKinsey, Markit (as of 31 December 2020). Current global bond market size: Bank of International Settlements, Securities Industry and Financial Markets Association as reported in the 2021 SIFMA Capital Markets Fact Book, July 28, 2021
[9] Source: Federal Reserve Z.1 data as of June 2020, available at: https://www.federalreserve.gov/releases/z1/20200611/z1.pdf

Exhibit 2 shows the number and percentage of total of ETFs vs. mutual funds at the start and end of the sample period corresponding to Exhibit 1. Here, we see that ETFs now make up an increasing percentage in each sub-asset class. Mutual funds, however, are still significantly larger in terms of the number of funds.

EXHIBIT 2

Count of Funds by Sub-Asset Class and by Investment Vehicle

	3/31/2007			**3/31/2022**		
	ETF	*MF*	*Total*	*ETF*	*MF*	*Total*
High Yield Bond	0.0%	100.0%	599	10.2%	89.8%	722
Intermediate Government	0.8%	99.4%	361	5.8%	94.2%	243
Corporate Bond	3.2%	96.8%	93	17.6%	82.4%	227

Source: Bloomberg, Morningstar as of 3/31/22.

Exhibits 3 and 4 provide summary statistics over the entire period (April 2007 to March 2022) for both ETF and mutual fund flows. We show these flows both in dollar space as well as percentage space (flows for a given month scaled by the AUM outstanding at the beginning of the month).[10]5 We also report scaled flows by aggregating monthly dollar flows across asset classes within a given investment vehicle and then dividing the total flow by the total AUM in that investment vehicle. We denote the scaled flow at the investment vehicle level by $f_{v,t}$

In Exhibit 4, we see some very large percentage changes for ETFs during the sample period. This is somewhat counterintuitive based on the earlier discussion of therole of the exchange layer in buffering actual creation/redemption flows. However, it is importantto understand the life cycle of the typical bond ETF. It takes time for new bond ETFs to develop scaled liquidity on exchange which is driven by broad investor adoption. Once this liquidity is established, we see the behavior described earlier where the majority of risk transfer occurs on exchange as opposed to creation/redemption.

EXHIBIT 3

Summary Statistics ($ millions) for Bond Fund Flows: April 2007-March 2022

	Total		**ETF**			**Mutual Fund**		
	ETF	**MF**	**Corp**	**Govt**	**HY**	**Corp**	**Govt**	**HY**
Mean	1,491	348	588	499	404	272	-17	94
Std. Dev	3,176	4,763	1,661	1,076	1,861	834	1,395	3,668

[10] We do not report standard errors as these flows are statistically significant in general given 180 months of data.

Max	14,695	20,640	12,083	4,172	7,776	3,603	3,787	13,702
Min	-8,802	-19,783	-4,992	-3,975	-7,259	-2,732	-6,057	-12,402

Source: Based on data from Morningstar as of 3/31/22.

We note that high yield ETF flows were skewed by large monthly percentage flows that came early in the observation period when these funds hadjust been incepted typically with a small amount of initial investment.

EXHIBIT 4
Summary Statistics of Scaled Flows (%) from April 2007-March 2022

	Total		ETF			Mutual Fund		
	ETF	**MF**	**Corp**	**Govt**	**HY**	**Corp**	**Govt**	**HY**
Mean	2.3	0.1	2.0	4.2	5.3	0.6	0.0	0.2
Std. Dev	3.7	1.2	4.1	9.5	14.9	1.7	1.3	1.6
Max	22.4	4.4	30.7	49.0	133.6	6.3	3.2	5.9
Min	-9.1	-4.7	-7.6	-26.7	-19.2	-5.2	-5.1	-4.5

Source: Based on data from Morningstar as of 3/31/22. All figures are in percent

We turn now to a summary of the events constituting our three risk on/ risk off metrics. Exhibit 5 shows the mean and standard deviation of the three measures. We also report the number of months above 1 and 2 standard deviations out of the 180 months in the sample period from April 2007 to March 2022. For example, there were 8 months where the high-yield spread change was above 2 standard deviations or greater than 1.64% and 32 months when this metric exceeded 1 standard deviation of 0.82%. For the S&P 500, there were 52 months with absolute returns beyond 4.46% and 9 months where the absolute return exceeded 8.92%. These statistics reflect the high dispersion of returns over the past 180 months ending March 31, 2022

EXHIBIT 5
Descriptive Statistics for Risk Metrics

	Mean	Standard Deviation	# of Monthly Observations > 1×SD	2×SD
S&P 500 Return	0.92%	4.46%	52	9
10y Tsy Change	-0.01%	0.24%	45	11
HY Spread Change	0.00%	0.82%	32	8

Source: Bloomberg as of 3/31/22 based on 180 months of data.

It should be noted that the three metrics for risk on/off are correlated (particularly high yield vs.

equities, with a correlation coefficient of -0.74), but not perfectly.[11]6 Given that high-yield bonds are closer to equities on the risk spectrum than investment grade bonds, such a correlation value is not surprising.

Correlations: Univariate Relations Between Risk Metrics and Flows

How do the risk metrics correlate with contemporary bond flows? Exhibit 6 shows the correlation cut by investment vehicle and sub-asset class.

EXHIBIT 6
Correlation of Bond Fund Flows with Risk Metrics: April 2007-March 2022

	Total Flows		**ETF Flows**			**Mutual Fund Flows**		
	ETF	**MF**	**Corp**	**Govt**	**HY**	**Corp**	**Govt**	**HY**
SPX	0.410	0.431	0.182	0.080	0.491	0.203	0.057	0.492
10y Tsy Chg	-0.098	-0.012	-0.114	-0.054	-0.034	-0.046	-0.202	0.071
HY Spd Chg	-0.286	-0.476	-0.119	-0.090	-0.331	-0.297	-0.081	-0.519

Source: Bloomberg as of 3/31/22 based on 180 months of data.

The correlations are intuitive and generally agree with our priors (note that positive changes in yields and high yield spreads likely lead to negative flows and vice versa, which is opposite of equities): risk off/on events and negative/positive flows tend to occur with wider/tighter high- yield spreads, higher/lower Treasury yields, and negative/positive stock market returns.

Flows and Extreme Events

The correlations reported in Exhibit 6 are generally instructive, but don't address specific concerns about flows in stressed markets. To examine the impact of large shocks – the core of the destabilization hypothesis – we look at significant risk on/off events as defined in Exhibit 5.

EXHIBIT 7
Mean Monthly Flows ($ million) by Change in 10-year Treasury yield

	Total		**ETF**			**Mutual Fund**		
Change in 10-y Yields	**ETF**	**MF**	**Corp**	**Govt**	**HY**	**Corp**	**Govt**	**HY**
+2 Std Dev	767	-1,336	50	-41	757	-95	-1,226	-15
+1 Std Dev	-19	-482	-371	323	29	55	-490	-48
-1 Std Dev	811	-663	514	449	-153	203	253	-1,119
-2 Std Dev	1,385	368	498	678	209	466	877	-975

Source: Based on data from Morningstar and Bloomberg as of 3/31/22.

[11] The correlations between the 10-year Treasury yield change and the S&P 500 return and high-yield spread changes, are respectively, 0.31 and -0.45.

Exhibit 7 shows the mean monthly flows in millions of USD by investment vehicle (MF, ETF)and the 3 sub-asset classes for changes in the 10-year yield.[12] Again, note that positive/negative changes in yields are typically associated with outflows/inflows.

The pattern of mutual fund flows during periods of rising and falling rates is generally as expected. When yields rise sharply, we see net outflows across mutual funds for the categories represented. The relationship between the various market movements observed is more nuanced for ETFs. Once again, part of this effect could be due to the secondary market exchange trading layer which resultsin a reduced correlation between market demand and creation/redemption flows. Furthermore, ETF flows have been positive, on average, for all scenarios with the exception of +2 standard deviation increases in US Treasury yields. Exhibits 8 and 9 show the mean monthly dollar flowsfor the other two risk metrics.

EXHIBIT 8
Mean Monthly Flows ($ million) by S&P 500 Returns

Change in S&P 500 Returns	Total		ETF			Mutual Fund		
	ETF	MF	Corp	Govt	HY	Corp	Govt	HY
+2 Std Dev	5,354	8,662	2,069	73	3,212	1,149	1,588	5,925
+1 Std Dev	4,055	3,695	1,202	681	2,172	372	69	3,254
-1 Std Dev	177	-267	73	664	-560	273	842	-1,382
-2 Std Dev	964	-6,597	1,383	-566	147	-758	-1,304	-4,535

Source: Based on data from Morningstar and Bloomberg as of 3/31/22.

EXHIBIT 9
Mean Monthly Flows ($ million) by Change in High-Yield Spread

Change in High Yield Spreads	Total		ETF			Mutual Fund		
	ETF	MF	Corp	Govt	HY	Corp	Govt	HY
+2 Std Dev	1,296	-3,963	1,432	-623	487	-468	228	-3,723
+1 Std Dev	252	-1,760	122	858	-728	65	348	-2,174
-1 Std Dev	4,499	5,631	1,716	323	2,459	648	611	4,372
-2 Std Dev	2,290	5,232	1,427	122	740	1,238	990	3,004

Source: Based on data from Morningstar and Bloomberg as of 3/31/22.

In both Exhibits 8 and 9, the flow pattern is similar to that of Exhibit 7. Flows in mutual funds behave as one might expect with respect to equity market returns, while changes in high yield spreads and ETF flows are less intuitive.

[12] Data shown are flows in absolute terms, and therefore cannot be taken as a direct indication of how manageable these flows were at fund level. We display flows relative to assets under management in Exhibit 13.

This behavior may potentially be explained by two dynamics. First,bond ETF growth over the period has been quite robust, so much so that investors appear to be migrating to the wrapper irrespective of temporary changes in market conditions. Second, given that ETFs enable rapid, efficient tactical trading, it is also quite plausible that investors take advantage of extreme market events to quickly position themselves in ETFs with a view that a reversion will occur.

Time-Series Models of Flows

In this section, we estimate linear time-series models where (scaled) flows depend on past flows and various market shocks, allowing us to study how the various risk metrics jointly affect flows. This will also allow us to answer questions of regulatory interest such as "what is the cumulative (3 month) impact of a shock to yields on flows? How does this differ across MFs vs. ETFs? Sub-asset classes?"

The basic model allows scaled flows (in percent) to depend on past flows, contemporaneous equity market returns (to capture flight to safety), contemporary and past bond market risk proxies:

$$f_{v,t} = \beta_0 + \sum_{i=1}^{n} \beta_i f_{v,t-i} + \delta r_{m,t} + \sum_{i=0}^{m} \gamma_i x_{t-i} + \varepsilon_{c,t} \quad (3)$$

Here, $r_{m,t}$ is the equity market return proxied by the monthly S&P 500 return, x_t is a bond risk metric, $\varepsilon_{c,t}$ is the error term representing exogenous shocks to flows, and *n* and *m* are the number of lags. Other than flows, the risk metrics are measured in decimal so that -15% is -0.15. Again,to dampen the impact of outliers, we scaled across sub-asset classes as described earlier to compute percent flows by month and by investment vehicle.

EXHIBIT 10
Time-Series Models for Scaled Flow (%)

	Mutual Funds		**ETFs**	
	Estimate	**t value**	**Estimate**	**t value**
Intercept	-0.08	-1.03	1.02	3.79
Lag Flow	36.73	6.09	0.44	7.24
S&P 500 Return	13.03	7.79	18.16	3.47
Chg 10-year yld	-95.02	-3.05	-332.95	-3.47
Lag Chg 10-year	-109.29	-3.68	-442.47	-4.72
No. of Obs.		179		179
R-Squared		0.38		0.37

Source: Based on data as of 3/31/2022 from Bloomberg and Morningstar.

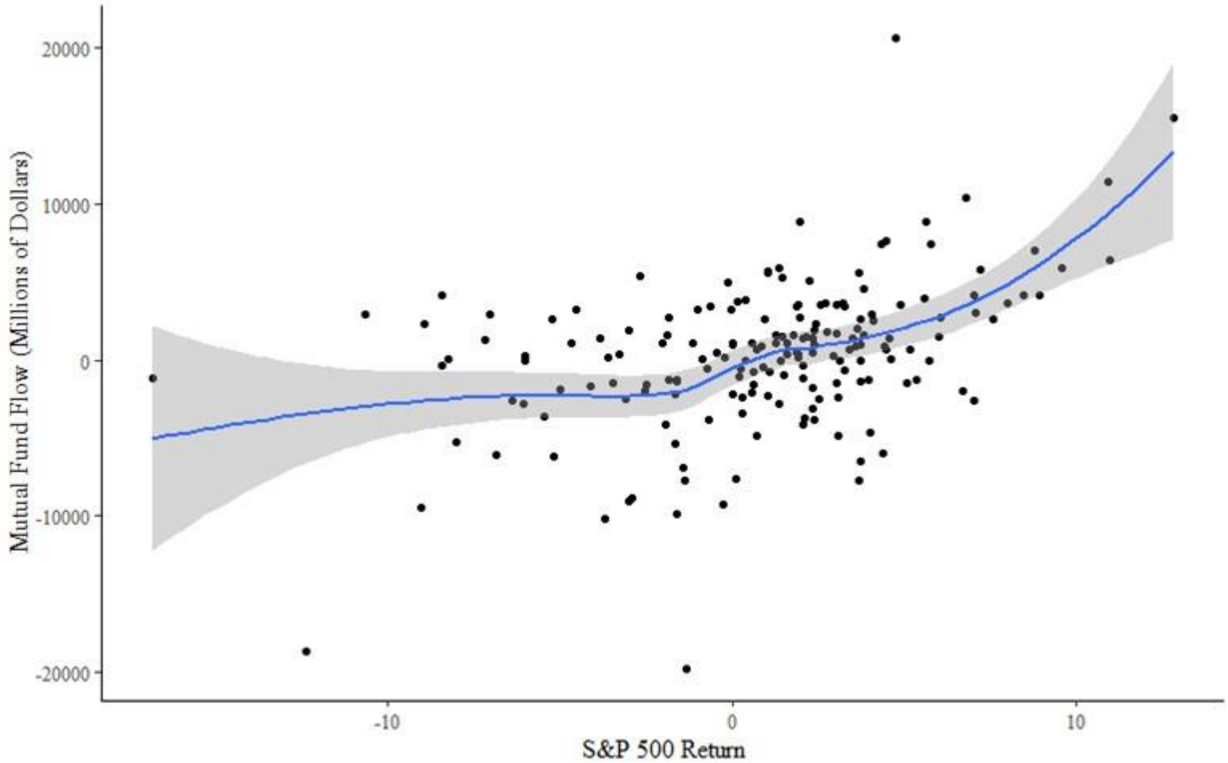
Exhibit 10 summarizes the results using $n = m = 1$ where our risk metric is the change in the 10-year yield. We observe that the fit is quite good in both models with a high R-squared and all variables except the intercept for mutual funds are highly statistically significant. The model allows us to gauge the impact of exogenous shocks to flows allowing for multivariate effects. Forexample, from Exhibit 3, a 2-sigma shock to 10-year yields is 0.48% or 0.0048. Multiplying the coefficient for mutual funds (-95.02) by this implies a reduction in assets of less than half a percent contemporaneously and about a percent after two months due to the lagged impact. For ETFs, the contemporaneous effect is larger than for mutual funds, almost 1.7%, but still far from being a problem in the context of broader bond market flows.

Evidence for Non-Linearities

The previous literature suggests that only large shocks may cause destabilizing flows. To examine non-linearities visually, we utilize a more modern regression technique known as the LOESS regression where the estimate is based on local observations, allowing for the fitted line to pick up potential “cliff” effects as postulated in the previous literature.[13]

[13] LOESS stands for locally estimated scatterplot smoothing. Unlike a polynomial fit, this is a non-parametric technique.

EXHIBIT 11
LOESS Regressions of Bond Mutual Fund Flows ($ million) on S&P 500 Returns (%)

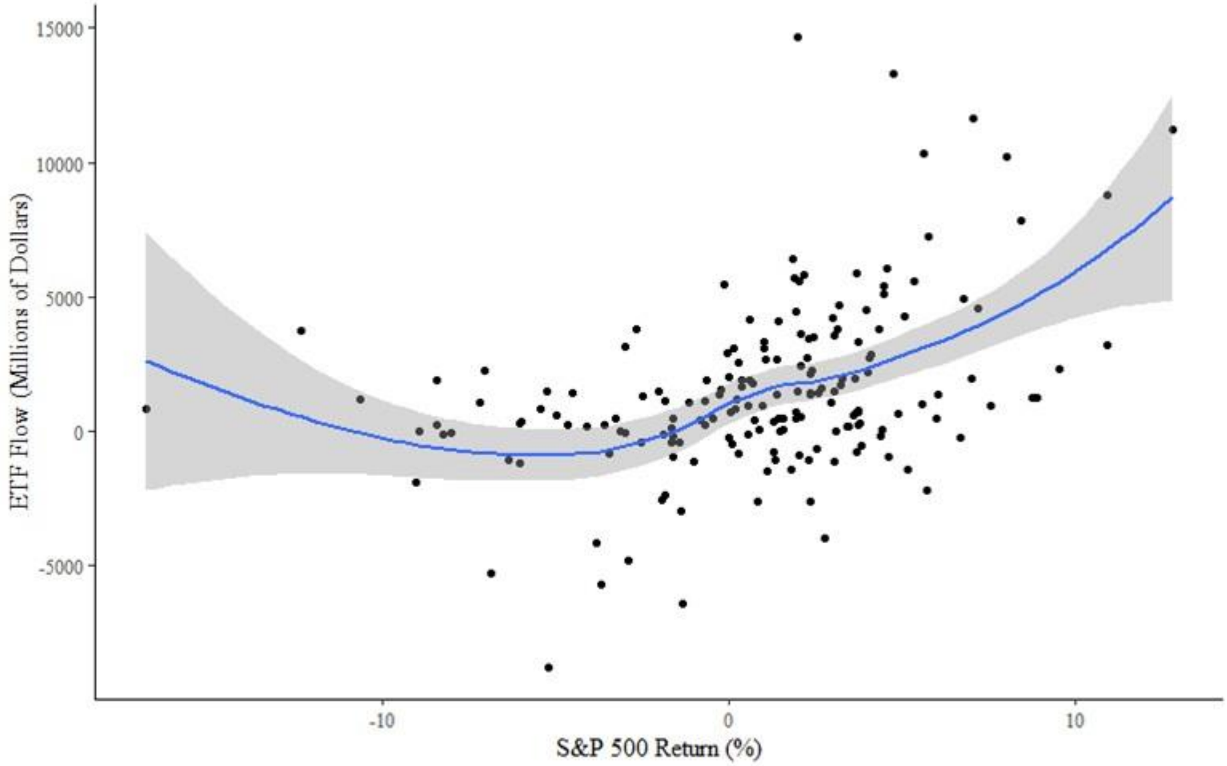


Source: Based on data as of 3/31/2022 from Bloomberg and Morningstar.

Exhibit 11 shows the LOESS estimated line and associated confidence interval for mutual funds where the horizontal axis is themonthly S&P 500 return and the vertical axis is the monthly flow in millions of dollars. For mutualfunds, consistent with our earlier analysis, the relation is generally upward sloping for positive returns, butrelatively flat or sticky fornegative returns. We obtain very similar results using flowsscaled by beginning of the month AUM.

For ETFs, the corresponding chart shown in Exhibit 12 appears quite different. Positive flows areassociated with both large negative and positive returns (a "U"-shaped relationship) which reinforces what was observed in the tabular data as well as the conjecture that investors employ ETFs tactically during large market movements.

EXHIBIT 12
LOESS Regressions of Bond ETF Flows ($ million) on S&P 500 Returns (%)



Source: Based on data as of 3/31/2022 from Bloomberg and Morningstar.

Quantifying the Impact of an Exogenous Shock

Finally, we consider the impact of exogenous shocks on scaled flows, where the bond fund flows in a given month are scaled by the AUM at the start of the month. Exhibit 13 shows a scatter plot that juxtaposes mutual fund and ETF *percent* flows against the S&P 500 monthly return. We picked the S&P500 return as its risk metric has the greatest range. The dispersion in ETF flows relative to mutual fund flows across positive and negative returns is noteworthy, further bolstering the conclusions drawn previously. Exhibit 13 also overlays a linear regression line (dotted) for mutual funds. We see the line is relatively flat; even with a -15% monthly decline in the stock market, we would predict less than a -2.5% outflow from all mutual funds.

EXHIBIT 13
Mean Monthly Percentage Fund Flows and S&P 500 Returns

Source: Based on data as of 3/31/2022 from Bloomberg and Morningstar.

CONCLUSIONS

There is renewed interest in the hypothesis that bond fund flows may, through a negative feedback loop, destabilize financial markets. Using 180 months of recent US bond mutual fund and ETF flow data ending on 3/31/2022, we find no evidence for the destabilization hypothesis. We use non-parametric techniques to test for non-linear impacts of shocks on flows and we show that contrary to some theories, even very large shocks do not appear to result in extreme flows (assets under management appear to be fairly durable). Time-series models show that flows depend on past flows, are positively correlated with stock market returns and negatively correlated with Treasury yields. Most interestingly, bond ETFs appear to exhibit some stabilizing properties, attracting assets in both risk-on and risk-off events. Taken in totality (open end mutual funds and bond ETFs), flows from these vehicles – especially in the context of the broader market – do not appear to be a source of dislocation or portend systemic risk in the fixed income markets.

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