Jane Street

Credit ETF Trading in Stressed Markets

Executive Summary

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In normal market conditions, market makers facilitate sizable flows into and out of credit ETFs by taking and laying off risk in a very cost-efficient manner. When markets are stressed, however, and investor flows are one-sided to sell for prolonged periods, market makers have less flexibility when it comes to managing the risk of their ETF positions. In such markets, laying off risk by selling the underlying bonds becomes more important and more costly, and market makers tend to respond by widening out their ETF markets.

There will be times when credit markets are repricing lower due to persistent selling in credit markets generally—including bond mutual funds, bonds directly, and credit ETFs—and trading will become stressed. But nothing about the ETF structure per se suggests that credit ETFs will *cause* the underlying markets to become stressed, as we expect ETFs and the cash bond market to reprice in tandem. Meanwhile, ETFs serve as efficient, open-access vehicles for those who need to sell (or want to buy) in calm and stressed markets alike. And they broadcast valuable information about the general price levels at which bonds are trading—often more accurately than the reported bond prices themselves.

Introduction

Exchange-traded funds tracking the credit markets have grown rapidly in size and popularity in recent years. Their proliferation, and the deep liquidity they offer in an asset class that historically has been prone to bouts of illiquidity, has created uneasiness among traders, policymakers, journalists and academics. With memories of the role played by derivatives during the global financial crisis of 2007–09 still lingering, some are asking whether credit ETFs might negatively impact trading in the underlying bonds in a stressed environment.[1]

In this report, we share our views on this topic as an ETF market maker and bond dealer. We argue that while credit ETFs will become more costly to trade in a stressed market, they don't pose a systemic risk to the credit markets. At the same time, they add transparency and efficiency to a credit market structure that has historically been opaque and difficult to access.

The report is structured as follows:

- In Part I, we discuss the mechanics of ETF market making and how market makers manage the "liquidity mismatch" between ETFs and bonds.
- In Part II, we use a recent bout of volatility in floating-rate notes to demonstrate that in stressed markets, the liquidity of the ETF will more closely reflect the liquidity of the underlying bonds.
- In Part III, we consider the impact of ETF liquidity and transparency on the liquidity of the credit markets as a whole.

1 See, for example, Mackintosh, J. (2018, February 9). Is It Finally Time to Worry About Junk ETFs? Retrieved from https://blogs.wsj.com/moneybeat/2018/02/09/is-it-finally-time-to-worry-about-junk-etfs/. Or, see Dannhauser, C. and Hoseinzade, S. (2018). The Transformation of Corporate Bond Investors and Fragility: Evidence on Mutual Funds and ETFs. Retrieved from https://www.darden.virginia.edu/uploadedFiles/Darden_Web/Content/Faculty_Research/Seminars_and_Conferences/Dannhauser-Hoseinzade.pdf.

Part I: Liquidity Mismatch in Normal Market Conditions

When flows from investors are two-sided, meaning that buy orders and sell orders are roughly evenly balanced, market makers employing "buy on the bid and sell on the offer"-style strategies can compete for order flow with market makers who are willing to take more risk. When flows become one-sided, however, ETF market makers willing to accumulate and manage risk tend to provide more liquidity.

One way in which ETF market makers manage risk is by creating or redeeming ETF shares via an authorized participant while buying or selling the underlying bonds.[2] Figure 1 below illustrates how ETF market makers use this very basic risk-management technique when flows are one-sided to sell. For a brief overview of the redemption mechanics for credit ETFs (and credit mutual funds), see the Appendix at the end of this report.

Figure 1. Market maker lays off credit-ETF risk in the bond market[3]

Investors sell ETFs to market maker. (Market maker is now long ETFs.)

Market maker redeems ETFs for bonds and sells those bonds in the market. (Market maker is once again flat.)

By converting the ETF shares into bonds and selling those bonds, the market maker essentially passes the risk on (or "lays the risk off") to bond-market participants. While this is often described as a "classic" or "textbook" ETF arbitrage trade, only a fraction of the trades that market makers do result in a creation or redemption. We describe the other ways in which market makers manage risk in more detail later in this section.

In a scenario where *all* market makers are laying off ETF risk in the credit markets, every dollar of ETFs sold to a market maker creates a dollar of bonds that market makers must sell. It's worth emphasizing, in the context of the aforementioned

2 Authorized participants are broker-dealers that have entered into an agreement with an ETF's distributor that allows them to execute "cash" or "in-kind" creations or redemptions. An in-kind creation is one in which the AP delivers securities—not just cash—to the fund in exchange for shares of the ETF. An in-kind redemption is one in which the AP delivers ETF shares to the fund in exchange for securities. APs can execute in-kind creations and redemptions on behalf of clients, their own market making units, or third-party market makers. For more on the AP function and how it is distinct from the market making function, see BlackRock's "A Primer on ETF Primary Trading and the Role of Authorized Participants," retrievable at the following URL: https://www.blackrock.com/corporate/literature/whitepaper/viewpoint-etf-primary-trading-role-of-authorized-participants-march-2017.pdf.

3 This diagram shows in-kind redemption. In some segments of the market—such as mortgage-backed securities ETFs or leveraged loan ETFs —cash redemption is more prevalent. In a cash redemption, the issuer sells bonds (or loans) and sends the cash to the market maker.

fears about systemic risks posed by derivatives, that nearly all credit ETFs are unlevered portfolios of bonds.[4] While investors and traders can always leverage their exposure to a credit ETF in traditional ways—through options, margin accounts, structured products and so forth—there is no leverage embedded in the ETF structure itself. That lack of leverage, combined with daily transparency into the ETF's holdings, means that nothing about the structure of credit ETFs per se suggests they will be the cause of disorderly trading in the underlyings. Selling credit ETFs is just a fairly vanilla way to sell credit, little different than selling credit mutual funds or bonds themselves. Very large net selling across ETFs, mutual funds and the bonds themselves can of course cause large market moves.

Nevertheless, the fact remains that ETF selling can and often does translate into bond selling in both calm and stressed markets. Given the so-called liquidity mismatch between ETFs and bonds—ETFs can be sold in size quite quickly, whereas selling bonds takes time—there is a worry that market makers could end up being stuck with more bonds to sell than can be digested by the market. In such a scenario, market makers would need to sell bonds at lower and lower prices while lowering their ETF bid prices. Bid-ask spreads would widen and trading would become expensive. As we discuss later in the report, there is an equivalent liquidity mismatch concern for bond mutual funds.

4 We're aware of just two "2X" credit ETFs for which a dollar of ETFs sold to a market maker could create *two* dollars of bonds that must be sold. These two funds currently have combined assets under management of about $9 million.

LIQUIDITY MISMATCH

The term "liquidity mismatch" refers to the fact that some credit ETFs offer deep liquidity at tight bid-offer spreads, whereas the underlying bonds can be very difficult to trade. Differences in market structure, which are described at a high level in the table below, go some way toward explaining the existence of liquidity mismatch.

ETF/Equities Market Structure	ETFs trade in an incredibly transparent, efficient and accessible market structure. Trades and quote changes are reported publicly in near-real-time, and quotes represent concrete buying or selling interest (quotes are "firm"). Generally speaking, there is very little friction to slow the progression of an order from the time of its origination in the mind of an investor or portfolio manager to the time of its final execution at a trading venue. So, the markets that investors see are the markets that exist "now," and investors can respond to changes "now" (or very close to it).
Credit Market Structure	The bond market, by contrast, has historically been less transparent, less efficient and less accessible. Dealers and trading venues have minutes and sometimes days before their trades are disclosed publicly—and in some cases the trades are never disclosed. Quotes aren't firm, and reliable pre-trade information can be hard to come by. Finding the right bonds to trade and then executing the trades is often a time-consuming, multi-step process even for professional bond investors.

Fortunately, credit market structure is evolving rapidly. While it still bears little resemblance to equity market structure, and may never mirror it exactly, it has recently adopted some equity-like features. We discuss two such features—electronification and portfolio trading—in Part III of this report.

Of course, individual bonds may simply be prone to bouts of illiquidity in ways that equities are not.[5] If that's true, evolving the market structure for credit toward a more equity-style structure may only mitigate—and not completely solve—liquidity mismatch.

5 See Benmelech, E. and Bergman, N. (June 21, 2017). Credit Market Freezes. Available at SSRN: https://ssrn.com/abstract=2990564. The authors argue that "when bond value deteriorates, bond illiquidity increases, as would be predicted by adverse selection stemming from the bond entering a region in which its value is informationally sensitive."

Liquidity mismatch in practice

In practice, market dysfunction driven by liquidity mismatch is a rare occurrence. High-yield corporate bond ETFs—the poster child for liquidity mismatch fears—have weathered several periods of heavy redemption activity in recent years with little apparent impact on market quality for the ETFs or the underlying bonds.

For example, over six days in early October 2018, investors pulled $4.5 billion from US long-duration high-yield ETFs, or 13% of the combined assets in those funds at the time. Bid-ask spreads for the iShares iBoxx High Yield Corporate Bond ETF (symbol: HYG) and the SPDR Bloomberg Barclays High Yield Bond ETF (symbol: JNK) remained a penny wide throughout that period despite the increase in price volatility. The combined size of the bids and offers posted within six basis points on either side of the midpoint of the National Best Bid and Offer—a proxy for the depth of the market—declined modestly. Price discounts to net asset value per share ("NAV"), the significance of which we discuss in more depth later in the report, existed but were unremarkable by historical standards.[6]

Bid-ask spreads for other well-known but less actively traded ETFs like the Xtrackers USD High Yield Corporate Bond ETF (symbol: HYLB), the PIMCO 0–5 Year High Yield Corporate Bond Index ETF (symbol: HYS), and the iShares Broad USD High Yield Corporate Bond ETF (symbol: USHY) were little changed. The change in market depth for these ETFs was a mixed bag: depth decreased for USHY but actually increased for HYLB and HYS. As with HYG and JNK, price discounts to NAV were modest by historical standards.[7]

Essentially, the data show that market quality for all of these high-yield credit ETFs changed very little despite the sudden burst of redemption activity.[8]

When it comes to *why* net ETF selling rarely seems to dent market quality, a simple observation is that the cash bond market likely does digest a significant portion of the selling pressure. Net ETF outflow figures provide a rough estimate for the quantity of bonds that ETF market makers *could* sell, and our experience suggests that more often than not bonds are indeed sold on the back of sizable redemptions. So for all the fears about liquidity mismatch, it must be acknowledged that the cash bond market has proven capable of facilitating risk transfer efficiently and at scale.

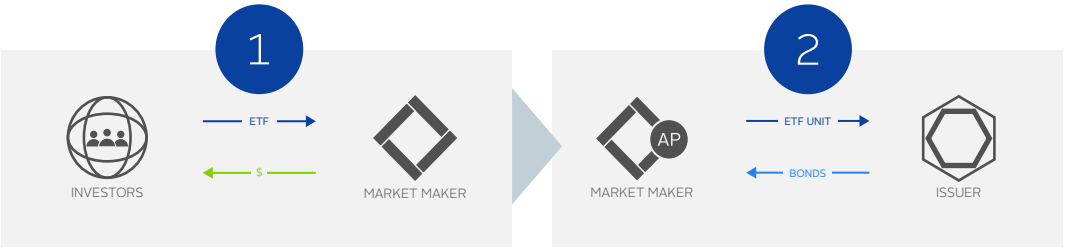
6 For HYG, the combined size of the bids and offers posted within six basis points on either side of the midpoint of the NBBO averaged roughly $17 million in the six days from October 3 to October 10, down from roughly $22 million in the 20 days leading up to October 3. For JNK, combined size averaged roughly $25 million from October 3 to October 10, down from roughly $35 million in the preceding 20 days. Closing-price discounts to NAV for the two ETFs were -0.41% and -0.49% at their lowest points, respectively, which were fairly modest for a volatile period. For example, since 2017, HYG and JNK have seen bigger NAV discounts on seven and eight separate occasions, respectively. The sources for this data are the US stock exchanges' proprietary data feeds and Bloomberg.

7 Using the same methodology described in the previous footnote, HYLB's bid-ask spread averaged 1.3 cents both before and during the period of heavy redemption (October 3–10), and its combined size increased from roughly $2.4 million to roughly $3.2 million. HYS's bid-ask spread decreased slightly to 2.6 cents from 2.7 cents, and its combined size increased from roughly $440k to roughly $490k. USHY's bid-ask spread increased to 7.2 cents from 6.2 cents, and its combined size 24 basis points on either side of the midpoint of the NBBO decreased to roughly $1.3 million from roughly $1.6 million. (We use 24 bps for USHY instead of 6 bps because the distance between that ETF's inside quote and its midpoint exceeded 6 bps throughout the period in question.) NAV discounts of -0.76%, -0.59% and -0.14% for HYLB, HYS and USHY, respectively, were in line with discounts seen in other volatile periods. The sources for this data are the US stock exchanges' proprietary data feeds and Bloomberg.

8 For more examples of how credit ETFs traded during periods of heavy redemption activity, see Section 3.2 of the "Report on the Design of Exchange-Traded Funds and Bond Funds" published by the ETFs and Bond Funds subcommittee of the SEC's Fixed Income Market Structure Advisory Committee. The report is retrievable at this link: https://www.sec.gov/spotlight/fixed-income-advisory-committee/etfs-and-bond-funds-subcommittee-report-041519.pdf.

Another factor that helps explain the resiliency of credit ETFs in the face of outflows is the competitive environment that drives market makers to trade and manage risk as efficiently as possible. Importantly, market makers aren't limited to doing the classic ETF arbitrage trade of redeeming and selling bonds immediately after buying ETFs from investors. If they believe the selling pressure is transient, they can and often do take risk by simply holding ETFs (or bonds) on their balance sheet while they wait for buyers to reemerge. If the selling is limited to only certain ETFs within a market segment, they can use other ETFs to hedge. Or, they can hedge with other instruments like credit default swap indices (CDX) or futures. Some of these alternatives are depicted in Figures 2 and 3.

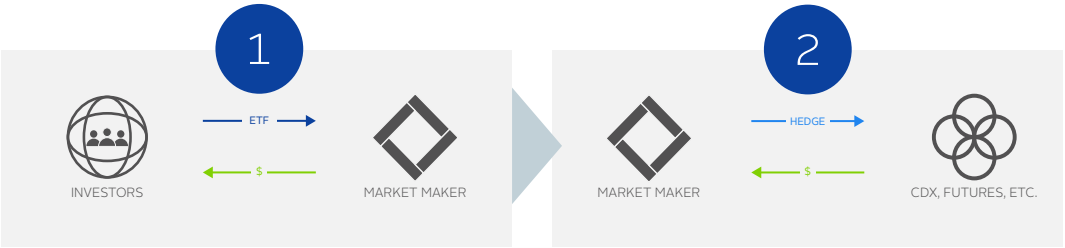
Figure 2. Market maker warehouses the risk (MM may stop after step 1)



Investors sell ETFs to market maker.
(Market maker is now long ETFs.)

Market maker redeems ETFs for bonds.
(Market maker is now long bonds.)

Figure 3. Market maker hedges with a different instrument



Investors sell ETFs to market maker.
(Market maker is now long ETFs.)

Market maker sells other instrument.
(Market maker now effectively flat.)

Trading derivative instruments with similar risk characteristics is often cheaper than trading the underlying credit, and so is—obviously—not trading anything at all. Cheaper trading in turn allows market makers to quote more competitively in the ETF market. Market makers are therefore directly incentivized to become adept at managing credit ETF risk without trading the bonds themselves.

At the same time, selling bonds is often a more attractive option than hedging with another instrument or taking risk, notwithstanding the generally higher costs of trading the bonds. As a result, market makers are also incentivized to become adept at trading bonds as cheaply as possible.

In practice, market makers avail themselves of all of the options mentioned above when faced with one-sided flows in ETFs. They lay off risk by selling bonds or derivatives where practicable, and they take risk opportunistically or with the goal of selling the bonds (or the ETFs) over a longer time horizon. Selling the bonds more patiently tends to reduce a market maker's trading costs, and it also diffuses the impact of net ETF selling on the underlying bond markets.

Market makers choose between these options in a very fluid, pragmatic fashion, always seeking the option or options that lower their all-in, risk-adjusted costs. This helps the market maker, obviously, as lower costs allow them to quote tighter ETF markets and win more trades. But it also helps the market itself, by reducing the impact of ETF flows on the underlying markets in some instances and by generally keeping prices for bonds, ETFs, and other related derivatives aligned.

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REDEMPTION INCENTIVES FOR ETF AND MUTUAL FUND INVESTORS

Credit ETFs and mutual funds both have flexibility and discretion when it comes to getting cash into the hands of selling or redeeming investors. Their redemption processes are different, however, as we show in the Appendix at the end of this report. One consequence of the different processes is that the cost of trading an ETF's underlying bonds is born by the buyers and sellers of the ETF, whereas the cost of trading a mutual fund's underlying bonds is born by the fund's remaining shareholders.

Market makers use their ability to adjust prices in the secondary market to charge ETF sellers for the all-in cost of selling the underlyings. For example, if an issuer's redemption basket contains more illiquid bonds than usual, market makers will bid for the ETF at lower prices in anticipation of incurring greater costs when selling the bonds in the basket. Any investors wanting to exit their positions would be forced to sell at those lower prices. Thus, in an indirect way, market makers force the exiting investors to pay for the ETF's transaction costs.

Mutual funds, by contrast, either don't charge exiting investors or charge them in ways that can be suboptimal.[9] Often, they allow redeemers to exit at the fund's NAV, a price that is based on today's end-of-day marks. If, in the process of selling bonds to raise cash to pay out redeeming investors, a mutual fund sells the bonds at prices below today's end-of-day marks, the redeeming investors still receive an amount of cash that is based on those end-of-day marks. The extra cash that redeeming investors receive is generated by the fund selling down a bit more of its holdings (or using idle cash), which leaves the fund's remaining shareholders with a claim on a slightly smaller portfolio. In other words, the remaining shareholders are diluted to pay for the transaction costs generated by redeeming shareholders.

This distinction, while nuanced, matters. An ETF investor that wants or needs to sell in a stressed market will bear the higher cost of demanding liquidity in such a market. But a mutual fund investor that redeems in a stressed market pays no such cost. Further, if a mutual fund investor refrains from redeeming, that investor will pay the potentially inflated transaction costs generated by those who do redeem. ETF investors are thus incentivized *not* to sell into a stressed market, whereas mutual fund investors *are* incentivized to redeem.

Meanwhile, remaining mutual fund shareholders are often left owning a less-liquid portfolio of bonds as the liquid holdings tend to be sold first when redemption demand is acute. So, in addition to bearing the transaction costs generated by others, mutual fund shareholders can also end up bearing additional liquidity risks.

9 Some mutual funds charge exiting investors via redemption fees (sometimes called dilution levies or dilution fees) or via "swing pricing." Redemption fees tend to be a fixed percentage amount. They do not fluctuate with volatility or liquidity demand or the overall strength or weakness of the underlying markets like ETF bid-ask spreads do. Thus, investors in such funds who redeem may be overpaying or underpaying—depending on the market environment—relative to the actual transaction costs generated by their demand for liquidity. Swing pricing, meanwhile, involves adjusting the fund's net asset value to account for certain costs related to sizable daily net inflows or outflows. Swing pricing tends to be less transparent compared to ETF bid-ask spreads and redemption fees.

Part II: Liquidity Mismatch in Stressed Market Conditions

If the order flow in credit ETFs is one-sided to sell for a prolonged period, market makers may be faced with the prospect of selling bonds into a stressed market. In such a situation, the liquidity of ETFs will more closely reflect the liquidity of the underlying bonds. Explicitly, if selling the underlying bonds is difficult or expensive, selling ETFs will become expensive, too.

The reason for this is simple and intuitive: if market makers can't easily exit long-ETF positions in the secondary market (because investors are net selling), can't easily exit by redeeming the ETFs and selling the bonds (because bond-market liquidity is costly), and can't find a suitable hedging instrument that's reasonably priced (because markets for those instruments are pricing in the stress as well[10]), they're going to be leery of buying more ETFs at prevailing prices. They will, however, bid for ETFs at lower prices such that buying the ETFs and selling the under-pressure bonds is still profitable. And in a truly distressed market where enough bonds simply cannot be sold, market makers might still bid for ETFs at prices that are low enough to compensate them for taking more risk while they wait for investor flows to become two-sided again (or for bond-market liquidity to snap back).

By lowering their ETF bid prices, market makers discourage further ETF selling. One can think of it as the ETF market's last-resort mechanism for resolving the liquidity mismatch problem. Meanwhile, ETF investors who very urgently need to sell can still do so—though they will likely pay a high price for the liquidity (though likely no higher than if they were selling a basket of individual bonds).

10 It's also true that being long an ETF and long a hedge ties up capital, which means that hedging is only a short-term solution in practice.

THE RISK OF NOT BEING ABLE TO REDEEM

Some market participants fear that the ETF redemption process could break down.[11] If authorized participants were to refuse to facilitate redemptions, for example, or if the ETF itself were to refuse to redeem its shares, market makers wouldn't be able to exchange ETF shares for bonds. In such a scenario, the ETF would likely trade at a significant discount to the value of its underlyings.

While theoretically possible, the odds of the redemption process breaking down are low. First, APs are simply agents working on behalf of either the firm's market-making unit or third-party market makers. They bear no market risk, and charge market makers fees or commissions. The AP function is, for the most part, a low-risk, low-cost, operational activity. Thus, while it's true that the broker-dealers that act as APs are not compelled by any law or regulation to accept a market maker's redemption order, it's not obvious why they would choose not to.[12]

Second, issuers have strong incentives to avoid suspending or discouraging redemptions.[13] In the short-term, doing so would almost certainly degrade the ETF's market quality. Longer-term, it would likely lead to reputational damage in the eyes of market makers, investors and regulators. Market makers would factor in any perceived greater risk of suspension into their pricing, and investors might look for alternative vehicles for gaining the exposure they seek.

Given that the AP function is low-risk and profitable, and given that issuers have strong incentives to avoid disruption, we expect the creation/redemption mechanism to work smoothly even in times of stress. If we were to single out one aspect of the process that gives us some pause, it would be the operational burden borne by issuers presented with multiple redemption requests in a short time span. That said, this is more of a friction—one that will hopefully be whittled away as issuers and market makers refine their processes—than a flaw.

11 See, for example, Doff, N. (2018, November 5). Hedge Fund Manager Stakes Own Cash on a Bet Against Credit ETFs. Retrieved from https://www.bloomberg.com/news/articles/2018-11-05/hedge-fund-manager-stakes-own-cash-betting-credit-etfs-crumble.

12 Some US-listed credit ETFs with non-US underlyings do require APs to post collateral during the trade settlement process for in-kind redemptions, which serves as a minor disincentive for broker-dealers to act as APs in such products. Industry participants are working on solutions that would streamline the trade settlement process in a way that eliminates this disincentive (or mitigates its impact). International credit ETFs account for 11% of total credit ETF assets in the US, and only a percentage of those ETFs require collateral to be posted.

13 In the US, in addition to the commercial incentives, Section 22(e) of the Investment Company Act of 1940 prohibits issuers from suspending redemptions except in certain extraordinary circumstances.

Case study: liquidity mismatch for floating-rate ETFs

For an example of how these market dynamics work, consider how ETFs tracking investment grade corporate floating-rate notes traded in December 2018. The month before, market participants began to doubt whether the economy would be strong enough in 2019 for the Federal Reserve to continue hiking rates.[14] Treasuries rallied and the yield curve flattened, with the 2–5-year segment of the curve rallying and flattening the most. Floating-rate ETFs, which had attracted strong inflows all year in part due to an expectation that rates were headed higher amid solid economic growth, were sold aggressively.[15]

The "natural" selling interest was one-sided, with ETF market makers acting as net buyers. Market makers redeemed shares of the ETFs and attempted to sell the underlying notes in order to lay off risk. It's likely that floating-rate mutual funds and direct holders of the notes were also selling.[16]

Simply put, the notes were hard to sell. Data from Bloomberg's BVAL pricing service show that floating-rate notes were sold at discount margins that were significantly inflated relative to the discount margins that prevailed earlier in the year.[17]

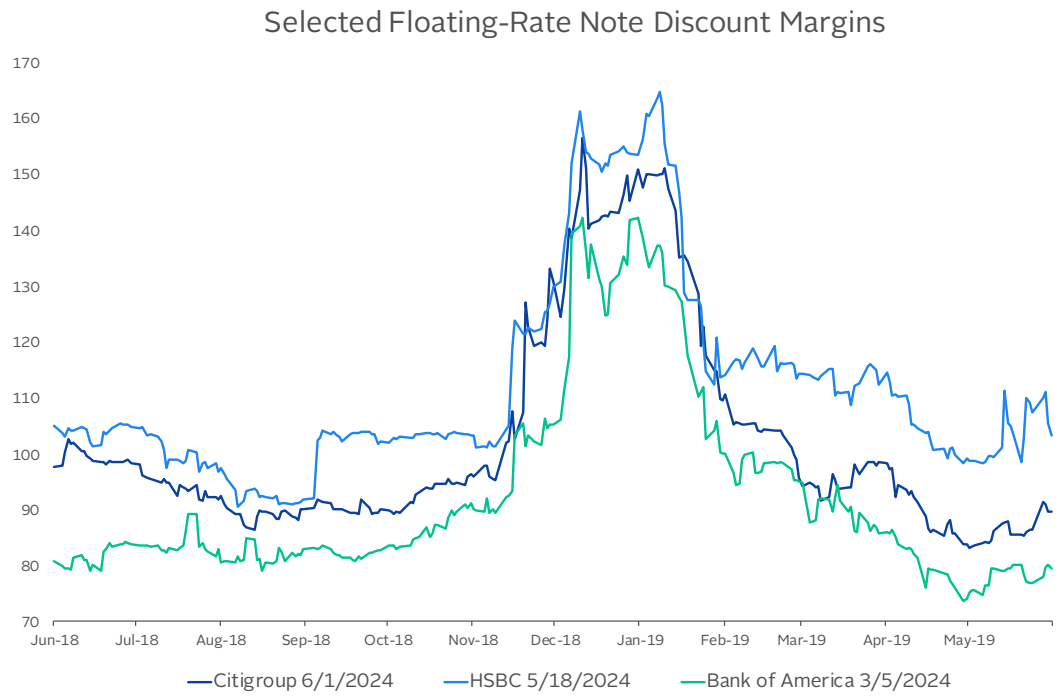
14 At the beginning of November, with the Fed Funds rate upper bound at 2.25%, Fed Funds futures markets implied a 53% chance that the upper bound would rise to 3% by end-2019. A month later, at the beginning of December, those odds had dropped to 30%. Odds of rate hikes pushing the upper bound to 2.75% fell from 84% to 69%.

15 In this section we use "floating-rate ETFs" and "floating-rate mutual funds" as shorthand for ETFs and mutual funds tracking dollar-denominated floating-rate notes issued by corporations with investment grade ratings. ETFs and mutual funds tracking other types of floating rate notes—for example, the WisdomTree Floating Rate Treasury Fund (symbol: USFR US) or the iShares Treasury Floating Rate ETF (symbol: TFLO US), which hold floating-rate notes issued by the US government—did not experience the same trading dynamics as those that track investment grade floaters.

16 IIndeed, it seems likely that mutual funds were bigger sellers than ETF market makers in December. The three biggest mutual funds investing in US floating-rate notes—the Lord Abbett Floating Rate Fund, the Fidelity Floating Rate High Income Fund, and the Eaton Vance Floating-Rate Advantage Fund—had combined assets of nearly $38 billion at the beginning of the month and saw a combined (approximate) $4.5 billion outflow. The three biggest ETFs tracking US floating-rate notes—the iShares Floating Rate Bond ETF (symbol: FLOT US), the SPDR Bloomberg Barclays Investment Grade Floating Rate ETF (symbol: FLRN US) and the Amundi Floating Rate USD Corporate UCITS ETF (symbols: AFLT FP, AFLE FP and AFLC SW)—had combined assets of nearly $22 billion and saw a combined (approximate) outflow of less than $2 billion.

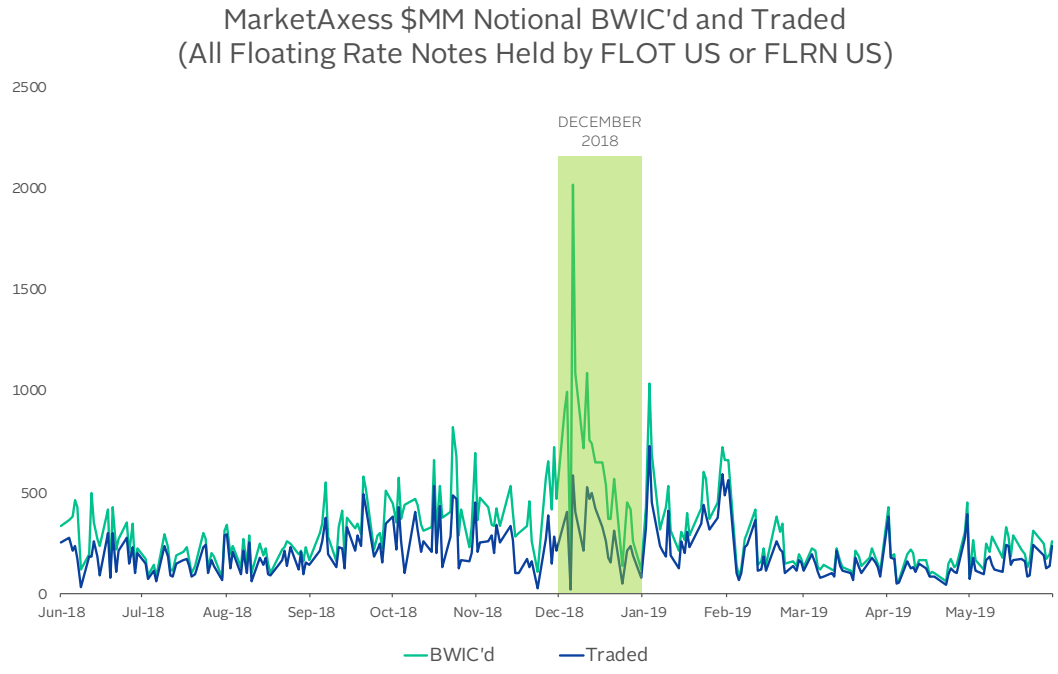
17 Discount margin is an estimate of a floating-rate bond's return in excess of its reference rate were it to be held to maturity.

The chart below shows discount margins for three such notes selected for illustrative purposes.



Source: Bloomberg

Furthermore, as shown in the chart below, bid wanted in competition (BWIC) requests spiked, but trading volumes based on those BWICs were only slightly elevated.

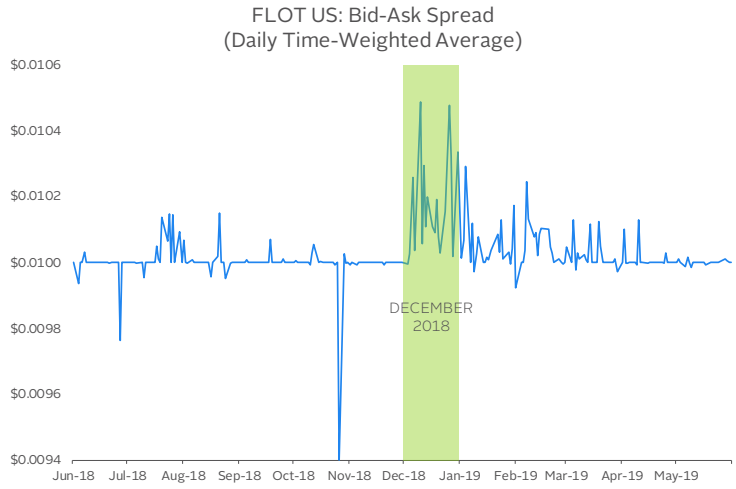


Source: MarketAxess; Jane Street

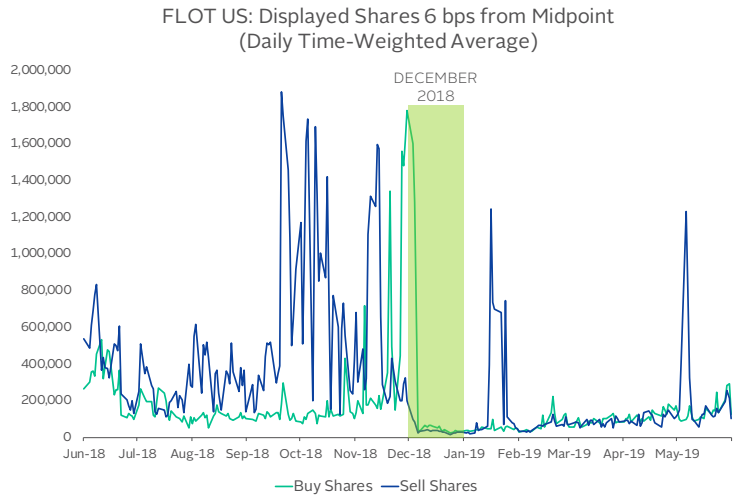
Taken together, the data reflect a market characterized by heavy selling demand and price-sensitive buying. In other words, the notes were trading, but liquidity was expensive.

The story was similar for floating-rate ETFs: they traded down sharply in price and their markets were thinner.[18] Specifically, the data show that the ETF markets changed in the following ways:

1. **Liquidity became more expensive.** Bid-ask spreads increased and displayed depth decreased for floating-rate ETFs when the underlying notes became difficult to sell in December. The charts below show how spreads and depth-of-quote changed for the biggest floating-rate ETF by assets under management, the iShares Floating Rate Bond ETF (symbol: FLOT US).[19]



Source: New York Stock Exchange; Nasdaq; Cboe

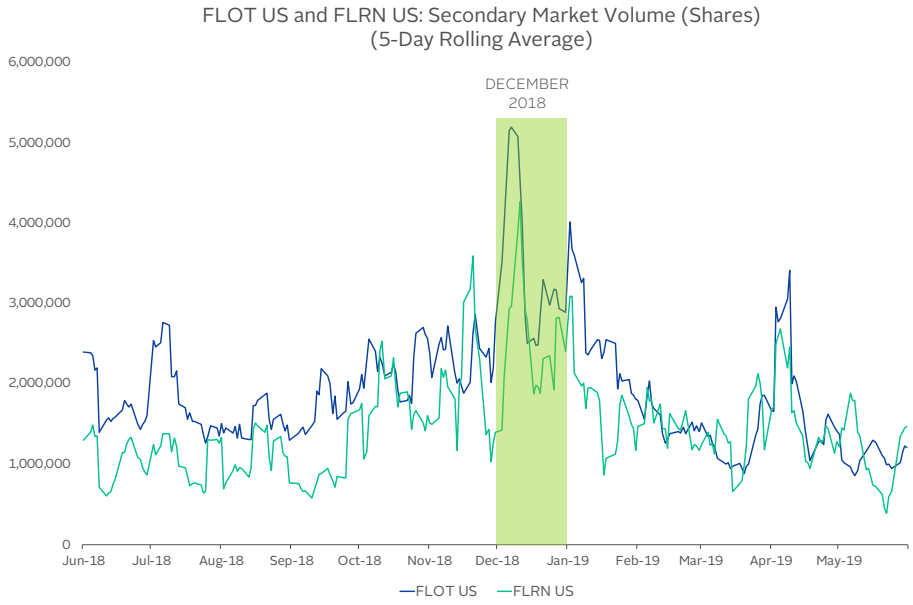


Source: New York Stock Exchange; Nasdaq; Cboe

18 Floating-rate bond ETFs traded down by a little over 1% from their November 30 closing levels to their intraday lows in the first week of December. A drop of that magnitude is quite rare for floating-rate ETFs.

19 The handful of sub-penny data points in the chart—for example, the average bid-ask spread of $0.0094 on October 26, 2018 —represent days when the inside market for FLOT US was locked for substantial periods during the day.

2. **Trading volumes were elevated.** Secondary-market trading of floating-rate ETFs spiked during the December turmoil. As noted by Federal Reserve Bank of New York Governor Lael Brainard in a recent speech, lower on-screen liquidity and higher trading volumes are not incompatible.[20]

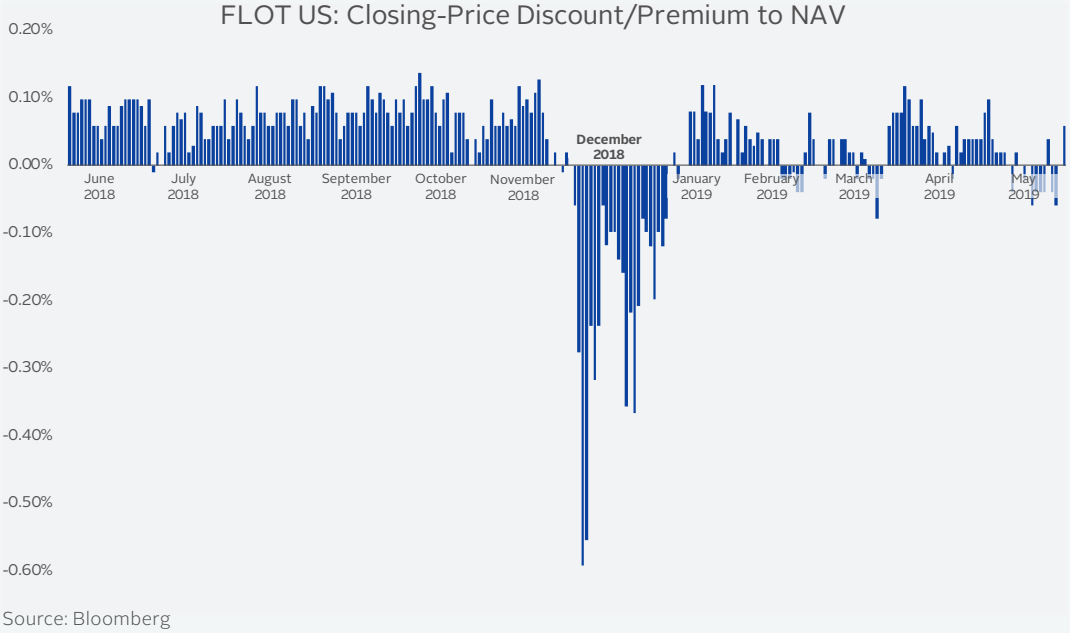


Source: Bloomberg

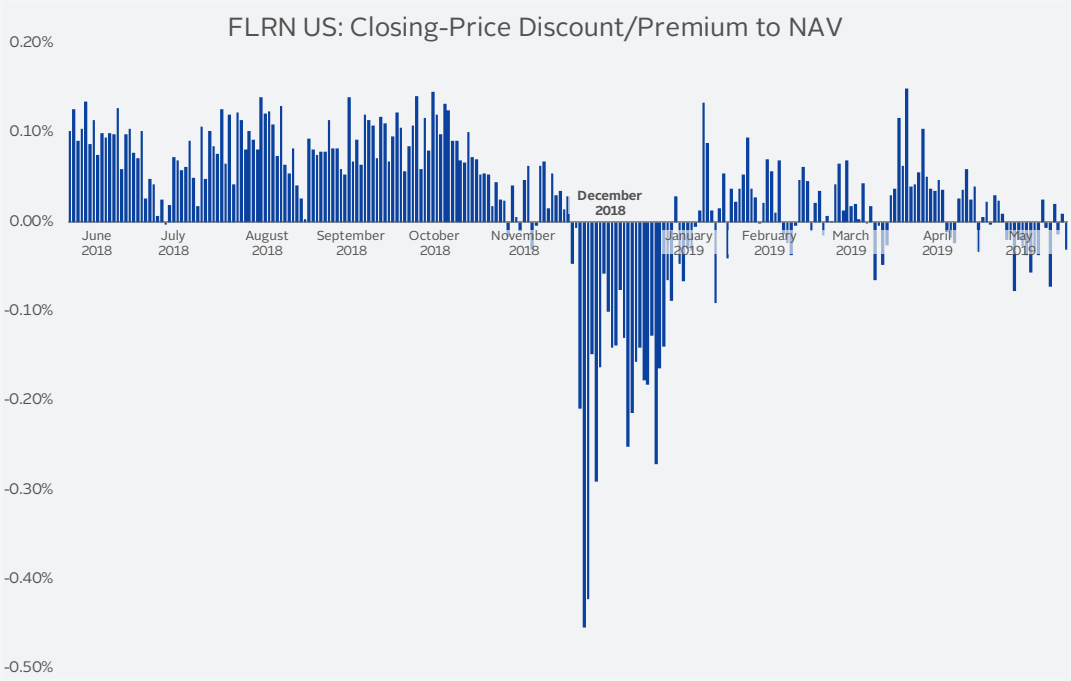
20 Specifically, Governor Brainard said, "High-speed market makers are able to manage perceived risks from sudden adverse price moves by greatly reducing the sizes of orders placed on electronic execution venues while, at the same time, increasing order placement rates as much as needed to accommodate increased trading volumes without the need to widen bid-ask spreads." The full text of her speech can be found here: https://www.federalreserve.gov/newsevents/speech/brainard20181203a.htm. In the case of the floating-rate ETFs, of course, market makers did widen bid-ask spreads slightly.

NAV DISCOUNTS IN VOLATILE MARKETS

Amid the early-December volatility, floating-rate ETFs traded at discounts to their net asset values. The below charts show the magnitude of those discounts for the two biggest floating-rate ETFs: FLOT US and FLRN US.



Source: Bloomberg



Source: Bloomberg

To understand why these ETFs appeared to trade at such steep discounts, some background on how pricing services calculate NAV is necessary.

At the highest level, a pricing service needs to assign a value to each bond in an ETF's portfolio in order to calculate its NAV. In normal market environments, doing so is fairly easy as security-specific information tends to be readily available. Also, the assumptions that the pricing service must make about the width of each bond's bid-ask spread tend to be reliable when markets are calm. That's important because pricing services need to convert publicly reported trade prices into estimates of actionable bid and offer prices in order to calculate NAV.[21]

When markets become volatile, information is harder to come by—especially for the less-liquid bonds in the portfolio. It can be difficult for pricing services to update the values of those bonds in a timely fashion. At the same time, bid-ask spreads tend to widen out. The real bid prices for the bonds are often lower—relative to traded prices—than they are when markets are calm.

Market makers, meanwhile, value credit ETFs by knowing (or estimating) where they can actually sell (and buy) the underlying bonds either now or at some point in the future. If it's clear that the bond market as a whole has moved lower in the last minute, they don't wait for each bond in the portfolio to trade at a lower price before updating their ETF markets. If bond bid-ask spreads have widened out sharply such that the bid prices are unusually low, the bid side of market makers' ETF markets will be commensurately low. If market makers' negotiations with other market participants are giving them information that the rest of the market does not see (because they don't result in trades), they are pricing that information into their markets.

Simply put, it's very difficult for pricing services to capture real-time trading dynamics and information in the way that market makers can. When ETF prices swing from premium to discount the way that floating-rate ETF prices did in early December, it's easy to jump to the conclusion that ETF traders are overshooting their mark by selling ETFs for less than they're worth. However, for ETFs that are actively traded, a more likely explanation is that trading dynamics are changing in a way that's hard for the pricing services to track.

21 Credit ETFs typically use either a mid-market NAV or a bid-price NAV. For mid-market NAVs, the inputs to the NAV calculation are the estimated midpoints between the bid and ask for all the bonds in the portfolio. For bid-price NAVs, the inputs are the estimated bid prices. Because bonds frequently trade at prices above their bid prices, ETFs using bid-price NAVs—such as FLOT US and FLRN US—trade at a premium to NAV in most market environments.

If selling were to intensify in a similar fashion in broader segments of the credit markets—think high-yield corporates, or municipals, or emerging-market sovereigns—we would expect similar trading dynamics for the relevant ETFs: wider bid-ask spreads, less displayed liquidity, higher trading volume, and discounts to published NAVs. As mentioned earlier, if market makers' options for managing or laying off the risk become more expensive because all of the correlated markets are repricing in anticipation of more one-sided flows to sell, market makers will lower their ETF bid prices to compensate.[22]

Of course, the magnitude of the changes to bid-ask spreads and the like would depend on the severity and persistence of the selling. Policy shifts by central banks, acute credit crises, recessions—each would likely trigger a different type of selling and therefore a different impact on ETF liquidity. Generally, the bigger the magnitude of the repricing, the more expensive the liquidity of underlyings and ETFs alike will be to access.

Comparison to mutual funds

As a final note on this topic, it's worth mentioning that credit mutual funds aren't immune to the higher costs that come from investors redeeming in stressed markets. Mutual funds facing heavy redemptions also have to sell bonds, and trading isn't free. The difference between mutual funds and ETFs, as we discuss in detail in the *Redemption Incentives for ETF and Mutual Fund Investors* call-out section above, is the manner in which they pass the transaction costs on to their shareholders.

ETFs essentially unbundle their transaction costs from the performance of the fund and charge those costs to the investors who are selling (and buying) the ETF. ETFs outsource this process, in a sense, to market makers, who charge investors on the ETF's behalf via the bid-ask spread. The market makers who manage the process most efficiently—who incur the lowest transaction costs when selling the underlying bonds, or who find a way to not sell them at all—can afford to quote tighter markets. Such market makers tend to set on-screen markets and win more trades.

Mutual funds, on the other hand, keep their transaction costs bundled with the performance of the fund.[23] Specifically, the high transaction costs generated by the selling of bonds in a stressed market manifest as a NAV that is lower than it would have been otherwise.[24] The lower NAV is a cost that is born by the fund's remaining shareholders.

The upshot is that mutual fund liquidity is every bit as expensive to the end investor

22 Even if market makers widen out, ETFs will still faithfully track the value of the underlyings.

23 As we note in the *Redemption Incentives for ETF and Mutual Fund Investors* call-out section, some mutual funds do attempt to unbundle transaction costs from the performance of the fund via redemption fees (sometimes called dilution levies or dilution fees) or via swing pricing.

24 For an explanation of how exactly transaction costs get imputed into a mutual fund's NAV, see Footnote 30 of the "Report on the Design of Exchange-Traded Funds and Bond Funds" published by the ETFs and Bond Funds subcommittee of the SEC's Fixed Income Market Structure Advisory Committee. The report is retrievable at this link: https://www.sec.gov/spotlight/fixed-income-advisory-committee/etfs-and-bond-funds-subcommittee-report-041519.pdf.

as ETF liquidity. Mutual fund liquidity is paid for by remaining shareholders, however, and not by redeeming (or subscribing) shareholders. Also, the cost of mutual fund liquidity is less transparent to the end investor than the cost of ETF liquidity.

Part III: Credit Market Liquidity Is Evolving

The open-access nature of the equity markets where ETFs trade means that any institutional investor—or anyone with a brokerage account for that matter—can quickly and easily enter the market to try to take advantage of a mispricing or dislocation in credit. A macro hedge fund manager spotting an opportunity to put on a mean-reversion trade, a wealth management firm executing a model portfolio rebalance, a retail investor who's been sitting on cash—any of these investor types can use ETFs to quickly deploy capital into credit. In fact, in the case of smaller investors, putting relatively small amounts of capital to work in the credit markets in a diversified fashion intraday is something they can *only* do with ETFs.

It's no surprise, then, that ETFs have become popular vehicles for market participants wishing to express news-driven or tactical views on credit. In Risk.net's 2018 Institutional ETF Trading survey, which Jane Street commissioned, 29% of the nearly 300 institutional investors surveyed reported that they regularly use ETFs for tactical purposes.[25] The impulse to trade the entire asset class in response to price movements or news should ensure that at least some ETFs continue to trade actively even if the underlying bonds aren't trading well.

Tactical trading also transmits information about broad market movements into ETF prices.[26] With the level of a broad index of bonds broadcast in near-real-time to all market participants via ETF price fluctuations, liquidity takers and providers in individual bonds can feel more confident that they're trading at a fair price. All else equal, greater confidence that prevailing prices are fair prices should encourage more trading and more liquidity in the bond markets.[27]

In a circular way, then, credit ETFs likely contribute to the liquidity of their underlyings even as they derive their own liquidity from the liquidity of those same underlyings. It would be a mistake to think of ETFs *only* as vehicles whose liquidity ebbs and flows with the liquidity of their underlyings.

25 Tactical use of ETFs is hardly a new development. See, for example, Bogoslaw D. (2009, February 26). ETFs: A Better Bet in a Bear Market. Bloomberg News. Retrieved from https://www.bloomberg.com/news/articles/2009-02-26/etfs-a-better-bet-in-a-bear-marketbusinessweek-business-news-stock-market-and-financial-advice. ("'We increased our exposure to high-yield and investment-grade bonds because of liquidity-driven selling, and as liquidity has improved, that's been very beneficial,' says Scott Kubie, chief investment strategist at CLS Investment Firm in Omaha. 'You want to be able to get the trade done in an expeditious manner,' he says, which ETFs allow.")

26 See Tucker M. and Laipply, S. (Winter 2013). Bond Market Price Discovery: Clarity Through the Lens of an Exchange. Retrieved from https://jpm.iijournals.com/content/iijpormgmt/39/2/49.full.pdf. ("This analysis suggests that liquid fixed-income ETFs may actually provide price discovery, evidenced by a leading relationship versus NAV/index values.")

27 Regarding the impact of the transparency brought about by TRACE trade reporting—and not by ETFs per se—see Goldstein M., Hotchkiss, E. and Sirri E. (2006, July 1). Transparency and Liquidity: A Controlled Experiment on Corporate Bonds. Retrieved from https://www.researchgate.net/profile/Michael_Goldstein6/publication/23536066_Transparency_and_Liquidity_A_Controlled_Experiment_on_Corporate_Bonds/links/0046351a87e769c359000000/Transparency-and-Liquidity-A-Controlled-Experiment-on-Corporate-Bonds.pdf. ("We find that depending on trade size, increased transparency has either a neutral or a positive effect on market liquidity, as measured by trading volume or estimated bid-ask spreads.") See also Bessembinder, H., Maxwell, W. and Venkataraman, K. Market Transparency, Liquidity Externalities, and Institutional Trading Costs in Corporate Bonds (October 2005). Available at SSRN: https://ssrn.com/abstract=644624 or http://dx.doi.org/10.2139/ssrn.644624. ("This study provides direct evidence on the issue by analyzing trade execution costs for institutional (insurance company) transactions in corporate bonds before and after the introduction of transaction reporting for corporate bonds through TRACE. The results indicate reductions in one-way trading costs for corporate bonds subject to TRACE transaction reporting that average five to eight basis points.")

Electronification and portfolio trading

Electronification and the growth of portfolio trading hold enormous promise for enhancing the liquidity of the cash credit markets. Electronification is shorthand for the growing influence of electronic trading platforms. These platforms enable fast, often anonymous execution of smaller sized orders. Portfolio trading is the trading of multiple bonds in a single negotiation, and it allows institutional investors to transfer to dealers diversified chunks of risk in a manner that's both cost- and time-efficient.

Both trends are empowering ETF market makers and other types of dealers to offer liquidity in the cash credit markets in new ways. From the perspective of liquidity takers—asset owners, asset managers and other institutional investors—they are new tools that can be used to transfer risk more efficiently.

In the context of stressed markets, having a bigger, more diverse pool of potential buyers and sellers of bonds and bond portfolios should make the credit markets more resilient. In all market environments, stressed or otherwise, ETF market makers being in the flow of trading for the underlying bonds should allow them to better price and provide liquidity in credit ETFs.

Conclusion

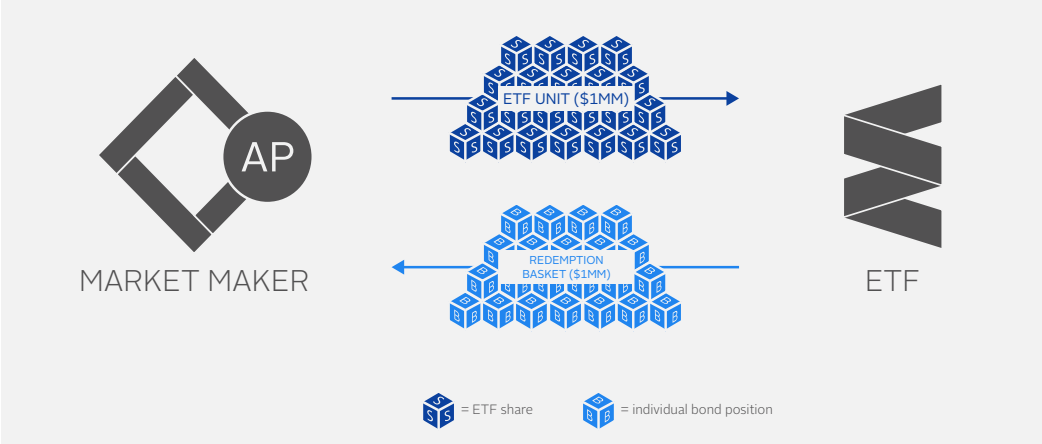
In this report, we avoid speculating on how future episodes of market stress might unfold, or how investors will react during such episodes. Instead, we focus on how market makers and other members of the ETF ecosystem would likely react to changes in investor behavior under different circumstances.

We believe that the structures, processes and incentives underpinning the ETF market work well, such that ETFs will faithfully transmit investor selling pressure to the underlying credit markets in times of stress. ETF liquidity may become strained and expensive in accordance with any strain in the underlying markets, and that may not be intuitively obvious to some investors. But ETFs will continue to trade, will continue to generate valuable information about where the underlying bonds are trading, and will continue to offer investors who are looking to exit their positions a means by which to do so.

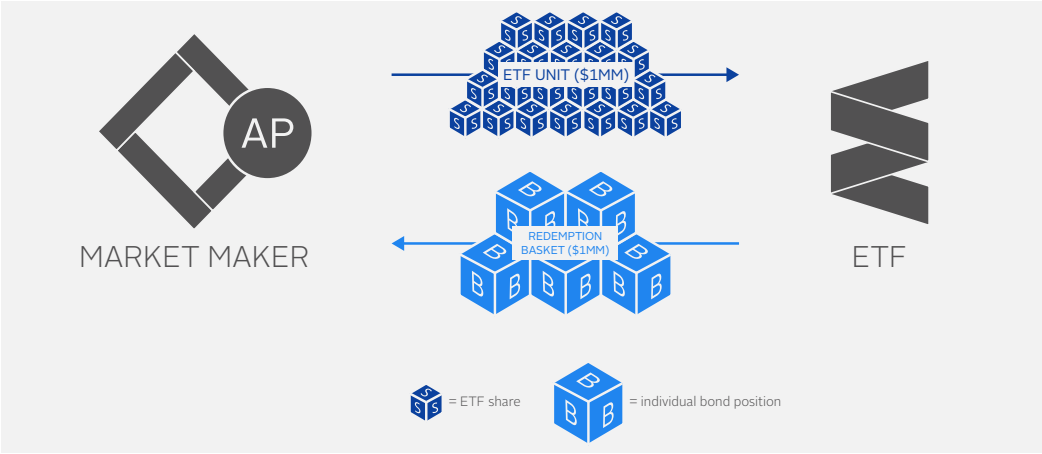
Appendix: Redemption Basics for Credit ETFs and Mutual Funds

The diagrams below illustrate how the redemption process works for credit ETFs and mutual funds under different circumstances. The creation process, which we don't show below to avoid needless repetition, works in roughly the same way but with the flows reversed.

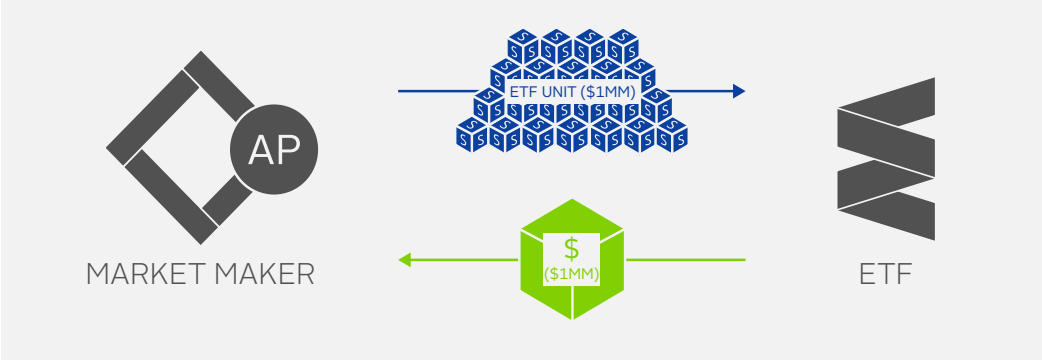
Credit ETF in-kind redemption (pro-rata). The market maker (MM), via an authorized participant (AP), delivers one or more ETF units to the ETF and receives a basket of bonds (and cash) of equal value in return. An ETF unit is a block of ETF shares—usually a round number like 10,000, 25,000, 50,000 or 100,000 shares—that is the minimum number of shares that APs can create or redeem. Pro-rata redemption means that the bonds and cash that the market maker receives have the same weightings as the fund itself.



Credit ETF in-kind redemption (custom). Some ETFs have a flavor of exemptive relief from the Investment Company Act of 1940 that allows them to deliver "custom" redemption baskets to market makers. A custom basket is a redemption basket with constituent weightings that differ from those of the portfolio itself. In practice, custom baskets tend to have fewer, bigger positions than an equivalent pro-rata basket.



Credit ETF cash redemption. The market maker (MM), via an authorized participant (AP), delivers one or more ETF units to the ETF and receives an equivalent amount of cash in return.



Credit mutual fund cash redemption. Investors deliver mutual fund shares to the mutual fund and receive cash in return. Mutual funds can technically facilitate in-kind redemptions by delivering the underlying securities to investors instead of cash, but such redemptions are rare as most mutual fund investors prefer to receive cash.