The Impact of the HYG ETF on the Liquidity of the Markets for the Underlying High-Yield Bonds

John D. Finnerty, Ph.D.

Natalia Reisel, Ph.D.

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Gabelli Business School
Fordham University
45 Columbus Avenue
New York, New York 10023

We would like to thank Doug Blackburn for many valuable insights.

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Abstract

We examine a link between a bond ETF and the underlying bond market liquidity. Using daily creation and redemption data for the HYG ETF, we find that including a bond on the HYG ETF's creation or redemption lists has a favorable impact on the bond's liquidity. This impact is stronger on stress days for redemptions but not for creations. Our results suggest that ETF mispricing arbitrage explains the improvement in high-yield bond liquidity. However, consistent with Pan and Zeng (2019), we also find evidence that transaction costs and inventory management limit the ETF arbitrage especially for creations.

1. Introduction

There is concern among bond market participants and regulators that the growing popularity of fixed income exchange-traded funds (ETFs) adversely affects the liquidity of the bond market.[1] Concerned parties suggest that the liquidity mismatch between fixed income ETFs and the underlying bonds encourages trading activity to move from the illiquid bond market to highly liquid bond ETFs thus causing the underlying bond markets to become even more illiquid. Dannhauser (2017) provides some support for this view. A counter argument to this centers on the unique ETF creation and redemption mechanism whereby ETF authorized participants (APs) can exchange a basket of bonds for newly created ETF shares (creation) or exchange outstanding ETF shares for a basket of the underlying bonds (redemption). This mechanism allows arbitrageurs to trade simultaneously in both markets to maintain the intuitive relation between the ETF price and the ETF's net asset value (NAV) thus providing a new rationale for trading illiquid bonds. In this paper, we study the impact that fixed income ETF creations and redemptions have on bond market liquidity and investigate the drivers of the creation and redemption process on both stress and non-stress days. We find significant improvements in high-yield bond market liquidity resulting from the creation and redemption process, which are driven by APs taking advantage of arbitrage opportunities even on stress days.

Much of the literature discussing an ETF's impact on liquidity has focused on the equity markets (Hegde and McDermott (2004) and Hamm (2014)). Dannhauser (2017), who is the first to investigate fixed income ETFs, finds that ETFs attract liquidity traders away from the bond market leaving a larger proportion of informed traders participating in the bond market.

[1] In 2017, the SEC formed the Fixed Income Market Structure Advisory Committee (FIMSAC) who, among other mandates, is studying the impact of fixed income ETF growth on corporate bond liquidity and pricing.

Additionally, Dannhauser finds a decrease in liquidity for bonds in investment-grade ETFs but no change in liquidity for bonds in high-yield ETFs.

Different from the existing literature, this paper uses a dataset from BlackRock for the iShares iBoxx $ High Yield Corporate Bond ETF (HYG ETF) during the period between January 2009 and December 2016. During this period, the fund portfolio manager published daily creation and redemption lists that targeted a subset of the HYG ETF's bonds for the creation and redemption baskets. BlackRock changed its practice after 2016 and currently includes all the bonds in the HYG ETF in both baskets. Although the nature of these lists is now different, our dataset offers a unique opportunity to test the impact of creations and redemptions on underlying bond market liquidity.

ETF portfolio managers use the creation and redemption process to manage portfolio tracking error. A list of bonds that the ETF is willing to accept to create an ETF share (creation basket) and a list of bonds that the ETF will deliver for redemptions (redemption basket) were published by BlackRock during the sample period after the close of trading on day t-1 for ETF redemptions and creations on day t. Hence, the baskets provided a demand signal for individual bonds that was available prior to the start of trading – bonds in the creation basket are demanded by the ETF and are more likely to be bought on the bond market while bonds in the redemption basket have negative demand by the ETF and are more likely to be sold in the bond market.[2] Consistent with this intuition, we provide evidence showing that the quantity of bonds in the HYG ETF significantly increased for bonds included in the creation basket and significantly decreased for bonds included in the redemption basket.

[2] While the redemption basket was delivered in the case of ETF share redemptions, the HYG ETF portfolio manager could take variations of the creation basket when creating additional ETF shares.

These regular daily data on the process of creation and redemption provide us with several important advantages in studying the impact of a bond ETF on underlying bond liquidity. First, previous studies observe ETF activity in one month but measure its impact the following month (e.g., Dannhauser, (2017). Our study is different. We study the impact of ETF activity on the same day as the demand signal since the daily creation/redemption baskets are available prior to the start of trading. Second, focusing on the subset of constituent bonds most likely to be impacted by creation and redemption activity increases the power of the statistical tests. Third, identifying a control bond population is challenging due to endogeneity concerns. Comparing the liquidity of ETF constituent bonds to bonds not in ETFs, for example, is problematic since an ETF may specifically target higher liquidity bonds. Our study uses the set of constituent bonds not included in either the creation or redemption baskets as the reference for measuring the impact of being tagged for creation or redemption in combination with bond fixed effects. This greatly diminishes endogeneity concerns. Moreover, we are able to disentangle the impact of creation and redemption activity. Pan and Zeng (2019) use a change in the ETF shares outstanding to proxy for the net creation/redemption activity. Our data enables us to investigate the differential impact of the creation and redemption mechanisms on underlying high-yield bond liquidity and makes possible a more focused study of the economic drivers of creations and redemptions.

The paper is in two parts. We begin by first investigating the impact of redemption and creation activity on underlying bond liquidity. APs, who are typically broker-dealers, specialist market-makers, or institutional investors, have the sole ability to engage in ETF creation and redemption activity by exchanging a basket of bonds for ETF shares or vice versa with the ETF portfolio manager. Such activity may result in increased trading in the bond market and thus increased liquidity. Using two different measures of daily bond liquidity, the bid-ask spread and log daily turnover, we indeed find increased liquidity for those bonds included in the ETF's creation or redemption baskets relative to bonds in the ETF but not included in either basket.

Creation and redemption activity have differing effects on bond liquidity during times of stress in high-yield markets. While creation activity has a weaker impact on bond liquidity on stress days than on non-stress days, redemption activity further increases bond liquidity on stress days. Increase in liquidity we find contrasts with predictions that liquidity should diminish as liquidity traders avoid high-yield bonds and invest instead in high-yield bond ETFs.

The second part of this paper investigates the drivers of ETF creations and redemptions to provide further insights into mechanisms that may affect bond liquidity. A primary motive for engaging in such activity is to capture arbitrage profits from the over- or underpricing of the ETF shares relative to the NAV of the underlying bond portfolio. As an additional and sometimes conflicting motive, Pan and Zeng (2019) propose that APs utilize the creation and redemption process to manage their corporate bond inventory. An AP stuck holding large quantities of illiquid bonds when the high-yield bond market becomes stressed may use the creation process, even if it conflicts with arbitrage from mispricing, as a means of decreasing its illiquid bond inventory and freeing up capacity to hold other assets on its balance sheet.

Conditional on being added to the creation basket, our empirical results provide evidence consistent with the mispricing arbitrage motive. We find significant increases in the quantity of bonds held in the ETF as the ETF price rises above the NAV. During times of stress, we find that the mispricing motive decreases and is outweighed by the inventory management motive. During times of stress, the relative ETF mispricing reverses indicating that the basket of bonds is more valuable than the ETF. Nonetheless, we find that though ETF creation is not useful for arbitrage during such periods, creation activity persists. This is consistent with the Pan and Zeng (2019) model, which predicts that APs will seek to remove illiquid bonds from their balance sheets via the creation process even if it exacerbates mispricing. Last, we find that creation activity decreases when bond liquidity is low since the increased transaction costs render the arbitrage opportunity unprofitable.

We also find evidence consistent with the mispricing arbitrage motive for bonds added to the redemption basket. Redemption activity increases during periods of stress because the ETF price tends to fall relative to the NAV on such days reversing the excess of ETF price over NAV that typically characterizes non-stress days. In this case, APs, likely a different sub-set, are still willing to take advantage of the arbitrage opportunity despite having to take on the risk by increasing their bond inventory. This explains our earlier finding that redemption activity increases bond liquidity on stress days. As with creations, we find that a decrease in bond liquidity adversely affects redemption activity due to the higher cost of arbitrage.

The paper continues as follows. Section 2 provides a brief overview of bond ETFs. We discuss related literature and testable predictions in Section 3. The data and the methodology are described in Section 4. Results are discussed in Sections 5 and 6, and Section 7 concludes.

2. Overview of Fixed Income Exchange-Traded Funds

We begin by describing corporate bond ETFs and explaining the institutional linkage between a corporate bond ETF and the underlying corporate bonds. We refer interested readers to Madhavan (2016), Ben-David, Franzoni, and Moussawi (2018), and Lettau and Madhavan (2018) for more detailed descriptions of ETFs.

Corporate bond ETFs belong to the broader class of fixed income ETFs, which include ETFs that hold government bonds, investment-grade corporate bonds, high-yield corporate bonds, municipal bonds, and money market instruments. Barclays Global Investors iShares introduced the first fixed income ETFs into the U.S. market in 2002, and iShares-sponsored fixed income ETFs still represent about 44% of the corporate bond ETF market (Blackrock, May 2021).[3] Fixed income ETFs have grown rapidly in popularity since their inception by providing an attractive alternative to investing directly in the underlying bonds. For example, for the month of May 2021, US Corporate bond ETF aggregate trading volume ($132.7B) compromised about 22% of the total volume traded by the underlying corporate bond market ($604.1B) (BlackRock, May 2021).

ETFs are basket securities, which are traded on an exchange with a single class of common stock. Each ETF has a sponsor, who at the time it creates the ETF specifies the fund's investment objective, the benchmark market index whose returns the ETF will seek to replicate (or beat), and the tracking methodology the fund's manager will employ in managing the ETF's bond portfolio. The HYG ETF, which we analyze, is designed to track the Markit iBoxx USD Liquid High Yield Index, which is comprised of U.S. dollar-denominated high-yield corporate bonds.[4] This ETF makes up 24.75% of the total US high-yield corporate bond ETF market (BlackRock, May 2021).

An ETF sponsor is responsible for publishing daily data concerning the ETF's portfolio. Managing an ETF is generally simpler than managing a traditional mutual fund because most

[3] iShares is now owned by BlackRock, which is the largest asset management firm in the world.
[4] BlackRock, iShares iBoxx $ High Yield Corporate Bond ETF, Fact Sheet as of 03/31/2021. Available at https://www.ishares.com/us/literature/fact-sheet/hyg-ishares-iboxx-high-yield-corporate-bond-etf-fund-fact-sheet-en-us.pdf. Last accessed June 6, 2021.

ETF share transactions occur on the exchange between investors without sponsor involvement. A bond ETF portfolio manager does not trade the ETF's shares or the underlying bonds. The bond ETF's sponsor appoints APs, who consist of broker-dealers, specialist market-makers, and institutional investors.[5] APs engage in large in-kind transactions in the ETF shares and the underlying bonds in connection with the creation and redemption of ETF shares: buying bonds in the open market, depositing the specified basket (a portfolio of bonds and any cash component)[6] with the fund sponsor in exchange for creation units (typically 50,000 ETF shares per unit), and selling those shares in the ETF market to effect ETF creation, and buying a multiple of 50,000 ETF shares, depositing them with the ETF sponsor in exchange for the specified basket, and selling those bonds in the open market in connection with ETF redemption. Redemption simply reverses the creation process.

3. Related Literature and Testable Predictions

While ETFs have been available in the market since 1993 (State Street Global Advisors' SPDR), the academic literature describing their impact on markets is still in its infancy. The most notable papers related to bond ETFs, and the research most closely related to ours, are Dannhauser (2017) and Pan and Zeng (2019).

Dannhauser (2017) focuses on the financial innovation of bond ETFs and their impact on the bond market. The author finds a significant valuation effect whereby a one standard deviation increase in the proportion of bonds held by the ETF lowers the yield spread for both the

[5] APs are financial institutions who are able to perform in-kind ETF creations and redemptions. Non-APs can only create and redeem ETF shares by acting through APs.
[6] The cash component is typically very small and includes creation fees (normally between $250 and $1,500 per unit), accrued and unpaid interest on the bonds, any unreinvested capital gains less losses since the last distribution, and cash in lieu of fractional shares.

investment-grade and high-yield markets. More relevant to this study, Dannhauser (2017) finds that ETF ownership decreases the liquidity of investment-grade bonds but has no impact on the liquidity of high-yield bonds and suggests that ETFs attract liquidity traders away from the bond market leaving a larger proportion of informed traders participating in the bond market.

Pan and Zeng (2019) construct a model that yields testable hypotheses describing how APs of bond ETFs, who also tend to be bond dealers, utilize the ETF share creation and redemption process to take advantage of arbitrage opportunities resulting from the relative mispricing between the ETF price and the NAV of the constituent bonds as well as to manage their bond inventory.

Bridging the gap between Dannhauser (2017) and Pan and Zeng (2019), this paper focuses on the daily ETF creation and redemption processes and their impact on daily bond market liquidity for the underlying bonds. The primary innovation of our research is a dataset obtained from BlackRock for the HYG ETF, which is the largest high-yield bond ETF. We focus on high-yield bonds because they are generally less liquid than investment-grade bonds and thus we expect any market impact of a fixed income ETF to be more consequential for high-yield bond valuation. For the time period from January 2009 until December 2016, the dataset lists the subset of HYG constituent bonds that the ETF was willing to accept to create an ETF share, referred to as the creation basket, and the (often different) subset of HYG constituent bonds that the ETF was willing to deliver to redeem an ETF share, referred to as the redemption basket. [7] The ETF portfolio manager constructs the two baskets in order to manage primarily the portfolio's tracking error.

[7] BlackRock's practice has since changed. BlackRock now includes all the bonds in the HYG ETF in each basket each day.

After the close of trading during the sample period, BlackRock, the ETF sponsor, disseminated to the APs a list of bonds that the ETF manager was willing to take to create an ETF share on the following trading day. It is therefore expected that the quantity of those bonds included in the creation basket should be more likely to increase in the ETF's portfolio than those bond issues that are not on the creation list. Likewise, the ETF manager also disseminated a list of bonds, the redemption basket, that the manager would deliver upon request by an AP to redeem an ETF share. Hence, it should be expected that when a redemption occurs that the quantity of the redemption basket constituents held by the ETF should decrease more than bonds that are in the ETF but not on the redemption list.

Thus, we can treat creation or redemption basket constituency as a demand signal. This signal allows us to disentangle the impact of creation and redemption activity, which in turn enables us to investigate the differential impact of the creation and redemption mechanisms on underlying high-yield bond liquidity and to perform a more focused study of the economic drivers of creations and redemptions.

3.1 Testable Predictions

One of the important roles of the AP is to help keep the ETF's share price in line with its NAV. As active bond market participants, the APs are expected to determine when the NAV deviates significantly from the ETF's share price and then help to correct the relative mispricing via arbitrage. APs use ETF creation and redemption to bridge the two markets, trading both the ETF shares and the constituent bonds in order to capture arbitrage profits and mitigate the relative mispricing. This arbitrage activity entails buying bonds in the creation basket in the bond market, exchanging them for ETF shares through the creation process, and selling the ETF shares in the stock market when the ETF's share price exceeds the ETF's NAV. It also involves buying ETF shares, exchanging them for the redemption basket through the redemption process, and selling the bonds in the bond market when the ETF's NAV exceeds its share price.[8]

Thus, this framework predicts that the liquidity of bonds listed in the creation and redemption baskets will increase more than those bonds that are not listed in either basket when such arbitrage activity takes place. Furthermore, this framework predicts that the relative mispricing should drive creation and redemption activity.

Pan and Zeng (2019), however, propose limits to such arbitrage, which might manifest on stress days.[9] Specifically, Pan and Zeng (2019) suggest that APs may also use the creation/redemption mechanism to manage their corporate bond inventory. Pan and Zengs' model predicts that APs will generally take advantage of arbitrage opportunities via the creation/redemption mechanism under normal (non-stress) market conditions. However, on stress days, when APs experience a shock affecting their desired inventory levels, depending on the relative cost of trading, they will use a combination of the underlying bond market and the creation/redemption process to restore their bond inventory to optimal levels. If there is a significant liquidity mismatch between the two markets, an AP might offload unwanted bond inventory through ETF creation even when the ETF is trading at a discount relative to the NAV, thus foregoing a potentially profitable arbitrage opportunity. Thus, this framework predicts that the impact of creation and redemption activities on bond liquidity is limited, especially on stress days and when transaction costs are high.

[8] APs could instead exchange bonds or ETF shares they hold in inventory, and following the exchange, they could hold the ETF shares or bonds, respectively, in inventory if holding them is more advantageous than selling them.
[9] See also Bessembinder, Jacobsen, Maxwell, and Venkataraman (2018), who argue that the most notable changes in the secondary market for corporate bonds do not manifest during normal trading, but emerge when the market is stressed.

In this paper, we first investigate the impact of redemption and creation activity on bond market liquidity and then investigate the role of the relative mispricing in motivating ETF creations and redemptions both on stress and non-stress days. To measure stress days, we use the Bank of America/Merrill Lynch high-yield corporate bond spread index.

4. Data and Variables

This study utilizes three primary data sources: BlackRock ETF data, TRACE, and CRSP. In this section, we describe the data used for sample construction and the key variables.

4.1 Sample construction

We start our sample construction with the BlackRock HYG ETF data. This dataset includes the daily lists of all HYG bond constituents, the number of bonds, and NAVs from January 2009 through December 2016. For each day, the data also includes a description of the creation and redemption baskets, which includes the identity of the bonds along with the number of bonds required. BlackRock historical data did not report the composition of the creation and redemption baskets prior to 2009. Further, after 2016, BlackRock changed its practice with respect to listing creation and redemption baskets by including all the bonds in the HYG ETF portfolio in the daily creation and redemption baskets. That is why our dataset spans the period from 2009 until 2016.

We then merge the BlackRock dataset with the TRACE dataset using 9-digit bond CUSIPs. TRACE includes important information needed to calculate our liquidity measures, such as bond price, buy/sell indicator, and bond quantity traded.

Additionally, we obtained share prices for the HYG ETF from CRSP, and we downloaded the Bank of America/Merrill Lynch high-yield corporate bond spread index we used to calculate the market stress indicator from the St. Louis Fed website.

4.2 Main variables

We use two common liquidity measures to investigate the impact of creation/redemption activity associated with HYG ETF constituent high-yield bonds. These measures are computed for each constituent bond on each day. This specification is different from Dannhauser (2017), who calculates monthly liquidity measures.

1. Bid-Ask Spread – TRACE includes a buy(B)/sell(S) indicator that distinguishes between trades when the dealer buys and sells from a customer. For constituent bond b on day t, the bid-ask spread is computed using the indicator as follows:

$$(Bid - Ask)_{b,t} = \sum_{i=1}^{N} A_i\, w_i^A - \sum_{j=1}^{M} B_j w_j^B \tag{1}$$

   This measure is interpreted as the dollar-weighted average bid-ask spread where the i^{th} trade is at the ask price A_i and the j^{th} trade is at the bid price B_j. This requires at least one buy and one sell trade per day.

2. Daily Trading Volume – For constituent bond b on day t, the daily trading volume is computed as the sum of the number of bonds traded across all reported transactions within the day. This uses the variable *entrd_vol_qt* available in TRACE.

We selected these two measures of bond liquidity because we believe they are best suited to measuring the liquidity of the markets for individual bonds on a daily basis.

Table 1 provides descriptive statistics for our liquidity measures and other main variables. The average bid-ask spread in our sample is 0.667 while the average log of daily trading volume is 7.25. About 21% of the bonds are in the creation baskets and 19% are in the redemption baskets. Average bond price is 103.82%.

In our analysis, we employ a stress indicator for the high-yield bond market. This stress indicator, $dStress_t$, is equal to one on days when the Bank of America/Merrill Lynch high-yield corporate bond spread index experiences a 1.96 standard deviation or greater increase and is zero otherwise. This stress indicator is based exclusively on the high-yield corporate bond credit spread because we are interested specifically in those days when the high-yield corporate bond market was likely to be experiencing a relatively high level of stress. The construction of our stress indicator is similar to the one adopted by Bessembinder, Jacobsen, Maxwell, and Venkataraman (2018). Stress days represent 2.5% of our sample on average.

5. Empirical Tests and Results

We begin by first confirming the credibility of the demand signal from bonds being listed in the creation and redemption baskets. We then discuss the empirical results that reveal the impact on liquidity from ETF creation and redemption. This is followed by an investigation of different rationales for ETF creation and redemption.

5.1 Creation/redemption demand signal

A unique aspect of our tests is the ability to identify the set of bonds designated each day for creation and for redemption. Our empirical analysis is conditional on bonds being in the creation basket, being in the redemption basket, or not being in either basket. This is possible since the portfolio manager of the HYG ETF announced the creation and redemption baskets prior to the start of trading each day. Not only does this increase the power of the tests by helping us to focus on those bonds that are most likely to be redeemed or created, but also distinguishing between redemption and creation allows us to better identify the unique differences between these two activities. However, even though the lists were published, there was no guarantee that any ETF shares would be created or redeemed the following day. Therefore, we first test the reliability of the demand signal by testing whether listing in the creation or redemption basket is indeed followed by actual changes in the numbers of those bonds held in the ETF's bond portfolio.

To do this, we consider the simple specification where we regress time $t-1$ to time t changes in the quantity of each bond on the dummy variables dCreate and dRedeem, which are equal to one if the bond is in the respective basket on day t and is zero otherwise:

$$\Delta q_{b,t} = a + b_b + d_c \times dCreate_t + d_r \times dRedeem_t + \epsilon_{b,t+1}. \tag{2}$$

In this model specification, a is a constant, b_b represents the bond fixed effect term, $dCreate_t$ and $dRedeem_t$ are indicator variables that take the value of one on days when the bond is in the creation or redemption basket, respectively, d_c and d_r are coefficients on the dCreate and dRedeem dummy variables, respectively, and $\Delta q_{b,t}$ is the change in the quantity of a bond held by the ETF from closing on day $t-1$ to closing on day t, $\Delta q_{b,t} = q_{b,t} - q_{b,t-1}$. If the creation and redemption basket demand signals are informative, then we should expect $d_c > 0$ and $d_r < 0$ indicating an increase in the quantity of bonds in the creation basket and a decrease in the quantity of bonds in the redemption basket, respectively.

Table 2 provides the empirical results of the test. Specifications (1) and (2) use changes in the quantity of bonds as the dependent variable while specifications (3) and (4) use the relative changes in bond quantities. Bond fixed effects are included for specifications (2) and (4).

Consistent with our expectations, we find that the coefficient on the dCreate indicator is positive and statistically significant for all specifications, and the coefficient on the dRedeem indicator variable is negative and statistically significant for all specifications. Hence, on days when bonds are included in the creation basket, there is a subsequent increase in the number of bonds held by the ETF, and on days when bonds are included in the redemption basket, this is subsequently followed by a decrease in the number of bonds held by the ETF.

5.2 Impact on bond liquidity

Next, we ask whether the process of creation and redemption affects the liquidity of the markets for the underlying bonds. It is important to note that not all bonds in the ETF are impacted by the creation or redemption process because only a subset of the ETF bond portfolio is required to redeem or create ETF shares. Therefore, any bond liquidity impact should primarily affect those bonds belonging to the creation or redemption baskets.

We use the following regression model:

$$liquidity_{b,t} = a + b_b + c_d + d_c \times dCreate_t + d_r \times dRedeem_t + \epsilon_{b,t+1}. \qquad (3)$$

The empirical specification tests the relation between being in the creation or redemption basket on day t and the bond's liquidity measured on that day. Both baskets are announced after the close of trading on day $t-1$ but before trading begins on day t. The dependent variable, $liquidity_{b,t}$, represents the liquidity of bond b measured on day t. It is estimated using the two liquidity measures described previously - bid-ask spread (Table 3) and daily trading volume (Table 4). The terms b_b and c_d represent bond and day fixed effects.

Results presented for the two liquidity measures consistently show that bonds in the creation and redemption baskets display higher liquidity than bonds not in the baskets. In Table

3, we observe that the coefficients on dCreate and dRedeem are negative and statistically significant at the conventional levels for 11 of 12 specifications. These results indicate that the bid-ask spread decreases on days when the bond is included in either the creation or redemption basket.

We also find that the impact on bond liquidity seems stronger for creations than for redemptions, which suggests that the bond purchases that take place in connection with ETF creation emit stronger signals to the underlying bond markets than the bond sales that take place in connection with ETF redemptions. It is consistent with the finance literature regarding the relative information content of securities sales and purchases, and in particular, the view that securities sales generally have less information content than purchases because sales include trades by liquidity seekers (Allen and Gale, 2004). For example, consider the bid-ask spread results in Table 3. Specification (12) shows that including a bond in the creation basket reduces its bid-ask spread on average by 0.04. Given that the median bid-ask spread is 0.35, this represents an 11% reduction in the spread; however, for bonds in the redemption basket, the impact is associated with a reduction in the bid-ask spread of 0.02. The asymmetric impact on bond liquidity seems inconsistent with liquidity traders exiting the bond market because the departure of liquidity traders would normally be expected to increase the proportion of informed traders and increase the information content of sales to a level similar to purchases.

Table 4 reports the impact on daily trading volume for bonds included in either the creation or redemption basket. The coefficients on the dCreate and dRedeem indicators are consistently positive and statistically significant at the 1% level for all specifications, including when controlling for bond and day fixed effects. Consistent with the bid-ask spread results, we find that being included in the creation basket consistently results in a greater increase in liquidity than when a bond is added to the redemption basket. Specification (12), for example, shows that the increase in liquidity is almost twice as large for bonds in the creation basket (0.21) as compared to bonds in the redemption basket (0.11).

While it is widely feared that ETFs reduce bond market liquidity by attracting investors away from the bond market to the more liquid ETF market, the evidence presented here consistently demonstrates that the ETF creation and redemption processes actually increase liquidity for bonds on the creation and redemption lists. This result holds when controlling for bond and day fixed effects.

5.3 Bond liquidity on stress days

The ETF creation and redemption processes increase bond liquidity. We explore this further by testing the relation between ETF creation/redemption and bond liquidity on stress days. Bessembinder, Jacobsen, Maxwell, and Venkataraman (2018) argue that the most notable changes in the secondary market for corporate bonds do not manifest during normal trading but emerge when the market is stressed. This argument is consistent with the Pan and Zeng (2019) model, which predicts that APs are less likely to take advantage of mispricing arbitrage opportunities on stress days, and thus the creation and redemption process is less likely to have a positive impact on bond liquidity on stress days.

To test the impact of stress in the high-yield market on bond liquidity, we augment regression model (3) by including a stress indicator variable and interactions:

$$liquidity_{b,t} = a + b_b + c_d + d_c \times dCreate_t + d_{cs} \times dCreate_t \times dStress_t + d_r \times dRedeem_t + d_{rs} \times dRedeem_t \times dStress_t + dStress_t + \epsilon_{b,t+1}. \quad (4)$$

The stress indicator, $dStress_t$, is equal to one on days when the Bank of America/Merrill Lynch high-yield corporate bond spread index experiences a 1.96 standard deviation or greater increase and is zero otherwise. Table 5 provides the results when using the bid-ask spread as the measure of liquidity.

It is first noted that bond market liquidity decreases on stress days as shown by the positive coefficient on $dStress$ indicating wider bid-ask spreads, and the coefficients on $dCreate$ and $dRedeem$ are consistently negative suggesting increased bond liquidity due to the creation and redemption processes, which is consistent with our previously reported results. Interestingly, creations and redemptions have an asymmetric impact on bond liquidity on days of heightened stress. The coefficient on the interaction term between $dCreate$ and $dStress$ is consistently positive but statistically insignificant indicating that creations have a similar impact on bond liquidity on stress days as on non-stress days. However, for redemptions, we find that the bid-ask spreads narrow even more due to the redemption process, indicating that the bonds become more liquid on stress days than on non-stress days. This can be seen in the negative and statistically significant coefficients on all the $dRedeem \times dStress$ interaction terms.

Table 6 provides a similar analysis but using daily trading volume as the dependent variable. Different from the bid-ask spread, daily trading volume increases on stress days as shown by the positive coefficient on $dStress$. Similar to the bid-ask spread, we again see the asymmetric impact that the creation and redemption mechanisms have on bond liquidity on stress versus non-stress days. While creations and redemptions generally result in increased bond liquidity on non-stress days, the negative and generally statistically significant coefficients on the $dCreate \times dStress$ interaction term suggest a reduced impact on liquidity for bonds in the creation basket on stress days. Moreover, the coefficients on the $dRedeem \times dStress$

interaction term are consistently positive and statistically significant at the 1% level suggesting even greater liquidity for bonds in the redemption basket on stress days.

Within the mispricing arbitrage framework, the increase in liquidity caused by redemptions on stress days and the decrease in liquidity caused by creations on stress days make sense if the mispricing on stress days is such that the ETF is cheap relative to the price of the underlying constituents. In such a case, an arbitrageur would buy the low-priced ETF in the ETF market, redeem it for the redemption basket of individual bonds, and then sell the higher-priced basket of bonds in the bond market. To test this possibility, we regress the $dStress$ indicator variable on the price difference between the NAV of the constituent basket and the ETF price,

$$Misprice_t = NAV_t - Price_{ETF,t}. \quad (5)$$

Table 7 provides the results of this test. The negative constant term, -0.515, indicates that the ETF is typically more expensive than the NAV of the constituent bonds. This changes in times of stress as the coefficient on $dStress$, 0.791, is not only positive but greater in magnitude than the constant term. This suggests that the direction of mispricing switches in times of stress. Whereas the ETF price is higher than the NAV of the constituent bonds during non-stress periods, during periods of stress, the basket of bonds becomes more valuable than the ETF. This is likely due to the liquidity imbalance between the ETF and the underlying bond markets. The price of ETF shares, being more liquid, responds more quickly to bad economic news while the prices of the bonds, being less liquid, respond more slowly.

During normal market conditions, the creation process has a greater impact on bond market liquidity because the ETF shares must be created by APs buying bonds, exchanging them for new shares, and selling the ETF shares to arbitrage the mispricing. This is consistent with the evidence provided above showing that the creation process generally has a greater impact on bond liquidity than redemptions during normal market periods. The story changes during times of stress. Since the ETF shares fall in value relative to the NAV of the constituent basket, the redemption process is required to arbitrage the mispricing. This explains why redemptions have a greater impact on bond liquidity than creation activity during periods of stress.

6. Dynamics of ETF Creations and Redemptions

We have established that the HYG ETF creation and redemption processes are associated with increases in the liquidity of the markets for the underlying bonds that are on the creation and redemption lists and provided initial evidence concerning the liquidity impact of trading related to the arbitrage of ETF mispricing. Pan and Zeng (2019) propose conditions under which arbitrageurs take advantage of the creation and redemption processes to alleviate relative mispricing between the ETF and the constituent bond basket. In their model, an AP, which is a bond dealer, trades a liquid ETF and illiquid bonds. When mispricing arises, the AP may create or redeem ETF shares to profit from the mispricing; however, while doing so, the AP must also manage its bond inventory risk associated with trading illiquid bonds and may face a balance-sheet constraint. Hence, an AP uses the creation and redemption processes not only for arbitrage purposes but also for bond inventory management purposes. We take a closer look at the interplay between the inventory management and mispricing arbitrage motives for creation and redemption in this section with the focus on stress days and transaction costs.

6.1 Relative mispricing and the dynamics of creations and redemptions

The impact of relative mispricing on ETF creations and redemptions is reported in Table 8. Here we separately analyze bonds in the creation basket and the redemption basket.[10] For specifications (1)-(4), the dependent variable is the change in the quantity of each bond in the creation basket from end of day $t-1$ to end of day t, and the dependent variable for specifications (5)-(8) is the same except that it is for bonds in the redemption basket. For both sets of results, the baskets are announced after the close of trading on day $t-1$ but before the start of trading on day t. The dependent variables are alternatively the change in quantity (Δq) and the change in the relative quantity ($\Delta q/q$).

We begin by investigating the impact of mispricing and stress on creations, regressions (1)-(4). Specifications (1) and (2) in Table 8 regress changes in the quantity of each bond held in the ETF creation basket on the mispricing variable. Specifications (3) and (4) add an interaction variable between mispricing and stress into the model.

It is first noted that the constant terms in the regressions are positive and statistically significant indicating that the quantity of each bond held in the ETF tends to increase conditional on it being in the creation basket. While the coefficient on the stress variable, *dStress*, is positive and statistically significant in specification (3), the coefficient on *dStress* is insignificant in specification (4). The increase in the relative quantity of each bond, $\Delta q/q$, appears unrelated to whether the market condition is non-stress or stress.

Recall that our mispricing variable, *Misprice,* is defined in equation (5) as the NAV minus the ETF price. The coefficient on *Misprice* is negative and statistically significant in all specifications suggesting greater creation activity (i.e., the quantity of bonds increases more)

[10] We exclude bonds that are in both baskets.

when the ETF is expensive relative to the NAV (i.e., *Misprice* is negative). This is consistent with arbitrageurs using the creation process to capitalize on the mispricing. However, with a positive coefficient on the interaction term between mispricing and stress, the increase in quantity due to mispricing is offset during times of market stress. This is because, as shown in Table 7, the mispricing on days of stress is on average positive, and hence, the creation process is no longer useful for capturing the arbitrage opportunity.

To see this dynamic better, the average mispricing on non-stress days is -\$0.515, as shown in Table 7, the negative value indicating that the arbitrage opportunity requires creating ETF shares. The change in quantity on non-stress days using coefficients from specification (3) in Table 8 is:

$$\Delta q = 79.134 - 138.826 \times (-\$0.515) = 150.630$$

where 79.134 is the mean change in quantity on non-stress days for the creation sub-sample. However, on stress days ($dStress = 1$), the average mispricing becomes \$0.276 (-0.515 + 0.791), as shown in Table 7. In this case, the increase in quantity becomes:

$$\Delta q = 79.134 + 24.349 - 138.826 \times (\$0.276) + 169.101 \times (\$0.276) = 111.839$$

Relative overpricing of the ETF results in increased creation activity, consistent with the argument that arbitrage is used to correct relative mispricing between highly liquid ETFs and illiquid bonds. In times of stress, when the relative mispricing changes sign rendering creations useless for arbitrage, APs still create ETF shares. It is in times of stress that APs seek to replace illiquid bonds on their balance sheet with liquid ETF shares (Pan and Zeng, 2019). In this circumstance, the inventory management motive outweighs the arbitrage motive resulting in exchanging the more expensive creation basket for the cheaper ETF shares. This switch in the dominant motive on stress days also explains a reduced impact on liquidity, as measured by trading volume, for bonds in the creation basket that we document in Table 6. Recall that the coefficient on the $dCreate \times dStress$ interaction term is negative and statistically significant. The APs stop buying bonds in the market for arbitrage purposes and instead exchange bonds that are already on their balance sheets for inventory management purposes.

The dynamics for bonds in the redemption basket are different. It is first noteworthy that the constant terms in regressions (5)-(8) are negative and statistically significant indicating that on days when bonds are placed in the redemption basket, the quantity held by the ETF decreases. The decrease is significantly greater on stress days as indicated by the negative and statistically significant coefficient on $dStress$ observed in both specifications (7) and (8), an empirical result which differs from the impact of stress days on creations. This is again related to the observation that the ETF price falls below the NAV of the constituent basket on stress days. As a result, we observe an increase in redemption activity as arbitrageurs take advantage of the relative mispricing.

When the NAV is greater than the ETF price (mispricing is positive), arbitrageurs buy the relatively cheap ETF shares in the ETF market, redeem them for the redemption basket, and sell the bonds in the bond market. Consistent with this behavior, and with a negative and statistically significant coefficient on mispricing in regressions (5)-(8), the quantity of bonds included in the redemption basket decreases as the NAV increases relative to the ETF price. There is some evidence that this effect is magnified on stress days as seen by the statistically significant negative coefficient on the interaction term $Misprice \times dStress$ in specification (7).

Our results suggest that the intensity of redemption activity, to take advantage of mispricing, may actually increase during times of stress, rather than decrease as Pan and Zeng's model predicts. Discussions with ETF market participants suggest that other APs, which are not bond dealers, may step in to take advantage of the relative mispricing.

6.2 Liquidity and the dynamics of creations and redemptions

The intensity of creations and redemptions should decrease during periods when the bonds in the creation or redemption baskets experience a dip in liquidity because the increase in transaction costs could make arbitrage unprofitable. Similarly, there should be a decrease in redemptions and creations during periods when the individual bonds become more illiquid.

We begin by first looking into those bonds that are included in the creation basket, which are included in regressions (1)-(4) of Table 9. Note that all specifications in this table include bond fixed effects. The increase in the quantity of bonds is statistically significantly related to both the bid-ask spread and the log daily trading volume, measures of liquidity. With a negative and statistically significant coefficient on the bid-ask spread variable, we find that as the bid-ask spread narrows, the quantities of individual bonds in the creation basket increase. A similar result is seen for the log daily volume measure. As the log daily volume variable has a positive and statistically significant coefficient, the quantities of those bonds in the creation basket increase as liquidity rises. Interestingly, the stress indicator does not have any impact on the intensity of creation with respect to liquidity.

Regressions (5)-(8) indicate similar results for bonds in the redemption basket. Remember the average change in bond quantity is negative for redemptions. With a positive and statistically significant coefficient on the bid-ask spread variable, we find that as the bid-ask spread widens the quantities of individual bonds in the redemption basket increase. Results are consistent across liquidity measures. As bonds become more illiquid, bid-ask spreads widen or daily trading volume falls, the intensity of redemptions decreases. The impact is even greater on stress days when the trading volume is used to capture liquidity, as indicated in specifications (7) and (8).

Overall, the results in this section are consistent with Pan and Zeng (2019). While arbitrageurs take advantage of the creation and redemption processes to profit from relative mispricing and thereby maintain a close relation between the ETF price and its NAV, this process is hindered by decreases in bond liquidity. As this effect seems to be stronger for bonds in the redemption basket, our results suggest that APs are particularly concerned with adding a basket of illiquid bonds onto their balance sheet via the ETF redemption process at times when the markets for the bonds are stressed.

7. Conclusions

We investigated the impact of the HYG bond ETF on the markets for its underlying high-yield corporate bonds. Our results differ from Dannhauser's (2017) in one important respect. We find that the impact of a bond ETF on bond market liquidity depends on whether the bonds are being bought and sold as part of the creation and redemption processes, which will normally have a favorable impact on liquidity.

We also find that the bond liquidity effects are more complex and subject to reversal during market stress periods. The HYG ETF did have a favorable impact on individual bond liquidity during stress periods for bonds on the redemption list due to APs using the redemption process to arbitrage ETF underpricing. We also find that during stress periods, APs' inventory management motive can outweigh the arbitrage motive resulting in APs using the ETF creation process to reduce their bond inventories even though it might involve a negative arbitrage consistent with Pan and Zeng (2019). Overall, our results indicate that the underlying market impact of a corporate bond ETF like HYG is not uniformly favorable or unfavorable over the entire market cycle, but instead, depends on how the trading and risk management decisions of APs, market-makers, broker-dealers, and institutional investors interact with the full panoply of economic factors that affect the quality of these markets and on how that interaction plays out as bond market conditions change.

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Table 1. Summary Statistics

This table shows summary statistics for the main variables used in our analysis. The sample covers the time period from 2009 until 2016 and includes bonds in the BlackRock HYG ETF. *Bid-Ask Spread* and *Trading Volume* are liquidity measures described in the text. Price is a bond price from TRACE. *dStress* is equal to one on days when the Bank of America/Merrill Lynch high-yield spread index experiences a 1.96 standard deviation or greater increase and is zero otherwise. *dCreate* equals one on days when the bond is in the creation basket, and *dRedeem* equals one on days when the bond is in the redemption basket. Δq is the change in the quantity of bonds in the ETF from day $t-1$ to day t. Δq/q is the change in the relative quantity of bonds from day $t-1$ to day t.

	Mean	Median	N
Bid-Ask Spread	0.667	0.345	246,678
Log(Trading Volume)	7.250	7.601	429,423
Price	103.815	105.500	429,423
dStress	0.025	0.000	1,231,914
dRedeem	0.191	0.000	1,107,634
dCreate	0.207	0.000	1,107,634
Δq	3.234	0.000	1,231,001
Δq/q	0.003	0.000	1,231,001

Table 2. Change in the Quantity of Bonds

This table presents results of regression analysis on the change in the quantity of bonds in the ETF after a bond appears on the HYG ETF creation or redemption list. The dependent variable in specifications 1 and 2 is Δq, the change in the quantity of bonds in the ETF from day $t-1$ to day t. The dependent variable in specifications 3 and 4 is Δq/q, the change in the relative quantity of bonds from day $t-1$ to day t. The sample covers the time period from 2009 through 2016 and includes bonds in the BlackRock HYG ETF. *dCreate* equals one on days when the bond is in the creation basket, and *dRedeem* equals one on days when the bond is in the redemption basket. Daily data are used. Specifications 2 and 3 include bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) Δq	(2) Δq	(3) Δq/q	(4) Δq/q
dCreate	76.724***	70.346***	0.012***	0.009***
	(0.888)	(0.999)	(0.000)	(0.000)
dRedeem	-80.006***	-83.703***	-0.010***	-0.012***
	(0.915)	(0.967)	(0.000)	(0.000)
Constant	0.060	2.090	0.002***	0.003***
	(0.411)	(0.429)	(0.000)	(0.000)
Bond fixed effects	No	Yes	No	Yes
Observations	1,105,055	1,105,055	1,105,055	1,105,055
R-squared	0.011	0.017	0.002	0.008

Table 3. Impact on Bond Liquidity: Bid-Ask Spread

This table presents results of regression analysis on the impact on bond bid-ask spread of listing in the HYG ETF creation or redemption basket. The dependent variable is Bid-Ask Spread described in the text. The sample covers the time period from 2009 through 2016 and includes bonds in the BlackRock HYG ETF. *dCreate* equals one on days when the bond is in the creation basket, and *dRedeem* equals one on days when the bond is in the redemption basket. Daily data are used. Specifications 4-6 include day fixed effects; specifications 7-9 include bond fixed effects; and specifications 10-12 include both day and bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
dCreate	-0.05***		-0.06***	-0.05***		-0.07***	-0.02**		-0.02**	-0.03***		-0.04***
	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)
dRedeem		-0.03***	-0.04***		-0.06***	-0.07***		-0.01	-0.01*		-0.02***	-0.02***
		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Bond fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Observations	206,869	206,869	206,869	206,869	206,869	206,869	206,869	206,869	206,869	206,869	206,869	206,869
R-squared	0.000	0.000	0.001	0.035	0.035	0.035	0.222	0.222	0.222	0.247	0.247	0.247

Table 4. Impact on Bond Liquidity: Trading Volume

This table presents results of regression analysis on the impact on bond trading volume of listing in the HYG ETF creation or redemption basket. The dependent variable is log(Trading Volume) described in the text. The sample covers the time period from 2012 until 2016 and includes bonds in the BlackRock HYG ETF. *dCreate* equals one on days when the bond is in the creation basket, and *dRedeem* equals one on days when the bond is in the redemption basket. Daily data are used. Specifications 4-6 include day fixed effects; specifications 7-9 include bond fixed effects; and specifications 10-12 include both day and bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
dCreate	0.64***		0.67***	0.56***		0.62***	0.28***		0.30***	0.19***		0.21***
	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)
dRedeem		0.38***	0.40***		0.23***	0.30***		0.14***	0.16***		0.10***	0.12***
		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Bond fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Observations	356,207	356,207	356,207	356,207	356,207	356,207	356,202	356,202	356,202	356,202	356,202	356,202
R-squared	0.006	0.005	0.011	0.057	0.054	0.059	0.164	0.164	0.165	0.218	0.218	0.218

Table 5. Bond Liquidity and Stress Days: Bid-Ask Spread

These table presents results of regression analysis on the impact on bond bid-ask spread of listing in the HYG ETF creation or redemption basket on stress days. The dependent variable is Bid-Ask Spread described in the text. The sample covers the time period from 2012 until 2016 and includes bonds in the BlackRock HYG ETF. *dCreate* equals one on days when the bond is in the creation basket, and *dRedeem* equals one on days when the bond is in the redemption basket. *dStress* is an indicator variable that is equal to one when the Bank of America/Merrill Lynch high-yield spread index widens 1.96 standard deviations or more from its mean and is zero otherwise. Daily data are used. Specifications 4-6 include day fixed effects; specifications 7-9 include bond fixed effects; and specifications 10-12 include both day and bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
dStress	0.037***	0.062***	0.057***				0.059***	0.085***	0.080***			
	(0.012)	(0.013)	(0.014)				(0.011)	(0.012)	(0.012)			
dCreate	-0.054***		-0.057***	-0.056***		-0.068***	-0.016**		-0.017**	-0.034***		-0.038***
	(0.007)		(0.007)	(0.007)		(0.007)	(0.007)		(0.007)	(0.007)		(0.007)
dCreate x dStress	0.062		0.065	0.075		0.053	0.052		0.052	0.073*		0.055
	(0.043)		(0.043)	(0.046)		(0.046)	(0.038)		(0.038)	(0.041)		(0.041)
dRedeem		-0.031***	-0.034***		-0.055***	-0.064***		-0.005	-0.006		-0.018***	-0.021***
		(0.005)	(0.005)		(0.006)	(0.006)		(0.005)	(0.005)		(0.005)	(0.005)
dRedeem x dStress		-0.084***	-0.082***		-0.111***	-0.104***		-0.095***	-0.095***		-0.096***	-0.090***
		(-0.028)	(0.028)		(0.033)	(0.034)		(0.025)	(0.025)		(0.030)	(0.030)
Bond fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Observations	206,752	206,752	206,752	206,750	206,750	206,750	206,741	206,741	206,741	206,739	206,739	206,739
R-squared	0.000	0.000	0.001	0.034	0.035	0.035	0.222	0.222	0.222	0.247	0.247	0.247

Table 6. Bond Liquidity and Stress Days: Trading Volume

These table presents results of regression analysis on the impact on bond trading volume of listing in the HYG ETF creation or redemption basket on stress days. The dependent variable is Trading Volume described in the text. The sample covers the time period from 2012 until 2016 and includes bonds in the BlackRock HYG ETF. *dCreate* equals one on days when the bond is in the creation basket, and *dRedeem* equals one on days when the bond is in the redemption basket. *dStress* is an indicator variable that is equal to one when the Bank of America/Merrill Lynch high-yield spread index widens 1.96 standard deviations or more from its mean and is zero otherwise. Daily data are used. Specifications 4-6 include day fixed effects; specifications 7-9 include bond fixed effects; and specifications 10-12 include both day and bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
dStress	0.407***	0.339***	0.360***				0.383***	0.323***	0.348***			
	(0.024)	(0.026)	(0.026)				(0.022)	(0.024)	(0.024)			
dCreate	0.648***		0.679***	0.559***		0.619***	0.283***		0.306***	0.199***		0.218***
	(0.014)		(0.014)	(0.014)		(0.014)	(0.014)		(0.014)	(0.014)		(0.014)
dCreate x dStress	-0.217**		-0.265***	-0.176*		-0.129	-0.322***		-0.333***	-0.252***		-0.201**
	(0.088)		(0.088)	(0.095)		(0.096)	(0.082)		(0.082)	(0.087)		(0.088)
dRedeem		0.237***	0.395***		0.224***	0.297***		0.129***	0.152***		0.089***	0.110***
		(0.009)	(0.009)		(0.011)	(0.011)		(0.010)	(0.010)		(0.010)	(0.010)
dRedeem x dStress		0.195***	0.164***		0.260***	0.237***		0.169***	0.160***		0.279***	0.257***
		(0.057)	(0.057)		(0.068)	(0.069)		(0.053)	(0.053)		(0.062)	(0.063)
Bond fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Observations	355,863	355,863	355,863	355,863	355,863	355,863	355,858	355,858	355,858	355,858	355,858	355,858
R-squared	0.007	0.005	0.012	0.056	0.053	0.059	0.165	0.165	0.166	0.218	0.218	0.218

Table 7. ETF Mispricing and Stress Days

This table presents results of regression analysis on ETF mispricing on stress days. The dependent variable, *Misprice*, is the difference between the ETF Net Asset Value and the share price. The sample covers the time period from 2012 until 2016 and includes bonds in the BlackRock HYG ETF. *dStress* is an indicator variable that is equal to one when the Bank of America/Merrill Lynch high-yield spread index widens 1.96 standard deviations or more from its mean and is zero otherwise. Daily data are used. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Constant	dStress	N	R-Squared
Misprice	-0.515***	0.791***	1,831	0.034
	(0.017)	(0.135)		

Table 8. Mispricing and Dynamics of Creation and Redemption

This table presents results of regression analysis on the impact of ETF mispricing and bond market stress on the change in the quantity of bonds in the creation and redemption baskets. The dependent variable in specifications 1, 3, 5 and 7 is Δq, the change in the quantity of bonds in the ETF from day $t-1$ to day t. The dependent variable in specifications 2, 4, 6, and 8 is Δq/q, the change in the relative quantity of bonds from day $t-1$ to day t. The sample covers the time period from 2012 until 2016 and includes bonds in the BlackRock HYG ETF. *Misprice* is the difference between the ETF Net Asset Value and the share price. *dStress* is an indicator variable that is equal to one when the Bank of America/Merrill Lynch high-yield spread index widens 1.96 standard deviations or more from its mean and is zero otherwise. Daily data are used. We exclude bonds that are in both the creation and redemption baskets. All specifications include bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Creation Basket				Redemption Basket			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δq	Δq/q	Δq	Δq/q	Δq	Δq/q	Δq	Δq/q
Misprice	-124.289***	-0.033***	-138.826***	-0.035***	-92.329***	-0.007***	-75.475***	-0.007***
	(4.157)	(0.002)	(4.400)	(0.002)	(3.185)	(0.000)	(3.453)	(0.000)
dStress			24.349**	0.003			-50.977***	-0.002***
			(10.703)	(0.005)			(9.502)	(0.001)
Misprice x dStress			169.101***	0.035***			-115.511***	0.002
			(20.696)	(0.011)			(13.927)	(0.001)
Constant	39.846***	0.006***	33.932***	0.005***	-112.507***	-0.009***	-103.684***	-0.009***
	(1.886)	(0.001)	(1.989)	(0.001)	(1.826)	(0.000)	(1.961)	(0.000)
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	139,209	139,209	139,082	139,082	122,001	122,001	121,831	121,831
R-squared	0.057	0.024	0.058	0.024	0.041	0.052	0.042	0.052

Table 9. Liquidity and Dynamics of Creation and Redemption

This table presents results of regression analysis of the impact of bond liquidity and bond market stress on the change in the quantity of bonds in the creation and redemption baskets. The dependent variable in specifications 1, 3, 5 and 7 is Δq, the change in the quantity of bonds in the ETF from day $t-1$ to day t. The dependent variable in specifications 2, 4, 6, and 8 is Δq/q, the change in the relative quantity of bonds from day $t-1$ to day t. The sample covers the time period from 2012 until 2016 and includes bonds in the BlackRock HYG ETF. Bid-Ask Spread and Trading Volume are bond liquidity measures described in the text. *dStress* is an indicator variable that is equal to one when the Bank of America/Merrill Lynch high-yield spread index widens 1.96 standard deviations or more from its mean and is zero otherwise. Daily data are used. We exclude bonds that are in both the creation and redemption baskets. All specifications include bond fixed effects. Robust standard errors are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Creation Basket				Redemption Basket			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δq	Δq/q	Δq	Δq/q	Δq	Δq/q	Δq	Δq/q
dStress	-71.538	-0.014	104.965	-0.009	-288.596***	-0.012***	475.114***	0.012***
	(52.182)	(0.012)	(141.900)	(0.375)	(25.464)	(0.001)	(68.981)	(0.004)
Bid-Ask Spread	-30.430***	-0.009***			10.164**	0.001**		
	(8.897)	(0.002)			(5.148)	(0.000)		
Bid-Ask Spared x dStress	33.149	0.006			-17.353	0.000		
	(43.700)	(0.010)			(23.255)	(0.001)		
Log(Trading Volume)			26.448***	0.004***			-18.024***	-0.001***
			(2.646)	(0.001)			(1.378)	(0.000)
Log(Trading Volume) x dStress			-20.566	-0.001			-89.658***	-0.003***
			(17.234)	(0.004)			(8.336)	(0.001)
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,247	14,247	21,969	21,969	33,375	33,375	54,216	54,216
R-squared	0.141	0.115	0.120	0.090	0.054	0.123	0.048	0.091