Corporate Bond ETFs:
Bond Yield and Liquidity Effects

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Abstract

Corporate bond Exchange Traded Funds (ETFs) lower the yield and have an insignificant or negative impact on the liquidity of constituent bonds. A 1% increase in ETF ownership decreases non-investment grade yields by 8.9 basis points and investment grade yields by 5.4 basis points. Two quasi-natural experiments confirm the lower yield effect. ETF activity has an insignificant impact on high yield bond liquidity, but increases the transaction costs of investment grade bonds. In both markets, ETF activity decreases the proportion of retail volume. These results support theoretical predictions that liquidity traders exit the underlying market when a basket security exists.

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1. Introduction

Financial innovation previously limited to equity markets has come to the corporate bond market. In particular, corporate bond Exchange Traded Funds (ETFs), baskets of bonds traded as a single stock, are now a popular investment vehicle for investors to establish, hedge, and manage their exposure to the underlying market. Theories predict that financial innovation may alter the underlying because of innovation's ability to complete markets, to offer lower transaction costs, and to address adverse selection and asymmetric information differences (Tufano (2003)). In this paper, I use the distinct institutional features of corporate bond ETFs to cleanly identify the implications of financial innovation for the underlying securities. Specifically, I investigate the impact of ETFs on the yield and liquidity of constituent bonds. I find that ETF ownership lowers the yields of both non-investment grade (high yield) and investment grade bonds. ETF activity also has an insignificant impact on high yield liquidity, but increases the transaction costs of investment grade bonds. In both the high yield and investment grade markets, the proportion of retail volume decreases significantly. Overall, my results support theories from Dow (1998), Gammill and Perold (1989), Gorton and Pennacchi (1993) and Subrahmanyam (1991), which predict that the existence of a basket security will lead liquidity traders to exit the underlying market

As the first exchange traded basket securities in the corporate bond market, ETFs have experienced significant growth since their 2002 introduction. At the end of 2013, ETFs had nearly $100 billion in corporate bond dedicated assets. Demand for ETFs has come from both retail investors, who have limited access to the underlying market, and from institutional investors, who use the vehicle to participate in or hedge against broad market movements.[1] Corporate bond ETFs have also attracted the attention of regulators concerned with the "liquidity illusion" created by the mismatched conditions of demandable equity backed by illiquid debt.[2] This paper focuses on corporate bond ETFs for three key reasons. First, the disparity between the ETF market and underlying market raises the potential for even greater effects than for equity ETFs. Second, given the importance of debt financing it is critical to understand innovation's role in the corporate bond market. Third, using corporate bond ETFs provides settings for clean identification strategies.

[1] http://www.icifactbook.org/fb_ch3.html
[2] http://www.bloomberg.com/news/2014-09-26/pimco-etf-probe-spotlights-270-billion-market-vexing-regulators.html

Using a sample of monthly bond observations from January 2009 to November 2013, I execute both a fixed effects model and quasi-natural experiments to address endogeneity issues associated with studies of financial innovation as described by Mayhew and Mihov (2004). In the fixed effects model, monthly observations of volume-weighted yields over the maturity-matched swaps rate are regressed on ETF ownership, credit risk measures, various lagged liquidity measures, and both bond and time fixed effects. I find that a 1% increase in ETF ownership decreases yield spreads by 8.9 basis points for high yield bonds and 5.4 basis points for investment grade bonds. Economically, these reductions correspond to a 2% and 4% decrease in average yield spreads, respectively.

I confirm the lower yield effect using two quasi-natural experiments to obtain exogenous variation in ETF status. My tests exploit the rules governing the indices followed by two important ETFs: the iShares iBoxx $ High Yield Corporate Bond ETF (HYG) and the iShares IBoxx $ Investment Grade ETF (LQD). These ETFs use Markit benchmarks, rather than the Barclays indices favored by mutual funds. By focusing on indices tracked only by ETFs, I am able to disentangle the ETF effect from a general index fund effect. First, I use a rule change that expanded the universe of bonds eligible for HYG. I find that bonds immediately purchased by the ETF due to the expansion have yield spreads 140 basis points lower than the control group, of original ETF bonds, over the six-month transition period. The original holdings, which experience a decrease in weighting, are used as controls to mitigate concerns that ETF bonds are inherently different from index bonds not held by the ETF. Next, I execute a natural experiment in the investment grade market by documenting that LQD strictly adheres to a minimum three year time to maturity threshold. This experiment shows that bonds sold due to the rule have 4.2 basis points higher yield spreads in the three months following the sale relative to maturity matched non-LQD investment grade bonds. The lower yield effect supports the anecdotal claims of Wall Street of an "ETF Bid."[3] Furthermore, it backs theoretical predictions that financial innovation increases prices and lowers expected returns (Gorton and Pennacchi (1993), Subrahmanyam (1991); Detemple and Selden (1991), Ross (1976)).

My empirical analysis continues by investigating the liquidity effect of ETFs on constituent bonds. Liquidity is a multi-faceted concept with no consensus proxy. Therefore, I use several proxies suggested by literature; including, the Imputed Roundtrip Cost (IRC) from Feldhütter (2012), the bid-

[3] http://blogs.barrons.com/focusonfunds/2012/10/01/the-bond-markets-etf-bid/

ask proxy from Chakravarty and Sarkar (2003) and Hong and Warga (2000), the price impact of trade from Amihud (2002), the Zero measure of Chen, Lesmond, and Wei (2007), and turnover. Following Korajczyk and Sadka (2008), I also use Principal Components Analysis (PCA) which combines information from the various measures to construct a common liquidity factor. I run fixed effects regressions of the different liquidity proxies on lagged measures of ETF activity, average rating, lagged active and index mutual fund ownership, and both bond and time fixed effects. Four attributes unique to ETFs are used to construct proxies of ETF activity: ETF ownership, creation and redemption intensity (Da and Shive (2013)), ETF turnover, and ETF short interest. Generally, ETF activity is shown to have an insignificant impact on the liquidity of underlying high yield bonds. However, in the investment grade market liquidity, as measured by cost proxies and the first principal component, is significantly negatively related to ETF activity. The results of these tests imply that individual bond liquidity may deteriorate. However, from a broad market perspective it is possible that liquidity is actually improved by the ability to trade in ETFs.

Finally, I examine theoretical predictions that basket securities induce liquidity traders to exit the market. For each bond-month, the volume attributed to different trade types as a portion of total volume is computed. Following Goldstein, Hotchkiss, and Sirri (2007), I denote any trades less than $100,000 as retail. I also use the TRACE truncation levels of $1 million for high yield bonds and $5 million for investment grade bonds to create additional volume bins. Running a fixed effects regression with the proportion of volume for each bin as the dependent variables, I document a negative relationship between the proportion of retail trading and ETF activity in both markets. I also show that for the average investment grade bond-month 52% of trade volume is retail sized, while there is a more even distribution across liquidity bins in the high yield market. These differences suggest a more active retail market for investment grade bonds and may account for the lack of liquidity results in the high yield market.

Overall, my results support theoretical predictions that ETFs can change the composition of traders in the underlying market as suggested by Dow (1998), Gammill and Perold (1989), Gorton and Pennacchi (1993) and Subrahmanyam (1991). The migration of retail traders out of the underlying leads to a higher proportion of informed traders, which is known to result in higher bid-ask spreads (Copeland and Galai (1983), Glosten and Milgrom (1985)) and lower potential profits (Easley and

O'Hara (2004), Gorton and Pennacchi (1993), Grossman and Stiglitz (1980)). Essentially, ETFs leave informed traders to compete for liquidity and to their trades being more informative, lowering expected returns (yields). Furthermore, the lower yields also are in-line with predictions that financial innovation completes markets from a spanning and risk transfer perspective (Detemple and Selden (1991), Ross (1976)).

As the first study of corporate bond ETFs, I extend the existing literature on the price consequences of financial innovation, which to date has produced conflicting theoretical predictions and empirical results. Empirically, Conrad (1989), Detemple and Jorion (1990), and Jordan and Kuipers (1997) find a positive price impact in their studies of options and Treasury bond futures supporting theories from Detemple and Selden (1991), Gorton and Pennacchi (1993) and Ross (1976). In contrast, Danielsen and Sorescu (2001) and Sorescu (2000) find the options effect turns negative after 1981, which they claim is due to lower short sale constraints (Miller (1977)). Two papers by Bae, Kang, and Wang (2013) and Madura and Ngo (2008) find conflicting results on the valuation effect of equity ETF introductions. Regardless of the underlying or innovation studies, the field has trouble obtaining clean identification due to endogeneity concerns around product introductions.

This paper also adds to the growing literature of basket securities, particularly ETFs. Hegde and McDermott (2004) show that the transaction costs of Dow Jones 30 stocks decreased, while Nasdaq 100 stocks were unaffected following the introduction of the corresponding ETFs. However, Van Ness, Van Ness, and Warr (2005) use a matched control group to document higher transaction costs for Dow Jones stocks. Hamm (2014) finds that ETF ownership increases the adverse selection component of the bid-ask spread for underlying equities. The higher transaction costs are similar to those found by Jegadeesh and Subrahmanyam (1993) in their study of S&P futures. Additional research finds that stock ownership by ETFs increases the comovement of stocks with the market Da and Shive (2013) and increases volatility Ben-David, Franzoni, and Moussawi (2014).

Finally, this paper contributes to the literature on the structure of the OTC corporate bond market. Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007) and Goldstein, Hotchkiss, and Sirri (2007) use the introduction of trade level reporting to document a negative relationship between transparency and transaction costs. Bao, Pan, and Wang (2011), Chen, Lesmond, and Wei (2007), Dick-Nielsen, Feldhütter, and Lando (2012) and Friewald, Jankowitsch, and

Subrahmanyam (2012) all demonstrate the importance of liquidity as a determinant of yield spreads. Das, Kalimipalli, and Nayak (2014) look at another form of financial innovation in the corporate bond market, Credit Default Swaps (CDS). The authors find that CDS have a detrimental impact on the efficiency and an insignificant effect on price discovery and liquidity of the underlying corporate bond.

2. Background

Fixed income ETFs were first introduced to the US market in June 2002 by iShares from Barclays Global Investors, now owned by Blackrock. Figure 1 documents the rapid growth in assets under management for three ETF types since the inception of the market. The first is all fixed income ETFs. The second includes all ETFs that hold corporate bonds, specifically pure corporate bond ETFs and total bond market ETFs. The third is pure corporate bond ETFs. Also plotted is the growth in ETF monthly volume over total TRACE volume over the period. This volume ratio demonstrates the growing popularity of ETFs as a fixed income investment alternative, with $2 of ETFs traded for every $5 of the underlying at its peak level.

[Insert Figure 1]

2.1. ETF Structure

Since this paper attempts to discern the impact of ETFs on the pricing and liquidity of the corporate bond market, it is important to understand the mechanisms that link the instrument to the underlying. Simply put, ETFs are basket securities traded on an exchange as a stock. The hybrid structure of ETFs combines the advantages of traditional mutual funds and Closed-End Funds (CEFs), with lower management fees, greater transparency, and tax efficiencies to attract investors (Poterba and Shoven (2002)). Although registered under the Securities and Exchange Commission (SEC) Act of 1934 and the Investment Company Act of 1940, the in-kind creation and redemption feature that distinguishes ETFs from their mutual fund peers requires relief from certain governance provisions. Key exemptions are related to sections of the Investment Company Act that require redeemable individual securities, continuous offerings, and trading only at the net asset value (NAV), while prohibiting transactions with affiliated persons.

2.1.1. *ETF Origination*

An ETF is created by a sponsor who specifies the investment objective, index, and tracking methodology. Fixed-income benchmarks are very large, thus representative sampling is typically employed. Moreover, eligibility is based on strict size, maturity, and ratings thresholds making inclusion and exclusion information-free events, unlike equity index changes (Dick-Nielsen (2013)). The duties of the sponsor include daily publishing and management of portfolio holdings. Generally, ETF management is much simpler than mutual fund management because most transactions occur between investors on the exchange without sponsor involvement. In addition, Authorized Participants (APs) – market makers, specialists, and other institutional investors – handle transactions in the underlying associated with sizeable creation and redemption demand. These transactions are discussed in further detail in the next section. Trading by the sponsor is typically limited to index changes and corporate actions. Since managers do not trade in the underlying to meet investor orders commissions, expenses, and capital gains are all suppressed.

One of my identification strategies relies heavily on an important sponsor, iShares. Not only was iShares the first to introduce fixed income ETFs, but it also continues to represent approximately 50% of the market. In particular, I focus on two of their funds, HYG and LQD. These ETFs were the first and remain the largest offerings in their respective investment class. Of particular importance, is that the indices used by HYG and LQD are administered by Markit rather than Barclays. Using ETFs that follow Markit indices allows me to disentangle an ETF specific effect.

2.1.2. *ETF Trading*

ETF trading occurs in two venues, the primary and secondary markets. The primary market is used by ETFs to handle liquidity shocks in the secondary market, to ensure that orders are filled, and to arbitrage excessive price deviations from NAV. This market is the direct channel linking ETFs to the underlying. It involves large transactions between APs and the sponsor in the in-kind creation and redemption process. An AP creates ETF shares by depositing the specified basket-a portfolio of securities and any cash component-with the fund sponsor in exchange for a creation unit (typically

50,000 ETF shares).[4] Upon receipt of the creation unit, the AP can sell the ETF shares in the secondary market. The redemption process entails the AP collecting ETF shares and exchanging the redemption unit for a basket of underlying. In contrast, the creation and redemption process of traditional mutual funds occurs between the fund and individual investors and entails an exchange of cash for individual units of fractional holdings in the underlying basket. The secondary market is represented by the supply and demand features that characterize common stocks and CEFs, where buyers and sellers of the ETF transact directly on the exchange. In contrast to CEFs, the number of shares outstanding of ETFs fluctuates due to the in-kind creation and redemption mechanism. Another distinguishing feature from CEFs is that, ETF investors with access to the corporate bond market can also engage in risky arbitrage between the secondary ETF market and the underlying market.

3. Data Description

This section details the comprehensive monthly dataset constructed from the period January 2009 to November 2013. First, corporate bond transaction data is sourced from TRACE. First introduced on July 1, 2002, the TRACE database now contains transaction level data for 99% of transactions in the corporate bond market, including the bond CUSIP, the transaction date and time, the price and yield, the volume, and after October 2008 an identifier for buy, sell, or dealer transactions. Reflecting the drive for improved transparency, the first corporate bond ETFs were introduced on June 26, 2002 concurrent with the first stage of TRACE. To avoid the confounding effects of TRACE introduction and to study a period when the assets held by ETFs are no longer negligible, the data begins in 2009.

For all transactions with an observable CUSIP in the TRACE historical database, I match bond level characteristics from Bloomberg on eight-digit CUSIP. Using these descriptive characteristics, I trim the dataset to include only fixed-rate straight, callable, and putable bonds. In addition, for each bond I create an average rating using numerical conversions of S&P, Moody's, and Fitch ratings. Finally, I filter out possibly erroneous trades using the method of Dick-Nielsen (2009) and set the reported yield to missing for any trades with a reported price under a dollar. Using the TRACE

[4] The cash component accounts for creation fees (range from $250 to $1,500 per unit), accrued coupon payments, interest on coupon payment, any capital gains less losses that have not been reinvested since the last distribution, and small amounts to cover rounding in the number of shares delivered

database, I compute monthly liquidity statistics for each CUSIP. Measures are winsorized at the 1% level to mitigate the influence of outliers.

The yield spread of a bond is calculated as the monthly volume-weighted yield over the maturity-matched risk-free proxy. I use the swap rate as the risk-free rate proxy rather than the Treasury rate to follow Grinblatt (1995), Collin-Dufresne and Solnik (2001), Longstaff (2004), Hull, Predescu, and White (2005), Blanco, Brennan, and Marsh (2005), and Feldhutter and Lando (2008). All of these authors argue that the Treasury rate is an inappropriate risk-free proxy due to its extreme liquidity and benchmark status. The computed yield spread is winsorized at the 1% level by investment grade status

Next, I identify and classify ETFs using the CRSP Survivor-Bias-Free U.S. Mutual Fund database and hand-collected data from fund fact sheets and prospectuses. I first attempt to identify corporate bond ETFs using the *et_flag* and *crsp_obj_cd* fields of the CRSP Mutual Fund Summary dataset. However, when I compare potential corporate bond ETFs found with this filter to those from various sponsors' websites, I find some errors. Therefore, I develop an alternative methodology that starts by compiling a list of all fixed income ETFs from both CRSP and the ETF database website.[5] I then use prospectuses to catalog the ETFs into one of twelve broad classifications.[6] Since this paper studies the corporate bond market, I focus on those ETFs that hold corporate bonds – Broad Based and Pure Corporate. I augment the classification scheme with six subclasses.[7] Finally, for each ETF identified as having maturity-based eligibility, I find the benchmark and the maximum and minimum time to maturity thresholds. In total, I identify 97 ETFs that have some portion of their holdings in corporate bonds. Of this number, 73 are pure corporate ETFs and 24 are broad-based fixed income ETFs.

Holdings data for TRACE bonds is primarily sourced from the CRSP Mutual Fund Quarterly Database, but with three critical modifications. First, the information for ETF offerings not affiliated with a mutual fund begins with regularity only in 2010. The missing data is particularly problematic because iShares represented 100% of corporate credit ETFs until 2007 and approximately 50% of the segment's assets as of the end of the sample. I address this issue by replacing the iShares data from

[5] http://etfdb.com/type/bond/all/

[6] (1) Government, (2) Money Market, (3)Municipals, (4) Mortgage Backed Securities, (5) Inflation-Protected, (6) Emerging Markets, (7) Preferred, (8) International Government, (9) Closed-End Funds, (10) Loans, (11) Broad-Based, and (12) Pure Corporate.

[7] (1) Inverse, (2) Leverage, (3) High Yield, (4) Investment Grade, (5) Maturity Based, (6) Bullet

the CRSP holdings database with the complete time series of month-end holdings from the company's website. To ensure the accuracy of the correction, I compare the months for which I have overlapping data and find that over 99% of the holdings match. Historical monthly holdings for non-iShares providers, such as SPDRs, Powershares, and ProShares, are unavailable leading to a potential underestimation of ETF holdings prior to 2010. Second, I account for portfolios that report holdings for all funds under one portfolio number. For instance, Vanguard considers ETFs as a separate share class of their mutual funds. To identify the portion of a portfolio's holdings attributable to the ETF, I find the weight of the ETF's total net assets relative to the total net assets of all associated funds. I then multiply this weight by the portfolio's holdings of each bond to obtain the ETF specific holdings. Third, I account for differences in monthly reporting by ETFs and quarterly reporting by mutual funds. To compute monthly estimates from quarterly reports I apply the reported end of quarter holdings to all months of the quarter. I then multiply the holding by the percentage change in fund assets between the reporting date and the observation month. For ETFs that are subsidiaries of a mutual fund, the mutual fund's holding is the difference between the total monthly holding and the ETF holding. I sum the par value of ETF holdings and mutual fund holds of individual bonds to determine the monthly percentage of a bond's amount outstanding held by the two groups. Any observation where the combined ETF and mutual fund ownership is greater than 100% is deleted.

Next, I obtain the daily price, volume, and returns of the ETFs from the CRSP US Daily Stock Database. In addition, I get daily shares outstanding and short interest data from Compustat. The daily shares from Compustat are updated with greater frequency than those from CRSP and thus give a more accurate view of the creation and redemption activities of the ETFs. Finally, I collect issuer-level credit risk controls from the Compustat Quarterly Fundamental File and compute equity volatility from the CRSP Daily Stock Database. Credit risk controls are also winsorized at the 1% level. The Compustat data is merged with the TRACE dataset on a six-digit CUSIP and the CRSP data is merged using the stock CUSIP from Compustat. In total I compile 496,806 bond-month observations on 20,312 individual bonds from 2,945 issuers.

Throughout the study I consider the implications for the ETFs on the high yield and investment grade bonds separately to account for differences in the pricing and functioning of the two subclasses of the investment spaces. Table 1 presents summary statistics of the observable characteristics of bonds held by ETFs for at least one month of the sample relative to non-ETF bonds.

[Insert Table 1]

Panel A documents the summary statistics for the 114,250 bond-month observations in the high yield market, representing 7,016 bonds from 1,602 issuers. In this market 25.4% of bond-months, 20.2% of individual bonds, and 45.4% of issuers have positive ETF ownership. The details of Panel A reveal that ETFs generally hold bonds with higher mutual fund ownership and coupons. Furthermore, there is a great disparity in the amount outstanding between ETF and non-ETF bonds, with ETFs preferring larger issues. Beyond these details all other characteristics are generally similar. Panel B reports the summary statistics for the 382,556 bond-month observations for 15,231 individual bonds from 1,754 issuers in the investment grade market. In this market, 35.5% of bond-months, 30.0% of individual bonds, and 62.9% of issuers are associated with ETF holdings. Again, the results show that bonds held by ETFs are larger, but here they hold lower rated bonds on average. However, the remaining characteristics are similar across non-ETF and ETF bonds. These summary statistics demonstrate the importance of controlling for bond specific characteristics to avoid the endogeneity concerns discussed in the next section.

4. Empirical Methodology and Results

This section details the empirical methodology and results. However, before proceeding I discuss endogeneity concerns common to studies of financial innovation. As described in Mayhew and Mihov (2004) these introductory events are not random, with both cross-sectional and time-series endogeneity concerns existing.

4.1. Endogeneity Concerns

Cross-sectional endogeneity arises if the bonds selected for inclusion in an ETF are different from those not selected on some observable or unobservable dimensions. Unlike equity ETFs, the size of bond indices and the characteristics of the corporate bond market make full replication impractical, if not impossible. In their attempts to replicate the cash flow, duration, industry, and rating characteristics of the benchmark it is possible that managers could hold bonds that are likely to outperform or the most liquid index bonds. While the liquidity story is reasonable, concerns of managers picking bonds likely to outperform are less plausible because ETFs focus on tracking error and replication rather than absolute performance.

Time-series endogeneity occurs because ETF introductions are the result of decisions made by sponsors. Since sponsors are often associated with traditional money managers, it is likely that product introductions are made in anticipation of investment themes advantageous to the investment space covered by the ETF. If it is true that sponsors create instruments in expectation of changing yields and liquidity, time series endogeneity may cause a spurious relationship between ETFs and the outcome variable of interest. Next, I propose fixed effects models and two quasi-natural experiments to address these endogeneity concerns.

4.2. The Yield Effect: Two-Way Fixed Effects Panel Regression

My attempts to identify a causal relationship from the ETF market to the corporate bond yields begin with a fixed effects panel regression. To correct for correlations between bonds from the same firm, standard errors are clustered at the six-digit issuer CUSIP level. In particular, for each investment grade class I run the specification,

$$Spread_{i,t} = \alpha_i + \lambda_t + \gamma \% ETF_{i,t} + \beta_1 X_{i,t} + \beta_2 Liquidity_{i,t-1} + \varepsilon_{i,t}. \quad (1)$$

where $Spread_{i,t}$ is the volume-weighted average of the yield spread of bond i to the to the linearly interpolated maturity-matched swap rate in month t. I incorporate bond level fixed effects, α_i, to account for time invariant bond heterogeneity and date fixed effects, λ_t, to control for common trends. $\% ETF_{i,t}$ is the percentage of total ETF ownership of a bond's amount outstanding.

Since two-way fixed effects are used, the only covariates, $X_{i,t}$, necessary are those that vary at the bond and date level. The controls include $Rating_{i,t}$, the numerical average of the S&P, Moody's, and Fitch ratings, to account for the impact of ratings changes.[8] I follow Blume, Lim, and Mackinlay (1998) by controlling for credit risk with $Leverage_{i,t}$, the market value of leverage; $Operating_{i,t}$, the ratio of operating income to sales; $LT\ Debt_{i,t}$, the ratio of long-term debt to assets; $Equity\ Vol_{i,t}$, equity volatility; and four pretax interest coverage dummies, $Pretax\ Dummies_{i,t}$.[9] In some specifications, I

[8] Results are robust to the use of S&P ratings dummies.
[9] The pretax dummies are defined using pretax interest coverage ratio (IRC) equal to EBIT over interest expense. Since the distribution is known to be highly skewed dummies are created to allow for a non-linear relationship. The first dummy equals the IRC it is less than 5 and equals five it is above. The second dummy equal zero if IRC is below, 5 if IRC is above 10, and IRC minus 5

also include mutual fund ownership, $\%MF_{i,t}$, and index fund ownership, $\%Index_{i,t}$, to ensure the results are robust to controlling for other institutional investors. Typically, the impact of general economic conditions is controlled for using the level and slope of the swap curve, but the time fixed effect eliminates the necessity of these controls. Common bond specific controls such as coupon, age, time to maturity, and amount outstanding are either time invariant or change linearly so they are not included in the specification.

4.2.1. *Liquidity Measures*

Finally, I control for lagged liquidity, $Liquidity_{i,t-1}$, using measures from the corporate bond literature and a common liquidity factor found from PCA. Lagged liquidity proxies are used since contemporaneous measures would be an endogenous control because it is a potential outcome variable to the covariate of interest. The first measure is the Imputed Round Trip Cost (IRC) from Feldhütter (2012), which is a proxy for the percentage effective spread. IRC utilizes a common occurrence in the corporate bond market of two or three trades happening close together after a period of no trades. The measure is computed as the difference between the highest and lowest price in a roundtrip trade over the highest price. Next, $HW\ Spread$ is the bid-ask spread of Hong and Warga (2000) and Chakravarty and Sarkar (2003). Using trading side indicators, the measure is calculated as the difference in the dollar weighted average price of trades transacted on the ask side minus the dollar weighted average price of trade transacted on the bid side. $Amihud$ is a measure of the price impact of trade developed by Amihud (2002). Amihud in this study measures the basis point price impact of a \$1 million trade. $Zeros$ is calculated as the sum of zero trade days and zero return days over total trading days in a month. Finally, $Turnover$ is used as a measure of trading activity.

Since there is no consensus in the literature on the appropriate measure of liquidity, I conduct a PCA to see which measures capture the information most relevant to liquidity. PCA extracts information from the liquidity measures to construct factors to maximize the explanatory power. Following Korajczyk and Sadka (2008), I standardize all measures so that they represent liquidity, rather than illiquidity. I also account for magnitude discrepancies, which can lead to overweighting, by normalizing the liquidity measures. I do so by defining $L_{i,t}^{j*}$, for bond i in month t for the j liquidity

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for values between 5 and 10. The third dummy equals zero if the IRC ratio is below 10, IRC minus 10 if it is between 10 and 20, and 10 if above. The fourth dummy equals zero if IRC is below 10, IRC minus 20 if IRC is between 20 and 100, and 80 if IRC is above 100.

measures (j=1,2,…,5). The standardized measure is $L_{i,t}^{j} = (L_{i,t}^{j*} - \mu^{j})/\sigma^{j}$, where μ^{j} and $\sigma^{j}$are the mean and standard deviation of liquidity measure j. The principal components analysis is presented below in Table 2.

[Insert Table 2]

Panel A shows the principal component loadings on each of the five liquidity measures. The first component explains 44% of the variation in the liquidity variables and is a transaction cost proxy. The second component explains 22% of the variation and is a Zeros measure. The third component explains 16% and is a trading frequency measure with the highest loadings on Zeros and Turnover. The remaining principal components explain less than 20% of the total variation and do not have clear interpretations. Panel B presents regressions of the yield spread on the credit risk controls and all of the principal components. From this panel it is evident that the first principal component has the known negative relationship between liquidity and yields. However, the second and third principal components have a positive coefficient is all specifications. This is likely due to the difficulty of interpreting the Zeros proxy. As Dick-Nielsen, Feldhütter, and Lando (2012) discuss, the number of days with no trades may actually decrease in periods of illiquidity as traders are forced to parcel out trades into more frequent trades of smaller size. Going forward I use $PC1$, the first principal component, as my final liquidity proxy. Appendix A presents detailed descriptions of the liquidity controls.

Summary statistics for these proxies are presented in Table 3. Panel A documents the distribution and Panel B the correlations.

[Insert Table 3]

4.2.2. *Results*

Panel A of Table 4 presents the results of the fixed effects panel regression in the high yield market, while Panel B is for the investment grade market. The first column runs the test without a liquidity proxy, while columns two through seven include different liquidity proxies. Finally, column seven includes both mutual fund and index fund ownership and column eight includes only index fund ownership.

[Insert Table 4]

Regardless of the specification, the coefficient on $\%ETF$ is negative. The coefficients indicate that a 1% increase in the portion of a bond held by the ETF leads to an 8.9 basis points lower yield spread for the high yield market and a 5.4 basis points lower yield spread for the investment grade market. Interestingly, the coefficient on ETF ownership is on three times larger than that on mutual fund ownership; while, the coefficient on index ownership is insignificant.

The panel setting achieves the objective of addressing endogeneity associated with ETF selection of bonds and time trends. However, it relies strictly on within bond variation for identification of a causal relationship. For instance, if each bond is only included in an ETF for one month, this observation drives the results. To further examine the relationship between ETFs and corporate bond yields, I execute two quasi-natural experiments

4.3. The Yield Effect: Quasi-Natural Experiments

In this section, I detail the two quasi-natural experiments that I use to obtain exogenous variation in ETF status. The corporate bond index market provides a clear setting to study inclusion and exclusion events given that eligibility is dictated by strict rules. Typically these rules are based on publicly available bond characteristics, such as amount outstanding, total issuer amount outstanding, rating, age, and time to maturity. I focus on the largest high yield and investment grade ETFs: HYG and LQD. As the original and largest offerings in their respective investment classes they provide a fair representation of the impact of corporate bond ETF market as a whole. These ETFs are benchmarked to Markit indices, rather than the Barclays family of indices used by most bond index managers. To the best of knowledge, no mutual fund explicitly uses the same benchmark as LQD and HYG.

The particular experiments that I focus on involve both an inclusion and an exclusion event. The inclusion experiment involves a rule change that expanded the universe of eligible bonds by removing a cap on the number of index constituents. The exclusion experiment involves a three-year minimum time to maturity threshold. In both settings, I run the difference-in-difference specification

$$Spread_{i,t} = \alpha_i + \lambda_t + \delta(Treatment_i * Post_t) + \beta_1 X_{i,t} + \varepsilon_{i,t}, \qquad (2)$$

where $Treatment_i$ is equal to one for bonds affected by the shock and zero for the control group. $Post_t$ is equal to one for the months following the event. The covariates, $X_{i,t}$, include average rating, leverage, operating, long-term debt, and equity volatility. Again in some tests I control for different institutional ownership. I do not include the pretax dummies of the panel regression because they do not vary sufficiently over the small windows studied. The coefficient of interest in both studies is δ, which identifies the differential effect of the event on the treatment group relative to the control group in the months following the shock.

4.3.1. *Quasi-Natural Experiment #1: The Expansion of the Index Universe*

Rule changes provide a clear environment to begin identification of the casual relationship between ETFs and the underlying bonds. In this quasi-natural experiment, I focus on rule changes to the indices followed by HYG and LQD. The particular rule change I use eliminated caps on the number of constituents of the underlying index followed by these two important ETFs. Specifically, on June 22, 2009 the Markit Group issued a press release modifying the eligibility guidelines for the iBoxx High Yield Liquid Index followed by HYG effective immediately upon rebalancing on June 30th. A similar rule change for the iBoxx Investment Grade Index was announced on September 17, 2009 for implementation over a three month period. I focus on the high yield rule change since it was announced first.

The new rule transitioned the existing index from an equal-weighted 50 bond index to a three-percent-capped value-weighted index including all eligible securities, nearly 300. The stated rationale was that the high yield market had doubled in size since the inception of the index making the limited number of constituents "less representative of the entire liquid high yield market."[10] In addition to removing the cap and altering the weighting method, the amount outstanding minimum was raised and an issuer amount outstanding minimum was imposed. The transition from the original index to the expanded index occurred over a six month period to allow a "gradual and orderly shift." The original index was defined as those bonds in membership on month end May 2009. The expanded index contained all bonds eligible, under the new methodology at each transition rebalancing, including members of the original index. During the transition period, pro-rata adjustments of old

[10] http://www.markit.com/assets/en/docs/products/indices/news/2009/06/Markit_iBoxx_USD_LQ_HY_Rule_changes_20090622.pdf

and new bonds occurred at each month-end (e.g. in June the original index was weighted at $\frac{5}{6}$ and the expanded index $\frac{1}{6}$ and in July the weights were $\frac{4}{6}$ and $\frac{2}{6}$). The ideal setting would be a completely unexpected rule change, but it is likely that bond market participants anticipated this redefinition since market makers and bankers sit on the Technical Committee charged with identifying constituents and recommending rule changes and asset managers make up the Oversight Committee responsible for reviewing recommendations. However, given the difficulty of accessing the high yield market it is unlikely that front running was a significant factor in the six trading days between the announcement of the rule change and the implementation. Also, anticipation would bias against significant results. Appendix C documents the details of the rule changes for both indices.

For the experiment to be a credible identification method, it is critical to ensure that the ETFs follow the index rules and to identify treatment and control groups. Figure 2 plots the number of holdings by the ETF. This figure shows that the funds adhere to the caps strictly prior to the announcements and quickly adjust their holdings to reflect the removal of the constituent caps. Next, Panel B of Figure 2 illustrates that HYG gradually bought the bonds of the expanded index, most likely reflecting the pro-rata adjustment during the transition period.

[Insert Figure 2]

HYG made the largest purchase of expansion bonds in July, so I consider all bonds purchased in this period as the treatment group. I use the members of the original index, which see their average weighting reduced from 1.95% in May to 0.84% in December, as the control group. I argue that this is the preferred control group for bonds added to the ETF early in the transition because the cap was the only thing preventing prior membership. In addition, using the original group reduces any concerns of selection bias discussed in the endogeneity section above. In the difference-in-difference specification of equation (2), $Treatment_i$ is equal to 1 for expansion bonds and zero for the original bonds. The typical difference-in-difference specification relies on one pre- and post-period. However, since implementation of the rule changes takes place gradually I rely on monthly time-series data. For the high yield bonds, I consider a six-month window around the event. Thus, $Post_t$ equals zero from January to June and equals one from July to December. I limit the number of periods to only the transition period to reduce potential serial correlation issues detailed by Bertrand, Duflo, and

Mullainathan (2004). Using additional pre- and post-periods is only useful if the common trend assumption underlying the difference-in-difference specification is satisfied, which I document below.

The coefficient of interest, δ, identifies the differential reaction to the rule change between the treatment and control group. A positive δ implies that the yield spreads of the expansion bonds are higher in the six months following the rule change than those of the original group. A negative δ indicates that the yield spreads of the treatment bonds are lower than those of the control group due to the rule change. Given the limited number of bonds in the sample, I cluster at the bond level.

Figure 3 depicts the time series of yields for the two groups around the event. I also include the average yields of bonds on the eligible list provided by Markit upon announcement of the amendment that are not purchased by the ETF in the six-month transition period. The figure provides evidence that the levels of yield spreads meet the common trend assumption. Additionally, it shows that the divergence in trends begins immediately after the expansion bonds were added to the index and occurs gradually over the transition period. Moreover, Figure 3 provides visual support for ETFs leading to lower yield spreads for constituents. Immediately following the rule change the yield spreads of the treatment group move lower relative to those of the original bonds reflecting their inclusion and the reduced weighting of the control bonds. Moreover, index only bonds, those added to the index but not purchased by the ETF, do not experience a similar movement indicating the ETF effect dominates the index effect. The figure ends in December 2011 when the weightings of control bonds stabilize at lower levels.

[Insert Figure 3]

Table 5 presents the results for the tests of the high yield rule change. To ensure that the same bonds are included in the pre and post sample, I require that each bond have non-missing observations for all variables in each month of the study. Columns one and two do not include the covariates to allow for a larger sample size. The $Post$ control in columns one and three shows that the trend in spreads is downward following the exit from the 2008 financial crisis. The sign on the covariate of interest in this quasi-natural experiment, $(Treatment_i * Post_t)$, is negative and significant in all models, supporting the findings of the fixed effects panel that ETF inclusion is associated with lower yields. In particular, bonds included in the ETF due to the expansion of the eligible universe have yield spreads 140 basis points lower than the original underlying following the rule change.

[Insert Table 5]

Overall, the results of this quasi-natural experiment around a rule change to the benchmark of the largest high yield ETF, HYG, support previous theoretical predictions and empirical results that financial innovation has a positive price impact on the underlying. Below I utilize an eligibility rule for LQD to further investigate the role of ETFs in the prices of investment grade bonds

4.3.2. *Quasi-Natural Experiment #2: Maturity-Based Exclusion*

ETFs with rules-based eligibility provide the setting for my next quasi-natural experiment. I focus specifically on funds with an inclusion or exclusion maturity threshold because eligibility is less likely to be associated with credit risk or a credit event. These ETFs, typically called long-term, intermediate-term, and short-term, stipulate in their prospectuses the maximum and minimum remaining maturity necessary for eligibility along with any other qualifiers. However, the majority of the twenty-seven funds initially designated as maturity-based follow Barclays indices, which are also the most common benchmarks for mutual funds. Considering these ETFs, would not allow for a proper disentanglement of an ETF effect from a general index effect. Therefore, to focus strictly on the impact of ETFs, I again consider LQD and HYG.

Plotting the time to maturity remaining on the last time a bond is held by either ETF relative to the cutoff, I find that only LQD appears to strictly follow the three year time to maturity minimum. Specifically, Figure 4 documents a sharp jump in sales by LQD around the 36 months to maturity threshold. HYG sales do not exhibit the same threshold behavior.

[Insert Figure 4]

For identification, I establish the treatment group as bonds sold by LQD for maturity reasons. From Figure 4 it appears that the majority of sales occur in the window of one month window around the threshold. I denote any bond sold within this region as my treatment group of "forced" sales. A control group is needed to allow for the possibility that there is something distinctive impacting bonds upon crossing the cutoff. For instance, many short-term mutual funds use a three year maturity maximum. I use all investment grade bonds with non-zero mutual fund ownership that have 3 years to maturity on the date of a LQD maturity-based sale as the control group.

[Insert Figure 5]

Figure 5 provides visual evidence in support of the negative yield effect relative to the threshold. Panel A plots the average monthly yield spread for the treatment and control dates relative to the threshold for the 36 months prior to the cutoff and 23 months post. The yields of both groups are on the natural decline into maturity, which supports the assumption of common trend necessary to implement the difference-in-difference identification strategy. Panel B collapses the graph to a one year window around the threshold. The difference between the yields of the two groups converges immediately following LQD's exit from the treatment group. It appears the natural downward trend of yields as maturity approaches pauses only for treatment bonds. This result suggests that the negative yield effect of ETF constituency is removed from the bond. Interestingly, even during the months immediately before the cutoff when the ETF is selling the bond putting pressure on prices, the yield still continues to move lower. It is not until LQD is no longer involved in the bond that the difference between the two groups diminishes.

To test the statistical significance of the results presented in Figure 5, I again use the difference-in-difference regression of equation (2). In this setting $Treatment_i$ is set to 1 for those bonds sold by LQD due to maturity and 0 for non-LQD bonds with three year time to maturity. $Post_t$ is 1 for the months after an ETF completely exits a bond. For instance, if a bond last appears in the holdings report on January 2011 with 3 years to maturity, I assume that it is sold in February due to the eligibility rule. The post period begins in March 2011. To account for this shift, the cutoff for control bonds is the month following the three year threshold. A three month window around the event is considered to increase the number of observations. Finally, as above I use clustered robust standard errors.

Table 6 reports the results of the maturity based natural experiment regression. Since the event being studied is an exclusion, the interpretation of the coefficient is opposite from the first experiment. The results are also supportive of ETFs causing lower yields for member bonds. More specifically, the bonds sold by LQD for maturity reasons have higher relative yield spreads in the three months following the sale than do other investment grade bonds held by mutual funds that cross the three year time to maturity threshold on the same date. The columns of Table 4 account for the ETF's activity in the treatment bonds in the month of the last reported holding. In particular, columns 3 and 4 eliminate bonds whose weight decreased 50% in the prior month, indicating that a remnant position is reported in the final month. Columns 5 and 6 use a 25% cutoff. Finally, columns 7 and 8 use a 10% cutoff.

[Insert Table 6]

4.4. The Liquidity Effect: Two-Way Fixed Effects Panel Regressions

After having established that ETFs lower the yields of constituent bonds, I turn my focus to the liquidity effects. To do so I account for different attributes of ETF activity using four different proxies. The first is the lagged percentage of the bond held by all ETFs, $\%ETF$. Second, I use a measure of the intensity of creation and redemption activity of an ETF developed by Da and Shive (2013). $C/R\ Intensity$ is the weighted average of the standard deviation of the number of shares outstanding divided by the mean shares outstanding during a month of all ETFs holding a bond. Creation and redemption could drive underlying liquidity since APs need to compile or sell baskets of the underlying security to maintain the ETF. The activity associated with C/R Intensity reflects the direct involvement of the ETF in a bond. Third, I use a weighted average monthly turnover of all ETFs holding the bond, $ETF\ Turnover$. While ETF turnover itself should not lead directly to activity in the underlying, it does reflect greater investor demand for exposure to the underlying and ease of executing arbitrage strategies. Finally, I use $Short$ as the weighted average of short interest in the ETFs holding a specific bond. While shorting firm-specific risk is possible in the individual lending or CDS markets, executing a large basket of short positions would entail a significant search cost or a fixed period contract. Therefore, ETFs may be a convenient instrument for institutional investors to initiate short positions in the corporate bond market to take a directional view or to hedge existing positions. Furthermore, the ability to short is a critical distinction of ETFs from other index products. Research suggests that short sellers should be mostly informed investors, given that shorting is a relatively expensive and risky activity (Diamond and Verrecchia (1987)). In fact, Boehmer, Jones, and Zhang (2008) find that institutional investors represent almost 75% of short sales, individuals just 2%, and the balance market makers and specialists. Appendix B provides details on the computation of these proxies. Table 7 presents the distributions and correlations of these proxies for ETF Activity.

[Insert Table 7]

Using these measures, I test the impact of ETF activity on the liquidity of constituent bonds using the two-way fixed effects regression,

$$Liquidity_{i,t} = \alpha_i + \lambda_t + \rho ETF\ Activity_{\ i,t-1} + \beta_1 X + \varepsilon_{i,t}. \tag{3}$$

where $Liquidity_{i,t}$ is one of the six liquidity proxies. Again I incorporate bond level fixed effects, α_i to account for time invariant bond heterogeneity and time fixed effects, λ_t to control for common trends in the corporate bond market. $ETF\ Activity_{i,t-1}$ is the lagged value of one of the four activity proxies. I also control for $\%MF_{i,t-1}$ and $\%Index_{i,t-1}$. These controls are lagged to account for reverse causality, that is the most liquid bonds funds attracting institutional ownership. $Rating_{i,t}$ is included to account for potential liquidity spikes related to ratings changes. The standard errors are clustered at the issuer level to control for correlations between bonds from the same firm. The coefficient of interest is ρ. The variables have been standardized to indicate liquidity, so that a positive ρ indicates higher liquidity and a negative coefficient lower liquidity

The panels of next two tables present the results for the various ETF activity proxies for the high yield market and investment grade market, respectively. In Table 8, all measures, including the principal component, are suggestive of an insignificant relationship between the ETF and the liquidity of the underlying high yield bond.

[Insert Table 8]

Table 9 reports the findings for the investment grade market. Results for turnover and zeros are inconclusive. However, the coefficients on $PC1$ and all the transaction cost proxies are strongly indiciatve of ETFs having a deleterious impact on liquidity. On average a 1% increase in the lagged ETF ownership of bond leads to a $0.02 increase in the bid-ask spread, a 2 basis points increase in the effective spread and 1.8 basis point increase in the price impact of a $1 million trade. Overall, the results suggest that the introduction of the derivative increases the cost of trading in the investment grade market.

[Insert Table 9]

These findings support the theories of Dow (1998), Gammill and Perold (1989), Gorton and Pennacchi (1993), and Subrahmanyam (1991) who predict basket securities will lead to higher transaction costs for underlying instruments due to decreased participation from liquidity traders. To examine if smaller liquidity traders have fled from the underlying corporate bond market, I examine the impact of ETFs on the proportion of total bond volume attributed to trades of different sizes. Following Goldstein, Hotchkiss, and Sirri (2007), I denote all trades less than $100,000 as retail. I develop further trade bins using the levels of truncation in TRACE.[11] For high yield bonds, Bin 2 is composed of trades between $100,000 and $1 million. Bin 3 includes trades greater than $1 million. For investment grade bonds, Bin 2 is the same as for high yield bonds. Bin 3 includes trades between $1 million and $5 million. Finally, trades greater than $5 million are in bin 4. I compute $\%Volume\ by\ Type_{i,b,t}$ as the total volume of bin b over the total volume of bond i in month t. I rerun the regression of equation (3) for each bin in each market using $\%Volume\ by\ Type_{i,b,t}$ as the dependent variable. Table 10 reports the results.

[Insert Table 10]

Table 10 documents that for nearly every measure of $ETF\ Activity$ in both the high yield and investment grade markets the proportion of retail trader decreases. The decrease in volume attributed to retail traders is between 9 to 59.9 basis points for high yield bonds and 12.0 to 31.9 basis points for investment grade bonds. Furthermore, the first row shows that there is a stark difference in the relative importance of the retail market between the two markets. In investment grade bonds the majority of trading occurs in retail-sized trades, while in high yield bonds institutional trades over $1 million are the most prevalent. This disparity may partially explain the differential liquidity findings. It is also important to note that while the underlying liquidity may decline, overall bond market liquidity may actually improve as ETFs are low bid-ask spread and high volume alternatives to gain exposure to corporate bond markets.

5. Conclusion

The historically opaque market, corporate bond market is undergoing change as financial innovation is introduced. The results of this paper provide evidence of the impact of a seemingly

[11] The truncation levels are $1 million in the high yield market and $5 million in the investment grade market.

redundant exchange traded basket security, an ETF, on underlying corporate bond holdings. Using fixed effects models and two quasi-natural experiments, I provide new evidence that the derivative instrument lowers yield spreads. I also find that the liquidity impact is insignificant for high yield bonds, but negative for investment grade bonds. While my results show that ETF activity decreases individual bond liquidity, it remains possible that overall liquidity is improved as investors can now transact in the highly liquid ETFs. Finally, I show that for both markets ETFs decrease the proportion of retail trades. Taken together, the results of this paper support theories that claim ETFs can alter the dynamics of the underlying corporate bond market. The migration of liquidity traders from the underlying market to the basket security leaves the underlying market with a greater fraction of informed investors. With a greater proportion of informed investors, the market has higher bid-ask spreads due to greater adverse selection risk (Copeland and Galai (1983), Glosten and Milgrom (1985)) and lower expected returns due more informative trades (Easley and O'Hara (2004), Gorton and Pennacchi (1993), Grossman and Stiglitz (1980)). Moreover, the lower yield spreads for constituent bonds support claims that derivatives can complete markets.

Together these results demonstrate that ETFs are having a distinct impact on the corporate bond market. Corporate bond ETFs are increasingly in the spotlight of regulators and institutional investors for what is deemed a "liquidity illusion." [12] However, there is also hope that the price transparency and immediacy provided by this innovation are the first steps towards centralized trading and standardization.[13] Therefore as the relevance of ETFs in the corporate market continues to grow, it important to understand the role of corporate bond ETFs in all facets of the underlying market structure, including volatility, price discovery, daily returns, and performance in periods of stress.

[12] http://www.bloomberg.com/news/2014-09-26/pimco-etf-probe-spotlights-270-billion-market-vexing-regulators.html

[13] http://www.tabbgroup.com/PublicationDetail.aspx?PublicationID=1141

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Appendix A: Liquidity Proxies

Variable	Description
PC1	Liquidity is a multifaceted concept for which there is no generally accepted measure. Following Dick-Nielsen, Feldhütter, and Lando (2012), I compose a liquidity proxy, PC1, as the first principal component. PCA utilizes all the information from the various measures to compute a proxy that maximizes the explanatory power. To execute the PCA, I follow Korajczyk and Sadka (2008), by standardizing all measures to represent liquidity, rather than illiquidity. I also account for magnitude discrepancies, which can lead to overweighting, by normalizing the liquidity measures. I do so by defining $L_{i,t}^{j*}$, for bond i in month t for the j liquidity measures (j=1,2,…,5). The standardized measure is $L_{i,t}^{j} = (L_{i,t}^{j*} - \mu^j)/\sigma^j$, where μ^j and σ^j are the mean and standard deviation of liquidity measure j. PC1 is generated using the loadings produced from this analysis.
IRC	Feldütter (2012) develops a method to identify associated trades and then compute a measure of transaction costs without relying on side identifiers. The method exploits a common occurrence in the corporate bond market where a bond will trade two to three times in a very short window following a period of inactivity. Since corporate bonds trade on an over-the-counter market, he claims these groups of trades likely occur when a dealer is finally able to match a buyer and seller, collecting the bid-ask spread. Feldütter (2012) defines an IRT as two or three trades in the same bond, on the same day with the same volume. For each IRT, the IRC is computed as $$IRC = \frac{P_{max} - P_{min}}{P_{min}} * 100,$$ where P_{max} is the highest price and P_{min} is the lowest price within an IRT. The daily estimate of the roundtrip cost is the average IRC for all IRTs in a day and the monthly IRC is the median daily observation. A higher IRC is indicative of higher transaction costs and thus lower liquidity.
HW Spread	Side indicators are available for the period of this study. An indicator of B (S) is used when a dealer buys from (sells to) a customer, indicating a transaction occurring at the bid (ask) price. use these indicators to compute the bod-ask spread measure of Hong and Warga (2000) and Chakravarty and Sarkar (2003), $$HW\ Spread_{i,t} = \sum_{n=1}^{N} P_n^A w_n^A - \sum_{m=1}^{M} P_m^B w_m^B,$$ which is the dollar weighted average price of the N trades transacted at the ask side minus the dollar weighted average price of the M trades transacted on the bid side. The measure requires at least one buy and one sell transaction each day. To eliminate any crossed quote measures, I set any positive observations to zero to maintain the intuition of the measure as a transaction cost. A higher HW Spread implies higher transaction costs and thus lower liquidity.

Amihud	Developed in the style of Kyle's (1985) lambda measure, Amihud's measure is a low-frequency proxy for the price impact of a trade. Computed as $$Amihud_{i,t} = \frac{1}{N_t}\sum_{j=1}^{N_t}\frac{\lvert r_j \rvert}{v_j} * 10^6$$ where N_t is the number of returns on day t, r_j is the return of consecutive transactions, and v_j is the dollar volume of a trade. This measure can be interpreted as the basis points price movement per one million dollars of traded volume. The monthly Amihud measure is the median daily measure for each month. A larger Amihud value implies a greater price impact for a given unit of trade and thus suggests lower liquidity.
Turnover	Computed as $$Turnover_{i,t} = \frac{Volume_{i,t}}{Amount\ Outstanding_{i,t}} * 100$$ A bond with higher turnover trades a greater portion of its issuance each day and is considered to be more liquid.
Zeros	Lesmond, Ogden, and Trzinka (1999) zero measures suggest bonds whose prices stay stagnant over long periods or bonds that do not trade for long periods are likely to be less liquid. The LOT model describes the circumstances in which trading occurs for informed and uninformed trading. Implicitly these proxies measure if the benefits of trade exceed the transaction costs, which include spread, commission costs, expected price impact costs, and possible opportunity cost of informed traded. Computed as $$Zeros_{i,t} = \frac{(Zero\ Return\ Days + Zero\ Trade\ Days)_{i,t}}{Trading\ Days_t} * 100$$ The zeroes measures may be difficult to interpret since the do not incorporate volume. As described in Dick-Nielsen et al. (2012), the number of zero days may actually decrease, suggesting more liquidity, in periods of illiquidity as traders are forced to parcel out trades into more frequent trades of smaller size.

Appendix B: ETF Activity Proxies

Variable	Description
%ETF	A basic measure of ETF ownership in a bond computed as: $$\%ETF_{i,t} = \frac{\sum_{k=1}^{K} Par\ Value\ Held_{i,k,t}}{Amount\ Outstanding_{i,t}},$$ which is the sum of the par value held by the set of K ETFs holding bond i in month t as a fraction of bond $i's$ amount outstanding.
C/R Intensity	Da and Shive (2014) develop a measure of the intensity of creation and redemption activity of an ETF. The measure is calculated as $$C/R\ Intensity_{i,t} = \frac{\sum_{k=1}^{K}\left(w_{i,k,t} * \ SD\ Shares_{k,t}\right)}{\sum_{k=1}^{K} w_{i,k,t}} * 100,$$ where, $$SD\ Shares_{k,t} = \frac{\sigma(shrout)_{k,t}}{\mu(shrout)_{k,t}}$$ Creation and redemption could drive underlying liquidity since APs need to compile or sell baskets of the underlying security to maintain the ETF.
ETF Turnover	The ability to quickly trade a basket of bonds is fundamental to the appeal of fixed income ETFs. The turnover of associated ETFs is computed as $$ETF\ Turnover_{i,t} = \frac{\sum_{k=1}^{K}(w_{i,k,t} * \ Turnover_{k,t})}{\sum_{k=1}^{K} w_{i,k,t}},$$ which is the weighted average monthly turnover of the set of K ETFs that hold bond i during month t. $Turnover_{k,t}$ is total monthly share volume over the average ETF shares outstanding in the month.
Short	ETFs are a convenient instrument for investors to initiate short positions for a directional view or to hedge existing positions. It is likely that this measure reflects the activity of institutional investors given that shorting is a relatively expensive and risky activity. The proxy is computed as $$Short_{i,t} = \frac{\sum_{k=1}^{K}\left(w_{i,k,t} * \ SI_{k,t}\right)}{\sum_{k=1}^{K} w_{i,k,t}}$$ where $$SI_{k,t} = \frac{\mu(short)_{k,t}}{\mu(shrout)_{k,t}},$$ The measure is the monthly weighted average of the short interest ratio of the set of *K* ETFs that hold bond *i* in month *t*. The short interest ratio is the average number of shares of the ETF held short over the average number of ETF shares outstanding.

Appendix C: Details of Changes in Eligibility Requirement for Markit High Yield and Investment Grade Indices

	High Yield (HYG)		Investment Grade (LQD)	
	Before 6/30/09	After 6/30/09	Before 9/30/09	After 9/30/09
Issue Amount Outstanding	$200 mln	$400 mln	$500 mln	$750 mln
Issuer Amount Outstanding		$1 bln		$3 bln*
Weighting	Equal	Market Value	Equal	Market Value
Cap		3%		3%
Ratings	Highest	Average	Average	Average
Age			<5 years old	
Time to Maturity	15≤T2M≤3	15≤T2M≤3**	T2M≤3	T2M≤3
Bond Type Eligible				Yankees
*$3bln face value of IG corporate excluding fixed-to-floater, callable, putable, and perpetual				
**Changed to 15≤T2M≤1 on 4/30/12				

Figure 1: The Growth of the Fixed Income ETF Market

Figure 1 presents the growth of the fixed income ETF market. The figures show the growth the entire market, the market for all ETFs that hold corporate bonds (Corporate & Total Bond ETFs), and the market for strict corporate bond ETFs. This figure reports the assets under management for the three groups. In addition, the proportion of ETF volume over TRACE volume in bonds held by ETFs is reported using the right vertical axis.

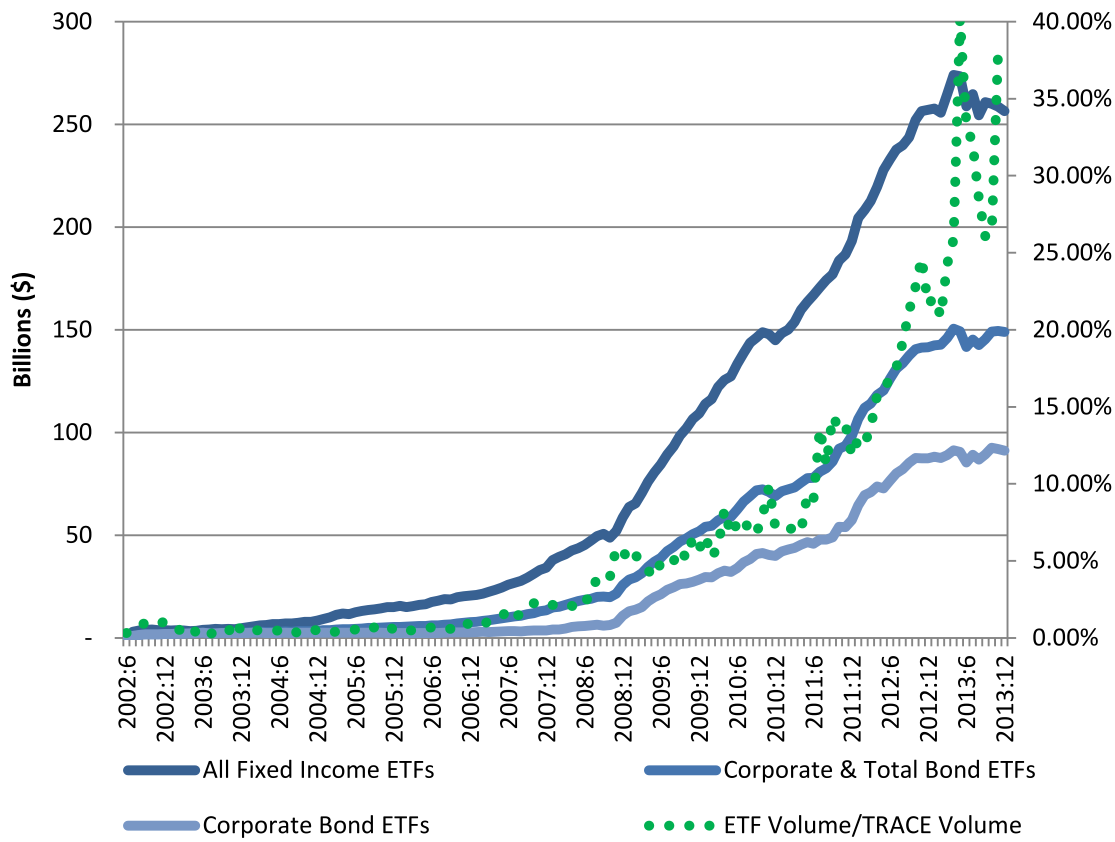
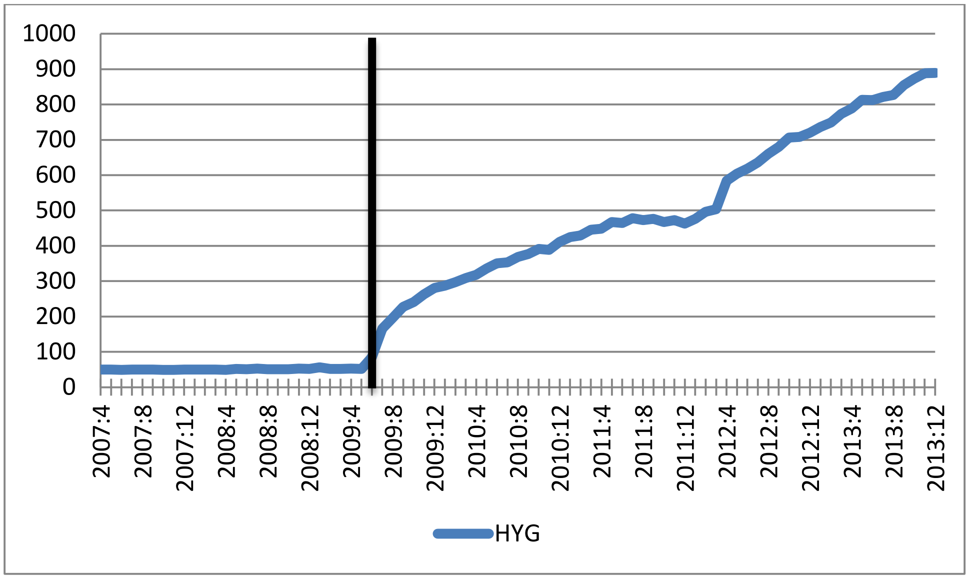


Figure 2: HYG Rule Change

Panel A: The Growth in Holdings of HYG

The figure plots the number of holdings by the iShares High Yield Liquid ETF, HYG. The vertical lines document the date that the index administrator, Markit, removed the cap on the number of constituents for the index followed by this ETF.



Panel B: The Number of Holdings of HYG Around the Rule Change

The number of holdings by HYG is presented in a table to identify the treatment and control groups for the quasi-natural experiment. Those bonds held by the ETF prior to the rule change are used as the control and labeled original below. Bonds included in the phase of the greatest increase in holdings are the treatment and labeled expansion below.

	HYG	
Date	**# Holdings**	**Group**
Jan-09	56	
Feb-09	52	
Mar-09	52	
Apr-09	53	
May-09	52	Original
Jun-09	**84**	
Jul-09	166	Expansion
Aug-09	196	
Sep-09	227	
Oct-09	241	
Nov-09	263	
Dec-09	281	

Figure 3: High Yield Rule Change

The average of monthly volume-weighted yield spreads over the swap rate for the bonds impacted by the June 2009 rule change are plotted below. The HYG Original bonds are those that were held by the ETF in the month before the 50 bond constituent cap was removed. The HYG Expansion bonds are those purchased by the ETF in July 2009. Also included in the figure are the bonds that were on the index list upon the rule change announcement, but were not purchased by the ETF.

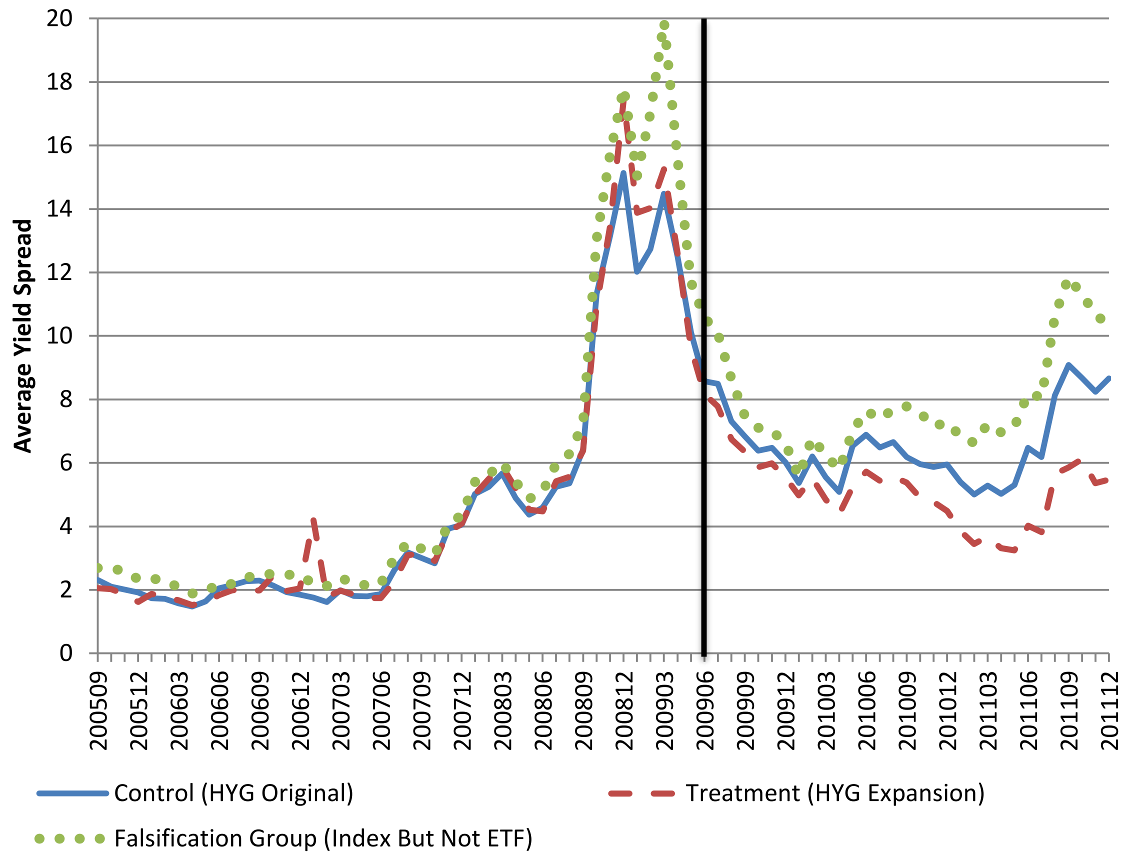


Figure 4: LQD Sales Relative to Three Year Time to Maturity Threshold

This figure shows the propensity of LQD to follow the three year minimum time to maturity rule established by the index. Specifically, the figure reports the time to maturity of a bond at the last month it is reported as a holding by LQD relative to the threshold. The treatment group is identified in the highlighted areas as “forced” maturity based sales.

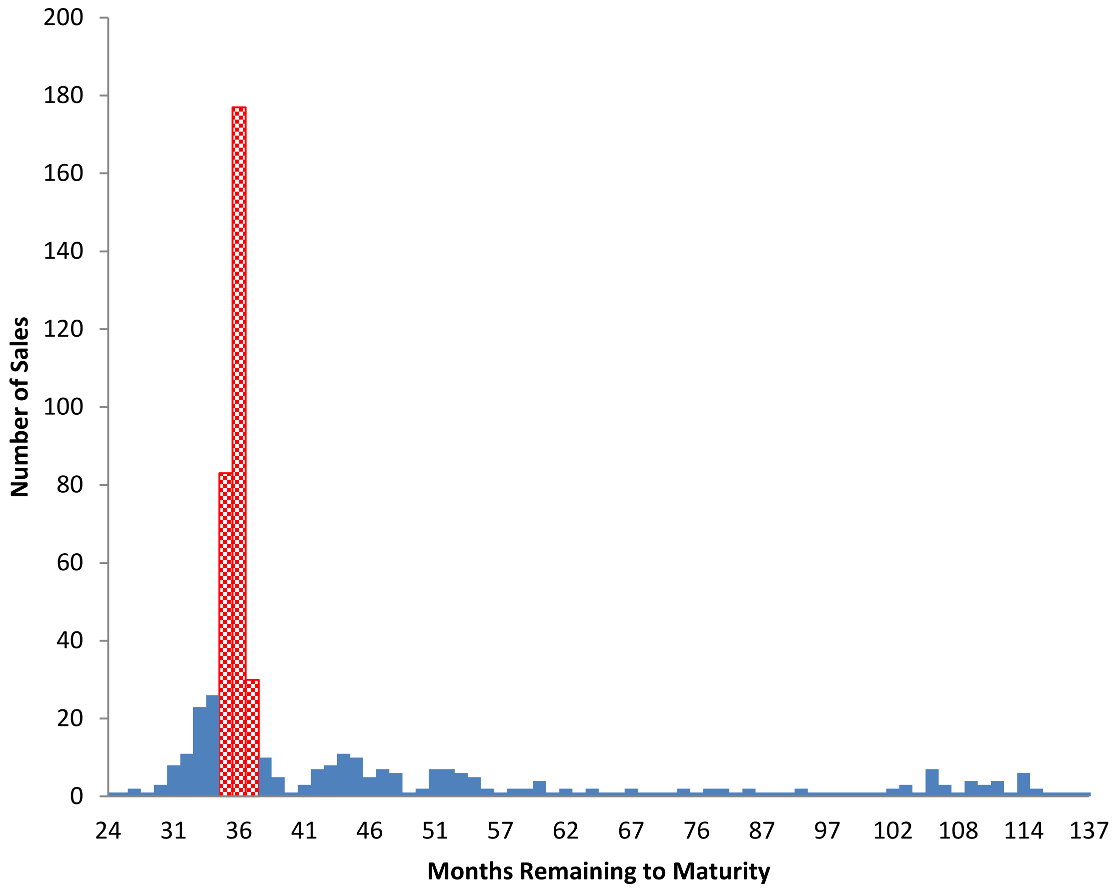
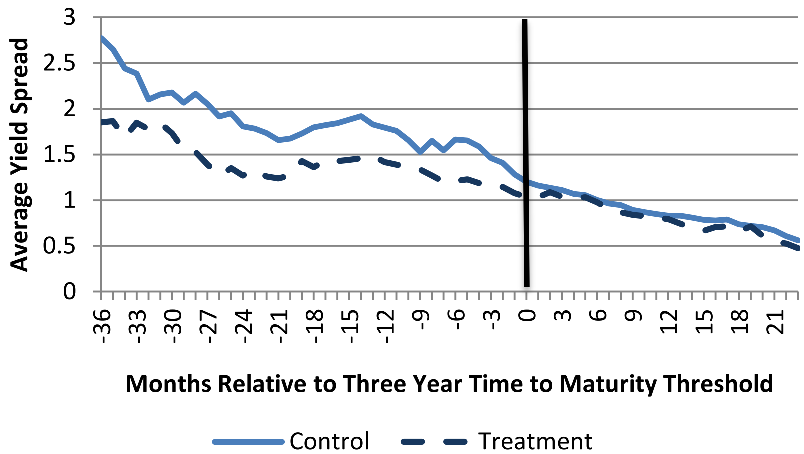


Figure 5: Yield Spreads Before and After Three Year Time to Maturity Threshold

This figure documents the behavior of the average monthly volume weighted yield spread of the treatment and control groups in the quasi-natural experiment. The treatment group is composed of bonds sold between one month prior to and two months after crossing the three year threshold. The control group includes investment grade bonds held by mutual funds with three years time to maturity remaining on the date of a maturity based sale by LQD. For the treatment group time zero is the month after the sale by LQD. For instance if a bond last appeared in LQD's holdings on January 2009, sale is assumed to occur in February 2009, and month zero is March 2009.   For control bonds time zero is the month following the crossing the three year cutoff.

Panel A: 36 Months Prior to Sale to 23 Months After



Panel B: One Year Window around Maturity-Based Sale

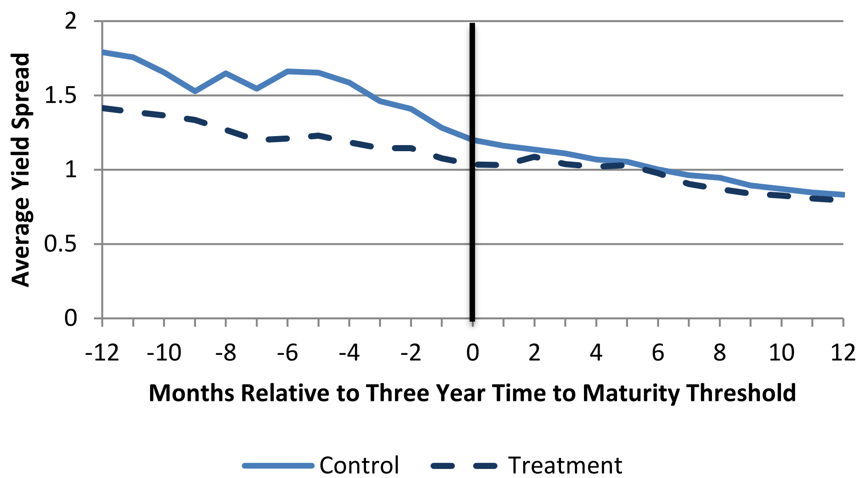


Table 1: Summary Statistics

Summary statistics on observable characteristics of bonds held by ETFs relative to those not held by ETFs. The data is composed of 496,806 bond-month observations for the sample period January 2009 to November 2013. ETF bonds are those held by a corporate bond ETF for at least one month. Panel A presents the high yield market statistics for 114,4250 observations. 28,995 observations on 1,414 individual bonds from 728 issuers have ETF ownership. 5,602 bonds from 874 issuers are non-ETF bonds. Panel B documents the characteristics of the 382,556 bond-month investment grade observations of which 135,946 observations are associated with ETFs. There are 4,567 individual ETF bonds from 1,104 issuers and 10,664 non-ETF bonds from 650 issuers.

		Panel A: High Yield Bonds				Panel B: Investment Grade Bonds			
		Mean	Median	Min	Max	Mean	Median	Min	Max
Non-ETF Bonds	Mutual Fund Ownership	6.38	0.18	0.00	93.47	0.83	0.00	0.00	94.26
	Index Fund Ownership	0.01	0.00	0.00	10.00	0.01	0.00	0.00	17.50
	Coupon	6.63	6.75	0.00	18.00	5.50	5.50	0.00	12.38
	Amount Outstanding (mlns)	154.06	100.00	0.00	8000.00	56.08	10.89	0.00	4250.00
	Rating	14.37	14.00	10.17	22.00	5.90	6.00	1.00	10.00
	Time to Maturity	6.79	4.90	1.00	29.96	10.31	8.59	1.00	30.00
	Age	6.04	5.38	0.00	83.72	5.76	4.96	0.00	76.47
	Leverage	56.80	60.39	13.90	91.23	60.04	65.37	13.90	91.23
	Operating	18.46	14.23	0.00	48.19	23.72	25.52	0.00	48.19
	Long-Term Debt	29.61	31.93	5.81	48.24	23.50	19.84	5.81	48.24
	Volatility	0.97	0.72	0.31	2.49	1.09	0.81	0.31	2.49
ETF Bonds	ETF Ownership	1.42	0.30	0.00	63.47	0.87	0.38	0.00	73.78
	Mutual Fund Ownership	20.58	19.25	0.00	98.78	6.55	4.12	0.00	96.66
	Index Fund Ownership	0.17	0.00	0.00	72.14	1.39	0.88	0.00	96.95
	Coupon	7.86	7.75	1.13	16.00	5.58	5.70	0.55	12.00
	Amount Outstanding (mlns)	612.24	488.00	6.43	7362.77	733.76	500.00	50.00	7750.00
	Rating	13.74	13.50	10.17	21.33	7.08	7.33	1.00	10.00
	Time to Maturity	6.36	5.75	1.00	30.00	10.15	6.74	1.00	30.00
	Age	3.24	2.35	0.00	21.84	4.30	3.29	0.00	24.05
	Leverage	53.95	52.99	13.90	91.23	42.22	34.99	13.90	91.23
	Operating	22.02	18.70	0.00	48.19	24.47	25.14	0.00	48.19
	Long-Term Debt	37.40	41.01	5.81	48.24	24.46	22.97	5.81	48.24
	Volatility	0.92	0.69	0.31	2.49	1.12	0.93	0.31	2.49
Total	ETF Ownership	0.57	0.00	0.00	63.47	0.43	0.00	0.00	73.78
	Mutual Fund Ownership	12.10	6.32	0.00	98.78	3.65	0.31	0.00	96.66
	Index Fund Ownership	0.07	0.00	0.00	72.14	0.69	0.00	0.00	96.95
	Coupon	7.13	7.13	0.00	18.00	5.54	5.60	0.00	12.38
	Amount Outstanding (mlns)	338.65	250.00	0.00	8000.00	390.70	250.00	0.00	7750.00
	Rating	14.09	13.67	10.17	22.00	6.48	6.50	1.00	10.00
	Time to Maturity	6.61	5.36	1.00	30.00	10.23	7.47	1.00	30.00
	Age	4.91	3.97	0.00	83.72	5.04	4.03	0.00	76.47
	Leverage	55.59	57.15	13.90	91.23	51.27	50.13	13.90	91.23
	Operating	20.03	16.06	0.00	48.19	24.09	25.20	0.00	48.19
	Long-Term Debt	32.94	37.11	5.81	48.24	23.98	21.62	5.81	48.24
	Volatility	0.95	0.71	0.31	2.49	1.11	0.88	0.31	2.49

Table 2: Principal Components

This table shows the results of the principal components analysis. Panel A presents the loadings on each of the five liquidity variables and the cumulative explanatory power of each component. The liquidity variables are standardized to represent liquidity, rather than illiquidity. They are also normalized to account for differences in magnitudes. Panel B shows the results of the regression of yield spread on credit risk controls and the principal components

Panel A: Principal Component Loadings

	PC 1	PC 2	PC 3	PC 4	PC 5
IRC	0.5791	0.2175	-0.0318	0.2386	0.7479
HW Spread	0.4806	0.1694	0.3026	-0.7901	-0.1564
Amihud	0.5611	0.1370	0.0368	0.5107	-0.6358
Zeros	-0.3115	0.5428	0.7510	0.2047	0.0500
Turnover	0.1474	-0.7814	0.5849	0.1269	0.0975
Cum. % Explained	43.48%	65.59%	81.07%	93.48%	100%

Panel B: Regressions of Spread on Credit Controls and Principal Components

	High Yield Bonds				Investment Grade Bonds			
Rating	0.728***	0.790***	0.296	0.419*	0.234***	0.236***	0.133*	0.206***
	10.60	12.19	1.05	1.65	14.59	13.77	1.93	3.78
Leverage	0.091***	0.061***	0.199***	0.090***	0.022***	0.020***	0.087***	0.040***
	10.74	6.51	13.15	6.67	10.10	12.19	13.15	9.70
Operating	-0.027***	-0.020***	-0.040***	-0.029***	-0.012***	-0.008***	-0.013***	-0.005
	-3.79	-3.10	-3.43	-3.15	-3.71	-3.66	-4.67	-1.49
LT Debt	-0.059***	-0.057***	-0.167***	-0.114***	-0.004	-0.007***	-0.042***	-0.011**
	-5.75	-5.60	-4.81	-3.73	-1.26	-2.67	-3.80	-2.04
Eq. Vol	0.482***	-0.007	0.164	-0.536***	0.131*	-0.150***	0.387***	-0.005
	4.34	-0.05	1.56	-4.94	1.89	-5.06	6.44	-0.28
Pretax 1	-0.002***	-0.001**	-0.001***	-0.000*	-0.021**	-0.005	-0.004*	0.003
	-5.33	-2.43	-7.09	-1.92	-2.40	-0.64	-1.83	0.84
Pretax 2	0.257***	0.158***	0.246**	0.174*	0.003	0.001	-0.008	0.009
	3.39	2.71	2.21	1.89	0.18	0.07	-0.48	0.89
Pretax 3	-0.057	-0.000	-0.077	0.005	0.024***	0.022***	0.004	0.016***
	-1.34	-0.00	-1.39	0.11	3.09	3.24	0.59	2.69
Pretax 4	0.002	-0.015*	0.005	-0.003	0.002	0.002	0.000	0.003
	0.24	-1.67	0.60	-0.30	0.53	1.08	0.17	1.21
PC 1	-1.685***	-1.208***	-1.614***	-1.028***	-0.326***	-0.227***	-0.247***	-0.074***
	-11.72	-11.33	-8.65	-9.05	-13.47	-11.30	-8.09	-3.43
PC 2	0.532***	0.595***	0.248**	0.397***	0.176***	0.079***	0.063***	0.017
	5.87	7.05	2.36	4.74	7.36	3.68	3.29	1.33
PC 3	0.615***	0.377***	0.716***	0.230***	0.062**	0.103***	0.143***	0.037**
	5.45	3.59	6.47	3.11	2.43	4.90	8.90	2.50
PC 4	0.644***	0.300**	0.440***	0.381***	-0.299***	-0.246***	-0.174***	-0.062***
	4.12	2.41	2.76	3.15	-8.77	-11.42	-9.75	-3.90
PC 5	-0.995***	-0.441*	-0.533*	-0.157	0.034*	0.026	0.007	0.013
	-2.88	-1.65	-1.96	-0.74	1.78	1.64	0.44	1.17
Constant	-5.782***	-4.937***	-1.283	8.398***	-0.352	-0.017	-2.208***	1.240***
	-7.12	-6.56	-0.35	2.78	-1.45	-0.10	-4.34	3.13
Bond FE	N	N	Y	Y	N	N	Y	Y
Time FE	N	Y	N	Y	N	Y	N	Y
R-sqr	0.363	0.516	0.664	0.750	0.350	0.562	0.679	0.799
Obs.	47,981	47,981	47,981	47,981	224,691	224,691	224,691	224,691

Table 3: Liquidity Proxy Summary Statistics.

This table shows the statistics for corporate bond liquidity proxies used throughout the study. Proxies are calculated monthly for each bond from January 2009 to November 2011 using TRACE data. Panel A shows the distribution of the proxies. *PC* is the first principal component. *Turnover* and *Zeros* are reported in %. *IRC* is the Imputed Roundtrip Cost in %. *HW Spread* is a bid-ask proxy. *Amihud* is reported as bps per million dollars. Panel B shows the correlation among the different measures, which are standardized to be measures of liquidity, rather than illiquidity.

Panel A: Distribution of Liquidity Proxies

	PC1	Turnover	Zeros	IRC	HW Spread	Amihud
1%	-5.474	0.015	0.000	0.000	0.000	0.000
5%	-2.983	0.966	4.545	0.000	0.087	0.092
10%	-1.948	0.254	13.636	0.032	0.174	0.400
25%	-0.559	0.905	33.333	0.101	0.369	3.748
50%	0.458	2.365	65.517	0.293	0.990	19.594
75%	0.994	4.973	86.364	0.709	2.069	54.391
90%	1.321	9.481	94.737	1.311	3.125	124.751
95%	1.476	14.607	95.455	1.829	3.905	205.595
99%	1.753	40.564	96.296	2.857	6.194	552.792

Panel B: Correlation of Liquidity Proxies

	PC	Turnover	Zeros	IRC	HW Spread	Amihud
PC	1.000					
Turnover	0.217	1.000				
Zeros	0.459	0.211	1.000			
IRC	0.854	0.026	0.238	1.000		
HW Spread	0.709	0.078	0.151	0.483	1.000	
Amihud	0.827	0.098	0.222	0.659	0.403	1.000

Table 4: Yield Spread Fixed Effects Panel Regression

Panel A reports results for high yield and Panel B for investment grade the results of the two way fixed effects regression

$$Spread_{i,t} = \alpha_i + \lambda_t + \gamma\%ETF_{i,t} + \beta_1 X_{i,t} + \beta_9 Liquidity_{i,t-1} + \varepsilon_{i,t}$$

Spread $_{i,t}$ is the spread of the volume-weighted monthly yield of bond *i* over the maturity-matched swap rate in month *t*. α_i is the bond fixed effect and λ_t is the time fixed effect. *%ETF* $_{i,t}$ is the percentage of a bond's amount outstanding held by all ETFs. Covariates that change at the bond-month level are used. *Rating* $_{i,t}$ is the average of numerical conversions of S&P, Moody's, and Fitch ratings, *Leverage* $_{i,t}$ is the market-value of firm leverage, *Operating* $_{i,t}$ is operating income to sales, *LT Debt* $_{i,t}$ is the ratio of long-term debt to assets, and *Eq. Vol* $_{i,t}$ is the volatility of the firm's equity. Columes 1-6 control for various lagged liquidity proxies, *Liquidity* $_{i,t-1,}$ including *PC1* the first principal component. Columns 8 and 9 include mutual fund ownership, *%MF* $_{i,t,}$ and index fund ownership, *%Index* $_{i,t}$. Standard errors are clustered at the issuer level and t-statistics are reported below the coefficients. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Panel A: High Yield Bonds

	Dependent Variable: Maturity-Matched Yield Spread to Swap Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
%ETF	-0.088**	-0.083***	-0.094***	-0.091**	-0.097***	-0.083***	-0.090***	-0.084**	-0.088**
	-2.42	-2.85	-2.67	-2.52	-2.82	-2.79	-2.58	-2.29	-2.42
Rating	0.593	0.419*	0.578	0.583	0.552	0.441*	0.557	0.591	0.594
	1.34	1.73	1.41	1.42	1.47	1.70	1.45	1.33	1.34
Leverage	0.094***	0.097***	0.099***	0.099***	0.093***	0.101***	0.096***	0.093***	0.094***
	4.67	7.32	5.48	5.50	5.31	7.42	5.39	4.61	4.67
Operating	-0.050***	-0.029***	-0.045***	-0.044***	-0.042***	-0.030***	-0.043***	-0.051***	-0.050***
	-2.61	-3.49	-2.79	-2.82	-2.79	-3.44	-2.83	-2.62	-2.61
LT Debt	-0.094***	-0.118***	-0.103***	-0.102***	-0.103***	-0.119***	-0.103***	-0.093**	-0.094***
	-2.66	-3.73	-3.22	-3.14	-3.22	-3.76	-3.21	-2.58	-2.66
Eq. Vol	-0.644***	-0.497***	-0.542***	-0.539***	-0.533***	-0.494***	-0.532***	-0.637***	-0.644***
	-4.90	-4.70	-4.77	-4.75	-4.62	-4.71	-4.69	-4.91	-4.90
PC (Lag)		-0.794***							
		-8.94							
Turnover (Lag)			-0.009						
			-0.50						
Zero Days (Lag)				-0.009					
				-1.36					
IRC (Lag)					-1.224***				
					-6.88				
HW Spread (Lag)						-0.246***			
						-4.13			
Amihud (Lag)							-0.007***		
							-7.25		
%MF								-0.027*	
								-1.87	
%Index								0.009	0.008
								0.23	0.20
Constant	7.405*	8.647***	8.350**	7.630**	8.016**	8.007**	8.385**	7.891*	7.402*
	1.78	2.80	2.26	1.99	2.34	2.49	2.41	1.93	1.78
Bond FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-sqr	0.730	0.733	0.720	0.720	0.725	0.728	0.724	0.731	0.730
Obs.	57421	46011	53816	53816	52018	46482	52787	57421	57421

Table 3: Yield Spread Fixed Effects Panel Regression

Panel B: Investment Grade Bonds

	Dependent Variable: Maturity-Matched Yield Spread to Swap Rate								
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
%ETF	-0.055***	-0.053***	-0.053***	-0.054***	-0.052***	-0.053***	-0.053***	-0.056***	-0.055***
	-4.23	-4.34	-4.39	-4.46	-4.33	-4.19	-4.28	-4.52	-4.28
Rating	0.178***	0.188***	0.184***	0.187***	0.184***	0.189***	0.186***	0.178***	0.178***
	3.54	3.41	3.41	3.56	3.42	3.42	3.44	3.64	3.54
Leverage	0.041***	0.040***	0.040***	0.040***	0.041***	0.039***	0.041***	0.041***	0.041***
	7.88	9.72	8.60	8.59	8.74	9.64	8.63	7.87	7.88
Operating	-0.006*	-0.005	-0.005*	-0.005	-0.006*	-0.005	-0.005*	-0.006*	-0.006*
	-1.69	-1.56	-1.65	-1.64	-1.72	-1.54	-1.67	-1.66	-1.69
LT Debt	-0.012**	-0.011**	-0.012**	-0.012**	-0.012**	-0.011**	-0.012**	-0.011*	-0.012**
	-2.01	-2.06	-2.06	-2.09	-2.08	-2.09	-2.06	-1.92	-2.00
Eq. Vol	0.003	0.014	0.016	0.016	0.017	0.014	0.017	0.002	0.003
	0.12	0.80	0.82	0.80	0.85	0.79	0.84	0.07	0.12
PC (Lag)		-0.024							
		-1.18							
Turnover (Lag)			-0.000						
			-0.36						
Zero Days (Lag)				-0.001*					
				-1.84					
IRC (Lag)					-0.015				
					-0.53				
Spread (Lag)						-0.047***			
						-3.19			
Amihud (Lag)							-0.000		
							-0.66		
%MF								-0.014***	
								-4.89	
%Index								0.001	0.000
								0.82	0.21
Constant	1.541***	1.525***	1.684***	1.597***	1.621***	1.464***	1.633***	1.592***	1.541***
	3.99	5.00	5.70	5.46	5.50	4.82	5.52	4.22	3.98
Bond FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-sqr	0.788	0.784	0.782	0.782	0.782	0.783	0.781	0.789	0.788
Obs.	312,525	209,254	275,350	275,350	261,630	213,462	267,811	312,525	312,525

Table 5: The Yield Effect of Index Expansion on High Yield Bonds
This table reports the results of difference-in-difference regressions to estimate the effect of ETF inclusion on bonds added due to a rule change that expanded the universe of eligible bonds using

$$Spread_{i,t} = \alpha_i + \lambda_t + \delta(Treatment_i * Post_t) + B_1 X_{i,t} + \varepsilon_{i,t}$$

$Spread_{i,t}$ is the spread of the monthly volume-weighted yield of a bond over the maturity matched swap rate. α_i is a bond fixed effect and λ_t is a time fixed effect. X_{it} are covariates that vary at the bond-month level. The controls include $Rating_{i,t}$ the average of numerical version of S&P, Moody's, and Fitch ratings, $Leverage_{i,t}$ the market-value of firm leverage, $Operating_{i,t}$ operating income to sales, $LT\ Debt_{i,t}$ the ratio of long-term debt to assets, and $Eq.\ Vol_{i,t}$ the volatility of the firm's equity. In the final column I also control for mutual fund ownership $\%MF_{i,t}$ and index fund ownership $\%Index_{i,t}$. $Treatment_i$ is equal to 1 for bonds added to the ETF during the largest purchase period in July 2009. The control group is composed of bonds originally held by the index whose weighting decreased due to the rule change. $Post_t$ equals one from July to December to account for the six-month transition from the original index to the expansion index and equals zero from January to June. $Treatment_i * Post_t$ is equal to one for treatment bonds following their inclusion in the ETF. Cluster robust standard errors are used and t-statistics are reported below the coefficients. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Dependent Variable: Yield Spread to Maturity-Matched Swaps Rate			
	(1)	**(2)**	**(3)**
Treatment*Post	-1.334**	-1.448**	-1.381**
	-2.48	-2.58	-2.50
Rating		-0.950**	-0.952**
		-2.41	-2.45
Leverage		0.101***	0.118***
		3.16	3.54
Operating		0.010	0.010
		0.82	0.76
LT Debt		0.004	-0.005
		0.02	-0.03
Eq. Vol		-1.193***	-1.228***
		-3.62	-3.93
% MF			-0.095**
			-2.38
% Index			1.138***
			3.14
Constant	13.036***	18.013***	19.563***
	23.31	2.61	2.75
Bond FE	Y	Y	Y
Time FE	Y	Y	Y
R-sqr	0.742	0.760	0.765
Obs.	936	540	540
# Treatment	41	24	24
# Controls	37	21	21

Table 6: The Yield Effect of Maturity-Based Sales on Investment Grade ETF Holdings

This table reports the results of difference-in-difference regressions to estimate the effect of ETF exclusion on bonds sold due to a time to maturity minimum rule using the specification

$$Spread_{i,t} = \alpha_i + \lambda_t + \delta(Treatment_i * Post_t) + B_1 X_{i,t} + \varepsilon_{i,t}$$

where $Spread_{i,t}$ is the spread of the volume-weighted yield of bond i over the maturity- matched swap rate in month t. α_i is the bond fixed effect and λ_t is the time fixed effect. $X_{i,t}$ are covariates that vary at the bond-month level. The controls include $Rating_{i,t}$ the average of numerical version of S&P, Moody's, and Fitch ratings, $Leverage_{i,t}$ the market-value of firm leverage, $Operating_{i,t}$ operating income to sales, $LT\ Debt_{i,t}$ the ratio of long-term debt to assets, and $Eq.\ Vol_{i,t}$ the volatility of the firm's equity. In some specifications mutual fund ownership, $MF_{i,t}$, and index fund owership, $Index_{i,t}$ are also controlled for. $Treatment_i$ is equal to 1 for bonds sold by LQD between one month prior to and 2 months after the three year time to maturity threshold. The control group is composed of investment grade bonds with 3 years to maturity and non-zero mutual fund holdings on the date of a maturity based sale. $Post_t$ is equal to one the month after the bond is sold by the ETF. To account for this shift $Post_t$ is equal to one for control bonds one month after crossing the threshold. $Treatment_i * Post_t$ is equal to one for treatment bonds following their sale. The different columns account for various weighting changes (Δw) in the month prior to sale. Standard errors are clustered by firm and t-statistics are reported below the coefficients. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	All		Δw<50%		Δw<25%		Δw<10%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post*Treatment	0.039**	0.038**	0.058***	0.057***	0.043**	0.043**	0.045**	0.045**
	2.12	2.06	2.91	2.85	2.21	2.18	2.13	2.10
Rating	0.072**	0.072**	0.051*	0.051*	0.056*	0.056*	0.054*	0.054*
	2.11	2.11	1.69	1.68	1.86	1.85	1.79	1.79
Leverage	0.013***	0.013***	0.014***	0.015***	0.014***	0.014***	0.015***	0.015***
	3.66	3.66	3.84	3.84	3.69	3.69	3.71	3.71
Operating	0.004**	0.004**	0.004**	0.004**	0.004**	0.004**	0.004**	0.004**
	2.33	2.36	2.29	2.31	1.99	2.02	2.00	2.02
LT Debt	0.005	0.005	0.006	0.006	0.004	0.003	0.004	0.004
	1.35	1.32	1.58	1.55	0.90	0.86	1.05	1.03
Eq. Vol	0.009	0.010	0.014	0.015	0.016	0.016	0.018	0.018
	0.82	0.89	1.21	1.24	1.41	1.43	1.50	1.51
%MF		-0.001		-0.001		-0.001		-0.001
		-0.53		-0.52		-0.59		-0.32
%Index		0.002**		0.002		0.002		0.002
		2.02		1.46		1.29		1.30
Constant	2.831***	2.831***	2.948***	2.950***	-0.815***	-0.813***	-0.818***	-0.816***
	6.07	6.02	6.49	6.45	-2.73	-2.72	-2.69	-2.68
Bond FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
R-sqr	0.958	0.958	0.959	0.959	0.961	0.961	0.960	0.960
Obs.	3,744	3,744	3,510	3,510	3,258	3,258	3,096	3,096
# Treatment	180	180	159	159	145	145	131	131
# Control	444	444	426	426	398	398	385	385

Table 7: ETF Activity Summary Statistics

This table shows the statistics for ETF activity in corporate bonds. Proxies are calculated monthly for each bond as the weighted average of the activity measure of all ETFs holding the bond. *%ETF* is the percentage ownership of a bond by all ETFs. *C/R Intensity* is the measure of the standard deviation of ETF shares outstanding over the mean number of shares. *Short* is the short interest of the ETF. Panel A shows the distribution of the proxies. Panel B documents the correlation among the different measures.

Panel A: Distribution of ETF Activity Proxies

	%ETF	C/R Intensity	ETF Turnover	Short
1%	0.002	0.000	0.292	0.083
5%	0.044	0.101	0.478	0.194
10%	0.096	0.282	0.567	0.268
25%	0.281	0.698	0.717	0.427
50%	0.791	1.481	0.937	0.722
75%	1.941	2.848	1.377	1.237
90%	3.247	5.236	1.941	2.404
95%	4.222	7.271	2.469	3.569
99%	7.691	15.284	5.214	7.216

Panel B: Correlation of ETF Activity Proxies

	%ETF	C/R Intensity	ETF Turnover	Short
%ETF	1.000			
C/R Intensity	-0.031	1.000		
ETF Turnover	0.027	0.524	1.000	
Short	0.126	0.310	0.404	1.000

Table 8: High Yield Liquidity Fixed Effects Panel Regression

This table reports the results of regressions of the six liquidity proxies, *Liquidity* $_{i,t}$ for bond *i* in month *t* on four lagged ETF activity proxies, *ETF Activity* $_{i,t-1}$ for the investment grade market from

$$Liquidity_{i,t} = \alpha_i + \lambda_t + \rho ETF\ Activity_{\ i,t-1} + \beta_1 X + \varepsilon_{i,t}.$$

The dependent variables are standardize to represent liquidity, rather than illiquidity. α_i is the bond fixed effect and λ_t is the time fixed effect. *%MF (Lag) and %Index (Lag)* are the previous month's active and index fund ownership, respectively, and *Rating* $_{i,t}$ is the numerical average rating from S&P, Moody's and Fitch. Panel A uses lagged ETF ownership, *%ETF (Lag)*, as the variable of interest. Panel B uses a measure of creation and redemption intensity, *C/R Intensity (Lag)*, while Panel C uses *ETF Turnover (Lag)*. Panel D includes *Short (Lag)* a measure of the short interest in an ETF. The ETF activity proxies in the last three panels are computed as the weighted average of the variable for all ETFs holding the bond. Standard errors are clustered at the issuer level and t-statistics are reported below the coefficients. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Dependent Variable:	PC1	IRC	HW Spread	Amihud	Turnover	Zeros
Panel A: %ETF	(1)	(2)	(3)	(4)	(5)	(6)
%ETF (Lag)	-0.001	-0.002	-0.005	0.078	0.051	0.138
	-0.21	-1.50	-0.77	0.34	1.12	1.17
Rating	-0.067	-0.026***	-0.072	-4.740**	0.560	1.266**
	-1.43	-4.17	-1.42	-2.55	1.31	2.04
%MF (Lag)	0.005***	0.001***	0.003**	0.209***	0.018***	0.180***
	4.71	2.68	2.46	4.36	2.91	8.53
%Index (Lag)	-0.001	0.001	0.003	0.118	-0.007	-0.381***
	-0.25	0.60	0.40	0.48	-0.07	-2.78
Constant	0.462	-0.479***	-0.405	1.811	-4.139	-78.478***
	0.73	-5.15	-0.57	0.07	-0.66	-8.90
R-sqr	0.5643	0.4022	0.5303	0.3113	0.4195	0.7539
Obs.	77,128	88,191	77,928	89,525	91,463	91,463
Panel B: C/R Intensity	(1)	(2)	(3)	(4)	(5)	(6)
C/R Intensity (Lag)	-0.001	-0.001	-0.001	-0.139**	0.005	0.045
	-0.84	-1.26	-1.00	-2.06	0.66	1.63
Rating	-0.066	-0.026***	-0.072	-4.729**	0.560	1.261**
	-1.43	-4.16	-1.42	-2.55	1.31	2.03
%MF (Lag)	0.005***	0.001***	0.003**	0.211***	0.019***	0.180***
	4.74	2.70	2.47	4.40	2.91	8.49
%Index (Lag)	-0.001	0.001	0.003	0.126	-0.004	-0.373***
	-0.26	0.52	0.35	0.50	-0.04	-2.73
Constant	0.460	-0.481***	-0.410	1.702	-4.104	-78.350***
	0.73	-5.17	-0.58	0.07	-0.65	-8.90
R-sqr	0.5643	0.4022	0.5303	0.3113	0.4195	0.7539
Panel C: ETF Turnover	(1)	(2)	(3)	(4)	(5)	(6)
ETF Turnover (Lag)	-0.000	-0.002	0.000	-0.489*	0.016	0.381***
	-0.09	-1.30	0.05	-1.78	0.49	3.65
Rating	-0.067	-0.025***	-0.072	-4.726**	0.559	1.254**
	-1.43	-4.15	-1.42	-2.55	1.31	2.01
%MF (Lag)	0.005***	0.001***	0.003**	0.211***	0.018***	0.179***
	4.73	2.71	2.46	4.40	2.90	8.47
%Index (Lag)	-0.001	0.001	0.003	0.130	-0.004	-0.377***
	-0.26	0.53	0.35	0.51	-0.04	-2.75
Constant	0.461	-0.481***	-0.408	1.732	-4.106	-78.303***
	0.73	-5.17	-0.58	0.07	-0.65	-8.86
R-sqr	0.5643	0.4022	0.5303	0.3113	0.4195	0.7540
Panel D: ETF Short Interest	(1)	(2)	(3)	(4)	(5)	(6)
Short Interest (Lag)	-0.006	-0.003**	-0.008*	-0.567***	0.002	0.382***
	-1.49	-2.51	-1.80	-2.78	0.08	4.03
Rating	-0.066	-0.025***	-0.072	-4.724**	0.560	1.254**
	-1.43	-4.16	-1.42	-2.55	1.31	2.01
%MF (Lag)	0.005***	0.001***	0.003**	0.210***	0.019***	0.179***
	4.73	2.70	2.47	4.39	2.90	8.44
%Index (Lag)	-0.002	0.001	0.003	0.112	-0.004	-0.365***
	-0.28	0.48	0.32	0.44	-0.03	-2.71
Constant	0.460	-0.481***	-0.410	1.776	-4.109	-78.347***
	0.73	-5.17	-0.58	0.07	-0.65	-8.86
R-sqr	0.5643	0.4023	0.5304	0.3113	0.4195	0.7541

Table 9: Investment Grade Liquidity Fixed Effects Panel Regression

This table reports the results of regressions of the six liquidity proxies, *Liquidity* $_{i,t}$ for bond *i* in month *t* on four lagged ETF activity proxies, *ETF Activity* $_{i,t-1}$ for the investment grade market from

$$Liquidity_{i,t} = \alpha_i + \lambda_t + \rho ETF\ Activity\ _{i,t-1} + \beta_1 X + \varepsilon_{i,t}.$$

The dependent variables are standardize to represent liquidity, rather than illiquidity. α_i is the bond fixed effect and λ_t is the time fixed effect. *%MF (Lag) and %Index (Lag)* are the previous month's active and index fund ownership, respectively, and *Rating* $_{i,t}$ is the numerical average rating from S&P, Moody's and Fitch. Panel A uses lagged ETF ownership, *%ETF (Lag)*, as the variable of interest. Panel B uses a measure of creation and redemption intensity, *C/R Intensity (Lag)*, while Panel C uses *ETF Turnover (Lag)*. Panel D includes *Short (Lag)* a measure of the short interest in an ETF. The ETF activity proxies in the last three panels are computed as the weighted average of the variable for all ETFs holding the bond. Standard errors are clustered at the issuer level and t-statistics are reported below the coefficients. *

Dependent Variable:	**PC1**	**IRC**	**HW Spread**	**Amihud**	**Turnover**	**Zeros**
Panel A: %ETF	(1)	(2)	(3)	(4)	(5)	(6)
%ETF (Lag)	-0.056***	-0.021***	-0.021*	-1.845***	-0.350***	-1.213***
	-3.63	-3.84	-1.90	-2.97	-5.92	-6.35
Rating	0.156***	0.046***	0.084***	6.730***	0.451***	2.938***
	4.13	3.31	2.77	4.27	5.82	8.37
%MF (Lag)	0.003**	-0.001	0.004***	-0.002	0.044***	0.032*
	2.47	-1.25	3.38	-0.04	5.78	1.82
%Index (Lag)	-0.010***	-0.003***	-0.007***	-0.309***	-0.062***	-0.136***
	-5.42	-3.79	-4.17	-4.40	-8.69	-6.70
Constant	-1.986***	-1.213***	-2.915***	-133.599***	1.980***	-70.925***
	-7.73	-12.41	-14.50	-11.74	3.97	-31.42
R-sqr	0.6761	0.4716	0.5556	0.3630	0.4967	0.8537
Obs.	246,419	316,135	251,684	324,362	335,064	335,064

Panel B: C/R Intensity	(1)	(2)	(3)	(4)	(5)	(6)
C/R Intensity (Lag)	-0.003*	-0.002**	-0.003	-0.143**	0.033***	0.043**
	-1.86	-2.44	-1.60	-1.97	5.36	2.30
Rating	0.161***	0.047***	0.086***	6.852***	0.480***	3.030***
	3.98	3.24	2.72	4.20	5.65	8.11
%MF (Lag)	0.003***	-0.000	0.005***	0.013	0.046***	0.039**
	3.12	-0.92	3.74	0.32	5.91	2.26
%Index (Lag)	-0.011***	-0.003***	-0.007***	-0.332***	-0.067***	-0.152***
	-5.32	-3.87	-4.05	-4.35	-9.09	-6.99
Constant	-2.027***	-1.226***	-2.928***	-134.728***	1.706***	-71.799***
	-7.38	-11.93	-14.04	-11.41	3.11	-30.17
R-sqr	0.6755	0.4711	0.5555	0.3629	0.4955	0.8532

Panel C: ETF Turnover	(1)	(2)	(3)	(4)	(5)	(6)
ETF Turnover (Lag)	-0.020***	-0.008***	-0.018***	-1.033***	0.056**	-0.013
	-2.70	-2.85	-2.70	-3.29	2.56	-0.22
Rating	0.160***	0.047***	0.085***	6.798***	0.480***	3.024***
	4.00	3.24	2.72	4.21	5.66	8.13
%MF (Lag)	0.003***	-0.000	0.005***	0.016	0.046***	0.040**
	3.20	-0.89	3.81	0.41	5.94	2.30
%Index (Lag)	-0.011***	-0.003***	-0.007***	-0.326***	-0.067***	-0.152***
	-5.38	-3.90	-4.09	-4.39	-9.13	-7.04
Constant	-2.019***	-1.223***	-2.920***	-134.278***	1.709***	-71.743***
	-7.43	-12.02	-14.16	-11.51	3.13	-30.27
R-sqr	0.6755	0.4712	0.5556	0.3629	0.4955	0.8531

Panel D: ETF Short Interest	(1)	(2)	(3)	(4)	(5)	(6)
Short Interest (Lag)	-0.024***	-0.008***	-0.021***	-0.854***	-0.038*	-0.140**
	-3.43	-2.84	-3.13	-3.10	-1.90	-2.56
Rating	0.159***	0.047***	0.085***	6.816***	0.474***	3.017***
	4.00	3.24	2.72	4.21	5.66	8.12
%MF (Lag)	0.003***	-0.000	0.005***	0.012	0.046***	0.040**
	3.08	-0.95	3.70	0.31	5.98	2.31
%Index (Lag)	-0.011***	-0.003***	-0.007***	-0.329***	-0.067***	-0.151***
	-5.36	-3.89	-4.07	-4.37	-9.11	-7.01
Constant	-2.018***	-1.224***	-2.920***	-134.459***	1.761***	-71.681***
	-7.43	-12.00	-14.16	-11.48	3.26	-30.25
R-sqr	0.6756	0.4712	0.5556	0.3629	0.4954	0.8532

Table 10: ETF Activity and Percentage of Volume by Trade Size

This table reports the results of regressions of the percentage of total monthly volume attributed to trades of different size, *%Type Volume* $_{i,t}$, for bond *i* in month *t* for different categories of trading volume. The transaction cost proxy is regressed on the four lagged ETF activity proxies, *ETF Activity* $_{i,t-1}$ as follows

$$\%Type\ Volume_{i,t} = \alpha_i + \lambda_t + \rho ETF\ Activity\ _{i,t-1} + \beta_1 Rating_{i,t} + \beta_2 \%Ownership_{i,t-1} + \varepsilon_{i,t}.$$

α_i is the bond fixed effect and λ_t is the time fixed effect. *Rating* $_{i,t}$ is the numerical average rating from S&P, Moody's and Fitch and is not reported. In some specifications lagged ownership is controlled for with *%MF* $_{i,t-1}$, mutual fund ownership, and *%Index* $_{i,t-1}$, index fund ownership. The ETF activity proxies are lagged ETF ownership, *%ETF (Lag)*, creation and redemption intensity, *C/R Intensity (Lag)*, *ETF Turnover (Lag),* and *Short (Lag)* a measure of the short interest in an ETF. The ETF activity proxies in the last three panels are computed as the weighted average of the variable for all ETFs holding the bond. The percentage of monthly volume attributed to different trade sizes is computed for both markets. Retail is composed of trades less than \$100,000. Bin 2 is for trades between \$100,000 and \$1 million. For the high yield market Bin 3 has all trades in excess of \$1million. For the investment grade market Bin 3 includes all trades between \$1 million and \$5 million and Bin 4 has trades greater than \$5 million. Panel A reports the results for the high yield market and panel B for the investment grade market. Standard errors are clustered at the issuer level and t-statistics are reported below the coefficients. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Panel A: High Yield			**Panel B: Investment Grade**			
	Retail	**Bin 2**	**Bin 3**	**Retail**	**Bin 2**	**Bin 3**	**Bin 4**
Mean	37.99%	21.78%	40.23%	51.92%	15.82%	20.52%	11.71%
%ETF (Lag)	-0.577***	0.563***	0.013	-0.327***	0.659***	0.346***	-0.678***
	-5.82	5.48	0.09	-3.71	4.82	4.45	-4.41
%MF (Lag)	-0.107***	0.026	0.081***	-0.056***	-0.037***	0.017	0.077***
	-4.71	1.47	3.91	-3.04	-2.59	1.03	3.74
%Index (Lag)	-0.657***	-0.487*	1.144***	0.011	0.108***	0.019	-0.138***
	-4.83	-1.95	3.31	0.57	4.79	0.74	-4.97
C/R Intensity (Lag)	-0.079***	0.181***	-0.102***	-0.117***	0.037	0.108***	-0.027
	-2.97	5.26	-2.59	-5.71	1.39	4.06	-0.96
%MF (Lag)	-0.107***	0.025	0.082***	-0.053***	-0.041***	0.014	0.080***
	-4.71	1.42	3.98	-2.87	-2.85	0.84	3.94
%Index (Lag)	-0.689***	-0.458*	1.146***	0.008	0.115***	0.022	-0.145***
	-4.82	-1.85	3.30	0.43	5.02	0.85	-5.09
ETF Turnover (Lag)	-0.386***	0.545***	-0.160	-0.270***	0.311***	0.113*	-0.154*
	-3.96	5.14	-1.07	-4.89	4.18	1.72	-1.78
%MF (Lag)	-0.107***	0.025	0.082***	-0.054***	-0.042***	0.015	0.081***
	-4.69	1.41	3.95	-2.90	-2.93	0.90	3.97
%Index (Lag)	-0.685***	-0.462*	1.147***	0.009	0.113***	0.022	-0.144***
	-4.76	-1.90	3.30	0.47	4.99	0.84	-5.10
Short Interest (Lag)	-0.099	0.215***	-0.115	-0.190***	0.354***	0.110	-0.274***
	-1.37	2.88	-1.08	-3.15	4.20	1.40	-3.11
%MF (Lag)	-0.108***	0.026	0.082***	-0.055***	-0.041***	0.015	0.080***
	-4.73	1.48	3.92	-2.95	-2.85	0.92	3.94
%Index (Lag)	-0.692***	-0.451*	1.143***	0.009	0.113***	0.022	-0.143***
	-4.79	-1.85	3.31	0.44	4.98	0.85	-5.08
Bond FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y
R-sqr	0.75	0.21	0.64	0.79	0.28	0.44	0.34
Obs.	91,477	91,477	91,477	335,133	335,133	335,133	335,133