ETFs and Price Volatility of Underlying Bonds

Anna Agapova[a]

Nikanor Volkov[b]

12/12/18

We wish to thank Christian Brownlees, Stéphane Chrétien, Stephen Jurich, Meredith Rhodes, Nadia Vozlyublennaia and participants of 2018 Financial Management Association meeting, 2017 Eastern Finance Association meeting, 2017 Southern Finance Association meeting, 2017 Paris Financial Management Conference meeting in Paris, 2017 ETF Research Academy event in Munich, and 2017 Russian Summer School on Institutional Analysis in Moscow for their valuable suggestions. The authors acknowledge the generous support of the Lyxor-Paris Dauphine ETF Research Academy. Any errors are our responsibility.

[a] Contact Author: Florida Atlantic University, College of Business, Finance, 777 Glades Road Boca Raton, FL 33431; Tel: 1-561-297-3493; Fax: 1-561-297-2956; email: aagapova@fau.edu

[b] Mercer University, 3001 Mercer University Dr., Atlanta, GA 30341; Tel: 1-678-547-6328; e-mail: volkov_ni@mercer.edu

ETFs and Price Volatility of Underlying Bonds

Abstract

The study examines effects of ETFs' ownership and flows on underlying bonds' returns and return volatility. On one hand, higher ETF ownership of a corporate bond is associated with a decrease in bond's return and volatility. This is consistent with liquidity-buffer hypothesis that ETFs may absorb some illiquidity of underlying bonds. On the other hand, the magnitude of ETF in(out)flows is associated with higher volatility of bond returns, while ETF flows have positive relation with the level of bond returns. This finding suggests that ETFs create demand pressure on underlying bonds, which in turn raises questions about possible systemic risks. However, absence of bond price reversal subsequent to the ETF flows suggests that increase in underlying bonds' volatility is an outcome of price discovery function of ETFs and not a result of increased noise trading in ETF market.

Keywords: bonds; ETFs; fund flows; volatility; return
JEL Classification: G12, G14, G15

1. Introduction

After more than two decades since the introduction of the first Exchange Traded Fund (ETF) in 1993, ETFs continue to gain its popularity in financial markets with a current US market capitalization of $3.3 trillion (Investment Company Institute) and $4.8 trillion in world-wide assets (research firm ETFGI), as of November 2017.[1] It is still a small fraction of managed portfolio industry, as mutual funds alone account for $14.7 trillion of assets in the US, excluding money market funds and fund of funds. However, ETFs tremendous growth raised numerous questions and concerns among researchers, practitioners and regulators. One of the central questions is whether trading in these funds creates some negative externalities, such as increased price volatility and price inflation/deflation of constituents of ETF portfolios or markets overall. There are a number of recent studies that look at how trading in equity ETFs affects liquidity and volatility of underlying stocks and stock markets in general (e.g., Hegde and McDermott (2004), Cheng and Madhavan (2009), Trainor (2010), Madhavan (2012), Hamm (2014), Israeli et al. (2016), and Ben-David, Franzoni and Moussawi (2018)).

First introduced in 2002, fixed income (bond) ETFs continue to grow in popularity as well, with their collective global (US) assets under management reaching $591 ($547.7) billion at the end of 2017.[2] This is equivalent to a 12.3% (16.6%) share of the global (US) ETF/ETP market. However, there is currently little research available on bond ETFs in general, and no research on the effect of bond ETFs trading on price volatility and price pressure of underlying bonds. We argue that the bonds that are ETFs constituents behave differently from bonds that are not part of

[1]According to the Investment Company Institute (ICI) website https://www.ici.org/research/stats/etf, as of November 2017, there were 764 Equity, 633 Global/International, 31 Hybrid, 90 Commodities and 310 Bond ETFs, with corresponding assets under management of $1,935.2 billion in Equity, $768.8 billion in Global/International, $7.5 billion in Hybrid, $68.2 billion in Commodities and $547.7 billion in Bond ETFs.
[2] According to research firm ETFGI and ICI. Data as of November 30th, 2017.

ETF portfolios. Purchases of ETF shares by investors increase demand for the underlying securities, thereby pushing the price of such securities up. However, when investors dump the ETFs, the process puts selling pressure on the same bonds, knocking down their prices relative to similar bonds outside of the ETF portfolios. Thus, we expect an increase in the price volatility and returns of bonds that are constituents of bond ETF portfolios with increase in net in(out)flows to the ETFs.

There is anecdotal evidence to this prediction, as reported in Wall Street Journal article on March 16, 2012: "as money flowed into high-yield ETFs in prior year [2011], the bonds held by the ETFs beat similar bonds that the ETFs did not own by a cumulative 0.99 percentage point for the full year, according to Bradley Rogoff, head of credit strategy at Barclays Capital. However, in the summer [2011], when nearly $1 billion flowed out of the ETFs, their bonds performed about three percentage points worse than comparable bonds."[3] Thus, the bonds that are part of high-yield ETF portfolios have been behaving differently from comparable bonds outside the ETFs. We set out to describe and explain the drivers for such differences in this paper.

A reason why investors may prefer ETFs versus direct investment in illiquid securities, e.g. bonds, is that ETFs provide insurance, diversification and simplified way of investing in such securities (see, for example, Agapova (2011), and Guedj and Huang (2009)). ETFs are considered to be more liquid than underlying securities. For example, Madhavan and Sobczyk (2016) and Ben-David, Franzoni and Moussawi (2018) provide evidence that equity ETFs are more liquid than a basket of the ETFs constituents. On one hand, ETFs can provide benefits to investors through improved liquidity of baskets of underlying securities and help in a price discovery process of constituents. On the other hand, demand volatility for shares of bond ETFs (or any other illiquid

[3] http://www.wsj.com/articles/SB10001424052702303863404577285501263960594

assets ETFs) may distort prices and raise price volatility of underlying securities, even further than in a more liquid stock market.[4] A counterargument, raised by some in the field, is that the current share of corporate bonds that are held by ETFs is not large enough to affect the price and volatility of underlying securities.[5] Therefore, it is an empirical question as to how, if at all, ETFs affect the price volatility of underlying bonds. If the predicted effect on bond volatility and returns is present, then investors face a tradeoff of investing through ETFs and benefiting from increased liquidity, diversification and reduced costs of trading as well as intra-day trading flexibility, or investing directly in bonds not associated with ETFs and avoiding non-fundamental volatility that ETFs may impose.

In contrast to findings of Ben-David et al. (2018), who study equity ETFs, we find that higher ETF ownership of a corporate bond is associated with decreased bond return volatility of 12.7 basis points and decreased returns of 40.7 basis points per a percent of ownership increase, on annualized basis. Controlling for the credit quality of constituent bonds reveals that ETF ownership of non-investment grade, i.e. junk, bonds, has no different effect on bonds' return volatility and return, compared to ETF ownership in investment grade corporate bonds. This result is consistent with the prediction that the liquid ETF market creates liquidity buffer through moving investors from less liquid underlying bond market to more liquid ETF market, and increases liquidity to the more opaque over-the-counter bond market.

An addition of a bond to an ETF portfolio decreases average bond's annualized volatility by 65 basis points and does not affect bond's return in the month of inclusion. An exclusion of a

[4] Ben-David, Franzoni and Moussawi (2018) show that noise traders in stock ETFs increase price volatility of the ETFs' holdings.

[5] US-listed corporate bond ETFs' collective holdings represented only 2.6% of the underlying corporate bond market at the end of 2016. Source: US Federal Reserve, "Financial Accounts of the United States", Q4 2016.

bond from an ETF portfolio does not affect bond's return volatility but increases annualized return by 6.13 percent in the month of exclusion.

Examination of the effect of ETF capital flows on the return volatility and the level of return of underlying bonds reveals a positive relation between absolute value of ETF flows and the volatility of bond returns, as well as a positive relation between ETF flows and the level of returns. One percent increase in net absolute ETF flows is associated with 3.2 basis points increase in underlying bonds annualized volatility, and one percent increase in signed flows is associated with 28.8 basis points increase in the bonds' annualized return. This result is consistent with the prediction that buying and selling pressure created by ETFs increases return volatility of underlying bonds, and creates upward (downward) pressure on bond returns with increase in ETF inflows(outflows) to the bond. We also find that selling pressure (net negative flows) has larger effect on bond return volatility than buying pressure (net positive flows) does, by 4.8 basis points on annualized basis. Controlling for the credit quality of constituent bonds reveals that junk status of a bond has no different effect on bonds' return volatility in comparison to investment grade corporate bonds' volatility response to ETF flows, but increases junk bond annualized returns 2.8 times (61.4 basis points) more than those of investment grade bonds. Controlling for both, bond junk status and ETF flows being negative, indicates that outflows increase underlying bonds' return volatility more than inflows, and do so more for junk bonds. We document a non-linear V-shape relation between the monthly bond level ETF capital flows and return volatility of underlying securities, and a positive linear relation between ETF flows and monthly bond returns. This result is consistent with the prediction that demand pressure in the bond ETF market translates into higher return volatility of underlying bonds, and increased (decreased) return level of underlying bonds as positive (negative) shocks to the capital flows to ETFs holding the bonds occur.

However, absence of bond price reversal after the ETF flows to the bonds suggests that increase in underlying bonds' volatility is an outcome of price discovery occurring in the ETF market and not a result of noise, i.e., liquidity trading in the ETF market. This results is in contrast with the finding by Ben-David et al (2018) that equity ETFs introduce non-fundamental increase in volatility of underlying stocks through noise trading in ETFs.

Some have argued that bond ETFs (and corporate bond ETFs in particular) could pose a threat to broader market stability through distortion of bond prices and increase in their levels of volatility, which has also been a subject of interest to global financial regulators.[6] However, it could also be argued that the current relative size of the bond ETF market is small (2.6% of the underlying corporate bond market at the end of 2016 per US Federal Reserve data) to possess a systemic risk at this time. Furthermore, the findings of the paper indicate that increased return volatility of bonds in ETF portfolios as a results of ETF flows is an outcome of price discovery mechanism, which implies improvement of market efficiency in underlying bond market.

The rest of the paper is organized as following: Section 2 discusses related literature, Section 3 develops hypotheses, Section 4 discusses data, Section 5 describes empirical analysis, while section 6 concludes.

2. Related Literature

Our paper is related to the literature that examines effects of ETFs on characteristics of underlying securities as well as portfolios of these securities. One strand of the literature examines

[6] http://www.bloomberg.com/news/articles/2014-09-23/etf-liquidity-risk-a-concern-for-regulators-wilkins.

the effect of ETFs on liquidity of ETF constituents and of an entire ETF portfolio, and shows theoretically and documents empirically (Madhavan and Sobczyk (2016), Ben-David, Franzoni and Moussawi (2018), and Broman and Shum (2018)) that ETFs of all asset classes have higher liquidity than underlying securities that comprise these portfolios.[7]

However, the effects may be different in equity and bond markets for underlying securities of the ETFs. Nam (2017) models that ex ante market accessibility plays a role on how liquidity of underlying securities changes when a basket that contains these securities is introduced to the market. She derives that if the market is less accessible, then liquidity of basket constituents improves, but the opposite happens when the market is more accessible. Her results indicate that, in contrast to the equity market, the inception of corporate bond ETFs improves the liquidity of the underlying bonds, especially for low volume, high yield, and long term bonds and for 144A bonds to which access was previously difficult for retail investors. Brogaard and Sultan (2015) also find that bond ETF holdings are more liquid than bonds not held by ETFs, and document that, in general, higher levels of ETF ownership contribute to higher liquidity scores for high-yield corporate bonds.[8] Dannhauser (2017) looks at the effect of an introduction of bond ETFs on underlying bonds' yield spreads and liquidity, and finds that ETF innovation reduces high-yield and investment-grade bond spreads, implying price increase. Dannhauser (2017) also finds that bond ETFs decrease liquidity trader participation, increase institutional ownership, and insignificantly or negatively impact the liquidity of individual bonds.

[7] However, some may argue that bond ETFs may have only perceived liquidity that has not been tested by extreme conditions of the markets yet.

[8] Fixed income ETFs generally employ a representative sampling strategy, not the strict indexing strategy utilized by the majority of equity offerings. Thus, this result on liquidity can also be interpreted as self-selection by ETFs to hold more liquid bonds, which can also be explained by ETFs' attempt to reduce a negative externality of bond ETF flows on price volatility of underlying securities.

A mechanism of ETF capital flow effect on underlying securities pricing is similar to that of mutual fund flows. As money flow in or out of the mutual funds, they create a demand pressure on the underlying securities' prices (e.g., Coval and Stafford (2007), Lou (2012), Vayanos and Woolley (2013)). The difference is that intraday trading in ETFs can attract high frequency traders. ETFs allow investors to access the market continuously and at a low trading cost, which can potentially attract more high-frequency demand than other institutional portfolios, including traditional index funds. Additionally, active mutual fund portfolio managers may have some flexibility in benchmark tracking and therefore may mitigate an impact of capital flows with choice of what underlying securities to trade, while arbitrage trading between ETFs and underlying securities is set by the index. Thus, ETF ownership and trading may create a larger price impact on underlying securities than mutual funds do. A number of studies show that mutual fund trading driven by investor flows results in significant price pressure in equity markets (Coval and Stafford (2007), Frazzini and Lamont (2008), Lou (2012), Edmans, Goldstein, and Jiang (2012), Khan, Kogan, and Serafeim (2012)). However, there is a documented difference between equity and bond markets with respect to mutual funds trades driven by investors' flows into the funds. Choi and Shin (2017) find that, in contrast to well-documented evidence of investors flows price pressure reported in equity mutual fund studies, mutual fund flows have only limited impact on corporate bond prices. They explain this finding with liquidity-sensitive trading conducted by corporate bond funds, as fund managers maintain high levels of cash and selectively trade high liquidity bonds. The authors also document that bond mutual funds do not sell one-to-one with capital outflows, and sell only 66 to 78 basis points of their bond holdings for one percent of outflows of their TNA. However, the authors do find that during market stress episodes such as the 2008 financial crisis, there is significant flow-driven price pressure.

ETFs, similar to conventional open-end mutual funds, provide a convenience of liquidity and diversification as a one-stop shop. What sets ETFs apart, is that they can be traded intraday as well as have an embedded arbitrage mechanism of in-kind transactions that keep ETF prices close to their net asset values (NAV) throughout the day. However, Broman and Shum (2018) and Ben-David, Franzoni and Moussawi (2018) argue that ETFs also attract short-term and noise traders, which can increase price volatility of underlying securities. Ben-David, Franzoni and Moussawi (2018) find that ETFs' ownership of stocks increases non-fundamental volatility of those stocks and introduces new noise to the market.

Even though, bond ETF managers do not have as much flexibility in amount and timing of trading underlying bonds as bond mutual fund managers have (as reported by Choi and Shin (2017)), they still may have more flexibility in index tracking than equity ETF managers do based on a replication mechanism used. Bond ETFs' close following of an index and in-kind transactions mechanism require trading of ETF underlying securities at the time and size of ETF capital flows. However, due to the size of the bond ETFs benchmarks, fixed income ETFs generally employ a representative sampling strategy, not the strict indexing strategy utilized by the majority of equity offerings. Given the different findings of how the mutual fund trading affects underlying securities, equities versus bonds, as well as difference in structure of ETFs and traditional mutual funds, it is an empirical question of whether ETF ownership and trading has a positive effect on the underlying bonds (i.e. liquidity-buffer effect and price discovery function), or a negative effect (i.e. increased noise trading).

An effect similar to that documented by Ben-David, Franzoni and Moussawi (2018) may be present for bonds held by ETFs versus bonds not held by ETFs. It can be due to noise trading as in equity ETFs, due to illiquidity and opacity of bond markets that can create difficulty trading securities with significant demand pressure, or due to price discovery effect. Because of the unique nature of the bond market, such as its low liquidity and low transparency, the effect may be different from one reported in the stock market.[9]

3. Hypotheses

Similar to the effect of mutual funds and other institutional investors flows on prices of stocks in underlying portfolios (Coval and Stafford (2007), Frazzini and Lamont (2008), Lou (2012), Edmans, Goldstein, and Jiang (2012), Khan, Kogan, and Serafeim (2012)), ETF flows may translate into price pressure on the underlying securities. In theory, the price pressure effect can be due to either liquidity trading or price discovery.

Liquidity trading hypothesis states that positive demand or liquidity shocks to ETFs that are unrelated to the fundamental value of the portfolio holdings, at first, increase prices of the ETFs and sequentially of underlying securities through an imbedded arbitrage mechanism, but then revert to the original price level leading to increased price volatility of the underlying securities. The same sequence with the opposite direction of the price movement would happen with a negative liquidity demand shock. Malamud (2015) derives this prediction in his dynamic model of ETFs. Ben-David, Franzoni and Moussawi (2018) show that equity ETFs increase price volatility in stocks owned by ETFs and attribute it to noise traders, finding a price reversal in underlying stocks after ETF flows, conforming to liquidity trading hypothesis. In general, such effect of ETFs

[9] Bao, Pan and Wang (2011) document that the illiquidity in corporate bonds is large and actually greater than measured by the bid-ask spread. They also show that bond illiquidity explains bond yield spreads and prices.

on price volatility of underlying securities can be present in all types of assets that are held by ETFs, including bonds.

However, the first alternative hypothesis to liquidity trading one is that ETF ownership can decrease volatility of underlying securities. Additional layer of market-making power that ETFs may be providing can create liquidity buffer. As in the futures market example documented by Grossman (1989), introduction of correlated assets allows investors to move their trading to a more liquid platform, such as ETFs, from less liquid market of underlying securities. That leads to liquidity shocks coming to the underlying market to be absorbed by the ETF market resulting in reduced price volatility of the underlying securities. Bond markets are very illiquid due to the over-the-counter structure. It is very possible that bond ETFs can act as liquidity buffers and decrease volatility of underlying bonds.

The last alternative, price discovery hypothesis claims ETFs are vehicles for improved price discovery (e.g., Glosten, Nallareddy, and Zou (2016), Madhavan and Sobczyk (2016)). In this hypothesis, if ETFs provide a price discover function, when a fundamental shock, i.e. permanent change to the value, happens to the underlying securities, then ETFs would experience a price change before the price movement in the underlying securities. The price of the underlying would temporarily continue to be stale and then follow the ETF price. The price reversal would not happen as it would with a liquidity shock. As a result, a positive relation could exist between ETF ownership and volatility, but the increased volatility would result from the faster impounding of fundamental information into prices. Tucker and Laipply (2013) show that liquid fixed-income ETFs may provide price discovery.

The examination of the effect of ETFs on underlying securities in the bond market is important because of the unique nature of the bond market, which is characterized by high illiquidity, low transparency and segmentation. We analyze the effect from two perspectives: from bond inclusion in ETF holdings and from demand pressure of ETF flows to bonds. Specifically, we formulate the following hypotheses.

H1null: ETF ownership has no effect on underlying bonds' return and return volatility.

H1a: Bonds experience higher (lower) returns and volatility of returns with increasing (decreasing) ETF ownership of the bonds – liquidity-trading hypothesis.

H1b: Bonds experience lower (higher) returns and volatility of returns with increasing (decreasing) ETF ownership of the bonds – liquidity-buffer hypothesis.

It is believed and documented that ETFs have higher liquidity than their underlying securities do. The characteristic of a traded portfolio having higher liquidity than liquidity of securities in the portfolio should be more pronounced for bond ETFs than for equity ETFs. So, we have two alternative hypotheses. As illiquidity of bond securities increases, the price pressure due to ETF trading would increase. The cost of the arbitrage mechanism embedded in the ETF structure would be higher in more illiquid securities. We expect that high-yield (junk) bonds would experience more price pressure and volatility due to ETF ownership than corporate bonds of higher investment grade quality, according to liquidity trading hypothesis. Alternatively, ETF ownership of junk bonds decreases underlying bond's volatility and negatively affects bonds' returns more than those of investment grade bonds, according to liquidity buffer hypothesis.

H2 null: Junk bonds' price level and volatility effect is not different from that of investment grade bonds.

H2a: The price level and volatility effect of ETF ownership is more pronounced for junk bonds – liquidity-trading hypothesis.

H2b: The price level and volatility effect of ETF ownership is less pronounced for junk bonds – liquidity-buffer hypothesis.

Alternatively, ETF ownership of bonds may have an effect on bond price level, return and volatility not due to noise, but rather due to fundamental price discovery function of bond ETFs, leading to an alternative effect than stated in the above hypotheses. Tucker and Laipply (2013) show that liquid fixed-income ETFs may provide price discovery. To tests price discovery hypothesis, we examine bond level ETF flow effect of price level and volatility of constituent bonds of the ETF portfolios.

Our next hypothesis is that a buying (selling) pressure created by bond ETFs' investors through capital flows to (from) ETFs puts a price pressure on underlying bonds in the direction of ETF capital flows. This is a more direct way of examining a demand pressure on performance of ETFs' bond constituents. Increased ETF inflows and outflows are excepted to have positive effect on underlying bonds' price volatility. Bonds that are constituents of ETF portfolios experience higher (lower) returns with increasing (decreasing) demand in ETF market, and higher volatility of bond returns with increase in magnitudes of ETF inflows and outflows.

H3: Net capital flows to ETFs positively affect underlying bonds' prices, while net magnitude of ETF inflows and outflows positively affect price volatility of underlying bonds.

H4: ETF flow pressure is more pronounced for junk bonds.

Both, liquidity-trading and price discovery hypotheses would have predictions stated in *H3* and *H4* on the ETF flow effect on underlying bonds' returns and volatility, as discussed above. A purchase of shares in a bond ETF by an investor causes an increase in the liquidity demand for bonds in the ETF portfolio, thus pushing up prices of underlying securities. However, when investors sell the shares of ETFs, the process puts selling pressure on the same bonds, reducing their prices relative to similar bonds outside the ETF portfolio. Alternatively, ETFs may provide a price discovery function for underlying bonds traded in the more opaque over-the-counter bond market. Thus, ETF flows' price volatility effect may be a reflection of a permanent shift in underlying securities' prices.

Thus, to determine whether the source of the price pressure of ETF flows on underlying bonds is due to liquidity trading or price discovery, we examine a presence or absence of price reversal after the flow occurrence. As a null hypothesis, we expect that there will be no price reversal after the ETF flows to underlying bonds, which would conform to price discovery hypothesis. An alternative hypothesis is that the bond prices reverse after ETF flows to the bonds, which would conform to the liquidity trading hypothesis.

H5: There is no price reversal after the ETF flows to the bonds.

4. Data

We collect a sample of all ETFs that have corporate bonds in their holdings, identified from CRSP mutual fund database and Bloomberg, for the period of 2010-2014. Data on bond ETFs' NAV, price, portfolio composition, and flows come from CRSP mutual funds database. We obtain the trade, bond-specific and issue-specific data on corporate bonds from the FINRA TRACE database. Bond-level characteristics data, such as issue date, maturity date, issue size, coupon rate, credit rating, as well as identifiers for callable and Yankee bonds, are from Mergent FISD.

For the purpose of our study, we follow the bond screening criteria similar to Bao, Pan and Wang (2011). To be included in our sample, the bond must be traded at least 75% of business days and have at least 10 observations of daily returns to calculate monthly return volatility based on daily returns. In calculating volatility of daily returns, price changes may be between prices over multiple days if a bond does not trade during a day. We also omit from the sample ETFs and mutual funds than have less than $10 million in assets under management. Table 1 presents statistics of number of all ETFs that have corporate bond holdings based on the sample of bonds that satisfy the screening criteria. The number of ETFs that have corporate bonds in their holdings increased 3.5 times from 115 to 515 between 2010 and 2014, while AUM of those ETFs increased by 80% from $137,806 million to $247,928 million. Bonds in our sample represent between 50% and 60% of unscreened bond sample in each year. The proportion of bonds held by ETFs in our sample increased substantially each year starting from 2.93% in 2010 to 50.29% in 2014. However, the average ETF ownership of a bond in the sample was 1.13%.

<Table 1 should be here>

5. Empirical Analysis

5.1. *Variables*

We use two measures as dependent variables in the tests performed in the study: (1) *Volatility*, measured as the standard deviation of all daily returns of a bond within a month, in percentage; and (2) *Return*, measured with a return on the bond within a month, in percentage, calculated as in Bao and Pan (2013) and Bessembinder et al. (2009).

The main variables of interest are the ETF ownership of a bond, bond-level ETF flows, and addition and exclusion of a bond to (from) an ETF portfolio. Other variables control for the overall market conditions, liquidity of the bond, and issuing firm characteristics. The variables are selected based on previous literature.

The definitions of explanatory variables are as follows:

ETF ownership of bond *i* in month *t* is defined as the sum of the dollar value of holdings by all ETFs investing in the bond, divided by the bond's capitalization at the end of the month, and multiplied by 100:

$$ETF\ ownership_{i,t} = \frac{\sum_{j=1}^{J} w_{i,j,t} AUM_{j,t}}{Mkt\ Cap_{j,t}}$$

where *J* is the set of ETFs holding bond *i*; $w_{i,j,t}$ is the weight of the bond *i* in the portfolio of ETF *j* at time *t*, which is extracted from the most recent quarterly report; and $AUM_{j,t}$ is the assets under management of ETF *j* at the end of the month *t*.[10]

ETF Flow is a bond-period level measure. It is weighted average of percentage change in ETF flows across the ETFs holding the bond. The weight is ETF ownership of the bond. A percentage change in ETF flows is measured as the monthly flow of capital to (from) ETF, calculated following Sirri and Tufano (1998). The calculation of *ETF Flow* is:

$$ETFFlow_{i,t} = \frac{\sum_{j=1}^{N}((TNA_{j,t} - TNA_{j,t-1} * (1 + R_{j,t})) * w_{i,j,t})}{\sum_{j=1}^{N} TNA_{j,t-1} * w_{i,j,t}}$$

where $ETF\ Flow_{i,t}$ is the weighted-average ETF flow to bond *i* at time *t*, $TNA_{j,t}$ is the Total Net Assets of ETF *j* at time *t*, and $R_{j,t}$ is ETF *j's* return at time *t*, $w_{i,j,t}$ is proportion of the bond *i* ownership by ETF *j* at time *t*. The measure is multiplied by 100 to be expressed in percentage.

[10] The continuous measure of ETF ownership is similar to Ben-David, Franzoni and Moussawi (2018)

Credit Rating is a ranking of a firm's credit rating (long-term issuer outlook) during the period, collected from Mergent FISD. Credit rating takes values from 1 to 22, with 1 being the highest credit rating (i.e., AAA) and 22 being the lowest (a firm in default) as in Dimitrov, Palia, and Tang (2015). *Junk* is a dummy variable that takes a value of one if the *Credit Rating* identifies the bond as non-investment grade (11 and larger as in Dimitrov, Palia, and Tang, 2015). *Maturity* is a bond's time to maturity in years. *Age* is a bond's time since issuance in years. *Log(Amt Out)* is a natural logarithm of a bond's amount outstanding in millions of US dollars face value. *Bond zero* is percentage of days in a quarter that the bond did not trade (see Dick-Nielsen et al., 2012). *Ln(Trades)* is the log of the bond's number of trades per month. *AIM* is the Amihud illiquidity measure calculated as in Dick-Nielsen et al. (2012) based on Amihud (2002) method. *AIM risk* is the standard deviation of the Amihud illiquidity measure as in Dick-Nielsen et al. (2012) *IRC* is the imputed roundtrip cost calculated as in Dick-Nielsen et al. (2012) based on Feldhütter (2012) *IRC risk* is the standard deviation of the imputed roundtrip cost as in Dick-Nielsen et al. (2012) *Turnover* is the bond's average monthly trading volume as a percentage of its issuance. *Ln(Avg Trade Size*) is the log of the average trade size of the bond in thousands of dollars of face value within a month. *MF Ownership* of bond *i* in month *t* is defined as the sum of the dollar value of holdings by all mutual funds investing in the bond, divided by the bond's capitalization at the end of the month. The calculation follows the methodology of calculating the *ETF Ownership* variable. *MF Flow* is a bond-period-level measure. It is weighted average of percentage change in mutual fund flows across the mutual funds holding the bond. It is calculated similar to *ETF Flow* measure. *Yankee* is a dummy indicating that the issue has been issued by a foreign issuer, but has been registered with the SEC and is payable in dollars. *Callable* is a dummy equal one if the bond is callable and zero otherwise.

5.2. *Univariate Analysis*

We first analyze characteristics of ETF-constituent and non-ETF constituent bonds and differences between the two groups on a univariate basis. Table 2 displays the summary statistics of dependent and explanatory variables for the sample of bonds used in the study in the multivariate tests presented in the following subsection. The statistics are presented based on the overall sample, and the sub-samples of bonds that are ETF constituents and those that are not. The variables are calculated on monthly basis unless otherwise specified. The differences between the constituents and non-constituent bonds' characteristics and the t-statistics for the difference are also reported in the last column of the table.

The mean daily return standard deviation, i.e., volatility, of all bonds in the sample is 1.041%, while non-ETF constituents show higher volatility of 1.122% in comparison to ETF-constituents' volatility of 0.827%, the difference of 295 basis points. The bonds' returns, on average, are 9.7 basis points higher for non-ETF constituents than for ETF constituents, with average monthly return of non-ETF constituent (ETF constituents) being 0.114% (0.016%). An average ownership of bonds that are ETF constituents is 1.13%, while among all bonds (part or not of an ETF portfolio) ETF ownership is on average 0.31%. This numbers suggest that ETFs do not have substantial ownership in any specific corporate bond. Mutual funds ownership in bonds is very similar to ETF ownership. *ETF Flows* are on average 1.308% of fund TNA invested in bond per month for ETF constituents, while mutual fund flows are less than half of what ETF flows are.

The univariate results suggest that bond ETF constituents are, on average, of a slightly higher credit quality (averaging around BBB+) and higher liquidity measured with bond age, amount outstanding, number of trades, Amihud illiquidity measure (AIM), IRC, AIM and IRC risk, and average trade size. ETF constituents have more of Yankee and Callable bonds than non-ETF constituents do. The credit rating is worse and the illiquidity measures are higher for the bonds that are not components of ETFs. These results may indicate that bond ETFs select bonds of higher quality and liquidity. Alternatively, there may be some reversed causality, whereas the bonds that are ETF components benefit from added liquidity that ETFs provide, which may result in more efficient bond pricing.

<Table 2 should be here>

Figure 1 presents relation between bond-level ETF flows, ranked by ventiles (20-quantiles), and underlying bonds' daily return volatility within a month, while Figure 2 shows relation between bond-level ETF flows, ranked by ventiles, and monthly returns. There is a non-linear V-shape relation between monthly bond level ETF flows and volatility, i.e., volatility increases with increasing inflows and outflows. There is a negative linear relation between ETF flow volatility and monthly returns, i.e. as inflows increase, returns increase, and vice versa, as outflows increase, returns decline.

<Figure 1 should be here>

<Figure 2 should be here>

5.3. *Multivariate analysis*

To test hypothesis *H1* of the effect of ETF bond ownership on return level and volatility, we regress our main variables of interest: *Volatility* and *Return* on a set of explanatory variables discussed above. The model that is applied for the overall sample of bonds that includes both ETF constituents and non-ETF constituents is of the following form:

$$Volatility_{j,t}\ (Return_{j,t}) = \alpha + \beta_1 ETF\ Ownership_{j,t-1} + \beta_2 Credit\ Rating_{j,t} + \beta_3 Time\ to\ Maturity_{j,t} + \beta_4 Age_{j,t} + \beta_5 ln\ AmtOut_{j,t-1} + \beta_6 Bond\ Zero_{j,t-1} + \beta_7 lnTrades_{j,t-1} + \beta_8 AIM_{j,t-1} + \beta_9 AIM\ risk_{j,t-1} + \beta_{10} IRC_{j,t-1} + \beta_{11} IRC\ risk_{j,t-1} + \beta_{12} Turnover_{j,t-1} + \beta_{13} lnAvgTradeSize_{j,t-1} + \beta_{14} MFonwership_{j,t} + + \beta_{15} Yankee_{j,t} + \beta_{16} Collable_{j,t} + \beta_{17} Volatility_{j,t-1}(Return_{j,t-1}) + e_{j,t}, \qquad (1)$$

where the main explanatory variable is a continuous variable of ETF ownership of a bond in a prior month. The other variables control for the overall market conditions, liquidity of the bond and issuing firm characteristics. We control for year, month and issuer fixed effects and robust standard errors.

We perform multivariate regression analysis to identify the effects of ETF ownership of a bond on bond's return volatility and the level of return. Separately, to test hypothesis *H2*, we examine the effect of a bond junk rating status on its return volatility and the level of return in interaction with ETF ownership of the bond. Finally, to test hypotheses *H3* and *H4*, we study the effect of the bond-period-level ETF flows on the return and return volatility of bonds included in ETFs.

Tables 3 reports results of the effect of ETF ownership on the return volatility of bonds and bonds' returns. The null hypothesis that ETF ownership of bonds has no effect on underlying bonds' returns and volatility is rejected as the coefficient on ETF ownership is negative and significant at 5 and 10 percent level, depending on model specification. Also, increase in ETF ownership decreases returns of underlying bonds: a coefficient on ETF ownership is negative and significant at 1 percent level. In economic significance, higher ETF ownership of a corporate bond is associated with decreased bond return volatility of 12.7 basis points and decreased returns of 40.7 basis points per a percent of ownership increase, on annualized basis. These results are inconsistent with the liquidity trading hypothesis, but consistent with the alternative hypothesis of liquidity buffer provided by ETFs to underlying bond market.

Based on the results of the model presented in Table 3, it is evident that increase in ETF ownership does not contribute to increased volatility and returns of underlying bonds, yet it may have a positive effect in decreasing volatility of bond returns and returns themselves through increased liquidity, which is a result of ETFs' participation in the bond market. Additionally, higher ETF ownership leads to lower returns of underlying bonds, which may also be due to improved liquidity of underlying bonds and better price discovery process for bonds that have higher ownership by ETFs.

<Table 3 should be here>

It is evident that the liquidity measures are determinant factors that explain the volatility of return and return itself. The variables that control for the macro-economic conditions and the bond's return and return volatility auto-correlation are also significant in explaining the volatility of returns and returns in the sample.

We further examine whether the effect of ETF ownership is heterogeneous across bonds with different ratings. To test hypotheses *H2* that the return volatility and level of return of non-investment grade, i.e., junk, bonds are more susceptible to demand pressures created by ETF ownership or alternatively benefit more from liquidity buffer effect, we run equation (1), while controlling for an interaction term of the *ETF Ownership* and *Junk* indicator variable. *Junk* takes a value of 1 if the bond's *Credit Rating* is between 11 and 22 (e.g., S&P BB+ or below) as in Dimitrov, Palia, and Tang (2015). Table 4 presents the results for bond return volatility and return as a dependent variable. The coefficient on *ETF Ownership* variable is negative and significant at 5 and 10 percent level, depending on model specification testing the effect on bond return volatility, which is consistent with results reported in Table 3. *Junk* variable is also positive in the volatility models, as expected, with junk bond having higher risk measured with return volatility. Though, interaction term of *ETF ownership* and *Junk* is insignificant, indicating that there is no marginal difference of ETF ownership effect on return volatility between junk and investment grade bonds.

With introduction of the *Junk* variable and its interaction term with ETF ownership, the effect of ETF ownership on bond returns, reported in Table 3, is still present with ETF ownership coefficient being positive and significant at 1 percent level. *Junk* variable and the interaction term of *ETF ownership* and *Junk* are insignificant, indicating that ETF ownership of non-investment grade, i.e. junk, bonds, has no different effect on bonds' return than ETF ownership in investment grade corporate bonds.

<Table 4 should be here>

Next, we examine whether adding (dropping) a bond to (from) at least one (all) ETF portfolio(s) affects returns and return volatility of the bond. The sample used in the Add sample consists of three bond months of observations – month prior to inclusion in an ETF (bond not included in any ETFs), month of inclusion in at least one ETF (the first month when the ETF ownership variable is greater than zero), and a month following the month of inclusion in at least one ETF. The Drop sample consists of three bond months – month when the bond was a part of at least one ETF (ETF ownership greater than zero), a month when the bond was dropped from all ETF portfolios (month when the ownership variable went to zero), and the month following the month of the bond being dropped from all ETFs. For multivariate analysis of bond's addition (drop) to (from) ETFs, we use the model specified in equation (1), where explanatory variables are *Add* and *Drop* dummy variables that identify the month of inclusion in at least one ETF portfolio (*Add*) and month of exclusion from all ETF portfolios (*Drop*) instead of *ETF Ownership;* a dummy variables *In ETF* (for the Add sample tests) and *Not in ETF* (for the Drop sample tests) to control for the post-inclusion or post-exclusion effects were also added to the model.

Table 5 reports results of the analysis of an effect of adding or excluding a bond to/from ETF portfolios on return volatility and bond's return. Addition of a bond to ETF portfolios has a negative relation with bond return volatility in the month of the addition. An addition of a bond to an ETF portfolio decreases average bond's annualized volatility by 65 basis points and does not affect bond's return in the month of inclusion. An exclusion of a bond from an ETF portfolio does not affect bond's return volatility but increases annualized return by 6.13 percent in the month of exclusion. The result of ETF addition on bond return volatility is consistent with the results reported in Tables 3 and 4, indicating that ETFs provide a positive function of liquidity buffer in the underlying bonds. The result of ETF addition and exclusion appears to be consistent with the notion that ETFs provide additional liquidity to the bond market, which results in a lower illiquidity premium in a form of lower returns when a bond is added to and higher liquidity premium when a bond is dropped from an ETF.

<Table 5 should be here>

The regressions that test Hypothesis *H3*, whether ETF flows affect the underlying bonds' return volatility and level of return, are performed on an abbreviated sample that includes only corporate bonds that are ETF constituents. This setup mitigates the self-selection issue that possibly affected the results obtained using the sample of all bonds, though we control for indogeneity in the previous test with use of a lagged ETF ownership variable. We test the model similar to one of equation (1), but, depending on the specification, we introduce two other explanatory variables: |*ETF Flow*|, which is the absolute value of ETF flows and is used in models for volatility, and signed *ETF Flow* that is used in return models, as described in section 5.1. As noted in the univariate analyses' results reported above, ETF flows and volatility have non-linear V-shaped relation. To control for this non-linearity we use absolute value of ETF flows and an interaction term of |ETF Flow| and indicator variable *Negative ETF Flow*. The second specification is used to examine if there is asymmetry in response of bond volatility to positive versus negative net ETF flows to a bond. We also substitute *MF Ownership* with *MF Flow* variable.

As in equation (1), all regressions are performed controlling for year, month and issuing firm fixed effects and robust standard errors.

Table 6 reports test results of the effect of absolute value of ETF flows on the return volatility of underlying bonds. The results show a highly statistically significant and positive relation between the magnitude of ETF flows and the volatility of bond returns. The results is consistent with hypothesis 3 that demand pressure of ETFs increases return volatility of underlying bonds. The results also show that both substantial ETF inflows and outflows to a bond increase the bond return volatility, with selling pressure having larger effect on volatility than buying pressure does. Controlling for a bond having a junk status, an interaction term of abs ETF Flow and Junk in the return volatility model produces no different results in term of bond return volatility in comparison to investment grade bond results. However, controlling for both negative flows and junk status indicates that ETF outflows from the junk bonds increase volatility of those bonds' returns significantly more than ETF outflows from high quality bond. In economic terms, one percent increase in net absolute ETF flows is associated with 3.2 basis points increase in underlying bonds annualized volatility. This result is consistent with the prediction that buying and selling pressure created by ETFs increases return volatility of underlying bonds, and creates upward (downward) pressure on bond returns with increase in ETF inflows(outflows) to the bond. We also find that selling pressure (net negative flows) has larger effect on bond return volatility than buying pressure (net positive flows) does, by 4.8 basis points on annualized basis.

<Table 6 should be here >

Similarly, consistent with hypothesis *H3* predictions, the results reported in Table 7 indicate that signed ETF flows have a positive relation with the return of underlying bonds: one percent increase in signed flows is associated with 28.8 basis points increase in the bonds' annualized return. Increasing buying pressure of ETFs increases underlying bonds' returns, while increasing selling pressure of ETFs decreases underlying bond's returns. It is also noteworthy that ETF flows have a great explanatory power over bond returns. The R-squared values in models reported in Table 7 are about double of those reported in the Return models displayed in Table 3. This again demonstrates a significant effect of ETF flows on bond returns.

As the last robustness check, we examine whether junk status of a bond affects the return results. We introduce an interaction term of signed ETF Flow and Junk in the return model. The effect of signed ETF flows on underlying bonds' returns is more pronounces for junk bonds. The relation between bond-level ETF flows and bond return is positive as reported above, but it is 2.8 times larger for junk bonds than for investment grade bonds. As ETF inflows to a bond increase, the return of the bond, especially a return of a junk bond, increases – buying pressure; as the ETF outflows from a bond increase, the return of the bond, especially a junk bond, decreases – selling pressure. Controlling for the credit quality of constituent bonds reveals that junk status increases junk bond annualized returns 61.4 basis points more than those of investment grade bonds.

<Table 7 should be here >

Controlling for a direction of the ETF flows on underlying bond returns reveals that returns are more sensitive to negative flows, i.e., outflows and even more so for junk bonds experiencing outflows (models 4, 5, and 6 in Panel A of Table 7). To make interpretation of the results easier, we split the sample into two subsamples of bond level ETF inflows and outflows. We also control for a junk status in those models. Panel B of Table 7 reports the results. Bond level ETF inflows negatively affect bond's returns, while outflows move return in the same direction of flows, indicating that outflows are the ones responsible for the price pressure on the underlying bonds, while inflows may increase liquidity of the underlying bonds leading to lowers returns. However, controlling for the junk status reveals that ETF inflows and outflows to junk bonds both have positive association with the returns, which is consistent with demand pressure on the price. Economically, outflows are more significant, one percent of ETF outflows from junk bonds decreases bonds' return by 160 basis points annualized, while ETF inflow to junk bonds increases bonds' returns by 3.6 basis points annualized.

Finally, we examine whether price reversal occurs after the initial price reaction to the ETF flows to bonds. If bond price reversal happens, then the bond price volatility introduced by ETF flows can be explained by non-fundamental effect of noise trading. If bond price reversal is absent, then the bond price volatility can be explained by price discovery function that ETFs have in the underlying bond market.

We run an OLS regression on panel data, controlling for date fixed effect using the following model:

$$Return_{j,t} = \alpha + \beta_1 ETF\ Flow_{j,t} + \beta_2 Credit\ Rating_{j,t} + \beta_3 Time\ to\ Maturity_{j,t} + \beta_4 Age_{j,t} + \beta_5 lnAmtOut_{j,t-1} + \beta_6 Bond\ Zero_{j,t-1} + \beta_7 lnTrades_{j,t-1} + \beta_8 AIM_{j,t-1} + \beta_9 AIM\ risk_{j,t-1} + \beta_{10} IRC_{j,t-1} + \beta_{11} IRC\ risk_{j,t-1} + \beta_{12} Turnover_{j,t-1} + \beta_{13} lnAvgTradeSize_{j,t-1} + \beta_{14} Yankee_{j,t} + \beta_{15} Collable_{j,t} + e_{j,t}, \quad (2)$$

where, dependent variable *Return* is bond returns over four time windows: return on a day of ETF flows, *Return [0,0]*, and cumulative return over 5 days, *Return [+1,+5]*, 10 days, *Return*

[+1,+10], and 20 days, *Return [+1,+20]* after the flows. *ETF Flows* are of daily frequency and calculated as before but with daily *TNA* and *R*. The rest of the control variables are as in the prior models.

Table 9 presents the results of the test. Coefficient of *Flow ETF* is positive and significant in models with dependent variable *Return [0,0]*, columns 1 and 2, and insignificant for any other windows of return measure, columns 3 through 8. Contemporaneous one-standard-deviation change in bond level ETF net flows is associated with 10 basis points change in bond daily return. However, no reversal in bond price is observed over the following 20 days of trading. This result is consistent with price discovery function of ETFs in the underlying bond market. Thus, even though, trading in ETFs, measured with bond level flows, increases volatility of the underlying bonds, this increased bond return volatility is not due to ETF noise trading, which is in contrast with results documented on a sample of equity ETFs (Ben-David et al, 2018).

<Table 9 should be here >

6. Conclusion

The literature argues that ETF trading can affect pricing of underlying securities. Some show that effect can be negative: e.g., Ben-David, Franzoni and Moussawi (2018) argue that ETFs also attract noise traders that can increase price volatility of underlying securities. Others suggest that ETFs may have positive effect though improved liquidity of portfolios that ETFs hold. For example, Madhavan and Sobczyk (2016) and Ben-David, Franzoni and Moussawi (2018) show that ETFs of all asset classes have higher liquidity than underlying securities in those portfolios. Nam (2017) shows that an ETF introduction improved liquidity of underlying bonds. Additionally, Tucker and Laipply (2013) show that liquid fixed-income ETFs may provide price discovery for underlying securities.

We investigate whether bond ETFs distort prices and raise price volatility of underlying securities. Our results suggest that both a positive and a negative effect may be present. In univariate analysis, we find that ETF constituent bonds enjoy lower levels of return and return volatility than those that are not included in ETFs. In multivariate analysis, we find that higher ETF ownership of a corporate bond is associated with decreased bond return volatility and decreased returns. In comparison, mutual fund ownership in corporate bonds have no effect on bond return volatility and have negative association with the bond return. Controlling for the credit quality of bonds reveals that ETF ownership of junk bonds has no different effect on bonds' return volatility in comparison to ETF ownership in any corporate bond. The result still shows negative relation of ETF ownership with return volatility as well as return, though return is less affected by ETF ownership for junk bonds. This result is consistent with prediction that the liquid ETF market provides a function of price discovery and increased liquidity to the more opaque over-the-counter bond market of illiquid junk bonds. However, more active participation of ETFs in corporate bond market may create a positive pressure on bond returns.

Examination of the effect of ETF flows on the return volatility and the level of return of underlying bonds reveals a positive relation between the magnitude of ETF flows and the volatility of bond returns, as well as a positive relation between ETF flows and the level of returns. This result is consistent with the prediction that demand pressure in the bond ETF market translates into higher return volatility of underlying bonds. This finding is consistent with the prediction that positive (negative) shocks to the capital flows to ETFs increase (decrease) return level of underlying bonds.

However, absence of bond price reversal after the ETF flows to the bonds suggests that increase in underlying bonds' volatility is an outcome of price discovery occurring in the ETF market and is not due to noise trading in the ETF market. This results is in contrast with the finding by Ben-David et al (2018) that equity ETFs introduce non-fundamental increase in volatility of underlying stocks through noise trading in ETFs.

There is a concern in the industry of whether bond ETFs (and corporate bond ETFs in particular) could pose a threat to broader market stability, which has also been a subject of interest to financial regulators around the world. Overall, the findings do not suggest that there is substantial systemic risk introduced by bond ETFs to the market for underlying bonds at this time, as the share of bonds held by ETFs is small, on average 1.13% of a bond outstanding value in ETFs holdings. However, as the bond ETF market grows and ETFs' ownership share of individual securities increases, market participants may wish to find new approaches to select bonds for the indexes underlying ETFs as well as specific ETF portfolios, particularly in high-yield bond ETFs.

Reference

Agapova, A., 2011. Conventional mutual index funds versus exchange–traded funds. *Journal of Financial Markets* 14, 323–343.

Amihud, Yakov, 2002. Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets* 5, 31-56.

Bao, Jack, and Jun Pan, 2013. Bond illiquidity and excess volatility. *Review of Financial Studies* 26.12, 3068-3103.

Bao, Jack, Jun Pan and Jiang Wang, 2011. The Illiquidity of Corporate Bonds. *Journal of Finance*, 66 (3), 911-946.

Ben-David, Itzhak, Francesco Franzoni and Rabih Moussawi, 2018. Do ETFs Increase Volatility? *Journal of Finance, forthcoming*.

Bessembinder, H., Kahle, K.M., Maxwell, W.F. and Xu, D., 2009. Measuring abnormal bond performance. *Review of Financial Studies*, *22*(10), pp.4219-4258.

Brogaard, Jonathan and Galib Sultan, 2015. A Systematic Analysis of Risk and Liquidity effect of Bond ETFs on the Underlying Bonds, *Working paper*.

Broman, Markus S. and Shum, Pauline M., 2018. Relative Liquidity, Fund Flows and Short-Term Demand: Evidence from Exchange-Traded Funds. *Financial Review*, Vol. 53, Issue 1, pp. 87-115, 2018.

Cheng, Minder, and Ananth Madhavan, 2009, The Dynamics of Leveraged and Inverse Exchange-Traded Funds, *Journal of Investment Management* 7(4).

Choi, Jaewon and Shin, Sean Seunghun, 2017 Liquidity-Sensitive Trading and Corporate Bond Fund Fire Sales. Available at SSRN: https://ssrn.com/abstract=2731844 or http://dx.doi.org/10.2139/ssrn.2731844 *Working Paper*.

Coval, J., and Stafford, E., 2007. Asset Fire sales (and Purchases) in Equity Markets. *Journal of Financial Economics* 86:479-512.

Dannhauser, Caitlin D., 2017. The impact of innovation: Evidence from corporate bond exchange-traded funds (ETFs), *Journal of Financial Economics*, 125(3), 537-560.

Dick-Nielsen, Jens, Peter Feldhütter, and David Lando, 2012. Corporate bond liquidity before and after the onset of the subprime crisis." *Journal of Financial Economics* 103.3: 471-492.

Dimitrov, V., Palia, D. and Tang, L., 2015. Impact of the Dodd-Frank act on credit ratings. *Journal of Financial Economics*, *115*(3), pp.505-520.

Edmans, A., Goldstein, I., and Jiang, W., 2012. The Real Effects of Financial Markets: The Impact of Prices on Takeovers. *Journal of Finance* 67:933-971.

Feldhütter, Peter, 2012. The same bond at different prices: identifying search frictions and selling pressures. *Review of Financial Studies* 25.4: 1155-1206.

Frazzini, A., and Lamont, O. A., 2008. Dumb Money: Mutual Fund Flows and the Cross-section of Stock Returns. *Journal of Financial Economics* 88:299-322.

Glosten, Lawrence R., Suresh Nallareddy, and Yuan Zou, 2016, ETF trading and informational efficiency of underlying securities, Research paper no. 16-71, Columbia Business School.

Grossman, Sanford Jay, 1989, An analysis of the implications for stock and futures price volatility of program trading and dynamic hedging strategies, *NBER Working paper* 2357.

Guedj, Ilan, and Jennifer Huang, 2009. Are ETFs Replacing Index Mutual Funds? *Working paper*, ssrn.com, http://ssrn.com/abstract=1108728.

Hamm, Sophia J.W., 2014. The effect of ETFs on stock liquidity. Working paper, ssrn.com, http://ssrn.com/abstract=1687914.

Hegde, Shantaram P., and John B. McDermott, 2004. The market liquidity of DIAMONDS, Q"s, and their underlying stocks. *Journal of Banking and Finance* 28, 1043-1067.

Israeli, D., Lee, C.M., Sridharan, S., 2016. Is there a dark side to exchange–traded funds (ETFs)? An information perspective. *Stanford University, Stanford, CA, Unpublished working paper.*

Khan, M., Kogan, L., and Serafeim, G., 2012. Mutual Fund Trading Pressure: Firm-Level Stock Price Impact and Timing of SEOs. *Journal of Finance* 67:1371-1395.

Lou, D., 2012. A Flow-based Explanation for Return Predictability. *Review of Financial Studies* 25:3457-3489.

Madhavan, Ananth (2012). Exchange-traded funds, market structure, and the flash crash, *Financial Analysts Journal*, 68(4):20-35.

Madhavan, Ananth and Sobczyk, Aleksander, 2016. Price Dynamics and Liquidity of Exchange-Traded Funds. *Journal Of Investment Management*, Vol. 14, No. 2, 1–17.

Malamud, Semyon, 2015, A dynamic equilibrium model of ETFs, *Working paper,* Swiss Finance Institute.

Nam, Jayoung, 2017. "Market Accessibility, Corporate Bond ETFs, and Liquidity". *Indiana University Working paper.*

Sirri, E.R. and Tufano, P., 1998. Costly search and mutual fund flows. *The Journal of Finance*, *53*(5), pp.1589-1622.

Trainor, Jr., William J., 2010, Do Leveraged ETFs Increase Volatility? Technology and Investment 1(3), 215–220.

Tucker, M and S. Laipply, 2013, Bond Market Price Discovery: Clarity Through the Lens of an Exchange, *Journal of Portfolio Management*, Winter, 49-62.

Figure 1 Effect of bond level ETF flows on constituent bond return volatility

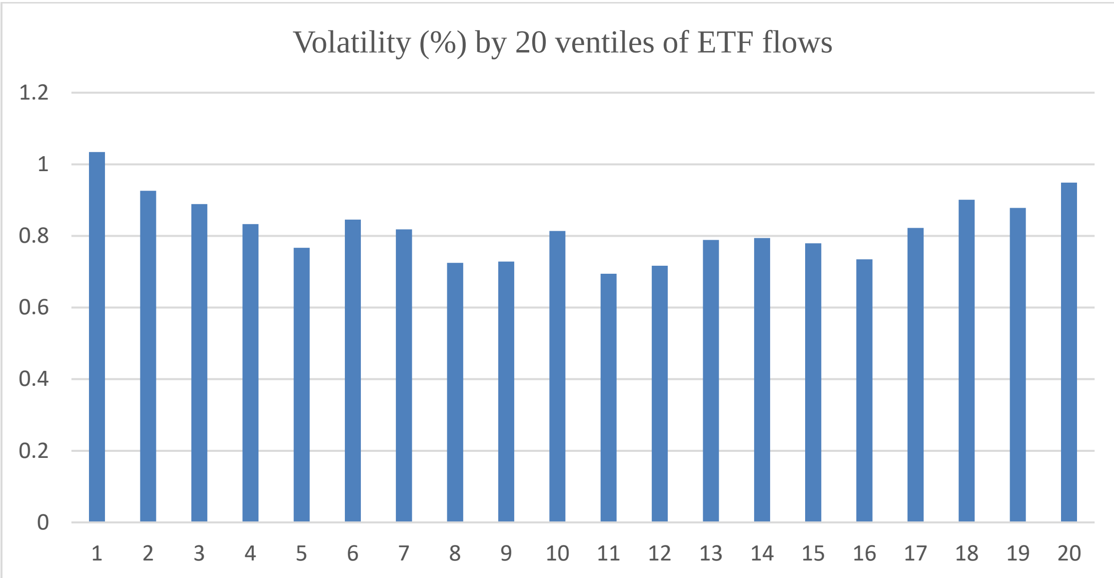

Figure 2 Effect of bond level ETF flows on constituent bond monthly returns

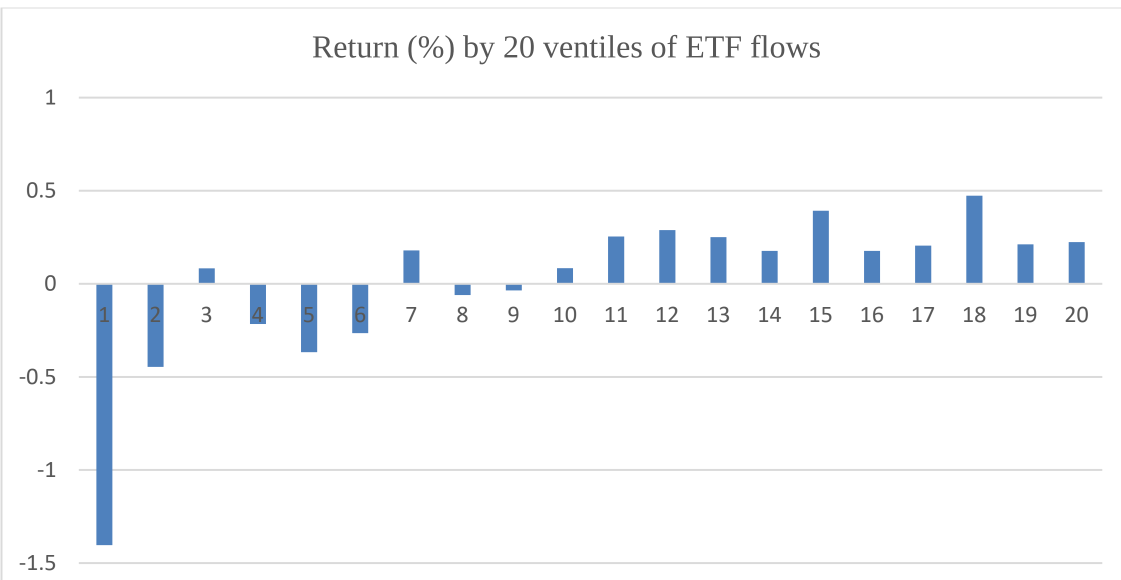

Table 1. Descriptive Statistics of Bond ETF market by year.

The table presents statistics of all ETFs that hold bonds after screening criteria are applied to the data. Column (1) reports number of ETFs holding bonds, Column (2) – assets under management (AUM) held by ETFs that hold bonds, column (3) – total number of bonds outstanding in the market based on the screening criteria of bond trading frequency, column (4) – number of bonds in column (3) held by ETFs, and column (5) – percentage of bonds held by ETFs [(4)/(3)].

Year	N of ETFs Holding Bonds	ETF AUM ($ Millions)	N of Bonds	N Bonds held by ETFs	% Bonds held by ETFs
	(1)	(2)	(3)	(4)	(5)
2010	115	137,806	2,727	80	2.93%
2011	352	213,112	3,242	374	11.54%
2012	438	346,387	2,819	739	26.21%
2013	382	234,675	2,953	1,083	36.67%
2014	515	247,928	3,118	1,568	50.29%

Table 2. Descriptive statistics

Return – monthly return on a bond calculated as the difference between the price on the first day of the month and the price on the last day of the month divided by the price on the first day of the month; *Volatility* – the standard deviation of all daily bond returns within the month; *Credit Rating* – a ranking of a firm's credit rating (long term issuer outlook) during the period. Credit rating takes values from 1-22, with 1 being AAA and 22 being D (a firm in default) as in Dimitrov, Palia, and Tang (2015); *AIM* – the Amihud illiquidity measure; *AIM risk* – the standard deviation of the Amihud illiquidity measure; *IRC* – is the imputed roundtrip cost calculated; *IRC risk* – is the standard deviation of the imputed roundtrip cost; *Bond zero* – percentage of days in a quarter that the bond did not trade; *Maturity* – number of years until the maturity of the bond; *ETF Flow* - is measured as the bond-level monthly net flow of capital to (from) ETF. This variable is design to capture effects similar to those captured by Flow. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

	Overall sample	ETF Constituent	Not ETF Constituent	Difference	
Dependent Variables					
Volatility, %	1.0413	0.8267	1.1216	-0.295	***
	1.003	0.654	1.095	-50.73	
	147,611	40,212	107,399		
Return, %	0.0868	0.0163	0.1135	-0.097	***
	3.195	2.377	3.453	-5.13	
	142,408	39,080	103,328		
Explanatory Variables					
ETF Ownership, %	0.3067	1.1273	-	-	
	0.940	1.525	-	-	
	147,877	40,236	-		
ETF Flows, %	0.3395	1.3076	-	-	
	3.202	6.183	-	-	
	147,877	38,391	-		
MF Ownership, %	0.3160	0.9953	0.0621	0.933	***
	1.095	1.713	0.561	11.82	
	147,877	40,236	107,641		
MF Flows, %	0.6161	0.5937	0.7181	-0.1244	**
	6.281	6.361	5.904	-2.30	
	48,862	40,047	8,815		
Credit Rating	8.2658	8.1216	8.3194	-0.1977	***
	3.901	3.467	4.049	-8.52	
	142,854	38,683	104,171		
Time to Maturity	7.653	7.633	7.661	-0.027	
	8.520	6.810	9.084	-0.55	
	146,315	40,200	106,115		
Age	3.9641	1.4558	4.9023	-3.447	***
	3.622	1.006	3.796	-179.72	
	147,704	40,211	107,493		
ln Amt Out	6.7161	6.8848	6.6536	0.231	***
	0.801	0.526	0.873	49.18	
	144,503	39,085	105,418		
Bond Zero	8.7688	8.7606	8.7718	-0.011	
	11.695	11.995	11.582	-0.16	
	144,609	39,099	105,510		
ln Trades	5.0881	5.0276	5.1105	-0.083	***
	0.847	0.841	0.848	-16.55	
	144,609	39,099	105,510		
AIM	0.2955	0.1396	0.3551	-0.216	***
	2.648	0.171	3.110	-13.67	
	140,794	38,930	101,864		
AIM risk	0.9103	0.3983	1.1112	-0.713	***
	14.484	8.580	16.220	-8.20	
	137,131	38,651	98,480		
IRC	0.0029	0.0023	0.0031	-0.001	***
	0.003	0.002	0.003	-40.91	
	141,901	38,983	102,918		
IRC risk	0.0035	0.0030	0.0037	-0.001	***

	0.005	0.003	0.005	-22.10	
	141,702	38,925	102,777		
Turnover	0.2732	0.2633	0.2769	-0.014	
	9.062	1.012	10.623	-0.25	
	141,838	38,979	102,859		
ln Avg Trade Size	12.6580	13.1568	12.4691	0.688	***
	1.267	1.028	1.298	94.05	
	141,944	37,345	104,599		
Yankee	0.1088	0.1388	0.0983	0.040	***
	0.311	0.346	0.298	21.95	
	147,809	38,414	109,395		
Callable	0.7576	0.8194	0.7359	0.083	***
	0.429	0.385	0.441	32.96	
	147,809	38,414	109,395		

Table 3. Bond return volatility, return and ETF ownership

The dependent variable in the regressions reported below is *Volatility* – the standard deviation of all daily bond returns within the month, and *Return* – monthly returns on corporate bonds. The variable *ETFOwnership* is percentage of ETF holdings in a bond. The rest of explanatory variables are same as in Table 2. Model 1 controls for liquidity, Model 2 adds *MF flows* and *Yankee* and *Callable* dummies, Model 3 adds lagged dependent variable. The regressions are run controlling for the year, month, and issuing firm fixed effects with robust standard errors. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

	Volatility			*Return*		
	1	2	3	1	2	3
Intercept	0.990***	1.116***	0.786***	-0.113	-0.028	0.316
	7.60	8.83	7.44	-0.37	-0.10	0.91
ETFOwnership$_{t-1}$	-0.008**	-0.007*	-0.006*	-0.033***	-0.035***	-0.034***
	-2.06	-1.77	-1.86	-2.98	-3.23	-2.96
Credit Rating	0.037***	0.038***	0.027***	-0.006	-0.006	0.003
	3.11	3.19	3.20	-0.35	-0.33	0.16
Maturity	0.027***	0.028***	0.020***	0.014***	0.014***	0.017***
	17.39	18.49	13.29	3.92	4.08	3.63
Age	0.003	0.001	0.001	-0.033***	-0.033***	-0.038***
	1.30	0.54	0.40	-6.29	-6.4	-6.11
ln Amt Out$_{t-1}$	-0.054***	-0.058***	-0.043***	-0.012	-0.013	0.006
	-2.92	-3.23	-3.24	-0.39	-0.45	0.16
Bond Zero$_{t-1}$	0.000	0.000	0.000	0.002**	0.002**	-0.002
	0.99	1.02	1.34	2.51	2.50	-1.16
ln Trades$_{t-1}$	0.034***	0.034***	0.021**	0.166***	0.166***	0.122***
	3.12	3.07	2.32	6.93	6.92	3.64
AIM$_{t-1}$	0.021**	0.021**	0.013**	0.024	0.024	0.025
	2.28	2.29	2.18	1.51	1.51	1.44
AIM risk$_{t-1}$	0.000	0.000	0.000	0.004	0.004	0.003
	-0.89	-0.85	-1.59	1.49	1.49	1.57
IRC$_{t-1}$	80.099***	81.421***	57.177***	43.742**	44.370**	54.352***
	13.11	13.64	11.98	2.42	2.47	2.61
IRC risk$_{t-1}$	-8.020***	-8.584***	-10.580***	6.167	5.894	5.922
	-2.89	-3.17	-5.96	0.55	0.53	0.45
Turnover$_{t-1}$	0.009	0.010	0.005	-0.001	-0.001	0.007
	1.29	1.34	1.08	-0.09	-0.06	0.59
ln AvgTrd Size$_{t-1}$	-0.026***	-0.028***	-0.018***	0.017	0.016	0.007
	-3.91	-4.42	-3.48	1.30	1.22	0.47
MFOwnership$_t$		-0.005**	-0.004**		0.007	-0.003
		-2.14	-2.03		0.59	-0.26
Yankee		0.158**	0.109**		-0.127	-0.073
		2.25	2.21		-1.6	-0.73
Callable		-0.125***	-0.089***		-0.062	-0.073
		-3.22	-3.21		-1.36	-1.34
Dep Variable$_{t-1}$			0.295***			-0.187***
			8.68			-9.90
Year & Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.3512	0.3506	0.4663	0.0440	0.0440	0.0700
N	129,483	129,483	129,472	129,487	129,487	125,703

Table 4. Bond return volatility, return, bond credit rating indicator and ETF ownership

The dependent variable in the regressions reported below is *Volatility* – the standard deviation of all daily bond returns within the month, and *Return* – monthly returns on corporate bonds. *Junk* is a variable that takes a value of 1 if the bond's credit rating is between 11 and 22 (S&P BB+ or below); *Junk*ETF Own* is an interaction term of the *ETF* and *Junk* grade variables. The rest of explanatory variables are same as in Table 3. The regressions are run controlling for the year, month, and issuing firm fixed effects with robust standard errors. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

	Volatility			*Return*		
	1	2	3	1	2	3
Intercept	1.369***	1.517***	1.044***	-0.012	0.089	0.457
	9.55	11.04	9.61	-0.05	0.37	1.62
ETFOwnership$_{t-1}$	-0.007**	-0.005*	-0.004	-0.039***	-0.039***	-0.036**
	-2.07	-1.65	-1.38	-2.61	-2.66	-2.40
*ETF Own*Junk*	-0.006	-0.005	-0.006	0.009	0.010	0.005
	-0.87	-0.77	-1.00	0.46	0.47	0.26
Junk	0.096*	0.097*	0.068*	0.054	0.055	0.080
	1.75	1.83	1.87	0.71	0.73	0.87
Maturity	0.028***	0.028***	0.020***	0.014***	0.014***	0.017***
	17.21	18.80	13.50	3.93	4.14	3.73
Age	0.003	0.001	0.001	-0.035***	-0.036***	-0.040***
	0.99	0.25	0.32	-6.16	-6.26	-5.92
ln Amt Out$_{t-1}$	-0.087***	-0.091***	-0.063***	-0.033	-0.035	-0.025
	-3.69	-3.80	-3.80	-1.31	-1.45	-0.84
Bond Zero$_{t-1}$	0.000	0.000	0.000	0.002**	0.002**	-0.001
	0.67	0.76	1.25	2.30	2.32	-1.01
ln Trades$_{t-1}$	0.043***	0.042***	0.026***	0.162***	0.162***	0.124***
	3.86	3.83	2.99	6.59	6.61	3.68
AIM$_{t-1}$	0.017**	0.017**	0.011**	0.015	0.015	0.017
	2.53	2.56	2.48	1.20	1.21	1.27
AIM risk$_{t-1}$	0.000	0.000	0.000	0.003	0.003	0.003
	-0.98	-0.75	-1.25	1.56	1.57	1.54
IRC$_{t-1}$	80.94***	82.47***	56.46***	45.03***	45.88***	56.57***
	12.64	13.38	11.31	2.59	2.66	2.83
IRC risk$_{t-1}$	-12.885***	-13.430***	-11.989***	2.141	1.833	0.367
	-3.55	-3.86	-7.53	0.25	0.22	0.04
Turnover$_{t-1}$	0.001***	0.001***	0.001***	0.000	0.000	-0.004
	2.63	2.64	5.10	-0.80	-0.80	-0.52
ln AvgTrd Size$_{t-1}$	-0.017*	-0.020**	-0.012*	0.023	0.022	0.019
	-1.92	-2.29	-1.95	1.58	1.53	1.24
MFOwnership$_t$		-0.007***	-0.005***		0.000	-0.010
		-2.82	-2.69		0.00	-0.81
Yankee		0.147**	0.099**		-0.089*	-0.038
		2.07	2.01		-1.81	-0.56
Callable		-0.147***	-0.102***		-0.082*	-0.095*
		-3.38	-3.37		-1.67	-1.6
Dep Variable$_{t-1}$			0.304***			-0.183***
			9.17			-10.07
Year & Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.294	0.290	0.444	0.043	0.043	0.068
N	133,633	133,633	133,620	133,639	133,639	129,622

Table 5. Bond return volatility, return, and addition/exclusion to/from ETF ownership

The dependent variable in the regressions reported below is *Volatility* the standard deviation of all daily bond returns within the month, and *Return* – monthly returns on corporate bonds. The variable *Add* takes a value of 1 if a bond becomes a constituent of at least one ETF. The variable *Drop* takes a value of 1 if a bond leaves all ETF portfolios and is no longer a constituent of any ETFs. The sample is based one month before, the month of add/drop and one month after the event. The regressions are run controlling for the year, month, and issuing firm fixed effects with robust standard errors. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

	Volatility				*Return*			
	1		2		1		2	
Intercept	0.634	***	0.570		-0.300		3.182	*
	2.61		1.03		-0.33		1.82	
Add	-0.041	***			0.093			
	-2.92				1.33			
In ETF	0.025	*			-0.145	**		
	1.91				-1.96			
Drop			-0.027				0.511	***
			-0.94				2.59	
Not in ETF			0.017				0.018	
			0.71				0.12	
Credit Rating	0.021	***	0.044	***	0.074	**	0.041	
	2.83		2.76		2.1		0.55	
Maturity	0.023	***	0.020	***	0.018	***	0.020	
	16.44		4.19		3.74		1.38	
Age	0.007		-0.006		-0.092	**	-0.142	
	0.69		-0.28		-2.50		-1.15	
ln Amt Out $_{t-1}$	-0.049	**	-0.098	**	-0.083		-0.095	
	-1.97		-2.3		-0.99		-0.53	
Bond Zero $_{t-1}$	0.001	***	0.000		-0.008	**	-0.004	
	2.71		-0.24		-2.18		-0.50	
ln Trades $_{t-1}$	0.058	***	0.061	**	0.168	**	0.174	
	4.78		2.36		2.47		1.17	
AIM $_{t-1}$	0.412	***	0.236	*	-0.277		-0.300	
	6.07		1.88		-0.76		-0.36	
AIM risk $_{t-1}$	0.000		0.000		-0.002		-0.008	
	-0.08		0.04		-0.27		-1.15	
IRC $_{t-1}$	38.807	***	57.330	***	26.003		0.919	
	7.10		4.37		0.93		0.01	
IRC risk $_{t-1}$	-10.977	***	-28.236	***	7.131		32.847	
	-3.49		-4.34		0.44		0.77	
Turnover $_{t-1}$	-0.002		-0.023	***	-0.023		-0.015	
	-0.84		-3.35		-1.37		-0.24	
ln AvgTrdSize $_{t-1}$	-0.018	**	-0.006		-0.044		-0.184	*
	-2.09		-0.32		-1.06		-1.95	
MF Ownership $_{t}$	-0.009	**	-0.019	**	-0.006		-0.036	
	-2.46		-2.45		-0.34		-0.80	
Yankee	0.160	***	-0.012		-0.026		-1.107	***
	3.90		-0.14		-0.13		-2.79	
Callable	-0.015		-0.217	*	-0.253		-0.838	*
	-0.2		-1.74		-0.95		-1.71	
Dep Variable $_{t-1}$	0.189	***	0.196	***	-0.253		-0.225	***
	8.25		3.44		-11.86		-6.44	
Year & Month FE	Yes		Yes		Yes		Yes	
Issuer FE	Yes		Yes		Yes		Yes	
R-squared	0.3729		0.4682		0.104		0.060	
N	10,658		3,535		10,099		3,414	

Table 6. ETF flows and bond return volatility.

The dependent variable in the regressions reported below is *Volatility* – the standard deviation of all daily bond returns within the month. Variable *|ETF Flow|* is the absolute value of net monthly flow of capital to (from) ETF aggregated on the bond level. *Negative ETF flow* is an indicator variable if the flow is net outflow. The rest of explanatory variables are same as in Table 2. The regressions are run controlling for the year, month, and issuing firm fixed effects with robust standard errors. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

	Volatility											
	1		2		3		4		5		6	
Intercept	0.164		0.132		0.083		0.249	**	0.085		0.251	**
	0.95		0.82		0.60		2.14		0.61		2.16	
|ETF Flow|$_t$	0.002	***	0.002	***	0.002	***	0.002	***	0.001	**	0.001	**
	4.12		4.12		3.71		3.14		2.28		2.2	
|ETF Flow|$_t$**Junk*							0.001					
							0.43					
|ETF Flow|$_t$** Negative ETF Flow*									0.003	***	0.002	**
									3.15		2.16	
|ETF Flow|$_t$**Junk* Negative ETF Flow*											0.006	**
											2.30	
Negative ETF flow									0.007		0.005	
									1.09		0.83	
Junk							0.190	***			0.184	***
							3.58				3.47	
Credit Rating	0.033	***	0.033	***	0.027	***			0.027	***		
	3.88		3.87		3.82				3.81			
Maturity	0.030	***	0.030	***	0.025	***	0.025	***	0.025	***	0.025	***
	26.71		26.88		19.97		19.88		19.85		19.82	
Age	0.012	**	0.013	**	0.011	**	0.011	**	0.011	**	0.011	**
	2.13		2.14		2.19		2.23		2.16		2.22	
ln Amt Out$_{t-1}$	-0.045	**	-0.044	**	-0.038	***	-0.038	***	-0.039	***	-0.039	***
	-2.52		-2.54		-2.59		-2.66		-2.66		-2.73	
Bond Zero$_{t-1}$	0.001	**	0.001	**	0.001	**	0.001	**	0.001	**	0.001	**
	2.28		2.28		2.32		2.37		2.28		2.31	
ln Trades$_{t-1}$	0.074	***	0.074	***	0.062	***	0.063	***	0.062	***	0.062	***
	8.55		8.47		7.78		7.92		7.72		7.90	
AIM$_{t-1}$	0.640	***	0.640	***	0.492	***	0.495	***	0.491	***	0.493	***
	8.40		8.42		8.69		8.68		8.68		8.66	
AIM risk$_{t-1}$	0.000		0.000		0.000		0.000		0.000		0.000	
	-0.49		-0.47		-0.77		-0.63		-0.72		-0.59	
IRC$_{t-1}$	56.493	***	56.478	***	46.455	***	47.436	***	46.498	***	47.483	***
	13.32		13.42		12.13		12.68		12.16		12.72	
IRC risk$_{t-1}$	-9.30	***	-9.33	***	-11.07	***	-11.43	***	-11.07	***	-11.45	***
	-3.95		-3.96		-5.44		-5.73		-5.46		-5.75	
Turnover$_{t-1}$	-0.004		-0.004		-0.004		-0.004		-0.004		-0.004	
	-1.22		-1.23		-1.48		-1.46		-1.46		-1.43	
ln AvgTrd Size$_{t-1}$	-0.004		-0.004		-0.003		-0.002		-0.003		-0.002	
	-0.77		-0.78		-0.57		-0.47		-0.57		-0.48	
MF Flow$_t$			0.001	**	0.001	**	0.001	**	0.001	**	0.001	**
			2.21		2.15		2.15		2.05		2.00	
Yankee			0.074		0.077		0.065		0.075		0.061	
			0.61		0.92		0.76		0.91		0.73	
Callable			0.020		0.016		0.018		0.016		0.018	
			0.42		0.41		0.46		0.39		0.45	
Dep Variable$_{t-1}$					0.185	***	0.184	***	0.185	***	0.185	***
					7.97		7.87		7.97		7.88	
Year & Month FE	Yes		Yes		Yes		Yes		Yes		Yes	
Issuer FE	Yes		Yes		Yes		Yes		Yes		Yes	
R-squared	0.4133		0.4127		0.4499		0.444		0.450		0.4445	
N	35,539		35,539		35,536		35,536		35,536		35,536	

Table 7. ETF flows and bond return.

The dependent variable in the regressions reported below is *Return* – monthly returns on corporate bonds. Variable *ETF Flow* is the signed net monthly flow of capital to (from) ETF aggregated on the bond level. The rest of explanatory variables are same as in Table 2. The regressions are run controlling for the year, month, and issuing firm fixed effects with robust standard errors. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

Panel A	*Return*					
	1	2	3	4	5	6
Intercept	-1.069 *	-1.021 *	-0.209	-0.670	0.050	-0.415
	-1.95	-1.83	-0.33	-1.35	0.08	-0.84
ETF Flow $_{t}$	0.024 ***	0.024 ***	0.025 ***	0.013 ***	-0.008 ***	-0.013 ***
	7.90	7.91	8.07	4.70	-2.76	-4.43
ETF Flow $_{t}$ ** Junk*				0.049 ***		0.014
				6.42		1.63
*ETF Flow * Negative ETF Flow*					0.077 ***	0.057 ***
					8.29	6.91
*ETF Flow * Junk* Negative ETF Flow*						0.108 ***
						4.49
Negative ETF flow					-0.229 ***	-0.204 ***
					-6.76	-6.35
Junk				-0.349		-0.095
				-0.70		-0.19
Credit Rating	-0.056	-0.055	-0.064		-0.062	
	-1.33	-1.33	-1.38		-1.31	
Time to Maturity	0.010 ***	0.011 ***	0.012 ***	0.011 ***	0.015 ***	0.014 ***
	4.02	4.11	4.07	4.01	5.23	4.93
Age	-0.078 ***	-0.080 ***	-0.094 ***	-0.095 ***	-0.096 ***	-0.098 ***
	-4.44	-4.50	-5.15	-5.15	-5.17	-5.31
ln Amt Out $_{t-1}$	-0.027	-0.028	-0.002	0.001	-0.009	-0.008
	-0.73	-0.75	-0.05	0.02	-0.23	-0.19
Bond Zero $_{t-1}$	0.000	0.001	-0.006 ***	-0.006 ***	-0.006 ***	-0.005 ***
	0.42	0.44	-3.50	-3.47	-3.15	-3.06
ln Trades $_{t-1}$	0.192 ***	0.192 ***	0.128 ***	0.122 ***	0.132 ***	0.124 ***
	5.24	5.23	2.86	2.76	2.90	2.81
AIM $_{t-1}$	-0.121	-0.121	-0.146	-0.135	-0.133	-0.127
	-0.51	-0.51	-0.56	-0.52	-0.51	-0.49
AIM risk $_{t-1}$	-0.004 *	-0.004 *	-0.004	-0.004	-0.003	-0.003
	-1.72	-1.72	-1.47	-1.50	-1.44	-1.45
IRC $_{t-1}$	17.529	17.735	24.916	21.849	24.503	22.052
	1.16	1.18	1.56	1.42	1.56	1.46
IRC risk $_{t-1}$	5.035	5.029	3.203	4.496	4.099	5.148
	0.54	0.54	0.33	0.48	0.43	0.56
Turnover $_{t-1}$	-0.009	-0.009	-0.002	-0.002	-0.003	-0.003
	-0.41	-0.41	-0.07	-0.07	-0.11	-0.12
ln Avg Trade Size $_{t-1}$	-0.006	-0.007	-0.039 *	-0.038 *	-0.036	-0.036
	-0.28	-0.32	-1.76	-1.67	-1.59	-1.58
MF Flow $_{t}$		0.002	0.003	0.003	0.002	0.002
		0.78	1.21	1.05	1.01	0.72
Yankee		0.077	0.161	0.213	0.126	0.186
		0.17	0.32	0.42	0.20	0.35
Collable		-0.060	-0.093	-0.108	-0.096	-0.109
		-0.53	-0.65	-0.74	-0.67	-0.76
Dep Variable $_{t-1}$			-0.174 ***	-0.170 ***	-0.175 ***	-0.170 ***
			-10.87	-10.56	-10.87	-10.46
Year & Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.082	0.082	0.095	0.097	0.102	0.107
N	35,540	35,540	34,338	34,338	34,338	34,338

Table 7 continued

Panel B	Return							
	Positive Flows				Negative Flows			
	1		2		3		4	
Intercept	0.034		-0.266		0.948		0.266	
	0.04		-0.37		1.07		0.37	
ETF Flow $_{t}$	-0.011	***	-0.014	***	0.037	***	0.015	**
	-3.78		-5.05		4.69		2.33	
*ETF Flow $_{t}$ * Junk*			0.017	*			0.118	***
			1.85				5.92	
Junk			-0.144				-0.049	
			-0.29				-0.07	
Credit Rating	-0.042				-0.107			
	-0.92				-1.64			
Time to Maturity	0.036	***	0.037	***	-0.014	***	-0.015	***
	9.16		9.26		-3.34		-3.77	
Age	-0.122	***	-0.122	***	-0.043		-0.048	
	-5.66		-5.64		-1.38		-1.54	
ln Amt Out $_{t-1}$	0.054		0.055		-0.151	*	-0.150	*
	0.94		0.97		-1.81		-1.82	
Bond Zero $_{t-1}$	-0.003		-0.003		-0.010	***	-0.010	***
	-1.49		-1.50		-3.48		-3.50	
ln Trades $_{t-1}$	0.118	**	0.114	**	0.173	***	0.160	***
	2.25		2.21		2.77		2.59	
AIM $_{t-1}$	-0.102		-0.097		-0.243		-0.236	
	-0.33		-0.32		-0.70		-0.67	
AIM risk $_{t-1}$	-0.005		-0.005		0.002		0.002	
	-1.44		-1.48		0.35		0.42	
IRC $_{t-1}$	15.720		14.160		37.708	*	35.145	*
	0.69		0.64		1.87		1.76	
IRC risk $_{t-1}$	11.707		12.176		-7.527		-6.965	
	0.94		1.01		-0.55		-0.51	
Turnover $_{t-1}$	0.013		0.014		-0.044		-0.044	
	0.59		0.61		-0.58		-0.57	
ln Avg Trade Size $_{t-1}$	-0.038		-0.037		-0.053		-0.052	
	-1.40		-1.37		-1.42		-1.38	
MF Flow $_{t}$	0.001		0.001		0.002		0.002	
	0.53		0.53		0.64		0.41	
Yankee	0.242		0.261		0.050		0.109	
	0.68		0.73		0.07		0.15	
Collable	-0.119		-0.126		-0.067		-0.076	
	-0.68		-0.72		-0.46		-0.53	
Dep Variable $_{t-1}$	-0.229		-0.228		-0.150	***	-0.150	***
	-10.14		-10.08		-6.86		-6.87	
Year & Month FE	Yes		Yes		Yes		Yes	
Issuer FE	Yes		Yes		Yes		Yes	
R-squared	0.091		0.092		0.154		0.161	
N	21,274		21,274		13,064		13,064	

Table 9: ETF flows and underlying bonds' price reversal.

The table reports estimates from OLS regressions of one- and multi-day returns on bond level ETF daily flows and controls. Controls are as in the prior models specifications and include bond level characteristics: Credit Rating, Maturity, Age, Log(Amount Outstanding), Bond Zero, Log(Trades), AIM, AIM risk, IRC, IRC risk, Turnover, Average trade size, and Yankee and Callable indicators. The regressions are run controlling for the date fixed effects with robust standard errors. T-statistics is reported under coefficients. The *, **, and *** represent the significance at 10, 5, and 1 percent respectively.

	Return [0;0]				*Return [+1;+5]*			*Return [+1;+10]*		*Return [+1;+20]*		
	1		2		3		4	5	6	7		8
Intercept	0.0096	***	-0.019		0.0062	***	-0.0233	-0.0016	0.0258	0.0099	**	0.1009
	16.18		-0.44		3.97		-0.27	-0.47	0.23	2.27		0.62
ETF Flow $_t$	0.101	**	0.099	*	-0.028		-0.084	0.189	0.061	0.056		-0.285
	2.04		1.69		-0.23		-0.69	0.71	0.23	0.16		-0.83
Controls	No		Yes		No		Yes	No	Yes	No		Yes
Date FE	Yes		Yes		Yes		Yes	Yes	Yes	Yes		Yes
R-squared	0.0000		0.0001		0.0002		0.0007	0.0001	0.0024	0.0000		0.0073
N	765,103		711,884		730,797		678,793	722,539	671,199	711,752		661,252