Corporate Bond Liquidity

The Rise of Institutional Investors in Bond ETFs

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#liquiditysqueeze

Jeffrey Meli
+1 212 412 2127
jeff.meli@barclays.com
BCI, US

Shobhit Gupta
+1 212 412 2056
shobhit.gupta@barclays.com
BCI, US

Zornitsa Todorova
+44 (0) 20 3134 4561
zornitsa.todorova@barclays.com
Barclays, UK

The growth of bond ETFs has mixed implications for corporate bond liquidity. Inclusion in bond ETFs improves a bond's liquidity. This is offset by institutional investors' use of ETFs to manage their liquidity needs which reduces aggregate market liquidity, a phenomenon most prevalent in the high yield market.

- Since their introduction in early 2000s, corporate bond ETFs have grown sharply in both total assets and trading volumes. We examine the implications of the growth of this market on the liquidity of the underlying corporate bonds, focusing on the potential for differential effects in the IG and HY markets.
- We find strong evidence that inclusion in bond Exchange-Traded Funds (ETFs) improves liquidity, particularly in HY. Transaction costs fall by over 14% for HY bonds included in HYG and by 3.5% for IG bonds included LQD, after adjusting for the selection bias inherent in the preference of ETFs for more liquid bonds. This effect appears to hold in both high- and low-volatility periods.
- Unlike in other asset classes, corporate bond ETFs are orders of magnitude more liquid than their underlying assets, potentially creating an incentive for institutional investors to use them to manage their own liquidity needs. In fact, both holdings data and trading patterns of ETFs linked to fund flows indicate that HY mutual funds use ETFs in this fashion.
- In contrast, there is little evidence of this use case in the IG market, which we ascribe to the structure of IG funds, whose benchmarks typically contain highly liquid Treasuries and Agencies, implying that IG managers are less dependent on corporate bond liquidity to manage flows.
- The use of HY ETFs naturally comes at the expense of corporate bond trades that otherwise would have happened. We show that the increased mutual fund ownership of ETFs has reduced aggregate HY market liquidity, although it is offset to a large extent for bonds included in ETFs which benefit from the liquidity spill-over generated by ETFs.
- On balance, we believe HY investors are better off so long as they use ETFs to manage at least some of their liquidity needs. We estimate investors only need to trade 4.8-5.6% of their total trading volume in ETFs to offset the increased cost of trading bonds. The

secondary volumes of HY ETFs are over 20% those of the bond market, and we believe that most investors with liquidity needs could easily exceed the breakeven we compute. Nonetheless, our analysis shows that investors who do not adapt to use new liquidity management tools and techniques could be made worse off as the liquidity available via traditional channels declines.

ETFs - a tool to manage liquidity in corporate bond markets

Over the past decade, both the assets under management (AUM) and trading volumes of corporate bond Exchange-Traded Funds (ETFs) has grown significantly. The assets of the five largest HY ETFs have grown by a factor of four over that time, and as of January 2020 comprised approximately 3% of the HY market.[1] Over the same period the five largest IG ETFs have grown by a factor of six and were nearly 2% of the market as of January 2020 (in both markets, ETF AUMs continued to grow sharply through the rest of the year). Secondary trading volumes have increased even more; in January 2020, the secondary trading volume of these five largest ETFs were 20% of the volumes in the HY corporate bond market,[2] equating to turnover that is nine times higher than that of bonds. The turnover of IG ETFs is over four times that of IG bonds.

Consistent with the experience of other asset classes,[3] we find strong evidence that inclusion in fixed income ETFs improves liquidity for both HY and IG bonds, compared to similar bonds that are not included, likely due to spill-overs from the create-and-redeem process. Moreover, the benefit from ETF inclusion holds in both high- and low-volatility periods, which addresses some of the concerns regulators have expressed about the impact of ETF products on the underlying corporate bond market during stressed conditions. Were this the end of the story, the introduction of bond ETFs would be a clear benefit to investors.

However, the effect of ETFs on HY bond liquidity in particular is more complex than this simple comparison suggests. Unlike in other asset classes, such as equities, corporate bond ETFs are orders of magnitude more liquid than their underlying assets. Institutional participants in the bond market who face liquidity needs, such as open-end mutual funds with inflows and outflows, have an incentive to own and trade bond ETFs to manage these needs, rather than having to rely solely on trading individual bonds. In addition to reducing transaction costs, ETFs weigh less on returns than holding cash (despite the management fees), and they better replicate cash returns than derivatives. Further, liquidity management has become a larger issue for institutional investors, due to both a decline in corporate bond liquidity since the financial crisis, and increased attention from regulators on the liquidity risks embedded within open-end fund structures.[4]

Both holdings data and the secondary trading patterns of HY ETFs indicate that HY mutual funds use ETFs to manage liquidity. Between 2013 and 2019 open-end HY mutual funds increased their ownership of HY ETFs by a factor of six. In 2013, the combined market value of HY mutual fund ETF holdings accounted for 2bp of the HY market, compared to 12bp in 2019.[5] There is a positive and significant correlation between fund flows and ETF ownership, both in aggregate and at the fund level. Finally, the secondary volumes of HY ETFs are far higher than

[1] The size of the market is proxied by the market value of the Barclays Bloomberg IG and HY Index.

[2] Note this does not include create/redeem activity

[3] Boehmer and Boehmer (2003); Hamm (2012); Marshall, Nguen and Visaltanachoti (2015); Agarwal, Hanouna, Moussawi and Stahel (2018)

[4] Bessenbinder, Jacobsen, Maxwell, & Venkataraman (2018); Bao, O'Hara, & Zhou (2018); Dick-Nielsen & Rossi, 2019; Goldstein & Hotchkiss, 2020)

[5] This is based on quarterly reported data and is likely a conservative estimate of ETF holdings intra-quarter.

those of other asset classes, suggesting that institutions are concentrating their trading needs into these vehicles.

In contrast, there is little to no evidence of this use of ETFs in the IG market – for example, IG mutual funds' ETF holdings represent less than 0.5bp of the IG market, and we find no relationship between fund flows and ETF ownership. We ascribe this difference to the structure of most IG mutual funds. Whereas HY funds are benchmarked against HY indices, which contain exclusively corporate bonds, IG funds are typically benchmarked against AGG indices, which also include Treasuries and agencies. The high liquidity of the former two asset classes means IG managers are not beholden to corporate bond liquidity when managing inflows and outflows, and so have no need to substitute trading volumes into ETFs.

While the use of ETFs is naturally attractive to individual HY managers, when aggregated across many investors, it has negative implications for the overall liquidity of the bond market. Trading HY ETFs to manage liquidity inevitably comes at the cost of some HY bond trades that would otherwise have happened. At an aggregate level, periods of elevated HY ETF turnover are associated with lower corporate bond volumes and higher Liquidity Cost Score (LCS, a Barclays proprietary measure of round-trip transaction cost). Further, our analysis of a full panel data set of individual bonds over time clearly shows that the substitution of trading away from bonds and into ETFs has reduced liquidity in the HY market. This negative impact of higher ETF institutional ownership falls most heavily on bonds that are not owned by ETFs – the benefit of ETF inclusion reduces the drag on transaction costs by 85%.

Despite the decline in bond liquidity, ETFs themselves are so liquid that the overall transaction costs paid by investors are lower, so long as they use ETFs to manage liquidity. We estimate the breakeven substitution into ETF trading of just 4.8-5.6% of total volumes, depending on how many ETF versus non-ETF bonds an investor trades. Considering both the ownership of ETFs by HY mutual funds, and the significant excess secondary volumes of HY ETFs (over and above those of similar asset classes like IG), we expect that investors with significant liquidity needs easily surpass this threshold. Investors such as insurers and pensions who do not have frequent liquidity needs and usually trade to implement relative value views (or changing opinions on a credit) do not typically own ETFs and are likely to be marginally negatively affected. However, given that trading volumes of HY ETF bonds, which have experienced only a modest decline in liquidity, are 3-4x the volumes of non-ETF HY bonds, the resulting increase in higher transaction cost should be relatively small.

At first glance, any decline in single-name liquidity would seem to be negative for issuers, particularly smaller companies whose bonds are unlikely to be included in ETFs. However, the use of ETFs by investors with substantial liquidity needs may reduce the importance of single-name liquidity in their investment decisions. In other words, investors may be more willing to buy less liquid bonds knowing that their overall reliance on single-name liquidity is lower, due to their use of alternative trading strategies.

Inclusion in ETFs improves LCS

An intuitive starting point to study the effect of ETF inclusion on single-name bond liquidity is to compare the average Liquidity Cost Score (LCS) of ETF and non-ETF bonds. In the IG market, the average LCS is 0.70% for LQD bonds and 0.84% for non-LQD bonds. In the HY market, the average LCS is 1.03% for HYG bonds and 1.58% for non-HYG bonds. Clearly, bonds included in ETFs have lower transaction costs than bonds not included in ETFs. However, this does not imply that inclusion in ETFs is responsible for these differences. There is serious selection bias at work because ETFs specifically seek to include bonds that are likely to be liquid in order to ease the create and redeem process.

In other words, ETF inclusion is not random, but is endogenously determined by bond characteristics. Therefore, to correctly isolate the effect of ETF inclusion on liquidity we must identify an appropriate group of *control bonds* – ie. bonds that are not included in ETFs, but are comparable to bonds included in ETFs on several key dimensions.

We address the issue of selection bias by estimating the impact of ETF inclusion (LQD for IG, HYG for HY) on a bond's LCS while controlling for several bond factors such as issue size, time since issuance, etc.[6] More formally we run the following regression:

$$\mathbf{LCS_{(it)} = \alpha + \beta ETF\ Dummy_{(it)} + Controls_{(it)} + \varepsilon_{(it)}}$$

We use monthly data between January 2013 and December 2019 across all the bonds in the investment grade and high yield indices.[7]

ETF Dummy is an indicator variable that equals 1 if a bond is included in the respective ETF in a given month and 0 otherwise. To account for systematic differences between ETF and non-ETF bonds we include an extensive list of bond-level factors – spread, numeric rating, time since issuance, maturity, duration and issue size. To capture aggregate trends in the market we control for volatility (VIX Index), the risk-free rate (3-month Treasury bill), net fund flows and the IG/HY Index spread. Finally, we control for any time-invariant (potentially unobservable) industry-level heterogeneities.

The main regression coefficient of interest is **β** (the coefficient on the **ETF Dummy**) which gives the difference in LCS between bonds included in ETFs and bonds not included in ETFs. Since LCS measures transaction costs, a negative coefficient signifies improvement in LCS and a positive coefficient signifies impairment in LCS.

ETF inclusion lowers bond-level transaction costs

For both HY and IG bonds, inclusion in an ETF is strongly associated with lower transaction costs (**β<0**) (Figure 1). In HY, we estimate that inclusion in HYG reduces LCS by 14.4bp. This is quite significant; in percentage terms, it is a 14% reduction in LCS. Granted, it is far less than the 55bp difference between the average LCS of HYG- versus non-HYG bonds, most of which is due to bond characteristics, and captured in our various controls. However, it is still an important reduction in transaction costs.

In IG, we estimate that inclusion in LQD reduces LCS by 2.4bp, which translates to 3.5% reduction in LCS for LQD bonds.[8] Again, this is far lower than the 14bp average difference in LCS between LQD and non-LQD bonds, which is mostly due to selection criteria. It is also less material economically than in HY: the benefit of ETF inclusion is four times stronger for HYG bonds than it is for LQD bonds.

[6] To address selection bias we apply two other approaches: (1) propensity score matching to select a robust sample of control non-ETF bonds and (2) a difference-in-differences regression analysis, where we follow bonds before and after they enter an ETF. The propensity score framework pairs each ETF bond with a non-ETF bond with similarly high probability (propensity) of inclusion in ETF. The difference-in-differences regression analysis follows the evolution of bonds' LCS before and after entering an ETF, compared to the LCS of similar bonds that did not enter the ETF. This approach allows us to estimate the effect of ETF inclusion on bond transaction costs over and above what is predicted by bond characteristics. The propensity score matching and difference-in-differences approaches provide the cleanest possible identification of the result in the absence of a randomised experiment. Regardless of the methodology we use, our results and conclusions are qualitatively unchanged – inclusion in ETFs improves bond-level LCS. Details on the propensity score matching and difference-in-differences methods are contained in the Appendix.

[7] We limit our sample to bonds included in either the Barclays Bloomberg Investment Grade Corporate Bond Index or the Barclays Bloomberg High Yield Corporate Bond Index. Comparing index ETF bonds to index non-ETF bonds should eliminate first-order differences in the two universes of bonds.

[8] We arrive at similar conclusions regardless of which measure of liquidity we use as the dependent variable in the cross-sectional regression outlined above. We test our model with 5 other liquidity measures – turnover, trade efficiency, spread and number of days with zero trading. Depending on the measure, we obtain a 8 % - 15 % improvement in liquidity in HY and 2 % - 4 % in IG.

FIGURE 1. Cross-sectional Regression

	HY LCS (bps)	IG LCS (bps)
ETF Dummy	-14.4***	-2.4***
	(-19.78)	(-13.98)
Bond-level controls	Yes	Yes
Aggregate controls	Yes	Yes
Industry Dummies	Yes	Yes
R2, %	46.3	74.2
N. observations	118,352	464,107
Data	2013-2019	

Source: Barclays Research. Note: Bond-level controls: OAS, numeric rating, duration, time since issuance, maturity, issue size. Aggregate controls: VIX, 3-month US Treasury-Bill rate, net fund flows, index OAS. Note: T-stats in parentheses. *** denotes significance at the 99% confidence level.

The relationship holds during high-volatility periods

The benefit of ETF inclusion on bond liquidity is likely more muted during periods of volatility. As idiosyncratic risk picks up, managing ticker-level risk usually takes precedence over lowering transaction costs.

To test if improvements in transaction costs dissipate during times of stress, we re-run the regressions on two sub-samples – high-volatility and low-volatility periods. We define high-volatility periods as months during which the value of the VIX index is greater than the 75th percentile of the distribution.[9] Similarly, we define low volatility periods as months during which the value of the VIX index is smaller than the 25th percentile of the distribution. The LCS benefit of ETF inclusion is indeed smaller, although still economically meaningful during high-volatility periods (Figure 2).

[9] The result holds if we define high (low) volatility periods using the 90th/10th percentile of the VIX distribution or above/below the median. Moreover, the LCS benefit holds during periods of ETF inflows as well as during periods of outflows.

FIGURE 2. ETF inclusion benefits liquidity even during high-volatility periods

	HY LCS (bps)		IG LCS (bps)	
	High Vol	**Low Vol**	**High Vol**	**Low Vol**
ETF Dummy	-12.8*** (-5.93)	-19.0*** (-5.43)	-1.35*** (-6.61)	-3.1*** (-10.91)
Bond-level controls	Yes	Yes	Yes	Yes
Aggregate controls	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
R2, %	48.2	35.3	78.2	74.9
N. observations	29,999	31,148	115,412	123,909
Data	2013-2019			

Source: Barclays Research. Note: Note: Bond-level controls: oas, numeric rating, duration, time since issuance, maturity, issue size. Aggregate controls: VIX, 3-month US Treasury-Bill rate, net fund flows, index oas. High (low) volatility periods are defined as months when the value of the VIX index is greater (smaller) than the 75th (25th) percentile of the distribution. T-stats in parentheses. *** denotes significance at the 99% confidence level.

HY institutional investors use ETFs for liquidity management

A typical narrative around ETFs is that they bring new investors into an asset class, who are attracted to the ease of trading and low management fees. These new entrants could be retail investors, or institutions that do not have the expertise or scale to manage the underlying assets directly. Regardless, the resulting create-and-redeem activity improves the liquidity of the underlying assets, to the benefit of existing investors.

This narrative depends crucially on the use of ETFs by new investors. It seems a reasonable assumption – most ETFs are of limited use to mutual fund investors in the underlying asset class. The management fees are a drag on returns, despite being low relative to actively managed investment products. An ETF could be a convenient placeholder for inflows, but this use would be temporary and limited, employed only for so long as it takes the manager to put the money to work in the underlying securities. While end-investors may substitute between ETFs and other retail products, such as open-end mutual funds (ie. ETFs compete with some institutional investors), even competitors to ETFs still benefit from the liquidity spill-over they generate.

However, a large difference between the liquidity of the underlying investments and the secondary market liquidity of the ETFs themselves could provide an incentive for institutions to own ETFs. Under that circumstance, strong secondary market liquidity of ETFs could help investors manage liquidity needs driven by inflows and outflows. For most ETFs this likely isn't an issue, because the underlying investments are themselves liquid enough that the benefits of using ETFs do not outweigh the drag caused by the management fees – for example, the liquidity of equities, particularly large cap, is likely high enough that this strategy is not employed.

This use case is harder to dismiss for corporate bonds, whose liquidity has declined over the past decade.[10] This is especially the case in the HY market where fund managers are typically benchmarked against HY indices, which obviously contain only HY corporate bonds. This

[10] Bessenbinder, Jacobsen, Maxwell, & Venkataraman (2018); Bao, O'Hara, & Zhou (2018); Dick-Nielsen & Rossi, 2019; Goldstein & Hotchkiss, 2020).

strategy is likely less compelling for IG managers. As mentioned above, the inclusion of Treasuries and Agencies in the AGG indices reduces managers' reliance on the liquidity available in the IG corporate market.

The potential substitution of ETF trades in place of trades in the bond market raises the possibility of a dark side to the liquidity story. Institutional investors, faced with declining liquidity in individual corporate bonds, trade ETFs when managing liquidity needs instead. These ETF trades inevitably come at the expense of corporate bond trades that would otherwise have happened, thus further reducing bond liquidity. It is possible that aggregate liquidity deteriorates due to increased presence of ETFs, even if the individual bonds that are included in ETFs still benefit relative to those that are not included.

Holdings data and ETF trading patterns suggest HY fund managers use ETFs

Holdings data provides strong evidence that this substitution is occurring in HY, but not in IG. In Figure 3, we plot the market value of positions in the five largest HY and IG bond ETFs held specifically by HY or IG open-end mutual funds, expressed as a percentage of total market value in the respective asset class.[11] We define HY/IG mutual funds as funds, which by prospectus, invest more than 50% of their assets in HY/IG bonds. ETF ownership has increased significantly amongst HY funds, but only very modestly for IG funds. During our sample period, we observe about 250 distinct HY MFs investing in HY ETFs, compared to only about 20 IG MFs investing in IG ETFs. ETF holdings of HY MFs represented 2bp of total market value in 2013 and 12bp in 2019. In dollar terms, HY mutual fund ownership of ETFs has increased from about $200mn in 2013 to about $1.4bn in 2019. For example, if the HY market size in 2019 were same as it was in 2013, HY MFs ownership of ETFs in 2019 would have accounted for 28bp of total market value (compared to 2bp in 2013).

In comparison, IG MFs ownership of ETFs has increased from 0.02bp of IG market value in 2013 to 0.5bp in 2019, which is several orders of magnitude lower than in HY. For example, in 2019 MFs ownership of ETFs is 24 times higher in HY than in IG.[12]

Figure 4 contains the portfolio allocation between ETFs, bonds and cash for a typical HY MF holding ETFs at three points in time – 2013, 2017, and 2019. In 2013, median HY ETFs holdings was 0.94% of total assets. However, by 2019 median ETFs holdings had increased 2.5 times to 2.36%. About three quarters of the increase in ETF holdings appear to be a replacement for cash.

The size of these holdings is in line with the use case we believe they are intended to meet. For example, in 2019 the monthly standard deviation of fund flows for HY MFs was between 2.0% and 2.3%, compared to median ETF holdings of 2.36% and an average of 3.5%. Further, the average holdings decline with fund size (Figure 5).[13] Given the strong negative correlation between fund size and volatility previously documented in the literature,[14] we would expect the result to apply equally well in our context – ie. smaller funds, which have more volatile flows, hold larger ETF holdings.

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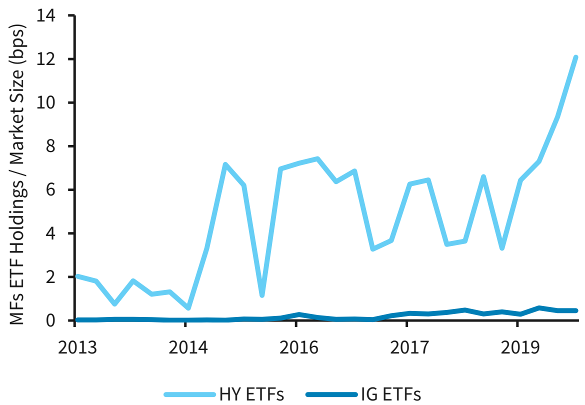
11 Holdings data is obtained from CRSP Mutual Funds Database.

12 In terms of number of shares, in 2019 HY (IG) MFs held 3% (0.5%) of total shares outstanding compared to 1.5% (0.2%) in 2013.

13 We believe that the fund-level relationships we document in this report to be very conservative estimates. The reason for this is that ETF holdings are reported at the fund portfolio level. A fund portfolio could contain several funds, which usually correspond to different asset classes. Variables such as size, flows and flows volatility are reported at the fund level. As a result, the same ETF holdings are matched to funds with very different sizes. These differences in the reporting aggregation are likely to mute the magnitude of the correlation coefficients we compute. To minimise noise in the sample, all fund-level analyses are limited to funds with total assets greater than $1bn.

14 See work by Rakowski (2010).

FIGURE 3. Bond ETF Ownership by HY/IG Mutual Funds



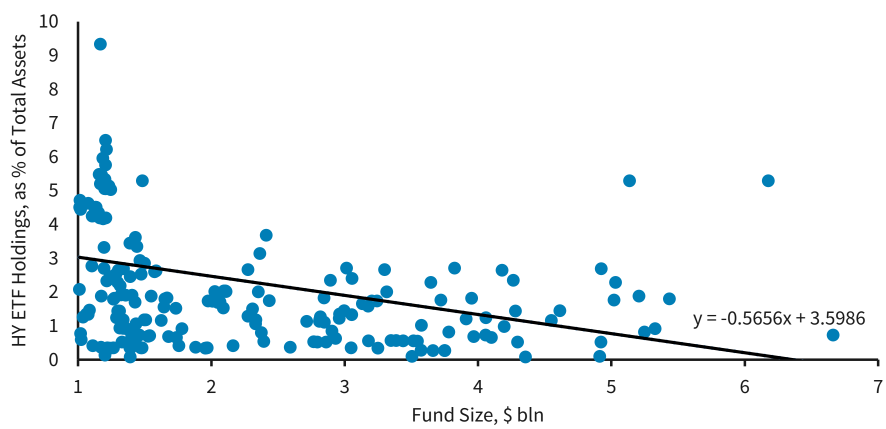
Source: CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Data based on HYG, JNK, SHYG, USHY, HYLB in HY and LQD, VCIT, VCSH, IGSB, IGIB in IG.

FIGURE 4. Portfolio Allocation - HY Mutual Funds

	Portfolio Allocation (Median)		
	HY ETFs	Bonds	Cash
2013	0.90%	89.60%	3.40%
2017	1.40%	88.80%	2.20%
2019	2.36%	88.60%	2.46%

Source: CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Statistics are based on funds holding a non-zero amount of HY ETF shares. The analysis is performed on a fund-level at three points in time – 2013, 2017 and 2019.

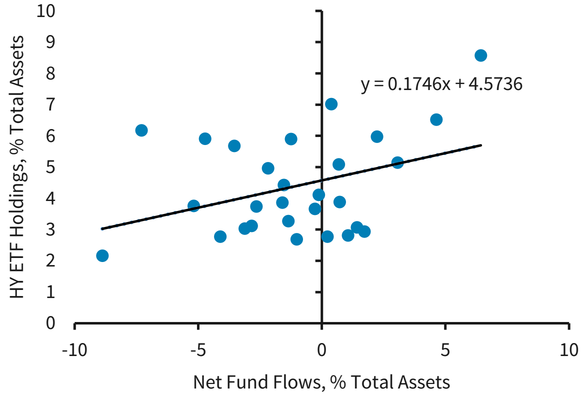
FIGURE 5. Fund Size and ETF Holdings



Source: CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Data sample limited to funds with total assets greater than $ 1 bln.

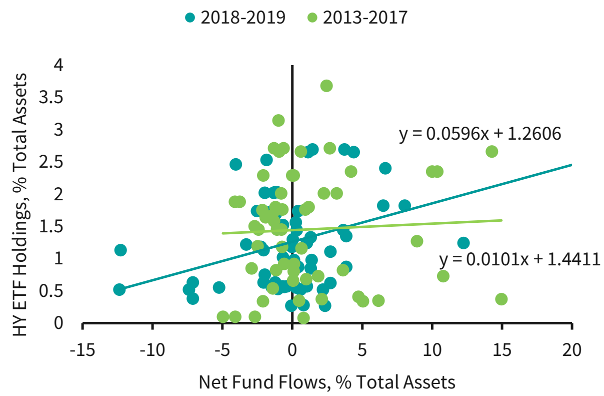
In addition, there is a strong positive correlation between net fund flows into HY MFs and their ownership of HY ETFs, both in aggregate (Figure 6) and on a fund level (Figure 7). During periods of inflows, HY MFs buy HYG shares, whereas during periods of outflows HY MFs sell HYG shares. Moreover, this relationship has strengthened over time, as the ownership of ETFs by MFs has grown. We split the sample into two periods (2013-2017 and 2018-2019) and show that the positive correlation between fund flows and ETF holdings is markedly stronger during the latter period.

FIGURE 6. Fund Flows and ETF Holdings – Aggregate Series



Source: CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Aggregate series computed as the average of all funds in a given quarter, weighted by total fund assets.

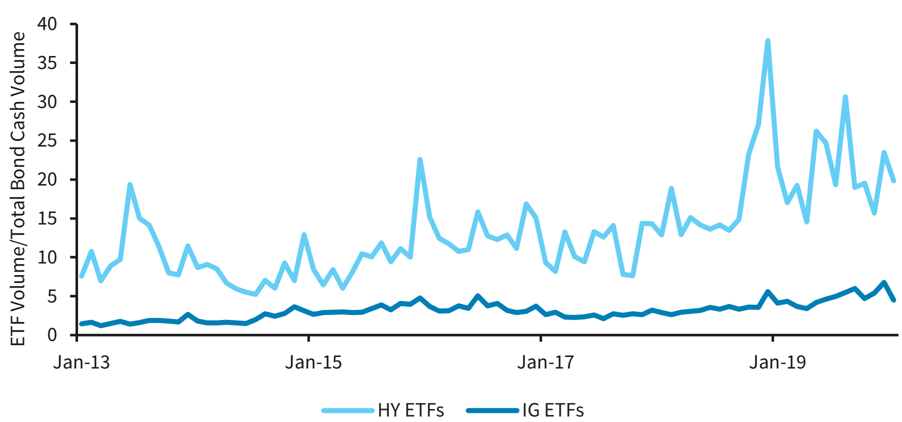
FIGURE 7. Fund Flows and ETF Holdings – Fund-level Series



Source: CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Data sample limited to funds with total assets greater than $1bn.

Secondary trading volumes of bond ETFs also indicate that HY ETFs are used for liquidity management, whereas IG ETFs are not. The turnover of HY ETFs is far higher, both relative to other classes of ETFs, and relative to the underlying HY bond market (Figure 8). We believe this is evidence that institutional investors with liquidity needs are concentrating their trading in ETFs. To demonstrate, we create the following hypothetical scenario, where HY ETFs make up 10% of the HY market, and MFs the other 90%. We also assume that MFs own 50% of the ETFs (for liquidity management), with the remaining owned by retail investors. Assuming that 1% of retail investors (in both ETFs and MFs) sell, we can compute the resulting sales of ETFs. The sales due to retail outflows in ETFs are 0.5% (1% x 10% x 50%) and the sales due to retail outflows in MFs are 4.5% (1% x 90% x 50%). The outflow of just 1% results in ETF outflows that are 5x higher – because all of the outflows from MFs are funded with ETF sales. This shows how the same underlying activity – retail inflows and outflows – can result in far higher secondary activity in ETFs that are used for liquidity management.

FIGURE 8. Secondary Volumes of HY/IG ETFs



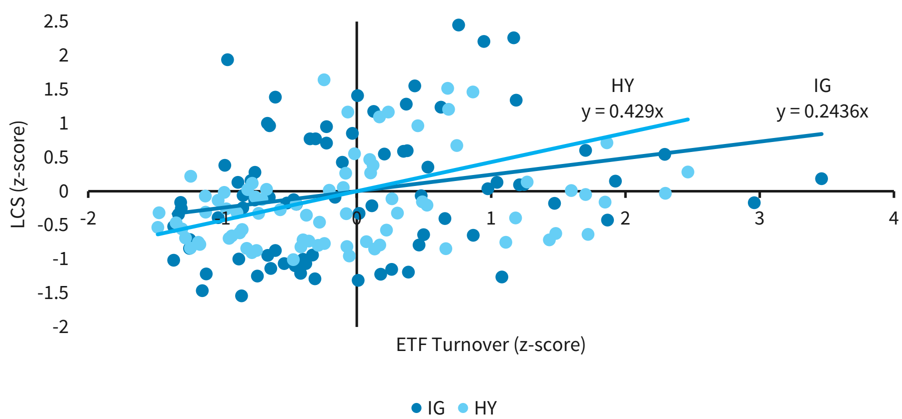
Source: Bloomberg, Data January 2013 – December 2019. Note: Data based on HYG, JNK, SHYG, USHY, HYLB in HY and LQD, VCIT, VCSH, IGSB, IGIB in IG.

Corporate bond liquidity declines as ETF use increases

So far, we have presented evidence that certain HY institutional investors are using ETFs for liquidity management, but that does not mean it is happening at a scale sufficient to affect the liquidity available in the corporate bond market, which is obviously much larger than the ETFs. To understand the implications, we start with the aggregate market, and then turn to bond-level data.

Figure 9 contains the correlation between aggregate LCS and ETF turnover. The two series are highly correlated, and the correlation is nearly two times stronger in HY than in IG. However, ETF turnover tends to be higher during periods of heightened volatility, which also coincides with periods of worse liquidity and higher transaction costs. Therefore, raw correlations have to be interpreted with caution since they could reflect spurious relationships or could lead us to overstate the magnitude of the relationship.

FIGURE 9. **Aggregate LCS and ETF Turnover**



Source: Barclays Research. Note: Aggregate monthly LCS is a weighted average of bond-level LCS, where weights are given by monthly TRACE trade volume. Both ETF turnover and LCS are standardised to have a mean of 0 and standard deviation of 1.

To address these concerns, we estimate a formal regression model of monthly aggregate LCS and ETF turnover, controlling for fund flows and volatility (VIX) and adjusting for seasonality (month-dummies):

$$\mathbf{LCS_{(t)} = \alpha + \beta_1 ETF\ Turnover_{(t)} + \beta_2 Net\ Fund\ Flows_{(t)} + \beta_3 VIX_{(t)} + Month\text{-}dummies + \varepsilon_{(t)}}$$

In both the HY and the IG market, higher ETF turnover is associated with higher transaction costs.[15] To evaluate the economic significance of the results, we compute the effect of a one standard deviation increase in ETF turnover on aggregate LCS – which is 25% for HY ETFs and 4.5% for IG ETFs. We obtain an increase in aggregate LCS of 9.5bp in HY and 1.2bp in IG. In percentage terms, this translates to an increase in LCS of 8% in HY and 2% in IG. In other words, even though the coefficients shown in Figure 10 on ETF turnover are only slightly higher for HY than for IG, the range of turnover is dramatically higher in HY, meaning that the effect of ETF activity on liquidity in HY is far more pronounced.

[15] Our results are qualitatively unchanged if we use aggregate bond turnover as the dependent variable in our time-series regression.

FIGURE 10. Time-series Regression – Aggregate LCS

	HY LCS (bps)	IG LCS (bps)
ETF Turnover	0.37*** -2.6	0.27*** -2.58
Net Fund Flows	1.7 -0.625	2.7*** -3.41
VIX	7.9*** -2.64	1.3** -1.78
Month-dummies (seasonality-adjustment)	Yes	Yes
R2, %	32.9	29.7
N. observations	82	82
Data	2013 – 2019	

Source: Barclays Research, Bloomberg, Investment Company Institute (ICI). Note: Standard errors are heteroscedasticity and autocorrelation robust (HAC) using 1 lag. T-stats in parentheses. HY ETF turnover calculated using data from: HYG, JNK, SHYG, USHY, HYLB. IG ETF turnover calculated using data from: LQD, VCIT, VCSH, IGSB, IGIB.

Our analysis so far shows that on an *aggregate level* higher ETF turnover correlates with lower bond liquidity in HY, but has only a marginal effect on liquidity in the IG market. At the same time, we also found that inclusion in an ETF improves the liquidity of an individual bond, relative to similar bonds that are not included – again this effect is notably stronger in HY. Together, these results imply that there are competing forces at play. ETFs reduce aggregate liquidity, but also shift liquidity into ETF bonds. Based on the very limited extent of MF ETF ownership in the IG market, which has averaged at 0.2bp over 2013-2019, we expect that institutional ownership of IG ETFs is unlikely to play an economically meaningful role on the liquidity of IG bonds. Therefore, we conclude that the (limited) gains to LCS, which accrue to bonds included in IG ETFs, are a net benefit to investors in that asset class.

However, the net effect on the HY market in general, and on HY ETF bonds in particular, is unclear. To assess the relative importance of these two forces, we take HYG as a representative example and examine the cross-sectional evidence on the interplay between HYG use and liquidity, using the following bond-level model:

$$\mathbf{LCS}_{(it)} = \alpha + \beta_1 \mathbf{MF\ Ownership}_{(t)} + \beta_2 \mathbf{MF\ Ownership}_{(t)} \times \mathbf{ETF\ Dummy}_{(it)} + \mathbf{Controls} + \varepsilon_{(it)}$$

where $\mathbf{LCS}_{(it)}$ refers to the LCS of bond *i* at time *t*. Mutual fund ownership refers to the market value HYG holdings of open-end mutual funds divided by total market value in HY (expressed in bp). As before, $\mathbf{ETF\ Dummy}_{(it)}$ is an indicator variable such that it equals 1 if a bond is included in an ETF and 0 if the bond is not included. The idea behind the interaction term ($\mathbf{MF\ Ownership}_{(t)} \times \mathbf{ETF\ Dummy}_{(it)}$) is that the effect of mutual fund ownership on liquidity depends on whether a bond is included in an ETF. For a non-ETF bond the effect of increasing mutual fund ownership by one basis point on LCS is given by the coefficient β_1. In contrast, the effect for an ETF bond is given by the sum $\beta_1 + \beta_2$.

In the HY universe, higher use of ETFs by mutual funds is correlated with lower liquidity ($\beta_1 > 0$), irrespective whether a bond is included in an ETF or not (Figure 11). A one basis point increase in mutual fund ownership increases LCS by 4.25bp. However, this effect is substantially weaker for ETF bonds compared to non-ETF bonds ($\beta_2 < 0$) and amount to 4.25bp – 3.61bp = 0.64bp. In HY, inclusion in HYG reduces the negative impact of higher ETF institutional ownership on LCS by 85%. In other words, non-ETF bonds have sharply lower liquidity as a result of the migration of trading into ETFs. However, for ETF bonds, the effect of this migration is nearly fully offset by the liquidity halo that ETFs provide to the bonds included in their portfolios.

FIGURE 11. Bond Liquidity and ETF Institutional Ownership

	HY LCS (bps)
ETF MF Ownership	4.25*** -27.2
ETF MF Ownership x ETF dummy	-3.61*** (-22.84)
Bond-level controls	Yes
Aggregate controls	Yes
Industry Dummies	Yes
R2, %	46.2
N. observations	118,324
Data	2013-2019

Source: Barclays Research, CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Note: Note: Bond-level controls: oas, numeric rating, duration, time since issuance, maturity, issue size. Aggregate controls: VIX, 3-month US Treasury-Bill rate, net fund flows, index oas. T-stats in parentheses. *** denotes significance at the 99 % confidence level.

Investors who use ETFs are better off

Although Figure 11 shows that rising institutional ETF ownership reduced liquidity in the HY market, this does not imply that HY investors are worse off for the introduction of ETFs. We estimate the transaction costs of HYG were only 1.1bp in 2019, c.1% of the LCS of HY bonds (the bid-offer of HYG was as high as 18bp in 2013, but fell sharply as secondary volumes increased).[16] The overall effect on the transaction costs that HY investors pay depends on the balance between their use of ETFs to manage their liquidity needs and the change in costs of trading bonds, which in turn depends on the extent to which they trade ETF versus non-ETF bonds.

Between 2013-2019, institutional ownership of HYG increased by 3.7bp (from 1bp to 4.7bp). Using the coefficients from Figure 11, this implies that the LCS of non-ETF bonds increased by 4.25bp x 3.7bp = 15.7bp; the increase is much smaller for ETF bonds, at 0.64bp x 3.7bp = 2.37bp, due the benefits of ETF inclusion. According to TRACE, the volume of ETF bonds is 70-80% of the total HY volume. However, this includes bonds that trade as part of the create-and-redeem process – we estimate this accounts for 5-8% of the volume, leaving us with 62-75% of volumes concentrated in ETF bonds.

Using this adjusted breakdown of volumes, we compute the breakeven quantity of ETF trading. This is the proportion of total trading that investors would need to do in ETFs (in place of single name bond trading) in order to offset the increased cost of trading bonds.[17] Because of the high liquidity of ETFs, this breakeven is only 4.8-5.6%. Note that given this is the fraction of an investors's total trading volume that should happen in ETFs, the amount of ETFs they need to own is obviously a much smaller amount. We believe that investors who use ETFs to satisfy liquidity needs would easily exceed this threshold. The secondary volumes of HY ETFs are c.20%

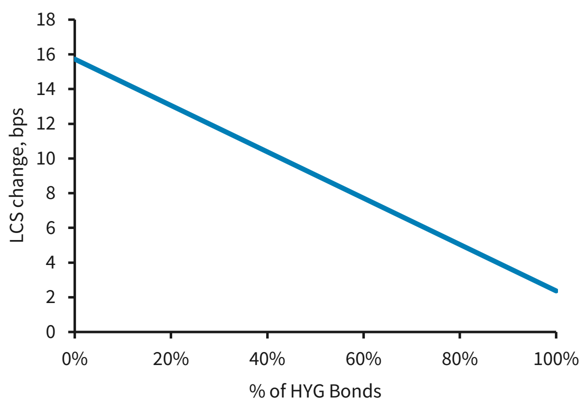
[16] Calculated as a percentage of the price using daily data: 100* (ask price – bid price)/price. Monthly (quarterly) values are averages of daily observations within a month (quarter). By construction, HYG bid-ask and bond LCS are roughly comparable.

[17] As of 2013, the average LCS of ETF bonds was 100bp and 153bp for non-ETF bonds. Owing to the 3.7bp increase in institutional ownership, our model predicts that in 2019 LCS has increased to 102.4bp for ETF bonds and 168.7bp for non-ETF bonds. Let's assume that an investor trades only non-ETF bonds, in which case the cost is 1753bp in 2013 and 168.7bp in 2019. The quantity Y of ETF trading, which equalises the two costs solves the following equation 153 = 1.13bp x Y % + 168.7bp (100-Y) %. In this case Y = 9.4%.

of those of the HY bond market, which is 10-15% higher than in IG.[18] That is itself 2-3x above the breakeven, and we believe only a portion of HY investors have this type of liquidity need (although they are likely responsible for most of the secondary volumes). Of course, investors who only trade for relative value or credit-specific reasons are likely worse off (eg. insurance or pension investors), but these investors have lower turnover, and thus are less affected by higher LCS.

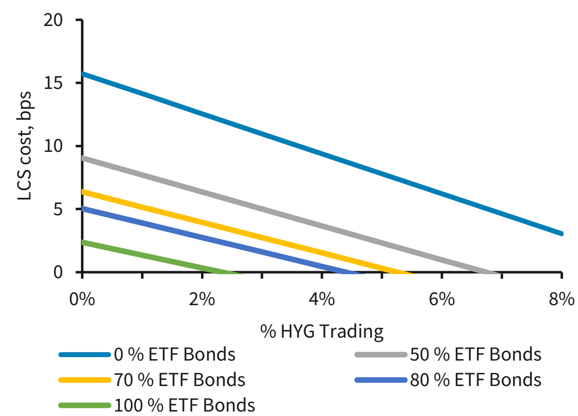
At first glance, it may appear that this shift is negative for issuers, whose bonds have higher LCS. However, the sensitivity of yields to liquidity may not be stable, particularly as investors develop new liquidity management tools. In other words, investors may be less concerned with the lower liquidity of non-ETF bonds given that they have the ability to use ETFs to manage flows, and thus are less likely to be forced to trade those bonds.

FIGURE 12. No ETFs – Varying the % of HYG Bonds



Source: Barclays Research

FIGURE 13. Varying the % of ETF and ETF Bonds - Examples



Source: Barclays Research

Combining the results in Figure 12 and Figure 13, we show that owing to the significant decrease in ETF LCS, investors would be better off if they traded a small amount of ETFs alongside bonds (split between ETF bonds and non-ETF bonds). In other words, investors haircut their bond trading by the same amount they increase their ETFs trading.[19]

A first caveat here is that it is possible that HY MFs do not trade in the exact same proportions as the rest of the market. For example, if MFs trade ETF vs. non-ETF bonds in a 9:1 ratio, our model predicts a breakeven (B/E) quantity of 3.4%. Further, ETF holdings data and secondary volumes we present in this report provide strong evidence that HY MFs generate a larger share of ETF trades than the average market participant does – in which case the B/E range indicated by our model would be more than enough to breakeven. Finally, for simplicity, our calculations assume that the cost of ETF trading is independent of trade size, whereas in reality large institutional investors could achieve better execution than 1.13bp. This would imply that our B/E estimates are rather conservative and should be considered as an upper bound.

Finally, the B/E range we estimate is consistent with the mean(median) percentage of MF assets invested in ETFs, which as of 2019 was 3.7% (2.4%). Taken as a whole, our results indicate that a substantial portion of liquidity-driven trading could be satisfied with ETFs.

[18] Some of this difference is likely due to the higher volatility of HY, but we believe most of the difference is due to the differential use of HY ETFs.

[19] Let's say an investor trades ETF vs. non-ETF bonds in a ratio 7:3. If the investor starts trading 10 % ETFs, the remaining 90 % total trading goes to bonds, split between ETF vs. non-ETF trading in the same amount as before.

Appendix – data and sample selection

Data and sample selection

We focus on the two largest ETFs by AUM in the HY and IG markets – iShares iBoxx $ High Yield Corporate Bond ETF (HYG) and iShares iBoxx $ Investment Grade Corporate Bond ETF (LQD) respectively.[20] We use CRSP Survivor-Bias-Free Mutual Funds database to obtain monthly bond holdings over the period January 2013 – December 2019. CRSP provides the most complete source of both active and inactive open-end US mutual funds. The database currently contains historical information on holdings, portfolio allocation, investment style and performance for 64,000 funds.

We also assemble bond-level data on liquidity, option-adjusted spread (OAS), numeric rating, time since issuance, maturity, issue size, duration and trade volume. We then merge this database to the CRSP holdings data on the bond-month level. We remove bond-month observations where any one of the above characteristics is missing or where monthly TRACE trade volume is $0. Finally, we augment our dataset with aggregate statistics – the VIX index, the 3-month US Treasury Bill, Index spreads, bond/ETF trade volumes and fund flows. Data on these variables comes from Bloomberg and the Investment Company Institute (ICI).

This leaves us with 118,352 bond-month observations for HY, and 464,107 bond-month observations for IG. 40% of our HY observations are included in HYG and 20% of our IG observations are included in LQD. All the remaining bonds which are not included in an ETF belong to the Barclays Bloomberg HY/IG Index bond universe. This is crucial as it allows us to remedy against selection bias and to compare ETF and non-ETF bonds more effectively.

Data and sample selection

In theory, the strongest evidence about the effect of inclusion in an ETF on a bond's liquidity would come from an experiment, where some bonds are randomly included in an ETF and others are not. In such a random trial, ETF and non-ETF bonds would be fully comparable since all bonds have the same probability of being assigned to an ETF. Since randomisation is impossible in our case, instead we rely on observational data to estimate the effect. However, the problem with such a study is that it is invariably subject to selection bias, since the probability of inclusion in an ETF likely depends on the characteristics of bonds. Although we address this issue by limiting our sample to index bonds only and controlling for a wide score of bond characteristics, some portion of the selection bias could still be unaccounted for, which could lead us to overstate the liquidity effect. One problem could be that the sample size of ETF bonds is 65% smaller than non-ETF bonds in the HY and 85% smaller in the IG market. Another problem could arise if the non-ETF sample contains predominantly bonds which have a very low chance of ever being included in an ETF. If this were true, adjusting for covariates in the regression could not sufficiently absorb the selection bias. We address these concerns using Propensity Score Matching (PSM).

The propensity score is defined as the probability of inclusion in an ETF conditional on a set of bond characteristics. To arrive at bond-level propensity scores for each period we estimate the following Logit model:

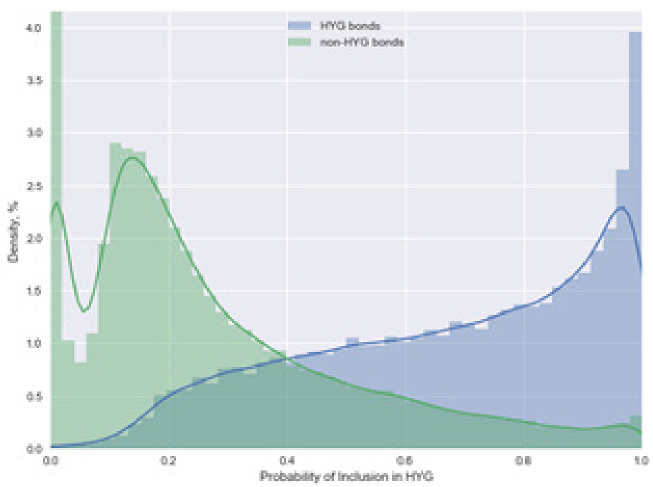
$$\textbf{Inclusion}_{(i,t)} = \alpha + \beta_1 \textbf{OAS}_{(i,t)} + \beta_2 \textbf{Rating}_{(i,t)} + \beta_3 \textbf{Maturity}_{(i,t)} + \beta_4 \textbf{Time since issuance}_{(i,t)} + \beta_5 \textbf{Issue size}_{(i,t)} + \varepsilon_{i,t}$$

[20] Given the heavy concentration of the ETF market, we believe these two ETFs are sufficiently representative of the market. For example, HYG holds 44 % of the AUM of the 10 largest HY ETFs and holds 3 times more assets than the next largest ETF. LQD holds of 30 % of AUM of the 10 largest IG ETFs and holds 1.5 times more assets than the next largest ETF. However, in some parts of the analysis we use ETF trade volumes for the 5 largest ETFs in their respective asset class

where $\textbf{Inclusion}_{i,t}$ is an indicator variable equal to 1 if bond *i* is included in an ETF at time *t*. As before, the Logit model is estimated separately for HY and IG bonds. Multiplying the logit coefficients with the values of the covariates we compute propensity scores. The advantage of using propensity scores is that the probability of ETF inclusion, which depends on many factors, is reduced to a single score (ranging between 0 and 1). This reduces the complexity of the problem and facilitates direct comparisons between bonds.

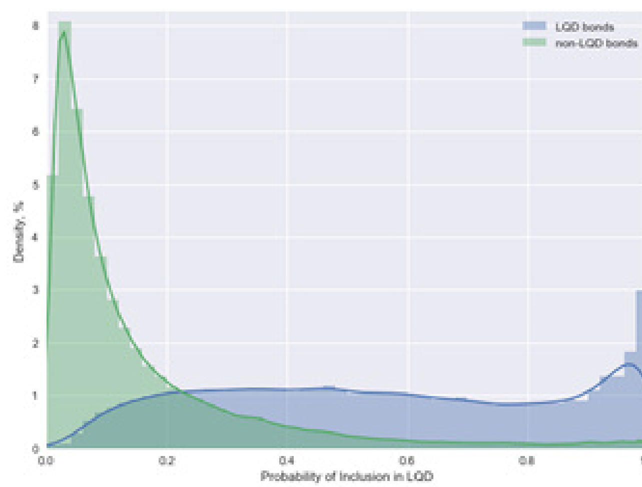
In Figure 14 (HY) and Figure 15 (IG) we plot the propensity scores separately for ETF and non-ETF bonds. We find that ETF bonds have considerably higher propensity scores than non-ETF bonds, with the effect being significantly more pronounced for LQD bonds. Moreover, approximately 10% of non-HYG bonds have less than a 10% chance of being included in HYG and approximately 25% of the non-LQD bonds have less than a 10% chance of being included in LQD. This evidence points to systematic differences between ETF and non-ETF bonds. At the same time however, there is overlap between the two conditional distributions for all propensity score values between 0.1 and 1. This suggests that in this range we could identify pairs of bonds such that for a given propensity score, one bond is included in an ETF and the other is not.[21] This means that bonds with similar propensity scores which are not in ETFs constitute a suitable control group for our ETF bonds.[22]

FIGURE 14. Propensity Score Distribution of non-HYG vs. HYG Bonds



Source: Barclays Research

FIGURE 15. Propensity Score Distribution of LQD vs. non-LQD Bonds



Source: Barclays Research

The ultimate goal of propensity score matching is to create two samples (ETF and non-ETF bonds) balanced on covariates. Covariates balancing means that the distributions of characteristics for ETF and non-ETF bonds should be approximately the same. For each covariate we compute the mean difference between ETF and non-ETF bonds, scaled by the standard deviation. We call this measure standardised mean difference (SMD) and we compute it separately for the unmatched and matched samples. A SMD score of 1 or above denotes a very large difference. Generally, as a rule of thumb, if the matching procedure worked well the SMD scores for all covariates should be less than 0.2.

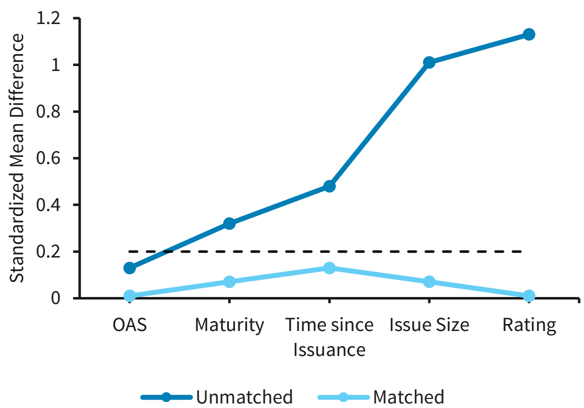
To verify this, in Figure 16 and Figure 17 we report the absolute SMD scores for HY and IG bonds, along with the 0.2 cut-off line for reference. The plot shows that the differences between ETF and non-ETF bonds in the unmatched data sample are quite large, re-iterating the point about selection bias and systematic differences between the two groups. However, the propensity

[21] This is more formally known as the Nearest Neighbor Algorithm for propensity score matching.

[22] This is feasible, despite the fact that less probability mass is located towards higher propensity scores for non-ETF bonds, because the sample size of these bonds is considerably higher than the sample size of ETF bonds.

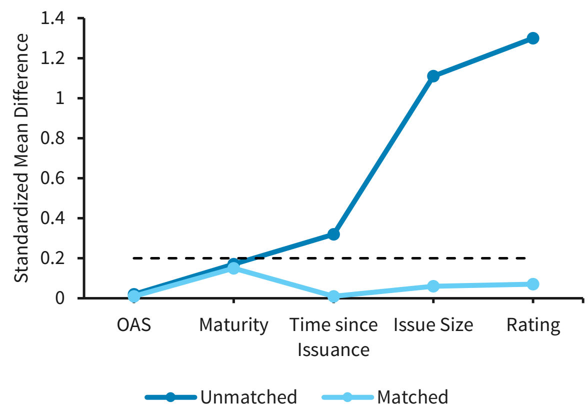
score framework clearly selects non-ETF (control) bonds such that the differences between ETF and non-ETF bonds are almost entirely eliminated.

FIGURE 16. **Covariates Balancing – HY**



Source: Barclays Research

FIGURE 17. **Covariates Balancing – IG**



Source: Barclays Research

We rerun the panel regression and report the coefficient estimates in Figure 18. As expected from such a conservative robustness check, the magnitude of the coefficients is reduced. However, the direction and statistical significance of the results remain unchanged.

FIGURE 18. **Cross-sectional Regression – Propensity Score Matching**

	HYG	LQD
ETF Dummy	-10.5***	-0.37***
	(-7.68)	(-3.06)
Bond-level controls	Yes	Yes
Aggregate controls	Yes	Yes
Industry Dummies	Yes	Yes
R2, %	43.6	74.1
N. observations	108.376	238,332
Data	2013-2019	2013-2019

Source: Barclays Research, CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Note: Bond-level controls: oas, numeric rating, duration, time since issuance, maturity, issue size. Aggregate controls: VIX, 3-month US Treasury-Bill rate, net fund flows, index oas. T-stats in parentheses. *** denotes significance at the 99% confidence level.

ETF Entry – Difference-in-Differences

So far, we have documented that broadly speaking bonds that are in ETFs have better liquidity than those bonds that are not in ETFs. However, since bonds enter and exit ETFs over time, the samples of ETF bonds, for example, in January 2019 and January 2018 are not the same. The same holds for the samples of non-ETF (index) bonds. Moreover, if the types of bonds that are likely to be included in ETFs would have better liquidity regardless of whether they are actually included in ETFs or not, the LCS difference we document could merely be an artefact of selection bias. If this holds, inclusion in ETFs does not entail any benefit to liquidity over and above what is predicted by bond characteristics.

This could be solved if we followed ETF bonds over time and compared their liquidity to suitable non-ETF bonds (*first difference*) before and after they join the ETF (*second difference*). This approach is commonly known as difference-in-differences and is a standard tool in econometrics literature.

In this section, we focus on the HYG ETF. We begin by recording the date when bonds first enter HYG. At that point in time, we use propensity score matching to pair newly-entered ETF bonds with appropriate control bonds, which are not part of HYG. We use the Logit procedure outlined in the section above. We require that we observe both ETF and control bonds for six months before and after the ETF entry date. This is a very demanding requirement, which significantly reduces our sample, but it allows us to cleanly follow the path of bonds and to separate index entry from ETF entry effects.

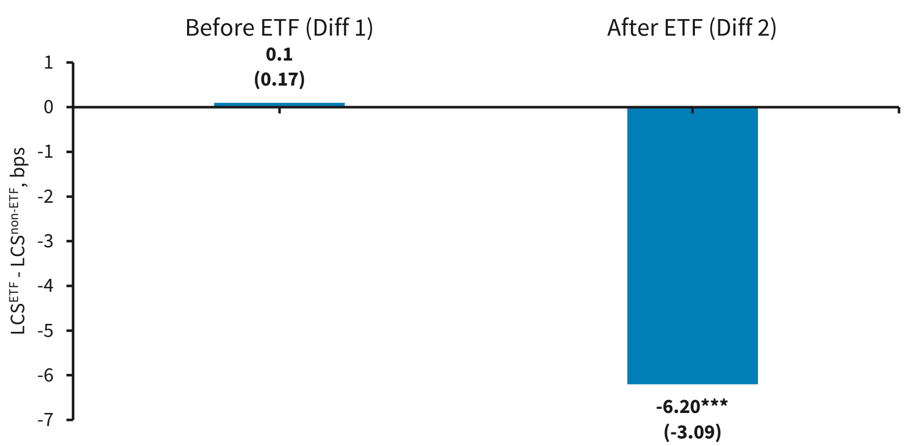
We estimate the following model:

$$\mathbf{LCS}_{(i,t)} = \alpha + \beta_1 \mathbf{Before}_{(i,t)} + \beta_2 \mathbf{After}_{(i,t)} + \gamma_1 \mathbf{OAS}_{(i,t)} + \gamma_2 \mathbf{Rating}_{(i,t)} + \gamma_3 \mathbf{Maturity}_{(i,t)} + \gamma_4 \mathbf{Time\ since\ issuance}_{(i,t)} + \gamma_1 \mathbf{Duration}_{(i,t)} + \lambda_{(i)} + \delta_{(t)} + \varepsilon_{(i,t)}$$

where $\beta_1 \mathbf{Before}_{(i,t)}$ and $\beta_2 \mathbf{After}_{(i,t)}$ are indicator variables equal to 1 for ETF bond *i* six months before and six months after it enters HYG. The inclusion of $\lambda_{(i)}$ (bond fixed effects) and $\delta_{(t)}$ (time fixed effects) make for an extremely conservative model specification. The average difference in LCS between ETF and non-ETF bonds before the entry is given by β_1 and the average difference in LCS between ETF and non-ETF bonds after the entry is given by β_2. The difference between the two differences i.e. $\beta_2 - \beta_1$ is the true impact on LCS from entering HYG.

We find that there is no statistically significant difference between ETF and non-ETF bonds before the entry – this is not surprising and confirms that the propensity score framework has indeed selected bonds with similar characteristics. However, after the entry, bonds in HYG have 6.2bp higher liquidity than non-HYG bonds (Figure 19). Since ETF and non-ETF bonds are otherwise similar to each other, we conclude that ETF entry improves bond liquidity.

FIGURE 19. ETF Entry – Difference-in-Differences Analysis



Source: Barclays Research, CRSP MF Database, Data Q1 2013 – Q4 2019. Note: Note: T-stats in parentheses. *** denotes significance at the 99% confidence level.

Alternative ETF Ownership Definition

In column (2) of Figure 20 we use an alternative definition of ETF ownership, defined as the dollar value of holdings of HYG investing in a given bond in a given month, scaled by the bond's issue size. For HYG bonds, the average ETF ownership is 1.8% and 1.30% for LQD bonds. Adding time and bond fixed effects, we obtain very similar results, which gives us confidence that the results we document are not driven by our specific definition of ETF ownership.

Comparison to JNK in HY

We investigate whether the result also holds for bonds included in the JNK ETF (column (3) Figure 20). JNK is the second largest HY ETF with approximately $13bn AUM. We find that bonds included in JNK have better liquidity than non-JNK bonds, although the effect is smaller than for HYG bonds. The fact that we also find a liquidity-improving effect is unsurprising since there is 70% overlap between the bonds held in HYG and JNK. The smaller effect is likely due to a combination of size effect – HYG is 3three times larger than JNK, and a turnover effect – HYG has two times higher turnover than JNK.

FIGURE 20. Robustness – Cross-sectional Evidence (HY)

	(1) Baseline	(2) ETF Ownership	(5) JNK
ETF Dummy	-14.4*** (-19.78)	-	-11.1*** (-7.19)
ETF % Ownership	-	-8.0*** (-9.89)	-
Bond-level Controls	Yes	Yes	Yes
Time-varying controls	Yes	No	Yes
Industry fixed-effect	Yes	No	Yes
Bond fixed-effect	No	Yes	No
Time fixed-effect	No	Yes	No
R2, %	46.3	(Demeaned Data)	46.9
N. observations	118,352	118,352	118,352
Data	2013-2019	2013-2019	2013-2019

Source: Barclays Research. Note: T-stats in parentheses. *** denotes significance at the 99% confidence level.

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