

The next
generation
bond market





How changes in market structure, liquidity & products are shaping tomorrow's bond markets

Fixed income markets have undergone significant structural change since the 2008 financial crisis. These seismic shifts are forcing investors to adapt to a new market paradigm that will challenge not only how they trade fixed income, but what types of products they use to build bond portfolios and manage risk.

In this paper, we examine the evolution of the bond market through three interconnected lenses: the liquidity environment, market structure and product preferences. All three are changing in the post-crisis era with implications for the shape of the future bond market and investors.

Similar to what took place in equities, we believe the coming years will be marked by a major transformation in fixed income. In this new world, investors may have to think differently about how to build portfolios, how to trade and what to trade.

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Executive summary

Investors must now think differently about how to navigate fixed income markets: from trading in a new market structure, to re-assessing liquidity, to determining which products will best deliver a desired outcome.

The rise of a modern, networked bond market

- The traditional principal-based fixed income market is transforming into a hybrid principal/agency market.
- Driving this change are the entrance of new market participants and the emergence of all-to-all trading technologies that offer an alternative means to trade bonds: from bilateral and voice-driven to multi-dimensional and electronic.
- The transition to a hybrid model is a challenge for investors, but may result in a more connected, diverse and modern bond market with more trading participants.

Liquidity needs to be reexamined

- Challenges post-crisis have forced traditional bond dealers to fundamentally rethink their business models.
- Broker dealer inventories have fallen, although the magnitude of the decline may be debated. At the same time, however, the size of the investment grade corporate bond market has tripled over the past decade to ~\$7.5 trillion in debt outstanding.¹
- Inventories have recovered somewhat recently, but relying solely on the old model will likely not suffice. Investors need to think about how best to access liquidity across products and asset classes, using a broader, more robust suite of liquidity measures and exposure vehicles.
- Not all investors have the same liquidity needs and the degree of liquidity required in part dictates the type of instrument employed for portfolio construction.

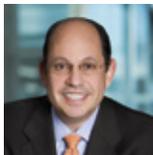
1. Source: Bloomberg, Barclays, as of 6/30/17.

Index-based products central to portfolio construction and risk management

- Today, the changing market structure means that building fixed income portfolios solely with individual securities can be increasingly costly and less efficient than in the past, leading investors to employ a range of instruments.
- Post-crisis, demand for transparent, standardized and bundled exposures has manifested in growth among index-based products like credit default index swaps (CDX), total return swaps (TRS) and bond exchange traded funds (ETFs). These products are fulfilling investor needs for building blocks to construct portfolios and manage risk more efficiently.
- Bond ETFs in particular have proven to be a valuable solution in meeting these needs. In the last five years, assets have grown 25% per year while trading volume has more than doubled. Bond ETFs are on pace to be a \$1.5 trillion market by 2022.²

The trend towards a networked bond market is likely to accelerate and be more disruptive than many market participants currently expect. We believe that those who embrace and adapt to the coming changes have the potential to benefit most.

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2. Based on the global AUM of \$741 billion and a 20% compound annual growth rate, as of 8/31/17.



The pre-crisis bond market

Over-the-counter and opaque

Liquidity

Prior to the 2008/2009 financial crisis, broker-dealers enjoyed a relatively low cost of balance-sheet funding and capital, enabling them to warehouse risk for extended periods of time. As a result, dealers were willing to make markets in significant size in both cash bonds and associated derivatives. Volumes were generally robust and liquidity was perceived as relatively deep across most asset classes.

As Figure 1 illustrates, as a largely principal trading market, the concept of liquidity was highly correlated with the inherent riskiness of an asset class. As an example, U.S. Treasuries were perceived to have a low degree of idiosyncratic risk and therefore considered highly liquid relative to speculative grade corporate bonds, which were perceived to have a high degree of idiosyncratic risk. Liquidity was often represented by the one dimensional metric of bid/ask spread, which tended to reasonably capture a dealer's risk appetite and ability to either hedge or offload risk.

Market structure

Bond trading was conducted almost exclusively in decentralized, over-the-counter (OTC) markets, where investors negotiated directly with broker-dealers. Trading was bilateral and voice driven.

Electronic RFQ platforms were just taking root, serving predominantly more liquid products such as U.S. Treasuries, Agencies and Agency MBS. Even with the advent of reporting systems like the Trade Reporting and Compliance Engine (TRACE), transparency generally remained challenged.

Products

In addition to traditional cash bonds, investors traded a variety of derivative instruments across interest rates and credit. Interest rate futures, swaps and options markets were generally robust. In credit, the immediate pre-crisis period saw investors able to source or hedge exposure to individual companies through bespoke single name credit default swaps (CDS). Over time, standards and documentation for CDS became harmonized across dealers. Counterparty exposure, however, was still managed through bespoke, bilateral collateral posting arrangements between dealers and individual clients.

While the move towards standardization in CDS helped facilitate growth in the CDX index contract, many other derivative exposures were often bespoke, complex structures that frequently employed significant degrees of leverage.

Figure 1: Pre-crisis liquidity framework

Asset liquidity dependent on perceived riskiness



For illustrative purposes only.



The post-crisis bond market

Regulation and reorganization

The global regulatory reforms enacted in the wake of the financial crisis have catalyzed change in fixed income markets. Notwithstanding the current debate around the appropriate size and scope of post-crisis regulation, the effects have been profound, impacting liquidity, market structure and fixed income product availability.

Liquidity

The onset of the crisis resulted in a sharp and immediate reduction in balance sheet and market liquidity as many broker-dealers and other market participants struggled with funding and capital adequacy challenges.

While liquidity recovered somewhat in the immediate aftermath of the crisis, the introduction of post-crisis regulation (Figure 2) among other things has resulted in higher funding and capital costs for banks and regulated broker-dealers.

Fixed income trading, traditionally reliant on bank or broker-dealer balance sheets, has been especially impacted. Higher funding and capital costs have resulted in a reduction in traditional risk warehousing, given challenges in attaining ROE targets. Market liquidity has also been impacted by a retrenchment in the repo financing market for individual bonds.

As a result, cash bond trading has migrated to more of a hybrid principal/agency model. Agency trading, in which buyers and sellers are located and matched by banks and broker-dealers, has played a more prominent role as opposed to facilitating trades more through principal risk taking.

Figure 2: Global regulatory and legislative development overview

Seismic regulatory shifts affecting all market participants

Legislation	Region	Summary	Effective date
Dodd-Frank Wall Street Reform and Consumer Protection Act	U.S.	An unprecedented rulemaking process, ongoing for more than eight years with nearly 400 new regulations involving at least a dozen regulatory agencies.	Varies
Volcker Rule	U.S.	Part of Dodd-Frank, generally prohibits banking entities from engaging in short-term (non market-making related) trading of securities, derivatives, commodity futures and options on these instruments for their own account. In addition, banks are not permitted to own, sponsor, or have certain relationships with hedge funds or private equity funds.	April 1, 2014
Basel III	Global	In December 2010, the Basel Committee on Banking Supervision (BCBS) agreed to new rules outlining global regulatory standards on bank capital adequacy and liquidity. The new rules require financial institutions around the globe to hold more and higher-quality capital, introduce a global liquidity framework, and establish a countercyclical capital buffer.	January 1, 2019
Markets In Financial Instruments Directive (MiFID II)	Europe	Building on the rules already in place since 2007, MIFID II aims to bring the majority of non-equity products into a robust regulatory regime and move a significant part of OTC trading onto regulated platforms to boost transparency.	January 3, 2018

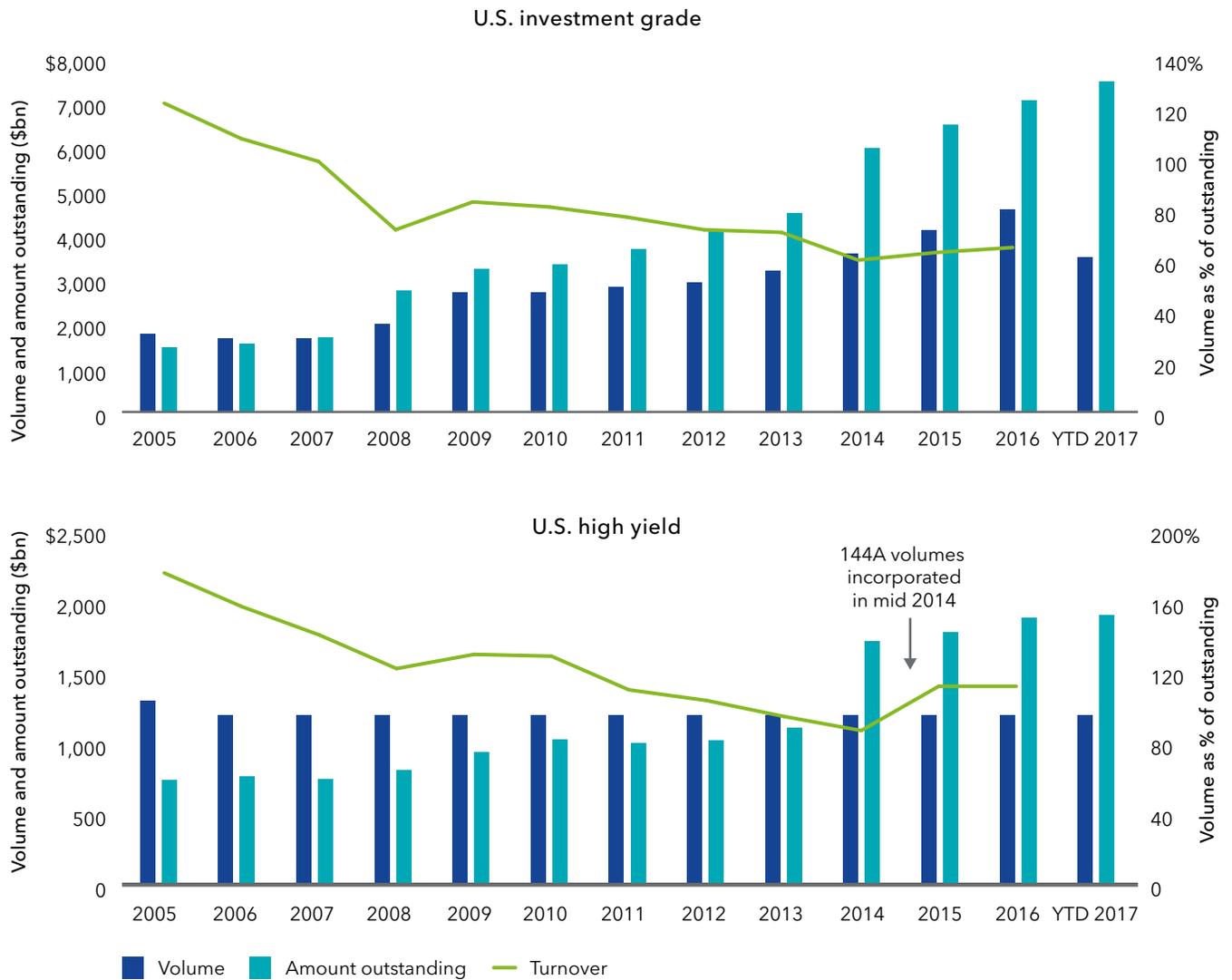
Source: SEC, SIFMA, ESMA, as of 6/30/17.

At the same time, corporate bond issuance has increased rapidly as companies moved to take advantage of historically low interest rates and improve their maturity profiles. This trend has flooded the market with record levels of new issues, but the result has been increased fragmentation.

Figure 3 illustrates the effect that growing issuance has had on the liquidity environment. While the amount of bonds outstanding has increased, secondary market trading volume has not kept pace. In fact, the turnover ratio for investment grade bonds has fallen from over 100% to about 65% since 2005.

Figure 3: Investment grade & high yield market turnover

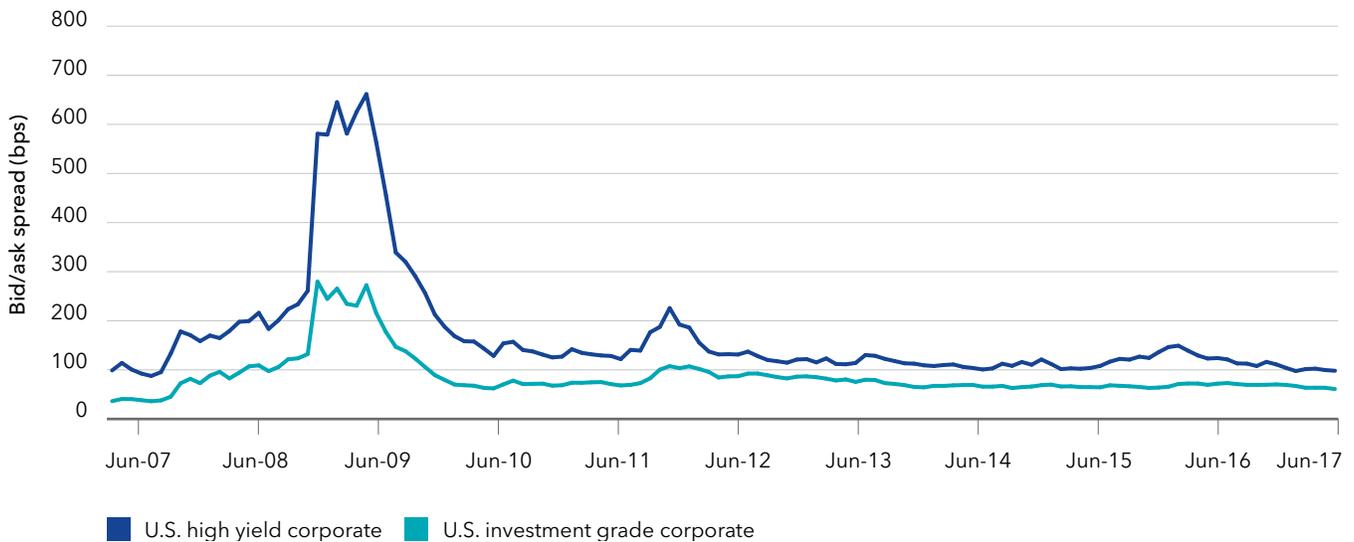
General decline in bond turnover



Source: MarketAxess, as of 6/30/17.

Figure 4: Barclays liquidity cost score

Traditional measures of liquidity may be deceiving



Source: Barclays, as of 6/30/17.

As a result, overall transaction costs and the time to trade have increased, yet bid/ask spreads are not necessarily wider (Figure 4) and have nearly reverted to pre-crisis levels. Importantly for investors, however, bid/ask spreads (as measured by Barclays liquidity cost scores) may not have the same information content with respect to liquidity as they once did. The optical narrowness of bid/ask spreads is in our view partially attributable to the shift towards more of an agency trading model for smaller trade sizes. While displayed bid/ask spreads do provide indicative trading levels, such levels are generally for smaller sizes at the “top of the book”. Larger trades usually incur significantly higher all-in costs.

Bid-ask spreads used to represent breadth and depth; now market depth is perceived to be far more shallow for a given quote, and liquidity is highly conditional on a host of factors.

These factors, including immediacy of execution, whether the full trade size was completed, or the impact on and resiliency of prices are not captured in the bid/ask metric.

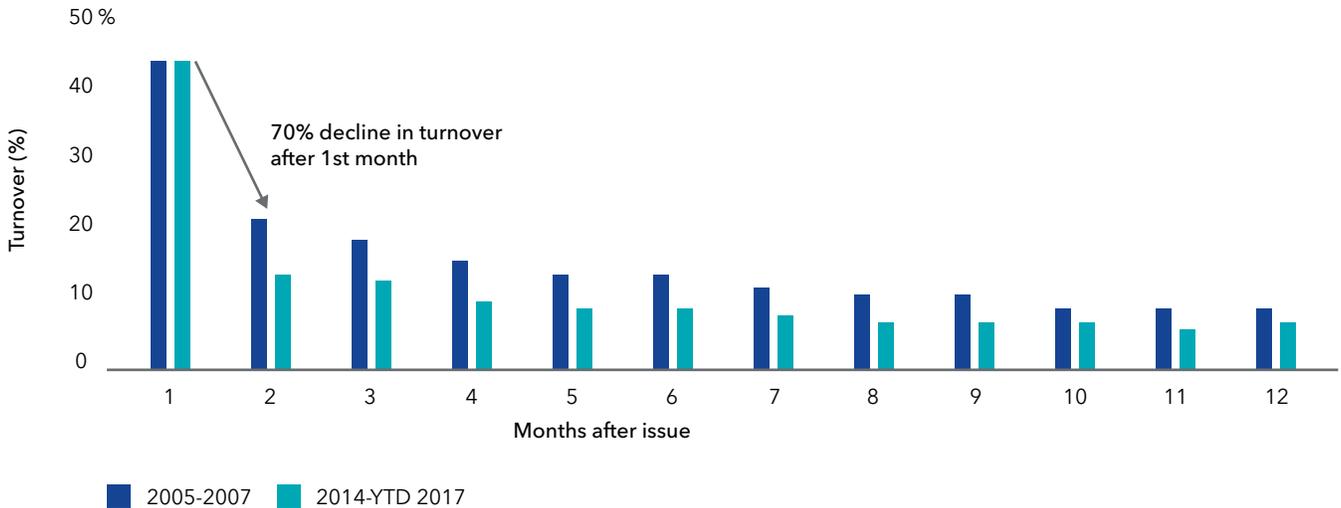
Ultimately, the largest driver of a given bond’s trading activity continues to be the amount of time since issuance. As time passes, trading activity declines sharply and eventually the security moves from being “on-the-run” to “off-the-run”.

Moreover, issuers typically issue new securities rather than tapping existing bonds, which further exacerbates fragmentation. Figure 5 illustrates the severity of this decay in trading. It appears that this dynamic has become more pronounced post-crisis.

One consequence of the changing nature in liquidity has been an even greater reliance by investors on the new issue market, which in turn has masked challenges in secondary market trading. There is a question as to what could happen if the robust new issue calendar abates due to some market impetus such as rising rates or perhaps even a change in the tax code. In that scenario, investor preferences may shift further towards index or portfolio products as individual issues become even more difficult and expensive to source.

Figure 5: Investment grade bond turnover after issuance

Secondary market trading support has declined



Source: JPMorgan, TRACE, as of 6/30/17.

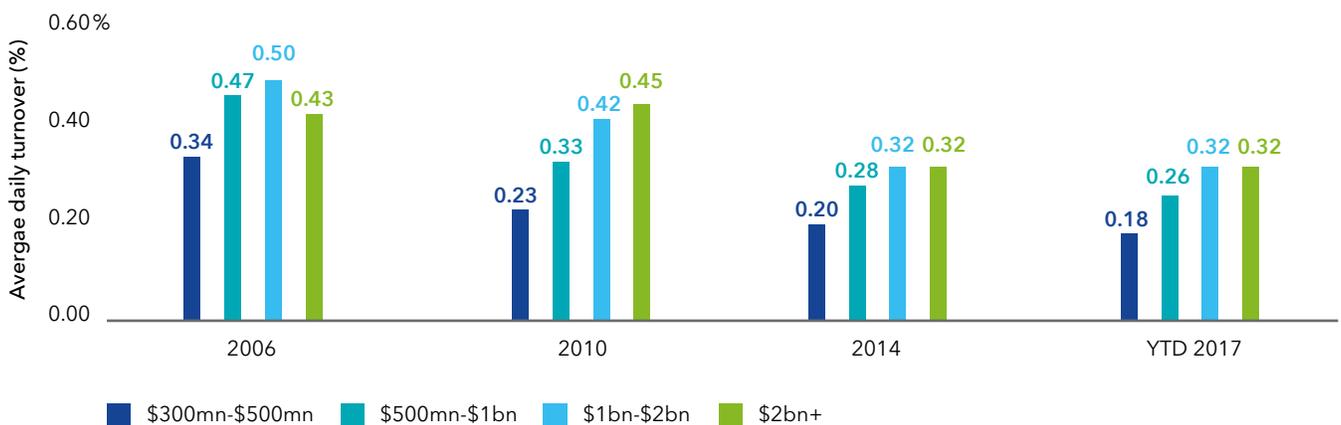
Interestingly, while market depth may be in question, market breadth is actually increasing. This is most evident in the high yield bond market as overall turnover has stabilized relative to the investment grade market. One potential contributing factor to the apparent stabilization in high yield turnover is the growing use of bond ETFs by institutions, which have become increasingly accepted by this investor base as an efficient beta access vehicle. The creation/redemption process of a bond ETF involves the exchange of a sample of index eligible bonds or a "basket" for ETF shares. As ETF volumes and activity

have increased, so has the underlying activity in bonds that they hold.

Figure 6 shows the tiering in turnover between larger bonds that are likely to be ETF constituents due to their size (per index inclusion rules, which dictate minimum size outstanding) vs. bonds that would not be included due to smaller size. Larger, index-eligible bonds have enjoyed stabilizing or increasing turnover, while smaller issues have continued to see declines.

Figure 6: Turnover of U.S. investment grade bonds based on size

Larger bonds have remained relatively liquid



Source: JP Morgan, as of 6/30/17.

Market structure

The decline in traditional risk warehousing and the commensurate increase in all-in execution costs and time to execution for larger trade sizes have created demand for additional liquidity providers and trading technologies. Electronic trading has grown across most asset classes, with entities such as non-bank principal trading firms and ETF market-makers playing larger roles. The growth in electronic trading and participation by these new players has been a result of the development of alternative trading protocols, an evolution in trading platforms and venues as well as the ongoing adaptation of operating models to the regulatory environment. Traditional banks and broker-dealers are also investing in the technology and personnel necessary to position for the continued growth in electronic trading.

According to a study from Greenwich Associates, 83% of investors surveyed are now trading bonds electronically. Similarly, electronic trading of investment grade bonds in the U.S. is now estimated to represent approximately 20% of the total investment grade trading volume, a three-fold increase from 2013 (Figure 7). As would be expected, this

growth has been driven primarily by smaller size trades, and approximately 70-80% of these trades are now electronic. The proliferation of small-lot electronic trading may help explain why bid/ask spreads have actually contracted, despite a reduction in overall market liquidity. Figure 8 illustrates the growth of trading activity on one such bond electronic trading platform, MarketAxess.

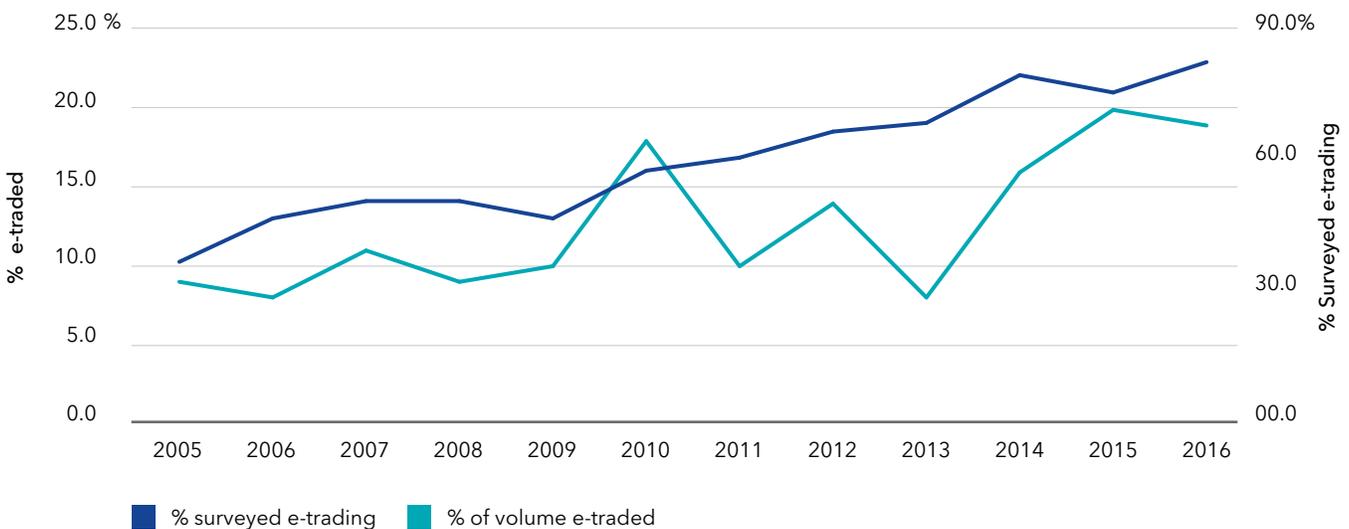
As discussed earlier, the presence of bond ETFs are contributing to the universe of bonds that are priced and traded each day.

This effect is due to how market-makers and authorized participants engage in the arbitrage activities that result in creation or redemption flows in bond ETFs. Such arbitrage activity has driven the development of more robust real-time valuation methods and pricing to complement traditional pricing services.

Finally, over time, TRACE has had a significant impact on market transparency in the U.S., while European markets are looking to MIFID II for the introduction of an equity-like consolidated tape.

Figure 7: Electronic trading of U.S. investment grade bonds

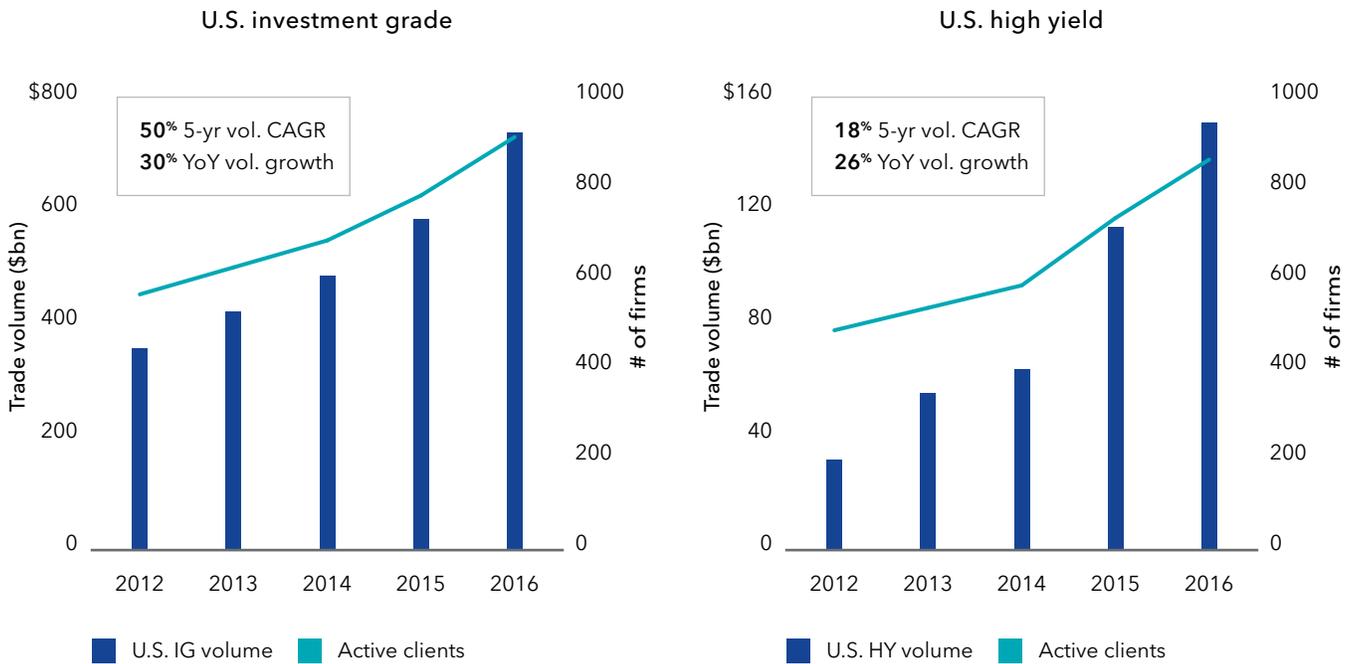
Corporate bonds are shifting towards electronic trading



Source: Greenwich Associates 2016 North American Fixed Income Research Study. Based on 115 respondents in 2005, 107 in 2006, 147 in 2007, 132 in 2008, 141 in 2009, 146 in 2010, 124 in 2011, 121 in 2012, 123 respondents in 2013, 104 in 2014, 105 in 2015 and 102 in 2016.

Figure 8: MarketAxess trading volume in U.S. investment grade & high yield bonds

Continued utilization of e-trading platforms



Source: MarketAxess, as of 12/31/16

Products

Since the crisis, trading in standardized derivatives (e.g., interest rate futures and index derivatives such as CDX/iTraxx) has remained robust. Although trading and liquidity in single-name CDS sharply deteriorated (Figure 9), these metrics appear to have stabilized once transaction clearing achieved critical mass through broad buy side and sell side adoption. For broker-dealers, cleared, index derivatives such as CDX generally have a broad, active user base and are more balance sheet and capital efficient than cash bonds. As a result, volumes in these instruments have remained relatively strong.

Accordingly, some investors have migrated risk exposure from the cash bond market to standardized derivatives to the extent they have the flexibility to do so from a legal, regulatory, operational and investment policy perspective.

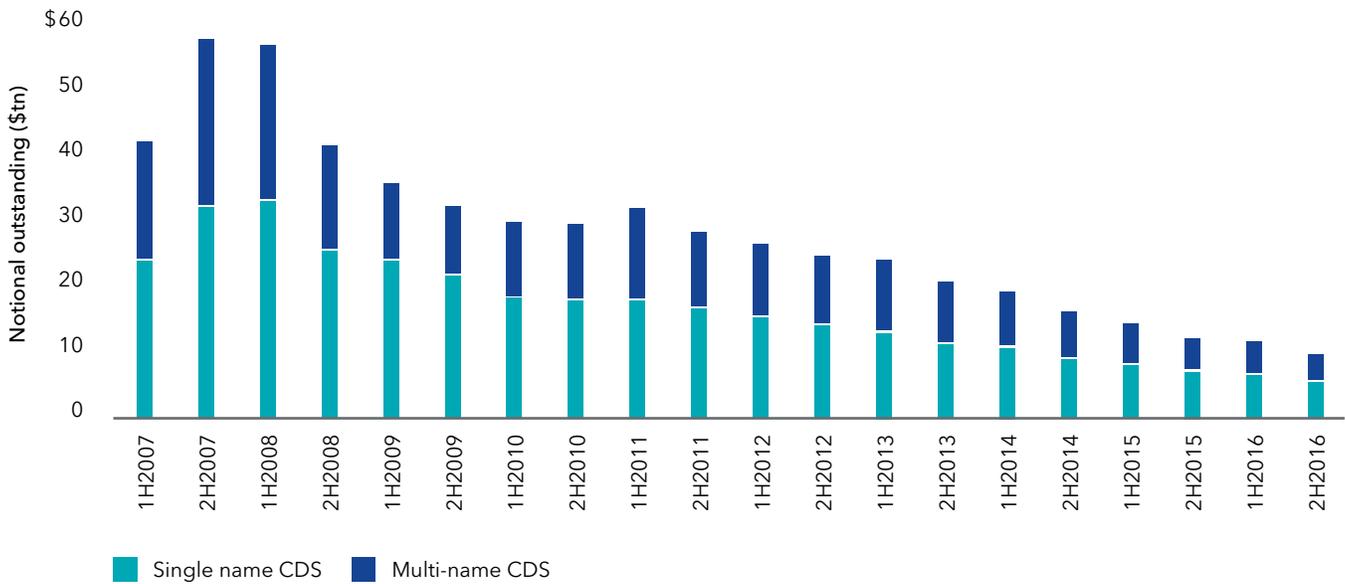
Many OTC derivatives are now centrally cleared, which has served to reduce counterparty risks and increase capital efficiency.

Other solutions such as single name bonds that are listed on exchange have not gained traction. Unlike the equity market, in which only one ticker exists for a company's common stock, the same company may have multiple bonds outstanding, each with unique identifiers. As discussed, these bonds rapidly become off-the-run securities as the time from issuance lengthens. Listing individual CUSIPs on an exchange has not solved this problem. The sheer amount and variety of CUSIPs creates fragmentation and prevents listed single bonds from having an active trading market.

Interestingly, bond ETFs have been a key beneficiary of market fragmentation. Bond ETFs effectively bundle individual CUSIPs into standardized, rules-based baskets that are perpetually "on the run". This aggregation of multiple bonds through the ETF structure can help reduce fragmentation and increase liquidity by focusing trading in a single line item.

Figure 9: Credit default swap notional principal

Single name CDS market has contracted substantially



Source: Bank of International Settlements, as of 12/31/16.

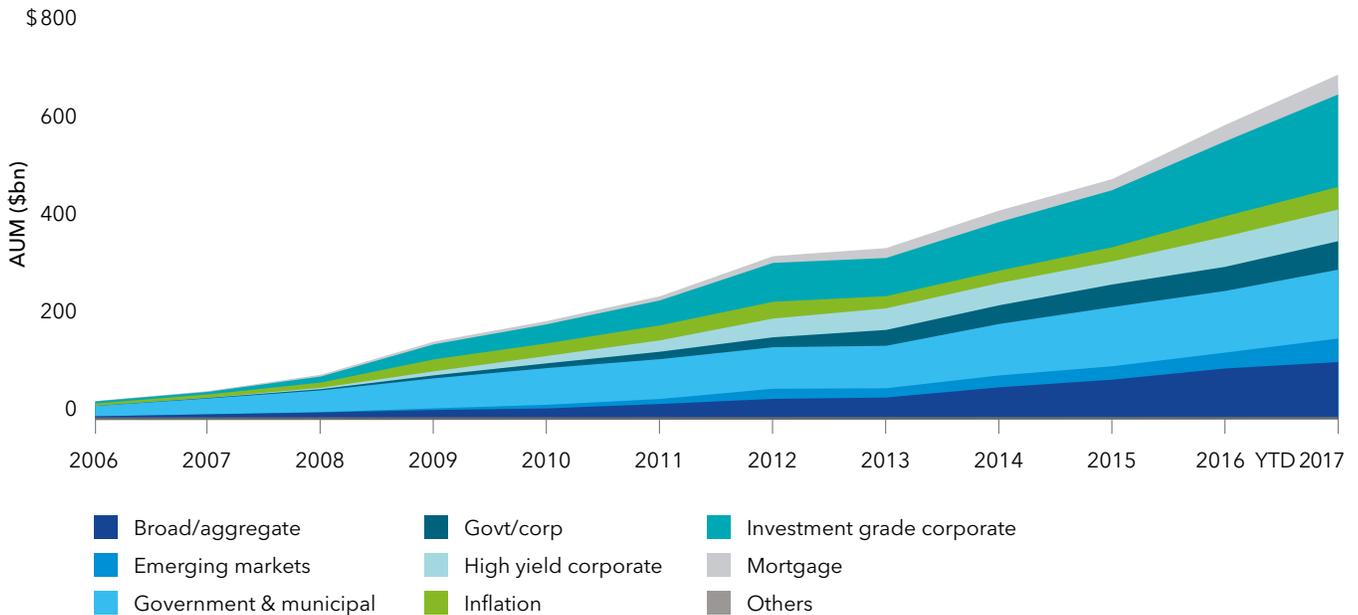
Pre-crisis, bond ETFs were used primarily as passive alternatives to mutual funds by retail wealth managers. Growth in recent years reflects both further penetration in retail channels as well as accelerating adoption by institutional investors such as asset managers, insurers, and pension funds. Although they now represent over \$740 billion in assets globally (Figure 10), bond ETFs are still less than 1% of the overall fixed income market.

Increasingly, bond ETFs are viewed as building blocks in both wealth and institutional portfolios, and as alternatives to individual securities and index derivative instruments.

According to a 2016 Greenwich Associates study, institutions use bond ETFs for applications such as portfolio completion, tactical adjustments, rebalancing and liquidity management. Liquidity, operational simplicity, and speed of execution were cited as the top reasons for bond ETF adoption.

Figure 10: Global AUM of bond ETFs

Post-crisis environment drives growth of bond ETFs



Source: BlackRock, Bloomberg, as of 6/30/17.

Figure 11: Characteristics of the exchange traded fund structure

Fixed income in an equity-like wrapper

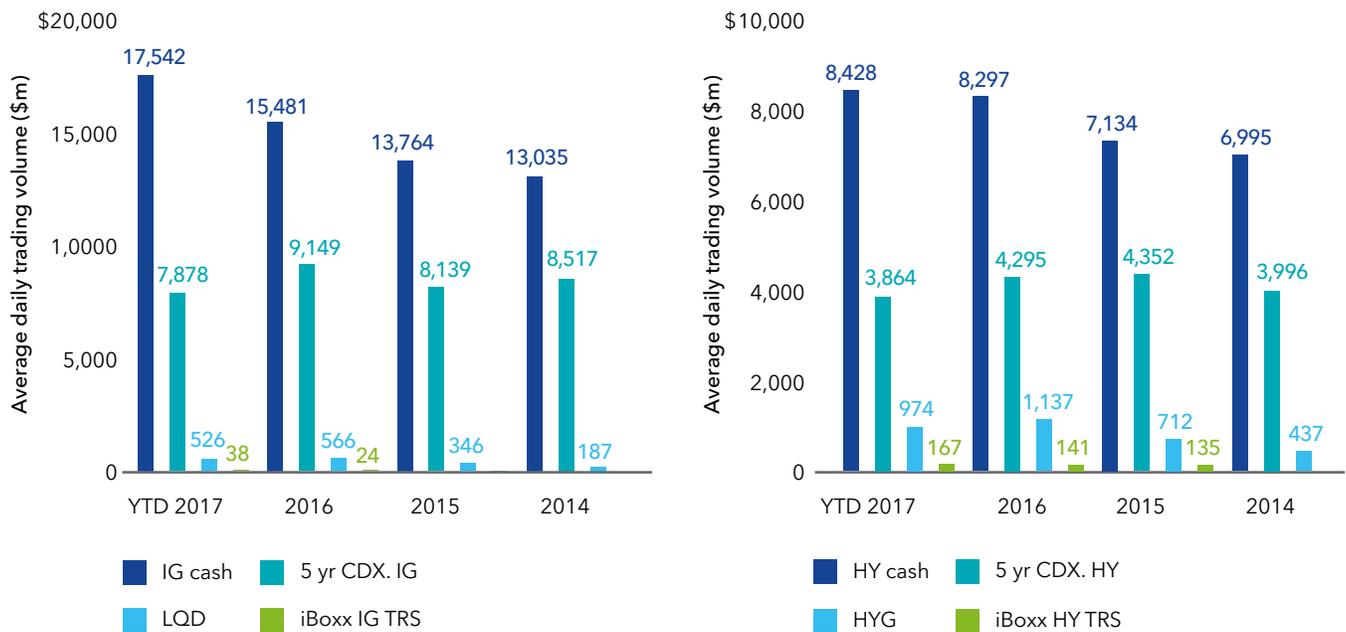
Characteristic	Description	Implication
Standardized exposure	Pools various types of similar and/or different financial assets into a single security type	Ability to more efficiently trade asset classes where it may be difficult or require special resources to source securities
Exchange-listed	Centrally listed like a stock on an equity exchange	All the potential benefits of liquid, large cap equity market infrastructure including transparency and greater access for all types of investors
Pricing transparency	Priced in real-time, even if underlying assets do not price as frequently	Implied pricing when underlying market closed or inactive. Potentially improved price discovery even when underlying markets closed or stressed
Incremental liquidity	Secondary market trading of ETF shares on exchange, independent from the underlying securities	Potential for improved trading costs and execution speeds by trading single security

A unique feature of the ETF structure is the ability for investors (with the help of banks/broker-dealers) to shift exposure between the underlying bond market and the ETF through the creation/redemption mechanism. End investors and banks/broker-dealers alike are using the dual access of exchange and OTC market to more efficiently trade as well as manage inventory levels. In particular, Authorized Participants with flow credit businesses are becoming increasingly sophisticated at managing inventory levels in the context of end investor ETF creation/redemption activity.

Market participants are realizing that it is possible to improve execution and gain operational efficiencies by accessing cash bond exposure through the ETF structure (Figure 11).

Indeed, the same drivers of demand for index derivatives such as CDX and TRS are also driving demand for bond ETFs as well as derivatives on those bond ETFs such as swaps and options. Figure 12 illustrates the growth of ETFs, CDX and TRS over the past several years. The iShares iBoxx \$ Investment Grade Corporate Bond ETF (LQD) and iShares iBoxx \$ High Yield Corporate Bond ETF (HYG) are used to represent an investment grade bond ETF and high yield bond ETF, respectively.

Figure 12: Volume growth across trading vehicles
Liquidity of indexed-based vehicles growing



Source: Bloomberg, BlackRock, FINRA TRACE, as of 6/30/17. There can be no assurance that an active trading market for shares of an ETF will develop or be maintained.



The next generation bond market

An era of technological transformation

As these trends gather pace, we believe the coming years will see a transformation in fixed income similar in many respects to that experienced in equities in the 2000s.

Market structure

The momentum behind the electronification of bond markets should continue, with significant increases in electronic trading, all-to-all networks, alternative trading protocols, central limit order books (CLOBs), and dark pools, which should impact not only cash bonds, but standardized vehicles as well.

Traditional banks and broker-dealers will likely remain at the center of the fixed income market as they continue to adapt their business models, investing in trading infrastructure and automation (including algorithmic trading and artificial intelligence), and embracing new trading practices and venues. However, while principal risk taking will remain in some form, it is unlikely to revert to pre-crisis levels of activity as the new hybrid agency/principal model becomes entrenched.

Moreover, advances in technology may allow traditional asset managers to play an increasing role as price makers with respect to trading through crossing networks, a shift requiring changes in behavior as well as the adoption of technology.

Non-bank principal trading firms and ETF market-makers will likely continue to increase their presence as liquidity providers. We believe such entities have become increasingly active in bond ETFs and the underlying cash bond markets, and will continue to branch into derivative markets as well.

The trend towards transparency on both a pre-trade and post-trade basis and the resulting increase in data will continue due to regulation and the momentum behind electronic trading. This proliferation of trade data will allow for greater innovation in automated market making activity and liquidity provision analytics.

Liquidity

We believe that the liquidity and regulatory environments will continue to be interconnected. Depending on the political landscape over time, regulatory burdens may ebb and flow, but the overall trends towards product standardization and transparency are likely to continue. In aggregate, liquidity should stabilize for individual cash bonds as the ecosystem continues to adapt and evolve.

However, rules-based instruments which reference market benchmarks (i.e., derivatives and ETFs) may see the largest gains in trading volume as investors discover the liquidity and diversification benefits they can offer. Similarly, the derivatives and lending markets that reference bond ETFs themselves are likely to deepen as adoption increases, potentially offering further sources of liquidity for investors.

Most importantly, relying solely on bid/ask spreads may no longer be an adequate indicator of liquidity. Investors should consider a multi-dimensional approach that takes into account volume, immediacy, depth, resiliency, vehicle and trading venue. We introduce a stylized, conceptual framework designed to highlight these key factors in Appendix A.

We believe that there will be a continued drive towards data generation, aggregation, and distribution. Real-time pricing of fixed income risk is more important than ever

given the increase in transparency from electronic trading and ETF primary and secondary activity. Enhanced trade reporting should be a significant driver of this type of pricing, particularly for cash bonds, but also for bespoke, non-centrally cleared derivatives.

Finally, scale economies will be key as data infrastructure costs will likely be prohibitive, leading to potential consolidation among data / pricing / index service providers. Data itself will become increasingly important with data providers seeking to protect and monetize the value of that data.

Products

We believe that index/basket exposure vehicles will serve as building blocks and play an increasing role in how investors construct fixed income portfolios. The trajectory may be similar to what was observed in the transition from individual equities to indexed equities through futures, swaps and ETFs. In the future, the offering of these vehicles in fixed income will likely be much more refined and granular, moving from broad indices into constituent sub-indices. This will allow investors to access fixed income exposures that are highly targeted by sector, industry, size, quality or a number of other factors or characteristics.

The creation/redemption process for bond ETFs could become much more sophisticated, robust and fluid due to enhancements in technology and widespread acceptance of the vehicle. Importantly, the creation/redemption process itself could serve as a conduit for bundling and unbundling of fixed income risk as well as optimizing liquidity across venues. This dynamic would afford investors more flexibility to navigate risk and liquidity by actively moving between individual cash bond and portfolio ETF exposures. The growth in borrow availability and in the liquidity of derivatives referencing ETFs can further increase the role of bond ETFs in the ecosystem.

Traditional derivative markets are likely to continue to trend towards cleared, benchmark reference products. Most derivative structures, even the more bespoke ones, may ultimately be electronically traded and cleared. CDX will continue to be augmented with more bond-like derivative exposures such as index TRS given that such products are more closely hewn to the cash bond market.

Further, we believe that the number and type of paired, complimentary derivative and ETF exposures (e.g., iShares iBoxx \$ High Yield Corporate Bond ETF (HYG) and iBoxx \$ Liquid High Yield TRS) will continue to grow in order to increase fungibility between the cash and synthetic markets. Derivatives on bond indexes and on bond ETFs themselves could be the dominant link between funded and unfunded exposure. Such a dynamic is already starting to occur in index TRS and credit ETF options.

With the growth of new instruments, portfolio managers will need to be more agnostic, starting with their desired outcome before determining the optimal exposure vehicle across cash bonds, derivatives or ETFs.

Understanding how these instruments are traded and behave relative to one another will be key in implementing efficient investment strategies.

Conclusion

While fixed income markets were already beginning to evolve prior to 2008, the fallout from the crisis has catalyzed a behavioral shift in the market and has dramatically accelerated three trends already underway:

- increasing transparency;
- adoption of standardized instruments and trading vehicles (e.g., rules-based derivatives and ETFs that reference market benchmarks);
- modernization of trading through clearing and electronic platforms.

In many respects, fixed income markets are evolving along a path similar to that of the equity markets. However, the structural features of bond markets, such as heterogeneity and fragmentation, don't naturally lend themselves to a pure equity market infrastructure. As a result, a more complex approach and more robust set of tools will be necessary to address the longstanding challenges of the bond market.

This evolution is likely to be faster and more disruptive than many market participants currently expect. We believe that those who embrace and adapt to the coming changes have the greatest potential to benefit.

A

Appendix

A multi-dimensional framework for evaluating liquidity

Given today's shifts in market structure and the rise of new exposure vehicles, the measure of liquidity in fixed income should be broadened beyond bid/ask spreads. We introduce a stylized, conceptual framework designed to highlight the key factors investors should consider:

- 1 **Quoted bid/ask spread:** The displayed bid/ask spread.
- 2 **Average daily volume:** The observed average daily trading volume as an indicator of historical trading capacity.
- 3 **Market depth:** The trade size that can be absorbed without significant market disruption.
- 4 **Immediacy:** The speed at which a trade is filled.
- 5 **Price resilience:** The time it takes an asset's price to recover following a market moving trade.

Case study: Measuring liquidity for U.S. investment grade bond exposure

Using this multi-dimensional liquidity framework, we can evaluate the liquidity profiles of three different investment grade corporate bond exposure vehicles.

The vehicles being evaluated include:

- **Individual cash bonds** represented by a sample of actively traded investment grade bonds.³
- **Index derivatives** represented by the on-the-run CDX.IG contract.
- **Bond ETFs** represented by the iShares iBoxx \$ Investment Grade Corporate Bond ETF (LQD).

3. References a basket of Anheuser-Bush Inbev (ABIBB) and Verizon Communications (VZ) bonds traded by BlackRock dealing desks.

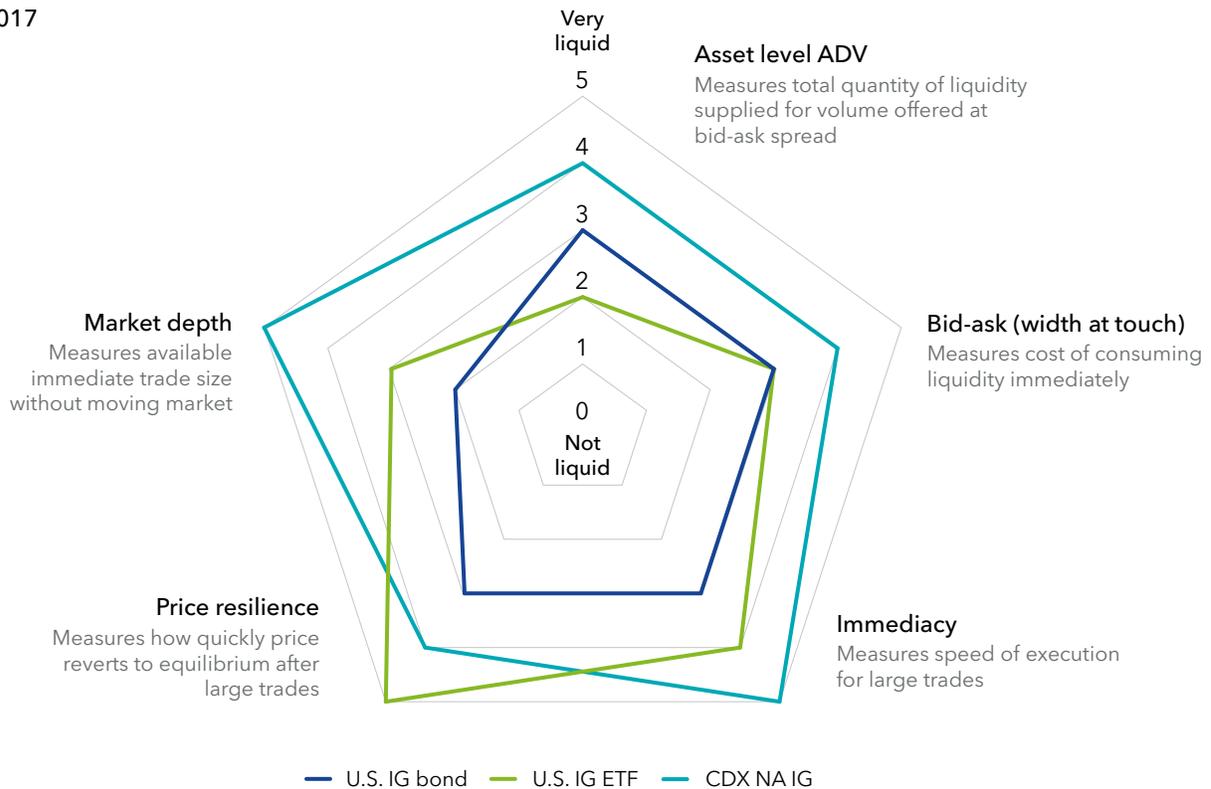
In Exhibit A, we have scored examples of each vehicle in the investment grade market based on the above five dimensions of liquidity with a scale from 1-5, (1 representing the lowest score and 5 representing the highest score). Accordingly, an instrument with a total score of 25 would exhibit the greatest estimated overall liquidity. For simplicity, the factors are equally weighted and may not reflect each factor’s actual relevance for a particular market or exposure.

In this instance, CDX.IG would rank the highest, with a score of 22, followed by an investment grade bond ETF, LQD, with a score of 17, and then finally the sample cash bond at 14.

Exhibit B shows this liquidity scoring system for each instrument over time. Note that the spread between the cash bond market and the other two instruments has been steadily widening. Overall, liquidity in the cash market has declined, while ETF liquidity has improved at the greatest rate.

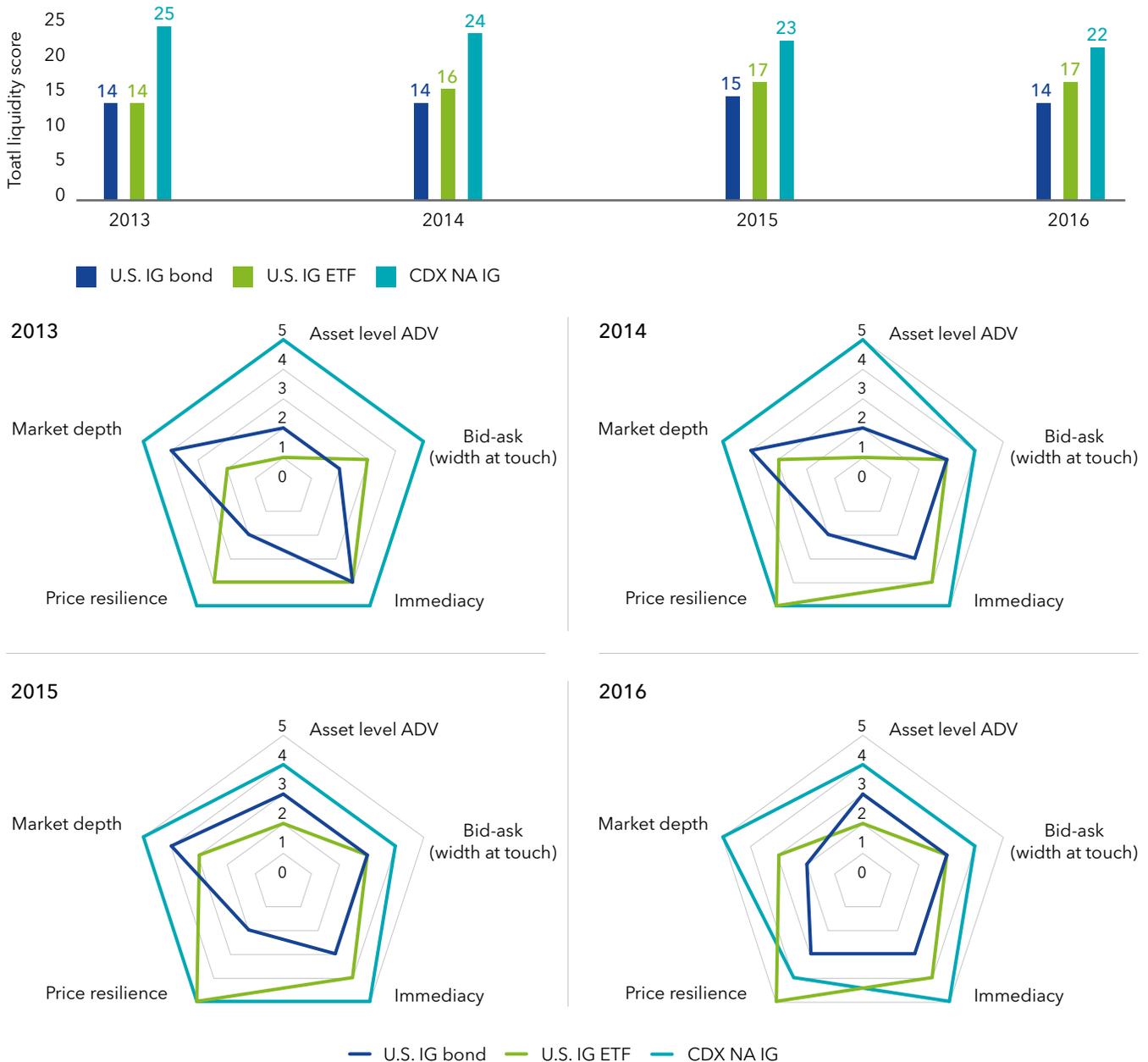
Exhibit A: Liquidity evaluation for U.S. investment grade bond exposure

YTD 2017



Source: BlackRock, as at 6/30/17. For illustrative purposes only. Please refer to the back page of the document for sources and assumptions on the liquidity framework.

Exhibit B: Liquidity evaluation for U.S. investment grade bond exposure over time



Source: BlackRock, as at 12/31/16. For illustrative purposes only

This framework highlights an important feature of the post-crisis bond market. The liquidity of a particular exposure vehicle may differ from the liquidity of the asset class itself. As one example, CDX is actually twice removed from the underlying cash market (i.e., CDX is an index derivative contract on individual default swap contracts on cash

bonds), yet is vastly more liquid than a given individual cash bond. The iShares iBoxx \$ Investment Grade Corporate Bond ETF (LQD) is another example, trading at tighter bid/ask spreads and higher ADV than the individual investment grade bonds that it holds.³

4. iShares iBoxx \$ Investment Grade Corporate Bond ETF trades a bid/ask spread of 1 bps compared to 35 bps for the underlying securities of the fund. Source: Bloomberg, NYSE Arca, as of 6/30/17.

What explains the divergence of liquidity between the exposure vehicle and the asset itself?

We believe that there are four contributing factors:

- **Diversification:** By aggregating individual exposures into a portfolio, idiosyncratic risk is replaced by systematic or market risk.
- **Standardization:** As an example, both CDX and LQD are standardized, rules-based exposures which follow reference benchmarks governed by inclusion and exclusion criteria.
- **Transparency:** Both CDX and LQD exhibit daily transparency, with the composition of each product available from a variety of sources.
- **Trading / clearing medium:** While CDX is traded exclusively OTC, LQD may benefit from being traded on an exchange, which can provide investors with unique trading efficiencies compared to the OTC market.

Each of these attributes may be thought of as decreasing cost and increasing liquidity. Diversified exposures are more manageable from a risk taking / risk management perspective than idiosyncratic exposures. Likewise,

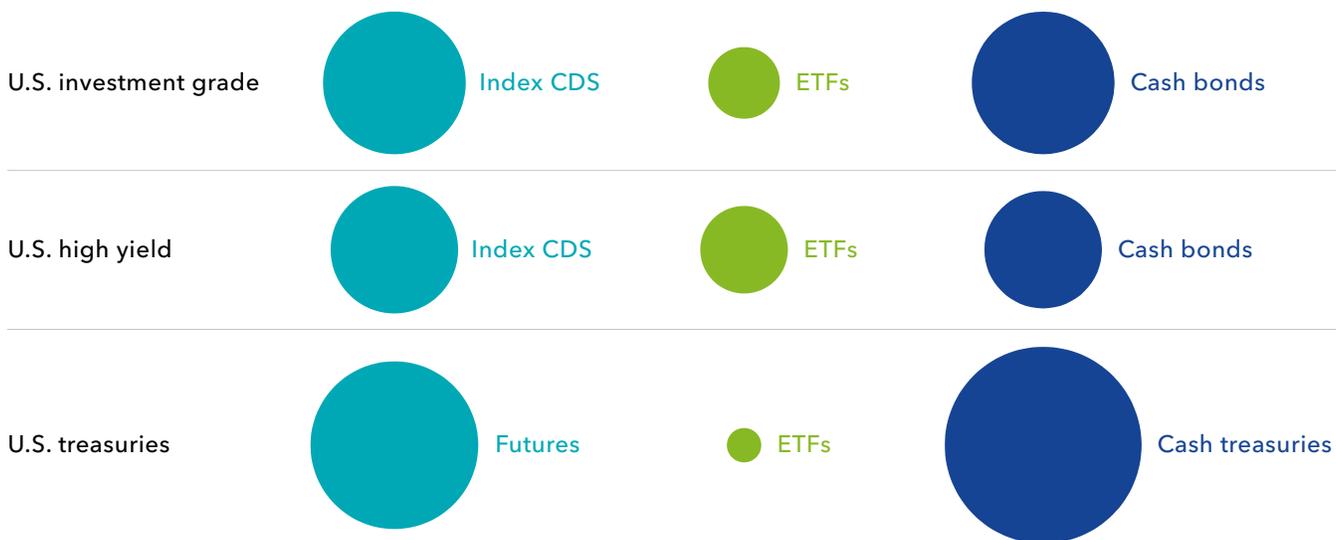
standardized and transparent exposures are more manageable than bespoke exposures due to far greater certainty around the nature of the risk.

In the case of the ETF, exchange trading confers a number of potential benefits, including real-time visibility into bid/ask spreads, market depth and trading activity as well as elimination of counterparty risk. In the case of CDX, mandatory clearing has greatly reduced counterparty risk, eliminating a former component of trading cost.

Taken together, it is not surprising that CDX and LQD tend to be more liquid than the underlying individual cash bonds that they represent. Similar effects can be observed in other markets such as equity and Treasury futures. Exhibit C illustrates a stylized representation of the relative potential liquidity of exposure vehicles across the U.S. Treasury, high yield and investment grade corporate markets. Importantly, however, this expanded liquidity of the asset class by new vehicles does not represent a “liquidity transformation” as is sometimes claimed. Rather, incremental liquidity represents a structural transformation that is additive to the markets.

Exhibit C: Aggregate market liquidity by investment vehicle

Derivatives and pooled vehicles can add incremental liquidity



For illustrative purposes only. Based on reported trading volumes as of September 2017, may not represent actual liquidity for the products shown at any given time. Graphic not drawn to scale.

Glossary of key terms

Bond exchange traded funds (ETFs)

Bond ETFs are typically registered funds under the 1940 Act consisting of a portfolio of bonds that are traded intra-day on an exchange, like an equity security. They are generally fully funded, unlevered vehicles that hold cash bonds. Most bond ETFs seek to track indices that follow specific segments of the bond market, such as government, investment grade corporate, high yield corporate or emerging market bonds. Rather than trading individual bonds in the over-the-counter (“OTC”) market, investors can access these exposures by purchasing an ETF on an exchange. The ETF structure can lower the cost of trading while providing real-time pricing information.

ETF creation/redemption

The process by which shares of ETFs are issued to, and redeemed from, Authorized Participants (APs). ETF creations and redemptions are typically for large blocks of shares and are settled by delivery of the ETF Basket (but may be settled for cash when in-kind delivery of assets is impractical, using a variety of transaction charges so that costs are borne by APs in a manner similar to an in-kind delivery).

Market makers

A broker-dealer that regularly provides two-sided (both buy and sell) quotations to clients.

Authorized participant (AP)

APs are financial institutions capable of managing complex securities settlements that create and redeem ETF shares in the primary market in exchange for underlying securities. Each AP has an agreement with an ETF sponsor that gives it the right (but not the obligation) to create and redeem ETF shares. APs frequently create or redeem shares in order to manage inventories of ETF shares sold or bought through trading in the secondary market. APs may act either on their own behalf or on the behalf of market makers or institutional clients.

Primary market

Refers to activities through which securities, including stocks and bonds, are issued and redeemed. The primary market for ETFs (where ETF shares are typically exchanged for the underlying securities) is available only to APs.

Secondary market

Refers to the market where securities, including ETF shares, are traded and includes trading through regulated exchanges (such as NYSE ARCA, NASDAQ and Bats), trading through Electronic Communications Networks (ECNs), and over-the-counter (OTC) trading among institutions.

Electronic bond trading

Typically a computer-based trading technology that displays bid and ask quotes from many market participants, and then automatically matches and execute trade orders.

All-to-all network

A trading platform that allows any platform member to negotiate and trade with any other platform member. The best known all-to-all platform is the modern stock exchange.

Principal trading firm

A trading firm that typically deploys proprietary automated trading strategies on trading platforms. Some firms may be registered as broker-dealers although they have no clients.

Central limit order book (CLOB)

A trading protocol in which outstanding offers to buy or sell are stored in a queue and are filled in a priority sequence, usually by price and time of entry. CLOBs are common for highly standardized securities and markets in which trade sizes can be small.

Important notes and sources: "Asset level ADV" score is determined based on the average daily traded volume (ADV) and turnover ratio of each instrument. Source is Bloomberg. "Bid-ask (width at touch)" score is determined using average daily bid-ask spreads. Sources are Barclays Research, TRACE, Bloomberg and BlackRock internal trading analytics. "Immediacy" and "Price Resilience" scores are determined using BlackRock trading data and analytics based on all transactions of the iShares iBoxx \$ Investment Grade ETF (LQD), CDX NA. IG, Anheuser-Bush Inbev (ABIBB) and Verizon Communications bonds (VZ) traded by BlackRock's dealing desks. Each transaction is evaluated based on traded notional amount, execution time stamp, order time stamp, execution price, daily closing price, and daily open price. "Market Depth" score is determined based on BlackRock trader and portfolio qualitative feedback. All data is measured as of June 2017.

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Fixed income risks include interest-rate and credit risk. Typically, when interest rates rise, there is a corresponding decline in bond values. Credit risk refers to the possibility that the bond issuer will not be able to make principal and interest payments. Non-investment-grade debt securities (high-yield/junk bonds) may be subject to greater market fluctuations, risk of default or loss of income and principal than higher-rated securities. Diversification and asset allocation may not protect against market risk or loss of principal.

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Lit. No. WP-NG-BOND-0917 36252 / 0917

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