

Innovation and evolution in the fixed income market

Vanguard commentary

October 2016

- At first blush, it may appear as though the fixed income market is less liquid than it has been in the past. Corporate bond markets have grown considerably over the last several years, just as dealers' appetite to hold bonds in inventory to facilitate trades has diminished.
- This shift in dynamics, though undeniable, is not a harbinger of doom, nor is it the end of the story. Rather, it's the beginning of a new chapter that highlights the resiliency of the financial markets and the imagination of many of its participants. The market and its participants are doing what they always do—adapting, innovating, and evolving.
- The markets have absorbed the changes spurred by the latest “new normal” by taking advantage of technological advancements and devising new methods of matching buyers and sellers. Maybe most important, the transformation of the fixed income landscape has not had the deleterious impact that some had predicted (or are still predicting).
- We believe that these changes born of regulatory reform and monetary policy—including electronic trading and increased competition—will stick. And we conclude that there is even more we can do to capitalize on the developments that have already taken hold.

Introduction

Vanguard believes that several key improvements will help electronic trading continue to evolve in ways that are most beneficial to investors. We strongly advocate for policies and practices that (1) limit the fragmentation of trading, (2) encourage direct interaction between buyers and sellers, (3) better link trading and order-management systems, (4) provide greater price transparency, and (5) protect against information leakage.

Our stance is supported by the following points, which we'll cover in more depth throughout this paper.

- The largest dealers have significantly reduced their bond inventories and the resources dedicated to bond trading. But despite constraints—both market-driven and self-inflicted—dealers continue to make markets, and participants can trade large volumes of bonds at market prices.
- Electronic trading has become increasingly important in fixed income markets, enabling greater use of automated, computer-driven trading based on algorithms. This has allowed a more diverse set of participants to enter the market, introducing new sources of liquidity, increasing competition, and reducing transaction costs. Although some fear that removing the human element from trading is a cause for concern, at Vanguard we do not believe that electronic trading increases market risk or impairs liquidity.
- Innovation in open-ended investment vehicles has generally boosted market liquidity because two of these vehicles (exchange-traded funds and target asset allocation funds) have provided stabilizing effects.

Finally, we offer our perspective on ways that technological advancements can help our industry continue to grow, and we expand on our simple blueprint for encouraging these developments.

All told, our examination shows that the potential for significant market disruption or systemic risk caused by a perceived reduction in liquidity is minimal. Prudent mutual fund regulation, the structure of funds, and the effective use of liquidity risk management tools by portfolio managers help ensure that liquidity risk—which comes with the territory in investment management—will not spill over to the broader financial markets in a systemic manner. We believe the mutual fund industry will continue to serve investors as effectively as ever.

A healthy dose of perspective

In our January 2016 paper, “Clear Perspectives on Bond Market Liquidity,” we provided an in-depth examination of the hypothesis that lower bond market liquidity portends a crisis for the financial markets. We found that this is simply not the case.

Among our findings:

- Liquidity is dynamic. The ability to convert an asset to cash in a reasonable amount of time and in a prudent manner changes constantly. It responds to shifts in investor preferences, dealer financing costs, profit opportunities, and a myriad of other factors that influence capital market activity. The cost of liquidity for a particular asset type, defined as the size of the asset's **bid-ask spread** (see Glossary), also varies based on a number of elements; it is not a binary measure.

Notes about risk and performance data: All investing is subject to risk, including the possible loss of the money you invest. Investments in bond funds are subject to interest rate, credit, and inflation risk. Investments in securities issued by non-U.S. companies are subject to risks including country/regional risk and currency risk. These risks are especially high in emerging markets. While U.S. Treasury or government agency securities provide substantial protection against credit risk, they do not protect investors against price changes due to changing interest rates. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income. Diversification does not ensure a profit or protect against a loss.

- Mutual funds, charged with helping shareholders diversify their portfolios across hundreds or thousands of securities and providing access to their money when needed, still make up only a small fraction of bond market capitalization. The belief that millions of “unsophisticated” investors would leave the market when trouble arose and trigger a liquidity crisis has proven unfounded. Time and again, mutual fund investors have not redeemed in significant numbers, even during the darkest days of the 2008 financial crisis. They didn’t broadly scramble for the exits in the aftermath of the U.K. “Brexit” vote in June 2016. Nor did they leave during December 2015’s volatility spike in the high-yield market that helped contribute to the liquidation of one mutual fund.
- There is no conclusive evidence that declines in inventory and turnover have had a negative effect on the liquidity metrics that matter most in bond fund management. In fact, bid-ask spreads on corporate bonds are narrower today than they were when dealer inventories were at all-time highs during the financial crisis. And the Federal Reserve has found¹ that a corporate bond trade now has a smaller estimated impact on a bond’s market price than it did in the years before the crisis.

So, why all the hand-wringing?

Despite the evidence presented in our January 2016 paper, concerns about liquidity persist in some quarters. This is an understandable reaction because some elements of fixed income trading have undergone significant shifts.

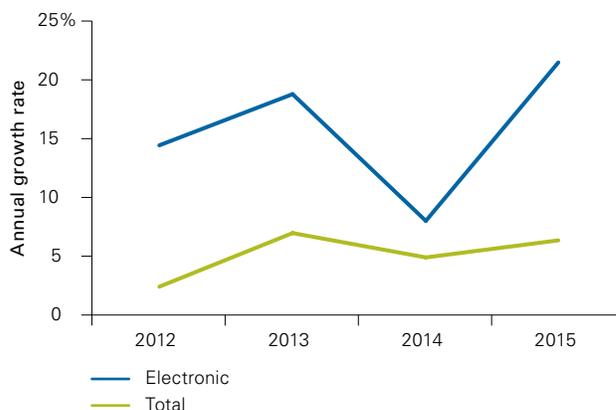
- The value of corporate bond inventory held by dealers globally has fallen considerably from its 2008 peak. The size of market-making desks has also shrunk in an effort to reduce costs as firms no longer need the coverage required prior to the global financial crisis.
- New regulations have changed the way that banks and other broker-dealers are capitalized and how they operate. The banking system is stronger and the financial system is less susceptible to the risks of leverage that precipitated the crisis. However, one of the trade-offs is that market making is more expensive for banks. As a result, they are less willing to take on the risk.

- Bond market volatility has dropped in response to the extremely low interest rate environment. Naturally, dealers are less prone to offer market making when the cost of liquidity has decreased or when profitability drops because of increased efficiency, lower volatility, or other factors.

Nonetheless, dealers continue to make markets in fixed income securities, and participants continue to execute trades at market prices. There is evidence that average trade size has shrunk, offset by an increase in the number of trades, but this was not unexpected. In fact, a similar effect was seen several years ago as equity markets moved to more electronic execution.

Overall trade volume has not declined (see **Figure 1**), and bid-ask spreads are narrower today than before the crisis, indicating ample liquidity in the corporate bond market (Federal Reserve Bank of New York, October 2015). With any security, brokers quote two prices: a **bid** (the highest price a prospective buyer is willing to pay) and an **ask** (the lowest acceptable price for a prospective seller). The smaller the difference between the two, the more easily—and cheaply—a security trades.

Figure 1. Growth in U.S. investment-grade bond trading

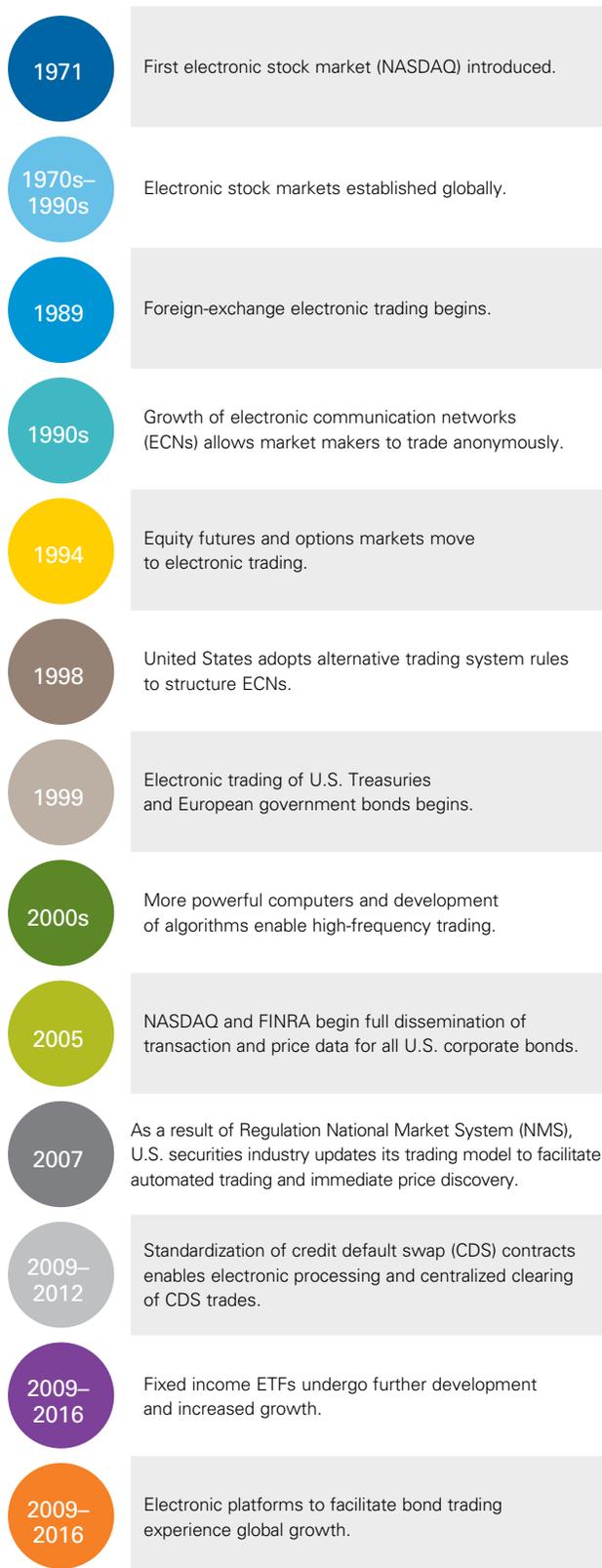


Notes: Growth is measured by the increase in average daily trading volume for each calendar year. Electronic growth is represented by MarketAxess U.S. high-grade trade volume data. Total growth is represented by U.S. high-grade trade volume as reported by FINRA Trade Reporting and Compliance Engine (TRACE). Consistent with FINRA TRACE reporting standards, both sides of trades are included in a company’s reported volumes when the company executes trades on a riskless principal basis between two counterparties.

Sources: MarketAxess, FINRA TRACE.

¹ Source: *A Six-Part Series on Bond Market Liquidity* (Federal Reserve Bank of New York, October 2015).

Electronic trading in capital markets: Key events



Source: Vanguard.

Technology is driving innovation

It should come as no surprise that retrenchment by traditional dealers has created opportunities for innovators to find more efficient ways to match buyers and sellers. And, of course, technology is at the center of this movement. At the same time that traditional dealers are struggling with their new world order, technological changes have helped lower the barriers to entry, making way for new—and very efficient—liquidity providers.

It's important to understand that electronic trading and automated trading are not synonymous. **Electronic trading** is the transfer of ownership of a security whereby the buyer and seller negotiate and/or execute the trade through systems such as electronic quote requests and communication networks. In **automated trading**, orders are placed—and decisions are made—online autonomously.

Electronic trading systems take several forms:

- **Request for quote (RFQ).** This is a common trading protocol in which users request prices from platform market makers on an order of a specific size. (The identity of the participants may or may not be disclosed, depending on the platform.) In most fixed income RFQ systems, the requests are sent only to dealers, and only in limited numbers. These systems, which are not necessarily built for speed, are generally used in markets characterized by a greater number and variety of securities, such as corporate bonds and off-the-run U.S. Treasuries. They may also be used in markets where participants lack the scale of large dealers. Tradeweb is an example of an RFQ system.
- **Central limit order book (CLOB).** With this trading protocol, active bids and offers are stored and then executed in priority order. Typically, quotes are transparent to participants in the interdealer market on a pre-trade basis. Used most often for strategies that depend upon speed, CLOB systems typically trade highly liquid securities, such as U.S. Treasuries. Examples are BrokerTec and eSpeed.
- **All-to-all.** This protocol, which represents a small but growing channel of electronic bond trading, allows buyers and sellers to interact directly with one another, providing a high level of transparency. This is an important distinction because most electronic trading platforms match dealers to dealers and to clients. Because so-called end clients are participating equally—and directly—with each other, costs are low and liquidity is highly accessible. For example, MarketAxess offers an all-to-all trading protocol.

What types of securities trade through these systems?

As you might expect, each electronic platform is not suitable for all types of securities, and all types of securities are not suitable for each platform because of the high degree of fragmentation in the bond market. A single issuer, for example, often makes multiple issuances that are not interchangeable. Electronic trading is more advanced in the largest, deepest, and more standardized markets that include many different types of participants and where secondary-market trading is conducted primarily among dealers. Here's a brief overview of what's traded where.

Government and agency cash bonds and fixed income futures

Electronic platforms that facilitate the trading of highly liquid sovereign bonds in the interdealer market have existed for some time in many developed and emerging markets. Automated trading in these securities has increased over the past several years (see **Figure 2**).

Figure 2. Electronic trading activity of government bonds in Europe



Notes: Figure shows the proportion of government bond investors based in Europe trading global government bonds electronically. Data are based on responses from 510 government bond investors in Europe in 2008, 352 in 2009, 400 in 2010, 372 in 2011, 385 in 2012, 416 in 2013, 405 in 2014, and 400 in 2015.

Source: Greenwich Associates *2015 European Fixed-Income Investor Study*.

A decade ago, banks and investment banks dominated U.S. Treasury trading. Over the past decade, however, these trades have largely moved to electronic platforms.

In the interdealer cash market and the futures market, high-frequency algorithmic traders provide additional liquidity by facilitating more than half of all Treasury trading.

In the client-to-dealer cash market, trading is not fully electronic. It's conducted primarily through RFQ systems, where dealers who receive a client request work the trade as an agent. In some cases, dealers may automatically match requests and offers. Trading does not take place through CLOB systems.

In the Treasury futures market, trading is more electronic because by law it must be conducted on a registered exchange (in practice, primarily the Chicago Mercantile Exchange). Today, approximately 90% of all Treasury futures trading that takes place on an exchange is conducted electronically.² Nonbank participants account for the largest share.

Corporate cash bonds

Electronic trading is less common in corporate bond markets because of the large number of securities issued. As there are often many "flavors"—same issuer, different issues—of the same bond, these securities trade less frequently. (In contrast, when it comes to equities, companies typically issue a single class of stock.) However, the rise of electronic trading has coincided with a decrease in average trade size and an increase in trade frequency. This trend is likely to continue, given the structural changes described earlier.

In 2015, nearly 80% of investment-grade bond market participants used electronic platforms for at least some trading functions—up from 58% in 2010.³ For the purposes of this study, "usage" included seeking quotes, posting quotes, or conducting trades.

In 2015, about 14% (or roughly \$575 billion) of all U.S. investment-grade corporate bond trades took place on the MarketAxess trading platform, up 78% from 2011.⁴

² Source: Bank for International Settlements, *Electronic Trading in Fixed Income Markets*, January 2016.

³ Source: Greenwich Associates, *The Continuing Corporate Bond Evolution*, December, 2015.

⁴ Source: MarketAxess, "2015 Highlights," *Trade On*, 2016.

All-to-all systems have seen tremendous growth in Europe. MarketAxess reports that its fixed income trading platform booked record volumes in the first three months of 2016. The company's global clients traded \$944 million of European fixed income products through its all-to-all system in the first quarter, up 140% from the previous quarter. Across European and U.S. securities, European clients traded \$4.8 billion in the first quarter of 2016, up 73% from fourth-quarter 2015.

Electronic trading provides many advantages to investors, including the following:

- **Broader market access.** The buy side—primarily investing institutions such as mutual fund providers, pension funds, and insurance companies—can participate directly (or via a designated dealer) to find a buyer or a seller. This broader level of access can bring together a disparate group of investors and traders who have varying interests and objectives, increasing the likelihood of a match.
- **Continuous access.** Increased connections between market participants—across platforms—provides real-time access to a broad group of liquidity providers and suppliers.
- **Greater transparency.** Price dispersion is reduced, price discovery is more rapid, and analysis of best execution and trading costs is more efficient.
- **Reduced costs.** The reductions have come in both direct costs such as trading (particularly for smaller trades) and indirect costs such as search. To be fair, electronic trading does not guarantee the lowest cost in all instances; a negotiation over the phone can yield a better one. However, researchers have found that it can reduce transaction costs, particularly for smaller trades and for bonds with certain characteristics such as higher credit quality and larger issue size.⁵ Search costs include the time and resources associated with identifying a counterparty.
- **Increased efficiency.** Electronic trading platforms facilitate straight-through processing and settlement of trades.

A real-life stress test for new liquidity providers

What happens when theory collides with reality?

October 15, 2014, was one of the most volatile days in the history of the bond markets. On that day, nonbank participants accounted for the largest share of market making. Principal trading firms (PTFs) accounted for more than 50% of the total trading volume across various bond maturities in both cash and futures markets. Traditional bank dealers accounted for 30% to 40% of volume in the cash market but less than 20% of the futures market.

At the height of the volatility (between 9:30 a.m. and 9:45 a.m., Eastern Standard Time), trading activity among PTFs increased sharply (to about 75% of the cash market and

about 68% of the futures market). At the same time, the share of bank-dealer trading activity declined (to about 21% of the cash market and 14% of the futures market).

These trading figures are consistent with the proportion of PTF trading volume in recent history and are not an anomaly for an unusually volatile day.⁶

Nonbank participants also maintained tighter bid-ask spreads than bank dealers did in both the cash and futures markets throughout the day.

This example illustrates the beneficial impact of PTFs during an extremely volatile period.

⁵ "Click or Call? Auction Versus Search in Over-the-Counter Market," *Journal of Finance*, 2015.

⁶ "The U.S. Treasury Market," *Joint Staff Report*, U.S. Department of the Treasury, July 2015.

Who's doing the trading?

As noted earlier, the movement toward electronic trading has resulted in the emergence of a more diverse set of market participants, increasing competition and providing new sources of liquidity.

Here's a breakdown.

- **Principal trading firms.** For the most part, these firms are involved in automated, high-frequency trading. They seek profits through the execution of a very large number of small trades typically held for a very short time (seconds or fractions of a second). Very little automated or electronic trading qualifies as high-frequency.
- **Buy-side participants.** These firms have always been a part of the equation, providing liquidity by buying and selling bonds without being reliant on dealers to take transactions on their balance sheets. Previously, traditional bank dealers typically assumed principal risk when providing liquidity to the market. Hedge funds, for example, have greater investment flexibility such as leverage and can employ a longer-term investment horizon or an automated high-frequency trading strategy. Mutual funds don't provide liquidity by taking assets onto their balance sheets and are severely restricted on leverage. However, they may make prices

that offer liquidity to others, provided the transaction is in the best interests of their clients. To be clear, buy-side firms have not become market makers. Rather, they are participating in the market directly—as buyers and sellers—more regularly. This is a positive development for the markets and for investors.

- **Traditional bank dealers.** The most traditional of trading entities continue to play a major role. They provide liquidity in the secondary market when conditions offer what they deem to be an appropriate level of profit given the associated risk.

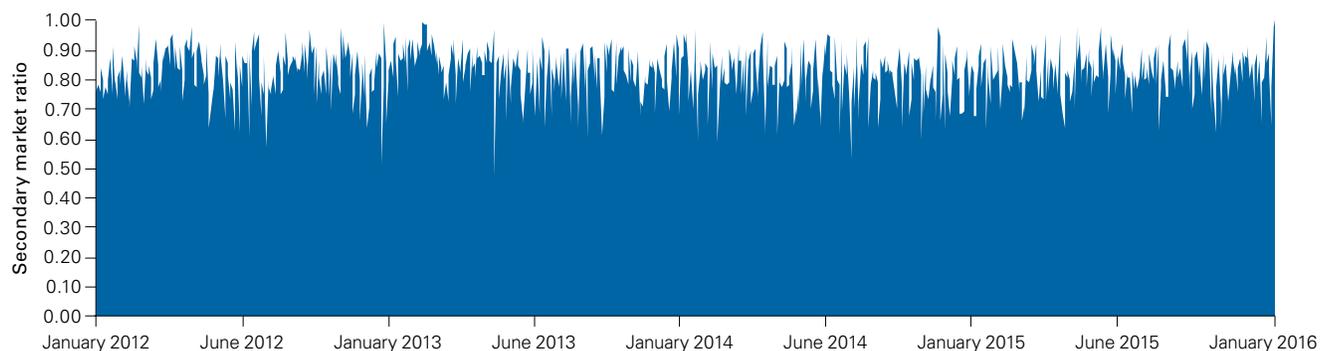
Liquidity's behind-the-scenes allies

Two relatively recent industry innovations—exchange-traded funds (ETFs) and target-date retirement funds—have deservedly garnered widespread market acceptance. Embedded in the design of these popular offerings are characteristics that increase efficiency and can effectively serve as market stabilizers. Simply put, structure matters. Let's take a look at each one.

Exchange-traded funds

Because the majority of ETF trading takes place on the secondary market (see **Figure 3**), these investment vehicles create an additional source of liquidity for bond fund investors.

Figure 3. The majority of bond ETF trading volume is conducted on the secondary market



Notes: Figure shows the percentage of daily bond ETF trading volume conducted solely on the secondary market. The median ratio is 83%, suggesting that for every \$1 in trading volume, only 17 cents results in primary market trading. Put another way, 83% of the trading volume results in no portfolio management impact and no trading in underlying securities.

Source: Vanguard calculations, based on daily data from Bloomberg.

In fact, according to data on transaction costs, ETFs have indeed contributed to higher liquidity in the fixed income markets. For example, as with any security, brokers quote two prices: the bid and the ask. The difference between the two prices for ETFs is often narrower than it is for the fund's underlying bonds. This is because the ETF consolidates many bonds into a standard trading unit, thereby concentrating liquidity. The net effect is that a narrower spread results in less profit for the broker that facilitates the purchase or sale of the ETF but cheaper transaction costs for the investor.

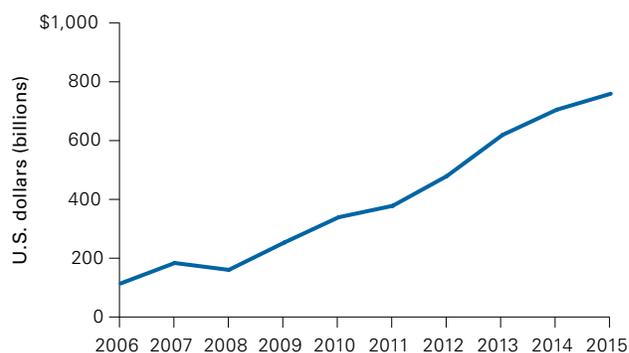
Case in point: December 2015 was a time of considerable stress in the high-yield credit market. Volatility spiked, and the Third Avenue Focused Credit Fund announced that it had suspended shareholder redemptions. Many participants used ETFs to buy and sell high-yield market risk. The result? High-yield bond ETFs traded in very high volume at tight bid-ask spreads, providing additional liquidity to the market.

Target-date funds

Target-date funds are unique because of their simplicity. Investors select a fund that most closely aligns with their goal—say, retirement. The fund then automatically and systematically shifts to a more conservative mix of investments (fewer stocks, more bonds) as the target date approaches. In the meantime, the investments within the fund are continuously rebalanced to ensure that the mix doesn't vary much from its mandate.

Bringing the fund back into balance requires a counterintuitive investment approach, but it is a practice that *adds* liquidity. Practically speaking, these contrarian-by-design funds are often buying investments that have declined in value and selling those that have risen. They are heading in the opposite direction of speculative investors, who are busy buying winners and selling losers. Target-date funds, therefore, can provide stability, particularly when market swings are considerable. And because of their meteoric growth (see **Figure 4**), which is expected to continue, the positive impact of this stabilization is significant.

Figure 4. Target-date fund asset growth



Source: ICI Quarterly Retirement Market Data, First Quarter 2016.

Notes about risk and performance data: Investments in target-date funds are subject to the risks of their underlying funds. The year in the fund name refers to the approximate year (the target date) when an investor in the fund would retire and leave the workforce. The fund will gradually shift its emphasis from more aggressive investments to more conservative ones based on its target date. An investment in a target-date fund is not guaranteed at any time, including on or after the target date. Investors should periodically monitor the portfolio to ensure it is in line with their current situation.

Our suggested blueprint

We believe that the widespread adoption of five key recommendations will bolster an already strong system by focusing on several core principles. These are: greater transparency, better systems integration, more direct interaction between buyers and sellers, and prudent controls on the number of trading venues and the information available through them. The following principles will help ensure that fixed income markets across the globe continue to evolve in the best interests of shareholders.

- **Limit trading fragmentation.** Focusing trading on a limited number of electronic venues, or aggregating trade information, will help ensure that the diverse universe of buyers and sellers will converge and liquidity will be concentrated. In addition, reduced fragmentation likely will mean lower search costs and more intense price competition.
- **Further develop all-to-all networks.** As noted earlier, these networks allow direct interaction between buyers and sellers. For example, asset managers can interact directly with dealers and other asset managers with whom they may not have a direct trading relationship. The result: lower costs and additional sources of liquidity. Also, these networks enable traditional buy-side firms to participate as “price makers” (but not market makers) when in the best interest of clients. The overall market benefits when buy-side firms more regularly participate directly as buyers and sellers.
- **Integrate trading and order-management systems.** Electronic platforms must evolve to better integrate trading systems with buy-side order-management systems in order to increase efficiencies and reduce search costs. For example, the ability to find bonds for potential sale or purchase based on their characteristics would enable buy-side firms to more easily identify substitute securities.
- **Provide greater price transparency.** A greater degree of pre-trade price transparency on electronic platforms is a necessary step in the evolution of fixed income markets. Continuous price setting, similar to that experienced in the move to electronic trading in equity

markets, will undoubtedly encourage participation. Not insignificantly, pre-trade security price data also support compliance with best-execution regulation—a benefit to both financial services firms and their investors. Vanguard is generally supportive of current regulatory efforts in the United States and Europe⁷ to expand post-trade reporting of secondary fixed income market transactions because of the benefits to investors.

- **Protect against information leakage.** Information is king, and transparency provides plenty of advantages for investors and market participants, but there can be too much of a good thing. Platforms must protect against unwanted dissemination of information from order-management systems. We must ensure that negotiations and trading activity are not unintentionally or unnecessarily shared.

Conclusion

There is no denying that the fixed income markets have undergone a considerable shift over the past several years.

However, our analysis demonstrates that market participants—both traditional players and newer arrivals—have adapted to the new reality. Trading has become less profitable for some, but at the same time doors have opened for new ways of linking buyers and sellers and maintaining a vibrant marketplace. This real, sustainable vibrancy stands in stark contrast to the often-repeated narrative that the shift in market dynamics spells trouble for the fixed income market and its participants.

Not surprisingly, advances in technology are at the forefront of the adaptation, evolution, and innovation that have taken hold. Sharing information, analyzing data, finding counterparties—and thus, completing orders—now take place in a seamless, timely, and efficient manner in high-quality, well-diversified markets.

The principles outlined above provide a solid framework for capitalizing on the advances already made and continuing to adapt as the market evolves further, as it almost certainly will.

⁷ Financial Industry Regulatory Authority Rule Filing SR-FINRA-2016-027 proposes to expand TRACE reporting rules to include certain secondary market transactions in marketable U.S. Treasury securities. The European Union’s Markets in Financial Instruments Directive (MiFID II) imposes transaction reporting requirements on financial market participants for a broader universe of financial instruments, including over-the-counter fixed income securities, among others.

References

Bank for International Settlements. *Electronic Trading in Fixed Income Markets*. January 2016.

Federal Reserve Bank of New York. *A Six-Part Series on Bond Market Liquidity*. October 2015.

Greenwich Associates. *The Continuing Corporate Bond Evolution*. December 2015.

Hendershott, T., 2015. "Click or Call? Auction Versus Search in Over-the-Counter Market," *Journal of Finance*, 2015.

MarketAxess. "2015 Highlights." *Trade On*, 2016.

U.S. Department of the Treasury, "The U.S. Treasury Market," *Joint Staff Report*, July 2015.

Glossary

Algorithm: A series of steps used to solve a problem or complete a process. In the trading world, algorithms are executed by computers to buy or sell securities under certain conditions. High-powered computers can instantaneously take into account numerous variables (often hundreds or more) spelled out by an algorithm.

Bid-ask spread: The difference between the price that a prospective buyer is willing to pay for a security and the price that a seller is willing to accept for that security. This difference represents the cost of completing the transaction.

Cash market: A system for immediate settlement of securities transactions, either electronically or on an exchange. (In contrast, a futures market facilitates trades that occur at a specified date.) Cash markets typically take two forms: the interdealer market, where institutions trade with one another, and the dealer-to-client market, where dealers trade with their customers (typically asset managers, insurance companies, and/or pension funds).

Electronic trading: Processing buy and sell orders over a communications network that links thousands of computers. Electronic trading is sometimes confused with high-frequency trading. All high-frequency trading is electronic, but not all electronic trading is high-frequency.

Exchange-traded fund (ETF): A basket of securities (stocks, bonds, or commodities) that trades on a stock exchange. Unlike mutual funds, which are priced once a day, ETFs can be traded throughout the day at prices that vary with the market. Though the vast majority of ETFs are designed to follow an index of securities, actively managed products are also becoming available.

High-frequency trading: A system that executes large numbers of orders extremely quickly. Using sophisticated algorithms and computers, the orders are placed based on certain market conditions and characteristics.

Interdealer activity: Trading conducted between banks and financial institutions.

Liquidity: Essentially, the ability to convert an asset to cash in a reasonable amount of time and in a prudent manner.

Market making: Maintaining an orderly and efficient market by offering to buy and sell securities at publicly traded prices. Firms that play this role—by agreeing to buy or sell or holding securities to help facilitate others' trades—may be called market makers or specialists.

Off-the-run: All Treasury bonds and notes issued earlier than the most recent batch (of similar maturities). Generally, these securities are traded less frequently than the most recent issues and therefore tend to be less expensive and offer a higher yield.

Order-management system: A computer-based platform for buying and selling securities that allows participants to enter and update orders and receive reports on their orders' status.

Principal trading firm (PTF): A company whose primary business is buying and selling securities, typically through proprietary automated trading strategies. Many, though not all, engage in high-frequency, algorithmic trading. A PTF may be registered as a broker or dealer but typically does not have clients.

Connect with Vanguard® > vanguard.com

For more information about Vanguard funds, visit vanguard.com or call 800-662-2739 to obtain a prospectus or, if available, a summary prospectus. Investment objectives, risks, charges, expenses, and other important information about a fund are contained in the prospectus; read and consider it carefully before investing.

Vanguard ETF Shares are not redeemable with the issuing Fund other than in very large aggregations worth millions of dollars. Instead, investors must buy and sell Vanguard ETF Shares in the secondary market and hold those shares in a brokerage account. In doing so, the investor may incur brokerage commissions and may pay more than net asset value when buying and receive less than net asset value when selling.



Vanguard®

Vanguard Research

P.O. Box 2600
Valley Forge, PA 19482-2600

© 2016 The Vanguard Group, Inc.
All rights reserved.
Vanguard Marketing Corporation, Distributor.

ISGLIQ 102016