Q4 2017

Technology Transforming a Vast Corporate Bond Market

GREENWICH ASSOCIATES

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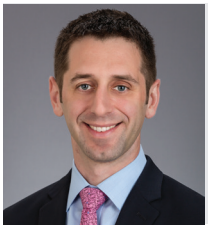

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BIG DATA AND MACHINE LEARNING ARE ALREADY BEING APPLIED TO AUGMENT THE INTELLIGENCE OF DEALERS AND INVESTORS

84%

OF INVESTMENT-GRADE INVESTORS UTILIZE ELECTRONIC TRADING, ACCOUNTING FOR 20% OF OVERALL VOLUME

Executive Summary

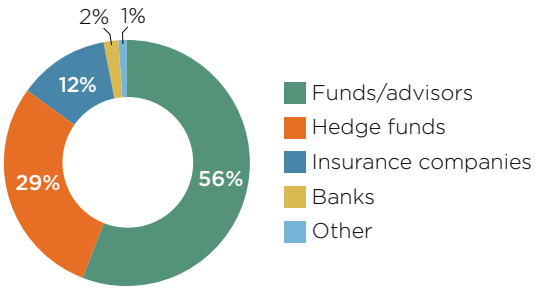
If providing technology to enable electronic trading of corporate bonds was the first phase of the market's evolution, then gathering, analyzing and putting data to work is phase two. The market will never be what it once was, with dealers willing to trade large block orders and hold them indefinitely to ensure their clients remained happy.

But as the market has sobered up and realized that the party is over, it is becoming increasingly apparent that tools now exist that can more than make up for the change in dealer behavior. Bond investors need only accept this medicine as the cure to what ails them, putting data to work to make better investments, better trades and ultimately to generate higher returns.

METHODOLOGY

In the spring of 2017, Greenwich Associates interviewed 215 U.S.-based investors of investment-grade (IG) and high-yield (HY) credit. Study participants were asked about their total volume traded in these products over the past 12 months, the percentage of that volume executed electronically, how that volume was allocated across various trading venues, and other market-structure-related topics.

RESPONDENTS BY INSTITUTION TYPE



Since the global financial crisis, the corporate bond market has become bigger, more fragmented and less liquid. In response, the buy side is deploying technology that leverages data and analytics and enables investors to access new sources of liquidity—both electronic and traditional.

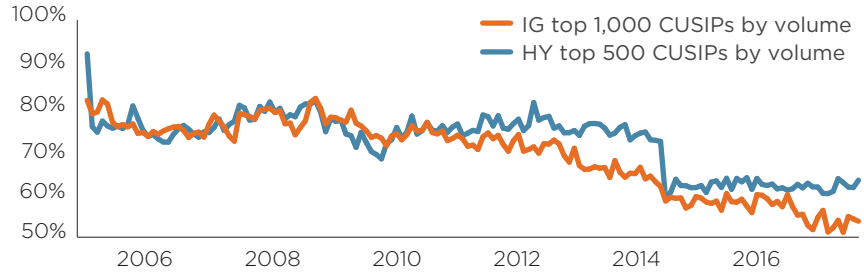
The decline in bond market liquidity over the past 10 years has been well documented. However, less attention has been paid to the sheer growth of the market and the complexity this rapid expansion has created for traders. In 2005, there was $748 billion in corporate debt issuance. That same year, trades of the top 1,000 investment-grade bonds by volume accounted for approximately 78% of TRACE-reported trading activity.

By the end of 2016, corporate debt issuance has jumped an amazing 200% to $1.5 trillion, and trading in that debt has become much less concentrated. Due to a sharp pickup in trading activity outside the top 1,000 corporate bonds, trades for bonds in this top tier now account for only about 55% of reported trades.

U.S. CORPORATE DEBT ISSUANCE

Source: SIFMA

TRACE REPORTED LIQUIDITY CONCENTRATION



Source: MarketAxess

The market's sheer size provides institutional investors with tremendous choice. That's great for the selective portfolio manager who can fine-tune portfolio risk and duration like never before. But for the trader who has to execute those trades, the fact that the market's post-crisis liquidity decline has been spread across an increasingly diverse list of bond issues represents a challenge that is driving a search for new skills and new technology on buy-side trading desks.

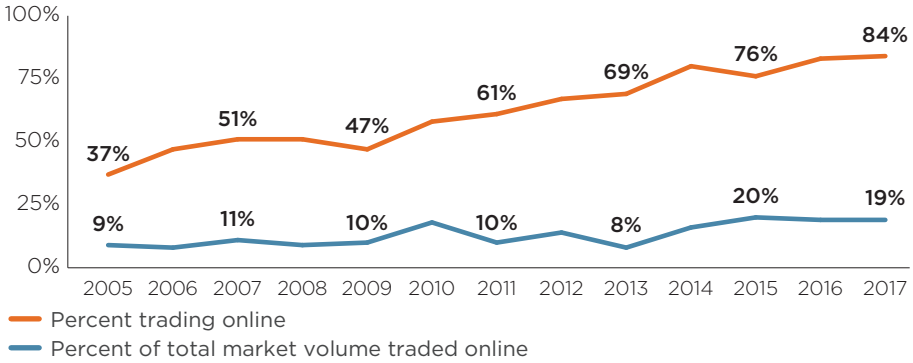
Electronic Trading Comes of Age

Nearly 85% of investment grade investors utilize electronic trading, which now accounts for 20% of overall trading volume on a notional basis. The increase in usage from just 69% in 2013 shows how quickly investors are adopting electronic trading and how rapidly electronic tools and venues are maturing.

Ninety-five percent of investors that trade electronically have MarketAxess on their desks, and they utilize it to execute 85% of their electronic trading on a volume-weighted basis. Despite the corporate bond startup boom of the past five years, only four other participants remain in the institutional landscape, each with their own value proposition. Although the percentage of IG volume traded electronically over the past year held steady overall, Tradeweb, Bloomberg, Liquidnet, and Trumid all continue to show growth in their buy-side desk penetration.

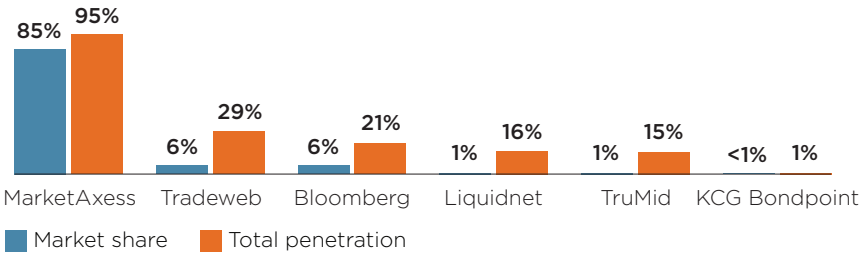
Investors are adopting electronic trading, and electronic tools and venues are rapidly maturing.

E-TRADING ACTIVITY—INVESTMENT-GRADE CORPORATE BONDS



Note: Based on 115 responses in 2005, 107 in 2006, 147 in 2007, 132 in 2008, 141 in 2009, 146 in 2010, 124 in 2011, 121 in 2012, 123 in 2013, 104 in 2014, 105 in 2015, 102 in 2016, and 102 in 2017.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

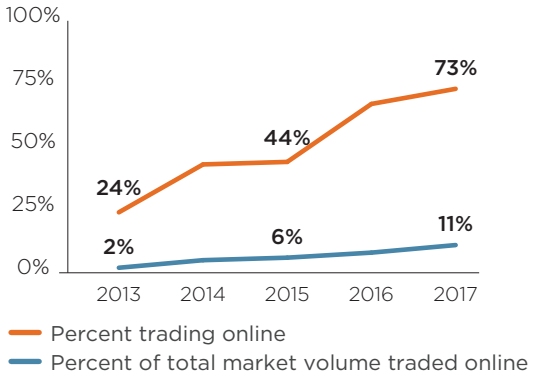
E-TRADING MARKET SHARE—INVESTMENT-GRADE CORPORATE BONDS



Note: Based on 87 responses from investment-grade corporate bonds investors trading electronically in the United States.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

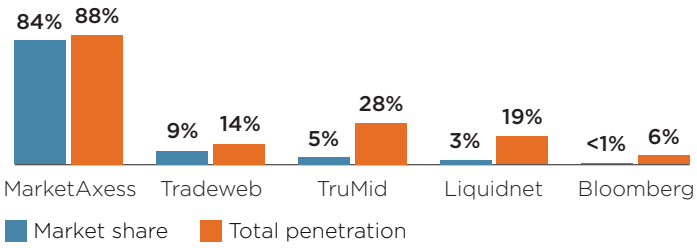
E-trading for high-yield bonds has seen an even greater surge in adoption in the past four years, with almost three-quarters of buy-side firms now utilizing an electronic trading platform—three times as many as in 2013. High-yield bond electronic trading is also at record levels on a volume-weighted basis, with 11% of trading now passing through an electronic platform. These data reconfirm our findings in previous years that the high-yield market continues to provide a huge growth opportunity for marketplaces and related technology providers.

E-TRADING ACTIVITY—HIGH-YIELD CORPORATE BONDS



Note: Based on 84 responses in 2008, 54 in 2009, 94 in 2010, 103 in 2011, 114 in 2012, 107 in 2013, 77 in 2014, 103 in 2015, 93 in 2016, and 93 in 2017.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

E-TRADING MARKET SHARE—HIGH-YIELD CORPORATE BONDS



Note: Based on 64 responses from high-yield corporate bonds investors trading electronically in the United States.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

MarketAxess remains the leader in high yield as well, with a near lock on the RFQ portion of the market. For rivals, the growth opportunity lies elsewhere, in trading protocols newer to the bond market. New entrants and offerings are increasing the size of the pie rather than stealing share. MarketAxess' Open Trading all-to-all offering is one example, with 38% of the volume executed on that part of the platform taking the form of high-yield bonds.

The impressive growth in users for TruMid and Liquidnet also reiterate the high-yield market's willingness to try new things, as both offerings offer all-to-all trading, albeit with unique underlying mechanics. Tradeweb's value proposition is rooted in block trade execution, which their 9% volume-weighted market share reflects.

PLATFORM MARKET SHARE METHODOLOGY

Each of our study participants provided their total volume traded in these products over the past year, the percentage of that volume executed electronically and then how they allocated that electronic volume across the trading venues they currently use. From the aggregate of these responses, we calculate volume-weighted market share and the percentage of investors using each platform.

Our study respondents are primarily the largest investors in the market, so our results generally do not reflect the platform usage of middle-market and smaller investors. We also do not capture in this study foreign investors trading U.S. credit on U.S.-based platforms. And lastly, we usually interview one individual per firm for each product type, generally the head of trading. As such, if someone else on the desk is utilizing a platform or has that platform installed but has yet to trade there, we would may not capture that installation.

THE IMPACT OF RETAIL

The institutional market drives the majority of trading in corporate bonds on a value basis, but retail and other trades often under $100,000 in size make up the majority of trading tickets. These two markets continue to operate quite separately with little interaction between institutional and retail buyers and sellers. However, while nothing will make up for a large asset manager's ability to trade $100 million worth of bonds with a dealer in one ticket, the impact of retail-sized trading on the institutional market is starting to grow.

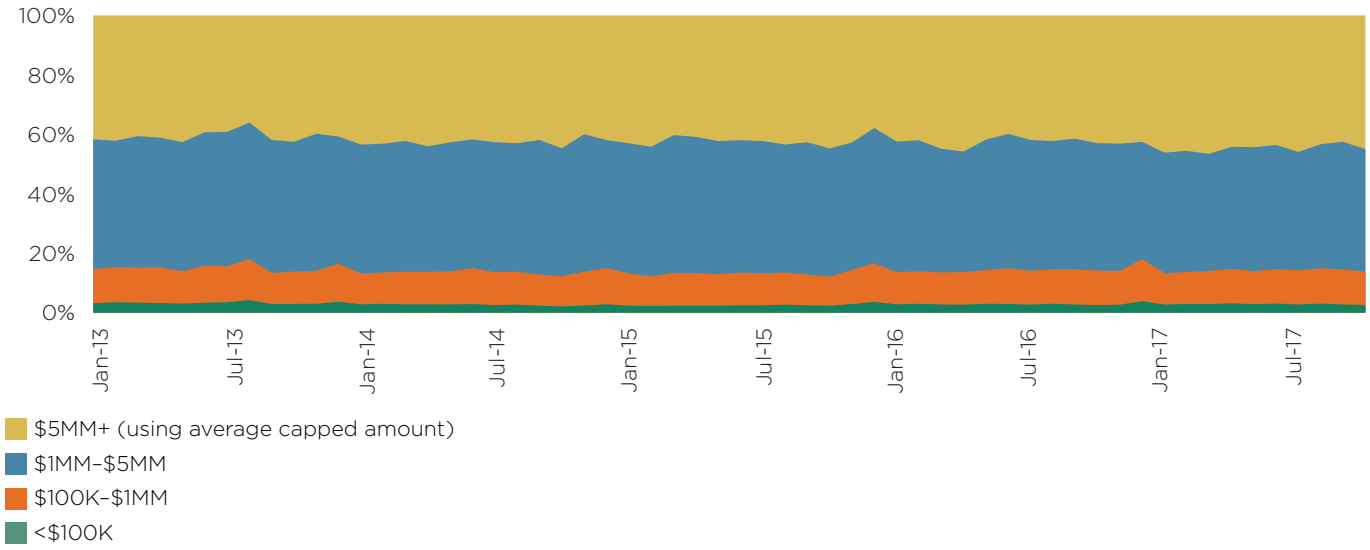
BondPoint, MTS, TMC, and Tradeweb Direct handle the majority of trading in these "micro-lot" trades. LSE's purchase of MTS, Tradeweb's purchase of BondDesk and a bank consortium's backing of TMC have shown the market's general interest in the segment. The recent acquisition of Virtu's BondPoint by ICE for $400 million only reinforces the market's perception of value for retail-sized corporate bond trading.

Around the Block

Given this growth and investors' keen need for liquidity, it seems that the future of electronic trading is bright. However, to achieve this potential, electronic venues will have to tackle one major issue: getting the buy side and sell side more comfortable with executing large trades on the screen. Although the technology certainly exists to allow these transactions, getting past the natural human inclination to speak with another person directly when the stakes get higher still represents a challenge.

Block trades make up no more of the market today than they did five years ago when the corporate bond startup boom began. In July of 2013, trades sized $5 million and higher made up 39% of the total volume traded; in July of 2017, that number was 40%.

TRACE INVESTMENT-GRADE TRADE VOLUME SHARE



Source: MarketAxess

Although that lack of change is somewhat stunning given the market structure changes that occurred within that time period, average trade sizes have been inching up as investors get more comfortable trading on screen. In the same way consumers have only recently grown accustomed to buying big-ticket items like furniture and appliances online, investors are gradually starting to execute larger transactions electronically. For example, the average size of a trade executed on MarketAxess has grown every year for the past several years. The average trade size executed on the newer platforms is also closer to the block level, reflecting a major focus on trade size from firms trying to boost electronic trading levels.

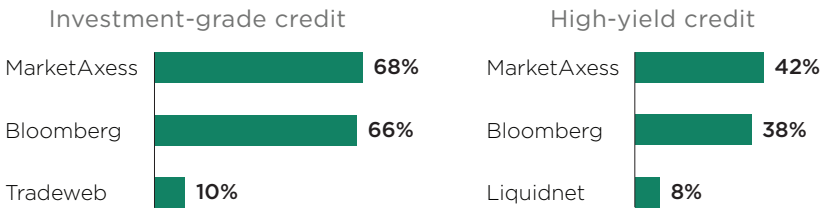
Getting past the natural inclination to speak with another person when the stakes get higher represents a challenge.

Data For Nothing and Analytics for Free

The competition for electronic trading volume has always been governed by the principle that liquidity begets liquidity. But trading venues have a new weapon in the fight to attract investors and liquidity: data.

As trading venues continue to improve their execution functionality and build the list of liquidity takers and makers on the platform, the last year has also brought a surge in new and enhanced data and analytics products. Among the features offered by these products are detailed market data beyond what TRACE offers, evaluated pricing, liquidity intelligence, transaction cost analytics, and benchmarks.

PLATFORMS USED FOR PRE-TRADE DISCOVERY



Note: Based on 50 investment-grade credit investors and 24 high-yield credit investors.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

Broadly speaking, these offerings fit into two categories: pre-trade and post-trade. Our research reveals that the buy side is primarily using MarketAxess and Bloomberg for pre-trade market intelligence. Both offerings are provided as a part of the total package, with no explicit additional charges. MarketAxess and Bloomberg's Terminal are on the desktops of nearly every U.S.-based credit investor, which in part explains their high usage.

However, both firms have realized the value data can provide and continue to invest heavily to enhance data and analytic offerings—even when they are not explicitly tied to new revenues. A more informed customer is one that is more able and willing to trade, which benefits both the platforms and the market as a whole.

Post-trade data and analytics are largely focused on transaction cost analysis (TCA) and benchmarking. TCA cannot be effective without a benchmark to track, and benchmarks are of little value without the ability to compare actual performance to the benchmark. Using a similar paradigm to pre-trade offerings, the trading venues are out in front in offering both of these services.

In a market with no single view of all activity, these platforms come to the table with a built in advantage over those offering third-party solutions. While TRACE does provide every U.S. corporate bond trade, it does not show unexecuted trades, partially executed trades, RFQ wins and losses, and other details that only individual market participants and electronic trading venues can capture.

The use of data-driven analytics is growing on the buy side, with TCA used by about one-third of global corporate bond investors, according to Greenwich Associates research. But in many cases, the output from these systems is underutilized and not integrated into the day-to-day workflow. The buy side is clearly moving in the right direction, but needs to make further investment in people, process, data, and technology integration. None will be completely successful without the others, with people and process needed to make use of the data and technology—and vice versa.

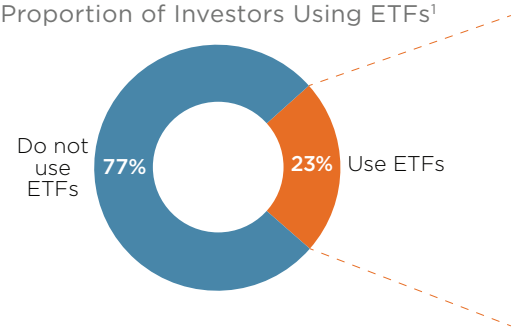
These investments will also increase the examination and likely use of all-to-all platforms and other new trading protocols. The better the desk understands the cost benefits of its choices, the more likely it is to experiment with new approaches. Those investment firms at which the portfolio managers and traders work closely together are also more likely to move forward, as investment choices can better take into account trading opportunities. While the original bond choice might be Coca-Cola, input from the trader might instead drive the portfolio manager to invest in Pepsi.

Tech Opens Door to Liquidity Providers

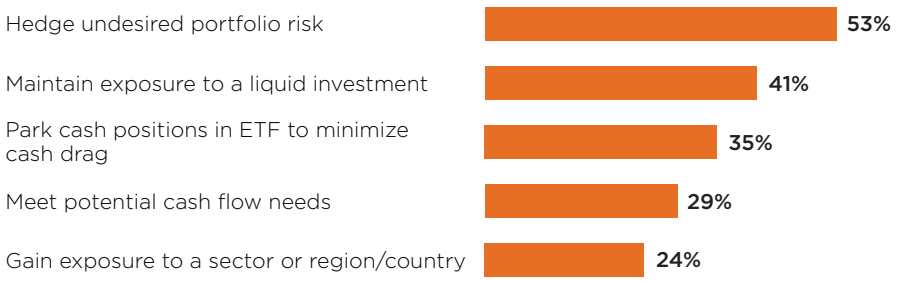
Technology has also enabled the rise of new liquidity sources. Corporate bond investors have been using derivatives as a complementary product for years, but only recently have begun to bring ETFs into the fold. Twenty-three percent of investment grade investors and 29% of high-yield investors now utilize ETFs in their portfolio to help with risk management, maintaining exposure as they work to trade in or out of less liquid instruments, and to manage cash balances. None of this would be possible without technology to manage the basis risk and possible tracking errors inherent in using index products.

USE OF ETFs—INVESTMENT-GRADE CREDIT INVESTORS

Proportion of Investors Using ETFs[1]



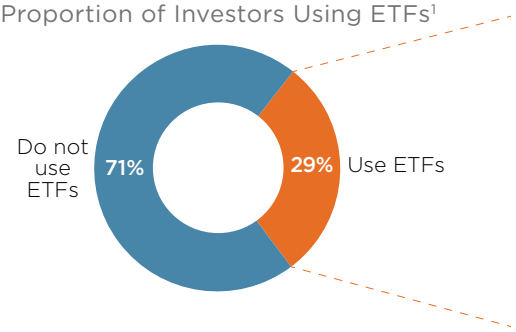
Reasons Investors Use ETFs[2]



Note: [1]Based on 96 responses in the United States. [2]Based on 17 responses in the United States.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

USE OF ETFs—HIGH-YIELD CREDIT INVESTORS

Proportion of Investors Using ETFs[1]



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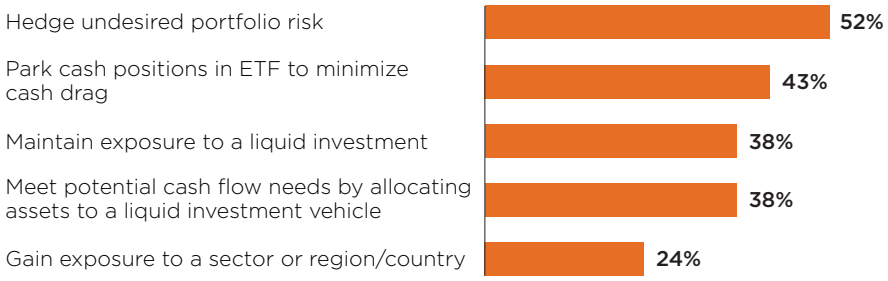
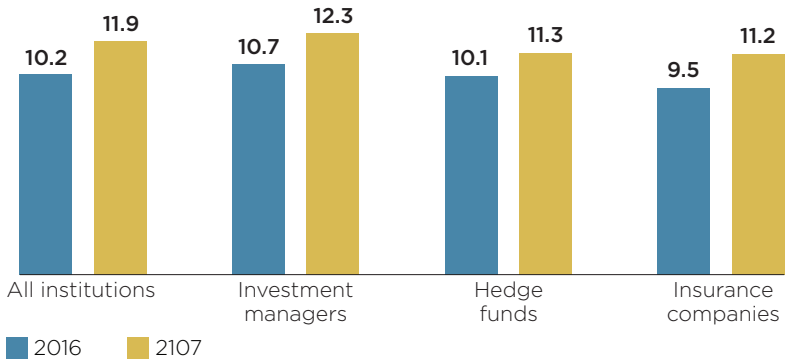


Note: [1]Based on 78 responses in the United States. [2]Based on 21 responses in the United States.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

The growth of fixed-income ETFs has also brought new liquidity into the underlying corporate bond market. Keeping ETF prices in line with those of the index constituent bonds requires firms willing and able to make markets in both. These firms, many of whom are authorized participants (AP), now contribute a notable amount of liquidity on the top corporate bond trading platforms. These firms are motivated by the profits found in the pricing arbitrage. They also benefit end investors by increasing turnover in the underlying bonds and keeping ETFs properly priced—making them a more effective tool for the uses listed previously. Both large banks (e.g., Goldman Sachs) and principal trading firms (e.g., Jane Street) fill this role.

AVERAGE NUMBER OF MEANINGFUL DEALER RELATIONSHIPS—INVESTMENT-GRADE CREDIT INVESTORS



Note: Based on 111 responses from investment-grade credit investors in the United States.
Source: Greenwich Associates 2017 U.S. Fixed-Income Study

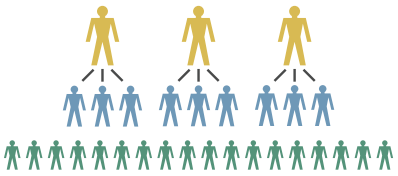
ETF AP's are not the only new source of liquidity to corporate bond investors. The buy side is now looking to more traditional liquidity providers as well, with the average number of meaningful investment-grade dealer relationships up 20% over the past year. While the majority of these firms are those traditionally known as "top corporate bond dealers," the growth in electronic trading has seen new entrants to the space grow in share as well. Goldman Sachs, Wells Fargo and J.P. Morgan are still the top three electronic trading counterparties for U.S. bond investors. However, firms like Millennium and SumRidge have considerably grown their market presence in the past year.

Driven in part by the technological advancements by these top firms, autoquoting has also expanded greatly over the past year in the corporate bond market. Liquidity providers are increasingly responding to RFQs below a certain size and/or risk threshold with no input from the trader, using algorithms to calculate a price appropriate for that particular request. These autoquoters don't simply use bond math, but instead, take into account the particular client, current market liquidity, the dealer's current risk position, and numerous other factors.

Goldman Sachs, **J.P. Morgan** and **Wells Fargo** were the

TOP 3

dealers used via multi-dealer systems for secondary cash bonds



This allows the dealers to handle the ever-increasing number of RFQs more quickly and efficiently, and clients, in turn, receive prices more quickly. As investors themselves start to utilize algorithms to automatically select the right counterparty for a given trade based on RFQ responses, the bond market will have its first foray into computers trading with computers.

We've said it before and we'll say it again—corporate bond dealing remains a capital-intensive business, and those with robust issuance businesses and long-term relationships will always remain central to the market. However, with dealers and investors alike now focused on electronic trading and empowered with data and analytics, execution quality and speed will allow new entrants to gain share where never before possible.

Conclusion

The buy side has accepted that electronic trading will be a key to navigating the 21st-century corporate bond market, and the sell side is coming around. The current 20% of investment-grade volume done electronically will work its way toward one-third over the next five years. The overall electronification of the market will accelerate even faster. While technology buzzwords like big data and machine learning might leave some bond traders rolling their eyes, these technologies are already being applied to augment the intelligence of dealers and investors, leaving them better equipped to focus on "neck up" activities with other complex yet repeatable tasks left to the computer.

If providing buyers and sellers of corporate bonds with tools that allow them to trade with each other marks the first phase of the market's evolution, gathering, analyzing and putting to work data is phase two. In coming years, we will see bond trading venues morph into data and analytics providers, with their liquidity pools as the mere foundation of the business. The additional insights available to the buy side will help not only traders, but also compliance teams become increasingly comfortable with all-to-all trading, and even, eventually, the idea of buy-side price-making.

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