



ALLIANCEBERNSTEIN®

TECHNOLOGY ENABLES MUNICIPAL INVESTING AT THE SPEED OF ALPHA

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EXECUTIVE SUMMARY

Today's complex, fragmented and fast-moving muni market is rapidly outpacing the capability and capacity of traditional portfolio-construction methods. The municipal market has changed significantly over the last 20 years, though most investors have barely adjusted their trading, research or portfolio-management methods. To be successful today, muni managers must be better, stronger, faster.

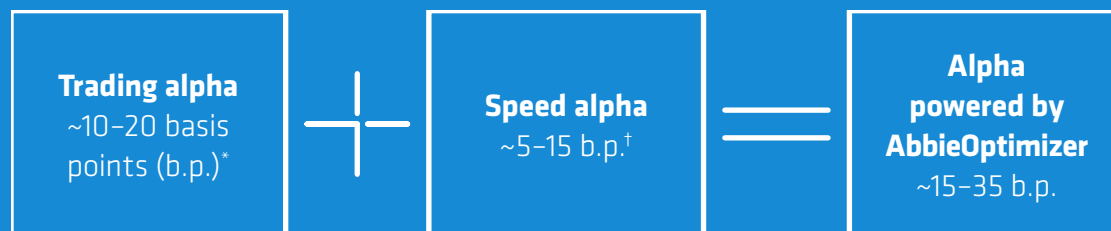
Time is money. Every day it takes to invest a portfolio is a day missing income. No one expects a construction crew to build an interstate highway with only a shovel and a hoe. Still, every day, muni managers try to assemble investment portfolios with one hand tied behind their back and antiquated tools in the other.

Simply navigating bonds offered is a case in point. Managers looking at a single bond trade may have to access four different systems to determine if (1) they already own the bond, (2) they like the credit, (3) the bond is priced correctly and (4) it is appropriate for one or more portfolios. By the time someone can check that list manually, the bond may be gone.

The muni market's current structure is rife with persistent inefficiencies that impede the unprepared and accelerate the equipped. Investment managers must embrace technology that seamlessly connects market intelligence and real-time security information with individual client portfolios to unlock these significant yet unconventional sources of alpha: trading alpha and speed alpha (*Display 1*).

DISPLAY 1: ADDING ALPHA THROUGH TRADING

In the scattered muni market, AB's AbbieOptimizer harnesses technology to continuously process real-time market data against portfolio parameters, finding and exploiting pricing inefficiencies.



*Trading alpha is the average of our execution price minus the bond's end-of-day evaluation price on that day divided by the account assets under management.

†Speed alpha is additional income accrued from investing portfolios faster than the industry average.

As of December 31, 2020

Source: AllianceBernstein (AB)

THE CURRENT LANDSCAPE

One of the biggest challenges facing investors today is finding the right bonds to build a muni portfolio that generates attractive income.

The muni bond market is complex, fragmented and in a constant state of change. The muni market has more than one million individual bond issues outstanding, representing more than 50,000 distinct issuers. More than 100,000 unique issues are available for sale every day, with anywhere between 30,000 and 50,000 trades of 10,000 to 20,000 individual securities (*Display 2*).

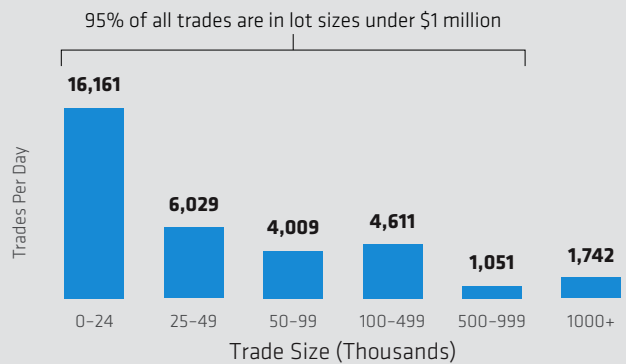
By comparison, the entire US stock market has fewer than 4,000 tradeable tickers. Tracking the municipal bond market requires an incredible amount of horsepower.

Further complicating matters, most municipal trades happen in small lots—approximately 95% of all municipal transactions are for less than \$1 million (*Display 3*).

Why does the size of the trade matter? How and where a position trades—and the discount or premium that may apply to that trade—often depends on its size. The same bond trading in a \$25,000 lot on

DISPLAY 3: FRAGMENTED LIQUIDITY CREATES TRADING CHALLENGES

Average Municipal Daily Trading Activity (Number of Trades)

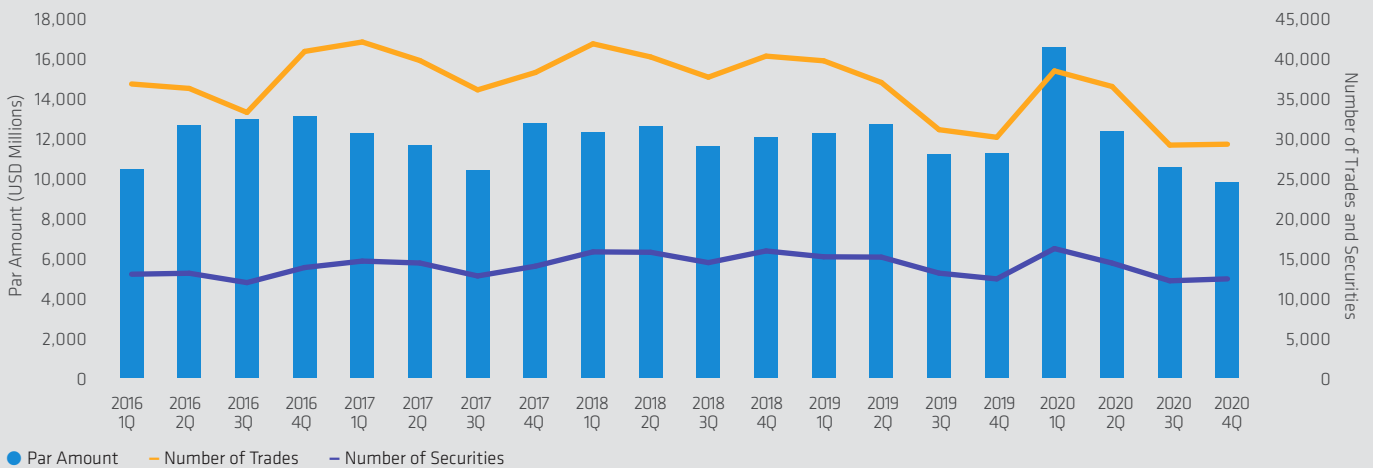


Historical analysis does not guarantee future results.

As of December 31, 2020

Source: Municipal Securities Rulemaking Board, Thomson Reuters Municipal Market Data and AB

DISPLAY 2: MUNI TRADING IS FRAGMENTED ACROSS THOUSANDS OF BOND ISSUES



Historical analysis does not guarantee future results.

As of December 31, 2020

Source: Municipal Securities Rulemaking Board and AB

trading platform A could have significantly different pricing than a lot of \$500,000 trading on platform B, with size, venue and other factors making the difference.

For standard managers building out new muni portfolios, sourcing and allocating large blocks of bonds across thousands of portfolios is much easier than finding small, mispriced opportunities that are appropriate for only a portfolio or two. Those large blocks are often also more expensive, as traditional muni managers bid for them against one another. Of course, that leaves abundant benefits for the clients of managers who have the technology to find quality bonds at discount prices (*Display 4*).

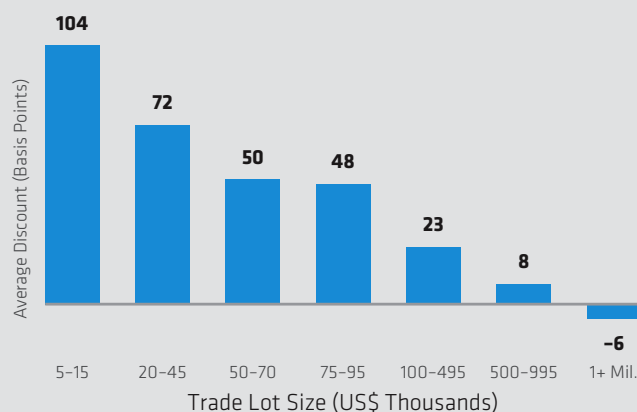
Liquidity in the muni markets has also changed significantly over the last 20 years, even though many managers trade like it hasn't changed a bit. Large, simple trades of over \$1 million made up 9% of all transactions before the global financial crisis but dropped to 4% in the 2016–2020 period. And the number of transactions under \$100,000 increased from 70% to 80% over the same periods.

The size, or par value, of bond trades has also shifted: Before the global financial crisis, 85% of the dollar value of munis traded in \$1 million increments. Today, that has dropped to 73%. And the par value of munis traded in lots under \$100,000 has doubled (*Display 5*).

What accounts for this phenomenon? Market structure changed. Bond dealers' 2019 inventories were already 67% below their pre-global financial crisis levels. By 2020, that 2019 level looked huge—dealer holdings were down by half again. That means there are fewer large trades available through dealers. Instead, managers are having to build portfolios by sorting through small lots offered via the bids wanted in competition (BWIC) method to find bonds to fill portfolios (see “Bids Wanted—Technology Needed,” page 3).

DISPLAY 4: SMALL TRADES OFFER GREATER ALPHA POTENTIAL

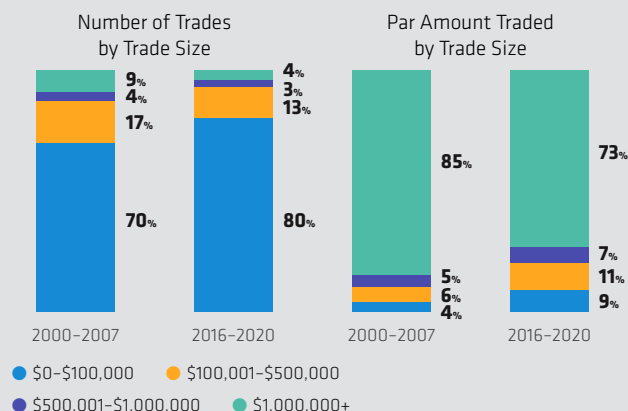
Median Discount to Evaluation Price



Historical analysis does not guarantee future results.

Data represent all municipal trades during 1Q 2021. As of March 31, 2021

DISPLAY 5: MUNI TRADING AND LIQUIDITY HAVE CHANGED SIGNIFICANTLY OVER 20 YEARS



Historical analysis does not guarantee future results.

As of December 31, 2020

Source: Municipal Securities Rulemaking Board and AB

Source: AB

BIDS WANTED—TECHNOLOGY NEEDED

Dealers offer bonds for sale from their inventories or on behalf of other traders. These offerings reflect prices that compensate the dealer for the cost and risk of holding the bonds until they sell.

By contrast, bonds sold using the BWIC method are usually bonds that managers need to sell, perhaps to liquidate a separately managed account. They collect bids, then sell to the most attractive offer. Sellers are often motivated to accept a below-market price to fulfill clients' liquidity needs. Managers who act as the counterparty, providing liquidity for sellers in dry patches, can often pick up quality bonds at a discount to market prices.

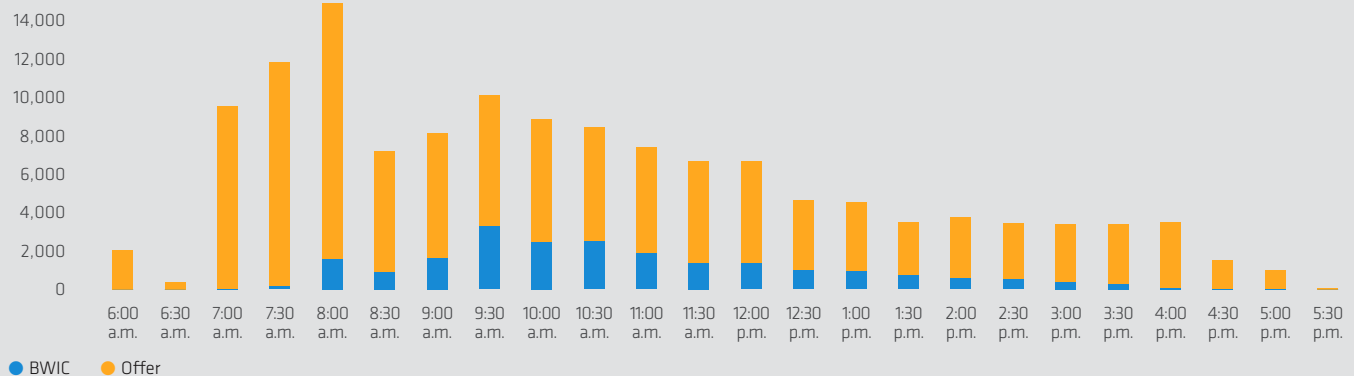
But there's a catch with BWIC trades—they expire, usually within an hour. Thousands of bonds trade per day via BWIC. That's thousands of bonds to evaluate, research, match with a portfolio and execute—every hour before time is up, and the process starts over with a new set of bonds. Managers employing a manual process are out of luck. There is no scalable, manual way to properly evaluate thousands of bonds per hour against thousands of accounts with unique client profiles.

Even time of day can matter. Total liquidity peaks early in the day, when dealers offer bonds for sale from their inventories. The composition of that liquidity changes, as bonds traded using BWIC become a bigger share of available bonds as the day goes on (*Display 6*).

Today's muni manager faces an increasingly complex market with roadblocks and hurdles everywhere. Overall trading volume has dropped. The size of individual trades is trending smaller. Time of day and type of trade matter more than ever. And speed is of the essence. This market is a far cry from the days when bonds traded over the telephone.

DISPLAY 6: MUNI MARKET LIQUIDITY COMPOSITION CHANGES OVER TIME...OF DAY

Average Daily Liquidity Analysis



Historical analysis does not guarantee future results.
 Three-month average of BWIC and offers by time of day
 As of April 30, 2021
 Source: AB

Given the challenges of the muni market, it's easy to see why many supposedly actively managed muni accounts rarely have activity. Most professional asset managers struggle to merely build muni portfolios, with most of them needing 30 to 90 days to fully invest a portfolio, given the fragmented market and manual processes. In a market where investors are battling for every basis point, each day a portfolio is less than fully invested is a day of forgone income. And with yields already low, managing portfolios without technology's leverage is a formula for meager returns.

The average manager is only functioning at partial capacity today because there is too much information for humans to process, comprehend and undertake. When managers are overwhelmed:

- + Portfolios take longer to fully invest.
- + Investment opportunities get overlooked.
- + The manager can't be active in the market at scale.
- + Customized tax management is limited.
- + There is little to no transparency around trading activity.
- + Managers can't exploit price inefficiencies.

Each of these issues has a direct, detrimental effect on client portfolios.

We think investors should expect more from their municipal bond managers.

LEVERAGING TECHNOLOGY TO SOLVE MARKET COMPLEXITIES

Despite changes to the muni market, in many respects the basic process for building active muni portfolios today is the same as it was 30 years ago. Managers comb through the market, monitor trading liquidity, evaluate prices and apply portfolio-specific considerations. Those tenets of portfolio management haven't changed much over the past decades.

THE NEW TECHNOLOGY

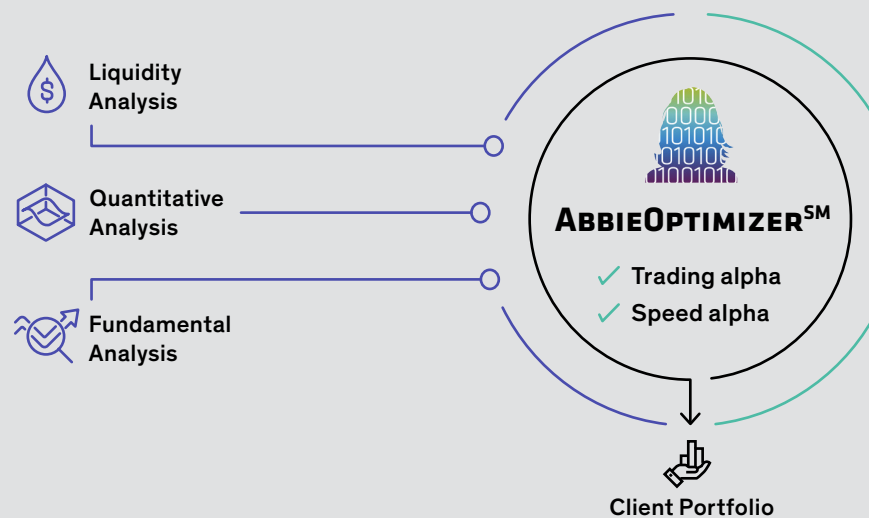
While the basic tenets of portfolio management haven't changed, the environment has, making new methods of execution necessary. Specialized technology applied effectively can supercharge the muni investing process, equipping it with a high-performance engine: faster, more efficient, more responsive and more intelligent. These attributes are critical for muni investors today, especially when low-yield markets make every basis point indispensable.

There are stand-alone tech solutions for trading, portfolio management and real-time liquidity monitoring. And, doubtless, some managers have digitized their research to infuse it throughout their organizations. But to truly harness the power of a tech-enabled investment process requires multiple fully integrated disciplines and systems—including market surveillance, liquidity monitoring, price evaluation and portfolio specifications.

The seamless integration of all trading and portfolio-management systems is the key to this well-oiled machine, and the traditional muni manager doesn't have it.

DISPLAY 7: LEVERAGING INNOVATION TO ENHANCE THE INVESTMENT PROCESS

Research and Trading Liquidity Data



Source: AB

To fill this gap, we built AbbieOptimizer—a portfolio-management engine that connects our investment systems and builds fully customized client portfolios from conception to execution faster and more efficiently (*Display 7*).

AbbieOptimizer links real-time trading data and market liquidity metrics with digitized research and portfolio-manager positioning, and marries them with a client's individual needs. The seamless integration of liquidity, pricing and portfolio construction revolutionizes the way we invest client portfolios.

This technological solution creates better outcomes for clients through transparent investment in the best available bonds that meet customized client objectives, better client reporting and the capture of trading alpha and speed alpha.

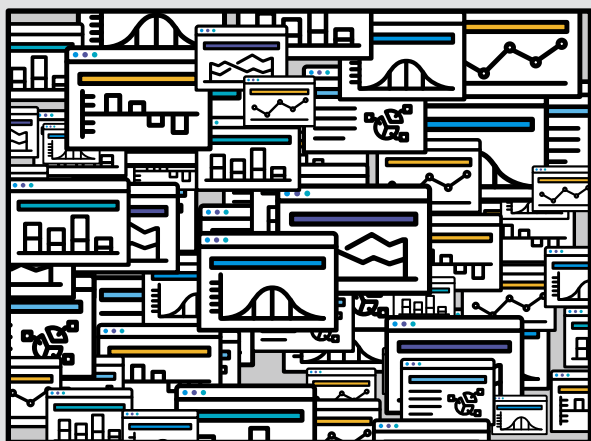
THE INNER WORKINGS OF ABBIEOPTIMIZER

AbbieOptimizer is critical in helping our Investment Professionals process overwhelming amounts of data and convert it to actionable information. Our municipal traders receive as many as 400,000 messages a day through trading platforms, online chats and emails. For a human, trying to sort through this vast volume of information is impossible.

Think about it this way: If a trader dedicated only one second to each message, it would still take more than four days to read them all. Not only is that impossible, but the effort also diverts investment professionals from applying their human intelligence, skills and trading expertise to complex value-add opportunities.

DISPLAY 8: ALFA—CREATING ORDER FROM CHAOS

MARKET VISUALIZATION FOR TYPICAL FIXED-INCOME TRADER



MARKET VISUALIZATION FOR FIXED-INCOME TRADER USING ALFA



Source: AB

STEP 1: LIQUIDITY ANALYSIS

To help separate the information from the chaos, we created ALFA, or Automated Liquidity and Filtering Analytics, a proprietary liquidity tool that continuously monitors hundreds of thousands of messages, offerings and specific broker-dealer inventories. ALFA uses this data to create a digital database of what is available to be bought and sold at any given time.

ALFA feeds this information directly to AbbieOptimizer, combining it with inputs from other modules (*Display 8*).

STEP 2: EVALUATING THE UNIVERSE

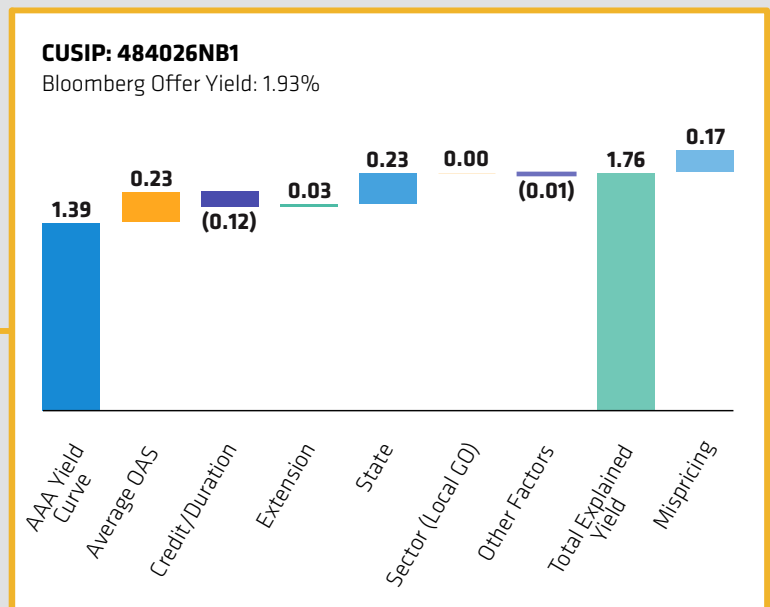
AbbieOptimizer leverages the market intelligence provided by ALFA with quantitative analytics, systematically pricing the entire muni bond universe throughout the trading day. The quant module gathers

real-time bid-ask prices from the stream of communications and direct trading-platform feeds.

However, having a price for every bond is not the same as knowing if the price for a bond presents an opportunity. The market may have 50 bonds available with similar attributes. It's essential to know which bonds are cheap or expensive relative to their fundamentals (*Display 9, page 7*).

AbbieOptimizer has this handled too. Our municipal quant model performs multiple regression analysis, a statistical tool for making predictions, across the entire bond universe to understand how up to 13 different factors affect the option-adjusted spread of each bond. Using this analysis, AbbieOptimizer pinpoints mispriced bonds, allowing traders to focus their attention on the best opportunities.

DISPLAY 9: THE HUNT FOR MISPRICED BONDS



Historical analysis does not guarantee future results.

OAS: option-adjusted spread

As of March 31, 2021

Source: Bloomberg and AB

STEP 3: APPLY FUNDAMENTAL RESEARCH

We've taken our heritage of in-depth fundamental research and brought it into the 21st century by digitizing it. Our investment-decision process integrates our credit research, so AbbieOptimizer focuses only on securities and issuers that our analysts view positively.

STEP 4: PORTFOLIO CONSTRUCTION

Each muni portfolio we manage follows the best thinking of our portfolio managers, including sector tilts, duration guidance, issuer targets and more. Additionally, we tailor portfolios to each client's unique parameters, such as state, tax bracket, recommended position size and other specific restrictions or limitations. And, of course, both sets of information are digitized.

Every time we optimize portfolios, AbbieOptimizer seamlessly combines portfolio-manager intelligence, unique client preferences, our fundamental research and real-time liquidity analysis into a trade list for hundreds of portfolios and positions in one fell swoop. AbbieOptimizer then syncs up with our integrated order and execution-management system to implement the trades.

AbbieOptimizer is the brains of the operation. It takes the chaos of data overload and streamlines it into actionable trades. This process is repeated at scale across thousands of transactions per day.

With the sprawling nature and disjointed liquidity of today's municipal market, managers that aren't tapping into technological innovation to execute those processes faster and more efficiently are falling behind, in our view. And they are leaving alpha on the table.

THE BENEFITS TO INVESTORS

AbbieOptimizer was designed to provide meaningful, measurable improvement to muni portfolio outcomes. When every basis point counts, managers need to use all the weapons in their arsenal to capture potential alpha.

BENEFIT #1: TRADING ALPHA

Trading alpha is the difference between the execution price paid for a bond and the market's stated price for that bond. It's a tangible measure of how well a manager's trading practices have adapted to the fragmented muni market—and it can add 10 to 20 basis points of performance to client portfolios through the initial investment process. But it isn't simple to generate.

Trading alpha requires the manager to leverage technology to take advantage of market dislocations. It's compelling when done at scale—across thousands of transactions—and at a broad scope stretching across the many trading platforms in the muni market.

All muni managers attempt to deliver value to clients through investment insight and portfolio design, but few can consistently add alpha through execution. That's because most managers haven't adapted to the new muni landscape. Despite the crowd of electronic trading platforms and alternative trading solutions, most investors access a single trading platform. Being shut out of the vast array of segregated venues hinders liquidity and execution while adding unnecessary costs. That can translate into lost returns and missed opportunities. Sourcing liquidity on multiple trading platforms simultaneously gives investors a better chance of benefiting from trading alpha.

With AbbieOptimizer constantly scanning the entire muni market across multiple platforms, our traders always have up-to-the-minute lists of available, appropriate and attractively priced bonds at their fingertips.

AbbieOptimizer also points out opportunities to provide liquidity to sellers, bidding on bonds at below-market prices. Before AbbieOptimizer, our trading was split equally between new and secondary issues. Today, we execute 65% of trades in the secondary market, with more opportunity to collect alpha by being a ready buyer. That efficiency and connectivity can translate into real value for muni clients. AbbieOptimizer allows us to buy municipal bonds at an average discount of almost \$0.50.

Bond sales can produce alpha too: in 2020, we generated more than \$1.2 million of execution savings for muni clients.

BENEFIT #2: SPEED ALPHA

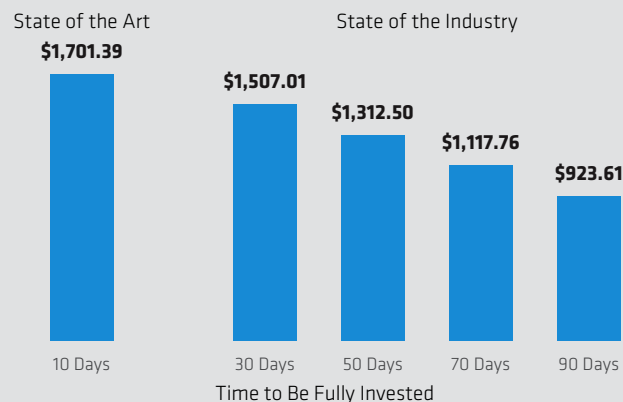
Faster investing adds value for clients—muni assets that are invested earn more interest than those that aren't. That's the definition of speed alpha: the added income accrued by investing portfolios faster than the industry average. And if bond managers can enhance portfolio returns through robust, active management, that can further boost the advantage of state-of-the-art trading (*Display 10*).

It takes most investment managers between 30 and 90 days to invest a portfolio manually in a disjointed muni market. That's a lot of time for large piles of cash to sit idle instead of generating income. It took us an average of 35 days to fully invest a new muni portfolio from cash in 2017. Today, with technology fully integrated into the process, we're able to do it in just 10 days if market conditions warrant. That's a 71% improvement—and much faster than the industry average.

AbbieOptimizer is directly responsible for the acceleration in our muni investing process. In 2019, our municipal trading desk processed an average of 1,500 trade tickets a month. Today, the same desk averages more than 7,000 trade tickets a month. AbbieOptimizer makes our muni investing process fast, reliable and repeatable across thousands of portfolios.

DISPLAY 10: SPEED ALPHA—TIME IS MONEY FOR CLIENTS

Interest Earned During the First 90 Days



Past performance does not guarantee future results.

Investment times are based on averages of accounts funded with cash. Timelines may differ based on market conditions and portfolio values. Interest accrued is an estimate based on average current yield of high-grade holdings.

For illustrative purposes only. There can be no assurance that any investment objectives will be achieved.

As of December 31, 2020

Source: AB

BONUS BENEFIT: MARKET DISCIPLINE

AbbieOptimizer cuts through the noise of a highly scattered muni bond market and an avalanche of communication during typical markets. This ability is even more critical—and profitable—when the noise becomes deafening.

We saw an example of this in early 2020. As concerns over the pandemic and the impact on the economy intensified, liquidity pressure and deteriorating investor sentiment caused cash-strapped investors to sell what they could. Overnight, the number of bonds offered for sale tripled, even though trading-desk resources did not. As this unfolded, trading in some sectors of the muni market detached from fundamentals.

Our systems flagged the abnormally high trading volumes in mispriced sectors. Our muni traders were able to quickly comb through thousands of available bonds in those sectors to find issues that met investment criteria. As a result, we were able to purchase more than US\$4 billion in municipal credit in 2020, taking advantage of the market dislocation to reposition portfolios.

QUESTIONS TO ASK YOUR MANAGER

Managers should stand ready to provide specific examples of how they have improved client outcomes using technology they built or bought. They should also have an explicit technology strategy that anticipates new developments in artificial intelligence, machine learning and fixed-income market conditions.

And investors should be asking questions to determine whether a bond manager is more likely to be investing under the status quo or looking at new and better ways to enhance their portfolio returns. To assess whether your muni manager has the right technology to succeed, consider asking your manager these questions:

- + **What are you doing to adapt to changing liquidity in the muni marketplace?** When liquidity is scarce, seconds matter. Managers who aren't addressing liquidity conditions with a tech solution could find themselves in the desert when markets dry up.
- + **What methods does your organization use to find liquidity? And where do you look?** Finding liquidity means scanning the entire market, not just Bloomberg. And technology should highlight opportunities that meet client needs, not just present data to be analyzed.
- + **Can your firm dynamically screen the market in real time based on individual client needs and preferences?** Finding bonds is only half the battle. Bonds must also be priced appropriately and fit each client's unique portfolio specifications.

- + **If market conditions permit and opportunities exist, can you invest new portfolios faster than 30 to 90 days?** Trading alpha—finding and exploiting opportunities to buy bonds at a discount—requires speed, especially when markets are stressed. If a manager is overwhelmed, it could mean missed opportunities—or worse.
- + **How does your team know what types of bonds, issues and maturities thousands of separately managed accounts need in real time? What does that reporting look like?** Without integrated, real-time systems, it's impossible for a team to efficiently build and manage customized portfolios. And when evaluating potential bonds, a moment's hesitation can cause managers to lose out on trades if others can move faster and more efficiently.

TECHNOLOGY WILL CREATE EVEN MORE ALPHA

Capturing alpha from sources such as liquidity, trading and investment speed can shift muni portfolios into a higher gear. But even with recent technological advances, inefficiencies in the muni market are still plentiful—and are future sources of alpha. As the market evolves and develops, we believe other sources of alpha will be discovered and tapped through technology.

The muni market will continue to change and evolve, but pools of muni liquidity are shallow and far flung. And market information is flying at light speed. Muni bond managers owe it to their clients to harness the power of technology and innovation to raise the bar on muni investing.

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IMPORTANT INFORMATION

0.5% is the average discount of our execution price minus the bond's end-of-day evaluation price on that day divided by account AUM.

Alpha is the risk-adjusted measurement of "excess return" over a benchmark. A positive alpha of 1.0 means the portfolio has outperformed its benchmark index by 1%. Correspondingly, a similar negative alpha would indicate an underperformance of 1%.

Past performance does not guarantee future results. There can be no assurance that any investment objectives will be achieved.

WORD ABOUT RISK

Interest-Rate Risk: Fixed-income securities may lose value if interest rates rise or fall—long-term securities tend to rise and fall more than short-term securities. The values of mortgage-related and asset-backed securities are particularly sensitive to changes in interest rates due to prepayment risk.

Credit Risk: A bond's credit rating reflects the issuer's ability to make timely payments of interest or principal—the lower the rating, the higher the risk of default. If the issuer's financial strength deteriorates, the issuer's rating may be lowered and the bond's value may decline.

Inflation Risk: Prices for goods and services tend to rise over time, which may erode the purchasing power of investments.

Municipal Market Risk: Debt securities issued by state or local governments may be subject to special political, legal, economic and market factors that can have a significant effect on the portfolio's yield or value.

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