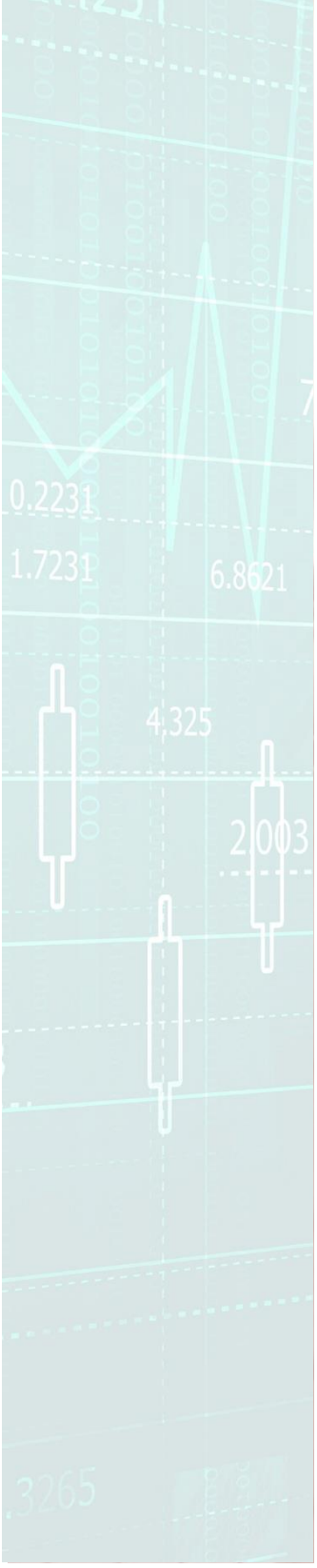
Rich-Cheap Bond Trading AI

Quantitative AI alpha extraction trading strategy

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Overbond

A changing landscape

The structure of fixed income markets has changed dramatically over the past decade. New regulations, government bond purchase programs, new products such as ETFs, the emergence of electronic all-to-all platforms and non-dealer liquidity providers using algorithmic and high frequency trading are among the developments re-shaping the industry.

A 40-year bull market in bonds has seen US 10-year Treasury yields fall from almost 16% to less than 1% and in major European markets 10-year rates are negative. At the same time, spreads on investment grade and high-yield bonds are historically tight. These low rates and tight credit spreads are expected to persist for years.

Investors searching for higher yields in this low-rate environment have been moving into lower-rated investment grade, emerging market and high yield bonds. But this introduces increased credit and liquidity risk and reduces diversification benefits as these lower-rated securities are more highly correlated with equities.

In this new landscape, electronic trading and the use of AI for trade automation have become the new standard. They are used by both the buy-side and sell-side and are a prerequisite for remaining competitive.

Major electronic bond trading platforms reported record trading volumes in 2020 and e-trading of corporate bonds has grown from under 10%[1] in 2010 to nearly one-third in 2020, according to Coalition Greenwich. In fact, Coalition Greenwich reported that in March 2021 a record average of $11.5 billion[2] per day of U.S. corporate bonds traded electronically. In Europe, electronic trading of European corporate bonds grew 61%[3] by volume between 2017 and 2020.

The increased electronification of the markets has also created more useable and accessible trade data. This increase in both real-time and historical transaction data has made it possible to aggregate large amounts of data for each client at a time that can be used for analysis by AI tools. This new generation of AI is being used to perform sophisticated relative value analysis including enhanced rich-cheap analysis.

Notes:

1. McPartland, Kevin. "Helping OTC Markets Advance along the Technology Adoption Curve." Coalition Greenwich. 16 June 2021: https://www.greenwich.com/blog/helping-otc-markets-advance-along-technology-adoption-curve
2. McPartland, Kevin. "April Spotlight: E-Trading of Corporate Bonds Hits $11.5 Billion per Day." Coalition Greenwich. 16 April 2021: https://www.greenwich.com/market-structure-technology/april-spotlight-e-trading-corporate-bonds-hits-115-billion-day
3. McPartland, Kevin. "Efficiency Through Automation: How the Fixed-Income Market Uses Data and AI." Coalition Greenwich. 30 January 2020. https://www.greenwich.com/fixed-income/efficiency-through-automation-how-fixed-income-market-uses-data-and-ai

Quant alpha in credit

Reflecting these changes in the market, buy-side fixed-income desks are spending heavily on technology and increasing their use of AI for analytics and automated trading. Greenwich Associates reports that buy-side fixed-income trading desks allocate 41%[4] of their total budget to technology, and in January 2020, 61%[5] of fixed income market participants surveyed by Greenwich said they were either using AI or planned to in the next 24 months.

New sources of corporate bond liquidity, the availability of richer data sets, the electronification of bond trading and the development of more powerful AI with cloud computing have now made purely quantitative bond trading execution possible. In simple terms: algo-buying, algo-selling.

Investors are increasingly turning to quant trading in fixed income to increase alpha. Bloomberg, citing data from Man Group, reports that long credit positions held by quants have doubled since 2018 - reaching about $23 billion[6]. In recent years firms such as Blackrock, Blackstone and AQR have started quant trading of fixed income.

Quantative hedge funds have been moving into the fixed income space. They're adding alpha and enhanced beta using strategies that isolate factors such as carry, momentum, quality and volatility and by applying quant modelling to directional, yield curve and rich-cheap analysis.

Overbond has harnessed AI and the wealth of new transaction information to bring quantitative trading to buy-side desks through an enhanced rich-cheap model. Combining both static and dynamic analysis of multiple factors, this new model provides insight well beyond the traditional analysis and is more powerful than what can be created through traditional spreadsheet methods.

Notes:

4. Coalition Greenwich. (2020, March 23). Tech Spending Drives Increases in Buy-side Trading Desk Budgets. [Press release] https://www.scribbr.com/apa-examples/press-release/
5. McPartland, Kevin. "Efficiency Through Automation: How the Fixed-Income Market Uses Data and AI." Coalition Greenwich. 30 January 2020. https://www.greenwich.com/fixed-income/efficiency-through-automation-how-fixed-income-market-uses-data-and-ai
6. Lee, J. (2021, July 10). Wall Street's Math Whizzes Are Racing to Wire Up the Bond Market. Bloomberg. https://www.bloomberg.com/news/articles/2021-07-10/wall-street-s-math-whizzes-are-racing-to-wire-up-the-bond-market

Overbond's rich-cheap model

With the Overbond suite, buy-side desks around the globe can generate systematic return with a real-time, fully back-tested, proven and transparent methodology that is scalable and interoperable.

Overbond's rich-cheap model (RCM) provides a quantitative method for screening for mispriced fixed income securities. It's a mean-reversion valuation model designed to pre-identify bonds as rich "sale" and cheap "purchase" candidates based on proprietary Overbond valuation metrics. Trade ideas start with a measurement of the yield to maturity (YTM) "spread", in basis points between two fixed income securities.

The RCM was tested on a rich-cheap trading strategy (RCS). Using pre-defined qualitative and quantitative criteria, a pair of bonds is selected from a sub-universe of bonds. This pair is a potential target for a long/short strategy in which an investor would buy/sell the respective cheap/rich bond pair to get market neutral exposure to idiosyncratic risk. The goal is to exit both positions at a profit after a mean reversion to market fair value.

Model Variables	Relevance
COBI secondary market curve (SMC)	Estimate of the credit curve's fitted fair value
COBI individual ISIN spread (COBI)	Estimate of the underlying bond's individual value

The **rich-cheap value (R/C)** of a bond at time *t* is given by the following difference:

$$\mathrm{R/C}_t = \mathrm{COBI}_t - \mathrm{SMC}_t$$

The **richness or cheapness** of a bond at time *t* is determined as follows:

$$x = \frac{\mathrm{R/C}_t - \min_n \mathrm{R/C}_i}{\max_n \mathrm{R/C}_i - \min_n \mathrm{R/C}_i}$$

The bond is considered Rich if **x <= 0.05** and cheap if **x >= 0.95**, meaning that rich bonds are in the bottom 5% of their 30-day history, while cheap bonds are in the top 5%.

The rich-cheap strategy is designed so that the likelihood of positive alpha is greater when both traded pair constituents are at or near their 30-day extremes.

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Overbond's rich-cheap model in practice

To demonstrate Overbond's rich-cheap analysis, the fixed income issues of Allstate and MetLife are analyzed. The analysis begins with an examination of the fixed income summary screens (figure 1) and then the rich-cheap interquartile for the issuers (figure 2).

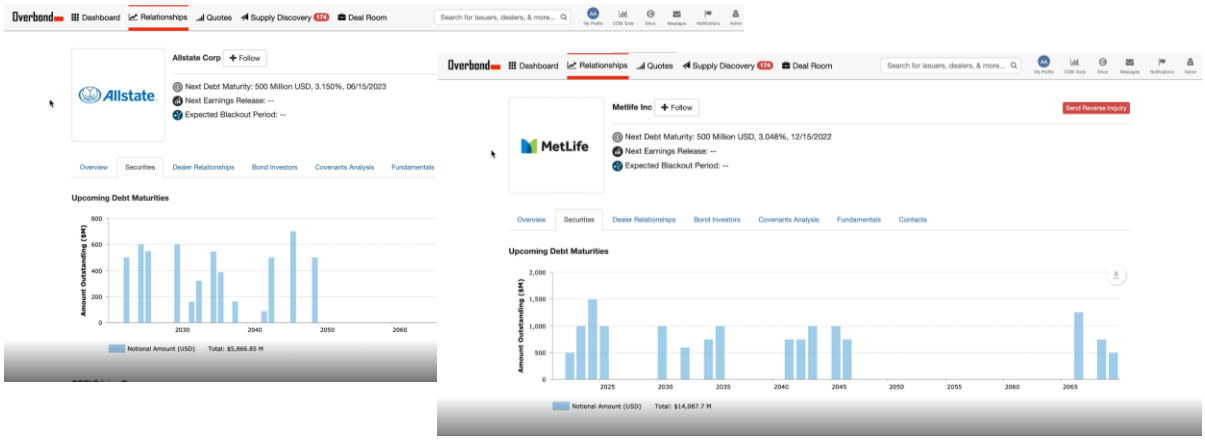


Figure 1. Fixed income issue summary for Allstate and MetLife as shown on the Overbond platform

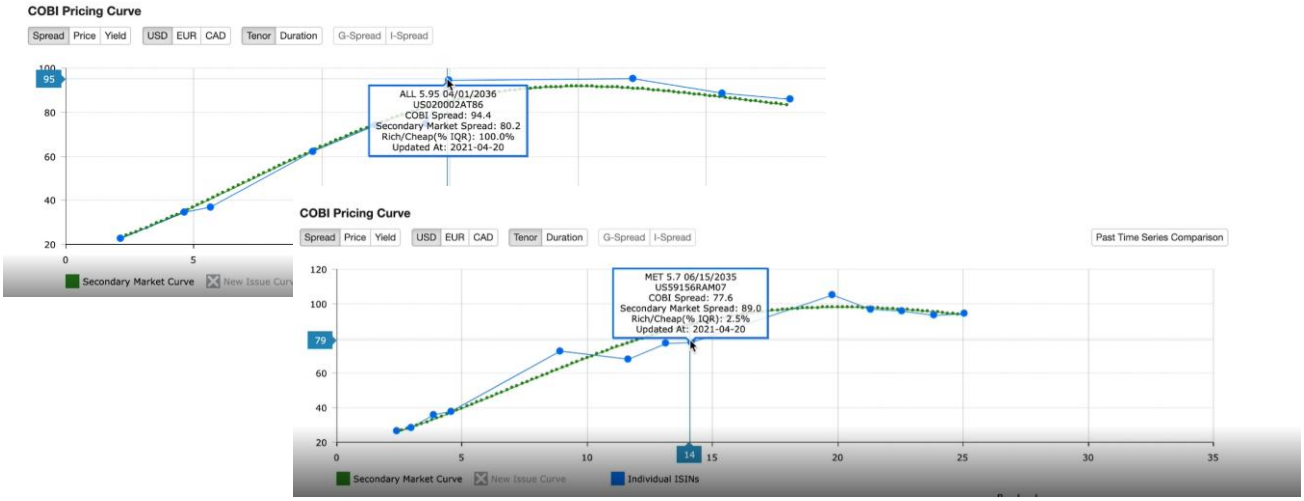


Figure 2. Rich-cheap metrics for the individual bonds as shown on the Overbond platform

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Overbond's rich-cheap model in practice

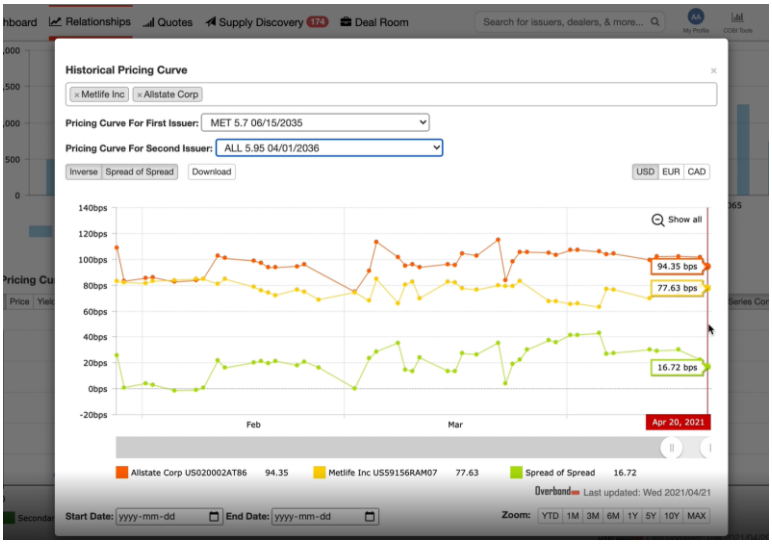


Figure 3. Historical bond pricing curves for Allstate and MetLife and their yield spread as shown on the Overbond platform

Next, the relative value of one bond versus another is examined using historical pricing curves and the spread between them (figure 3).

A single rich/cheap calculation and score allows an investor to isolate one pair of tradable bonds. The Overbond algorithm allows investors to analyze pairs of bonds that may fit their portfolio composition. The algorithm has been trained to simultaneously find many alpha generating opportunities in the market.

With the Overbond suite, buy-side desks around the globe can generate systematic return with a real-time, fully back-tested, proven and transparent methodology that is scalable and interoperable. Trade ideas require at least one value metric such as the spread in yield-to-maturity (YTM) between two fixed income securities as measured in basis points (bps).

Example

- Bond A YTM = 1.200%
- Bond B YTM = 1.350%
- Yield spread = (1.350 – 1.200) x 100 = .15 x 100 = +15 bps

In fixed income "pairs" trading, investors hope to benefit from a tightening, or narrowing, of the yield spread following trade execution. In the above example a tightening would occur if the spread of B over A was to move from +15 bps to a smaller spread such as +5 bps.

Rich-cheap model: static valuation

Because yield and price are inversely related, a tightening implies a positive return, while a widening implies a loss. Other value metrics that might be used include the price spread, spread of z-spreads, OAS spread, and cost of carry spreads.

Static valuation based on COBI actual vs fitted differentials
The primary metric used for the rich-cheap strategy is the spread between the COBI- generated individual ISIN (COBI) spread and the COBI-generated fitted secondary market curve (SMC) spreads i.e., blue dots vs green fitted curve on our COBI pricing page.

Example - Bond A vs. Bond B
Bond A – COBI spread (Blue Dot) 88 bps; SMC spread (Green Line) 92 bps
COBI spread – SMC spread = 88 – 92 bps = -4 bps
Bond B is considered "rich"

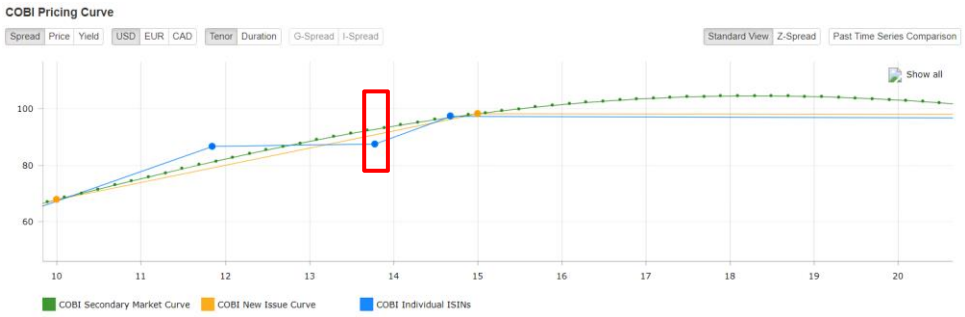


Figure 4. COBI and secondary market spread curves for Bond A

Bond B – COBI spread (Blue Dot) 150 bps; SMC spread (Green Line) 130 bps

- COBI spread – SMC spread = 150 – 130 bps = +20 bps
- Bond A is considered "cheap"

Therefore, the spread of spreads (Bond A minus Bond B) = -4 bps minus +20 bps = +16 bps

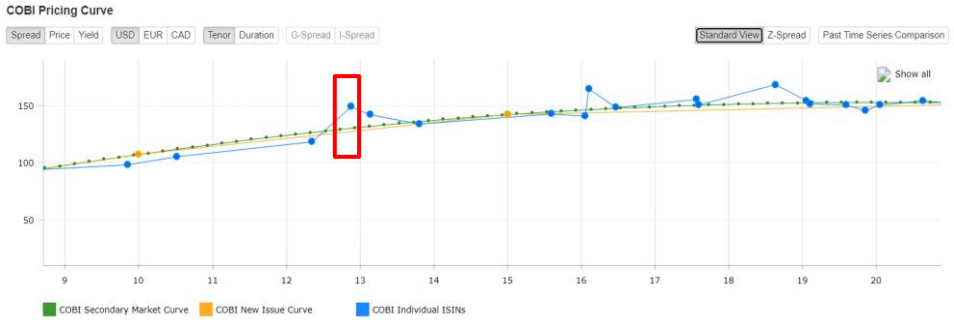


Figure 5. COBI and secondary market spread curves for Bond B

Rich-cheap model: dynamic valuation

The previous static valuation analysis can be supplemented with a dynamic analysis by comparing the current spread differential between the COBI spread and the SMC spread for target sale and purchase bonds over time.

Example

- Bond X – COBI spread minus SMC spread = -5 bps, with a 30-day range of -5 bps to +1 bps (bottom of the range)
- Bond Y – COBI spread minus SMC spread = +7 bps, with a 30-day range of +3 bps to +7 bps (top of range)

The % IQR is simply a measure of where the current value is compared to its 30-day history, expressed as a percentage.

- For Bond X, % IQR is 0%, i.e., 100 x ((current – low) / (high – low)) = 0%
- For Bond Y, % IQR is 100%, i.e., 100 * ((current – low) / (high – low)) = 100%

On a 30-day historical basis, Bond X is “rich” while Bond Y is “cheap”

The trading strategy is to sell bonds that are BOTH statically (negative COBI vs. SMC differential in absolute basis points) and dynamically rich (% IQR at or near 0%) and buy bonds that are both statically (positive COBI vs. SMC differential in absolute basis points) and dynamically cheap (% IQR at or near 100%). Specifically:

1. Sale bonds with COBI – SMC differential <= - 5 bps, and % IQR <= 5%
2. Purchase bonds with COBI – SMC differential >+ + 5 bps, and % IQR >= 95%

Trading strategy – risk neutral pairs

We generally look for trades on a comparable risk neutral basis – i.e., similar tenor, credit rating and industry group. Specifically:

1. Absolute value of tenor differential <= 1.0 year (e.g., a 5-year vs 4- to 6-year)
2. Credit rating allowance no greater than one grade (e.g., BBB vs. BBB-, BBB, or BBB+)
3. Same industry group (e.g., Energy)

Trading strategy

This produces a subset of trading opportunities for follow-up filtering. This tiering of the tests eliminates unnecessary calculations.

Historical dynamic valuation

Trading strategy – Bollinger Bands

The rolling 30-day moving average and standard deviations on the spread of COBI vs. SMC spread are calculated. A secondary test is then imposed such that trade entry must be at a level >= the 30-day moving average plus two standard deviations – this -2 to +2 standard deviation vs moving average is called the Bollinger Band. It is assumed that most trades that meet the primary % IQR test for each leg individually will also meet this secondary "at the upper Bollinger Band" test for the spread of spreads on the pair.

Trading strategy – Basis point volatility

Basis point volatility is the n-day standard deviation of day-to-day changes in the spread of spread over an n-day time horizon, e.g., 30-day standard deviation of 30 day-to-day changes in the spread of spreads on the pair.

The actual basis point volatility of prospective trades is calculated for two reasons:

1. as a basis for establishing an exit target
2. as a secondary trade filter

Trading strategy – Exit levels

The exit target is set as entry level minus three standard deviations.

Because trades are only entered at the 30-day moving average plus two standard deviations, the exit target is effectively the 30-day moving average minus one standard deviation (+2 – 3 = -1).

The exit target is set at the time of trade execution. Only subsequent changes in the actual spread of spreads are relevant, not how the moving average moves higher or lower over time or how the Bollinger Bands widen or narrow.

Trading strategy – Cost of carry

It is important to establish the cost of carry on the overall pairs trade.

Carry is based on two main factors: the coupon income on a bond (e.g., 2.00% coupon equates to 1.00% in income over a 6-month period), and the pull-to-par effect (e.g., a 5-year bond trading at 105 will trade at 100 at maturity and roughly 104 after one year).

Cost of carry is additive across the pair (i.e., the cost of carry on the purchase bond minus the cost of carry on the sale bond).

Positive carry adds to the overall value of the trade over time while negative carry subtracts from it.

Positive carry is generally more desirable, but it should not be the sole determinant.

Trading Strategy - Secondary filtering

Final secondary filtering:

1. Exclude negative carry trades where volatility is insufficient to compensate
2. Minimum 30-day basis point volatility – as a proxy for the speed of reversion

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Back-testing simulation

The strategy assumes that a pair of bonds will be held for an average period of 30 days following a customizable trade signal. Given a rich and cheap bond, a trading pair is defined. A pair is valid (tradable) if it respects the following quantitative and qualitative requirements:

Qualitative requirements

1. The industry group must be the same.
2. The ratings must be within one rating tier of each other.
3. The tenors must be within one year of each other

Quantitative requirements

1. The z-score of bid yield differential (buy bond minus sell bond) must exceed the 30-day average by some number of standard deviations.
2. The ratio between expected profit and cost must exceed four. The cost is a combination of the net pair carry, where cost of carry is defined by the sum of the daily roll down, coupon and funding cost.

The parameters used for back-testing were:

Descriptive statistics	
Sub – Universe	218 bonds
Time Period	30th July, 2020 to 1st April, 2021
Number of Issuers	98
Number of ISINs	218
Tenor Range	2 – 20 years
Credit Ratings “S&P”	A- and above
Frequency of trading	Signal based

Back-testing simulation of the rich-cheap strategy: results

As summarized in the following table, the strategy involved the execution of 11 trades covering the period from July 30th, 2020 to March 30th, 2021. It generated an annualized return of 1.65% with a Sharpe ratio of 1.37. The total holding period was 327 days with an average holding period of 30 days. A fixed repo rate of 0.5% and a risk-free rate of 0.8% were assumed. Total capital deployed was120 Million and the net profit was $1.77 Million.

Rich Cheap Strategy	
Repo Rate Assumption	0.50
Expected Profit / (Transaction & Carry Costs) Ratio Threshold	4.0
Risk Free Rate	0.80
Trade Count	11
Average of Individual Simple Returns	1.468
Average of Individual Annualized Returns	18.02
Sum of Trade Values	120,053,040
Sum of Gains	1,769,692
Simple Return	1.474
Total Holding Period (days)	327.0
Average Holding Period (days)	29.7
Annualized Return	1.647
Standard Dev Excess Returns	.616
Sharpe Ratio	1.376

Business Impact

Overbond has created positive business impact for clients around the globe, including top tier buy-side firms representing over $900 billion in assets under management. We work with clients to actively explore the application of new technologies that can serve as the catalyst for trading automation and improved risk management, trade flow and pre-trade and post-trade analytics.

AI Application	Business Objectives	Key Benefits
Intelligent automation and enhanced decision-making	• Automate trade flow and relative value trading • Produce a high performance market neutral trading strategy • Increase desk P&L	• Trading desks can create a desk-specific proprietary consolidated data tape by aggregating historical and live data from multiple sources, • COBI-Pricing enables the creation of various curve visualizations and front-end trade analytics tools that are natively integrated with trader's desktop. • COBI-Pricing liquidity modelling allows desks to determine the liquidity of little-traded bonds, construct liquidity profiles for holdings and monitor liquidity. • Investors can predict market behaviour with buy/sell indicators. • Investors can predict bond issuance probabilities • Users can determine precise executable prices in up to 30% more situations when there is no directly observable trading price in the market • Desk revenue can be grown significantly through enhanced pricing and liquidity insight • Relative value trading pairs can be identified with the a rich-cheap strategy that is fully integrated with automated bond trading and execution workflow • Investors can outperform in low-yield environments by using the rich-cheap strategy to increase alpha • The rich-cheap strategy can significantly reduce the costs of rebalancing

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Implementation considerations

Institutions considering implementing AI predictive analytics and big-data transformation projects can accelerate the process using externally calibrated models and market signals. Below are several key considerations and questions for executives in charge of their firm's AI roadmap:

- What is the current state of our fixed income in-house data?
- What are our data science and engineering capabilities?
- Are we building AI capabilities to grow revenue or cut cost?
- How can we redefine the boundaries of our data universe or identify alternative data sources necessary to feed the AI engine?
- Given that the AI learning curve is steep, where do we begin?
- How do we rapidly create and execute AI proof of concept use cases?
- What are the key success factors for our AI roadmap?

Custom AI Services

Overbond works with clients to identify and recommend practical AI analytics use cases that are aligned with the strategic goals of the financial institution.

We assess your current AI capabilities and design a roadmap to help you realize value from AI applications. We manage cross-channel data flows across multiple systems and enable custom front-end visualizations.

Proven Methodology

With our targeted approach and implementation methodology, we quickly demonstrate the value of AI analytics to test use cases. This enables clients to plan and implement change management and facilitates stakeholder buy-in.

Operational Acceleration

We help clients build and deploy custom AI solutions to deliver proprietary analytics to achieve tangible business outcomes. Our experience combines calibrated models, design patterns, engineering and data science best practices to accelerate value realization and reduce implementation risk.

AI Analytics-as-a-Service

Overbond helps customers design and oversee mechanisms to harness AI to optimize and improve existing fixed income credit valuation, issuance and pricing prediction and pre-trade opportunity monitoring. Our team of world-class data scientists and engineers manage an iterative implementation approach from current state assessment to operational handover.

About Overbond

Overbond is a developer of process-redefining, AI-driven data and analytics and trade automation solutions for the global fixed income markets. Overbond performs market surveillance, data aggregation and normalization, and deep AI quantitative observation on more than 100,000 corporate bonds and fixed income ETFs. Applying proprietary artificial intelligence to pricing, curve visualization, market liquidity, issuance propensity, new issuance spreads, default risk and automated reporting, Overbond enables trade automation and enhances trade performance and portfolio returns. Clients of Toronto-based Overbond include global investment banks, broker dealers, institutional investors, corporations and governments across the Americas, Europe and Asia. For more information, please visit www.overbond.com.

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