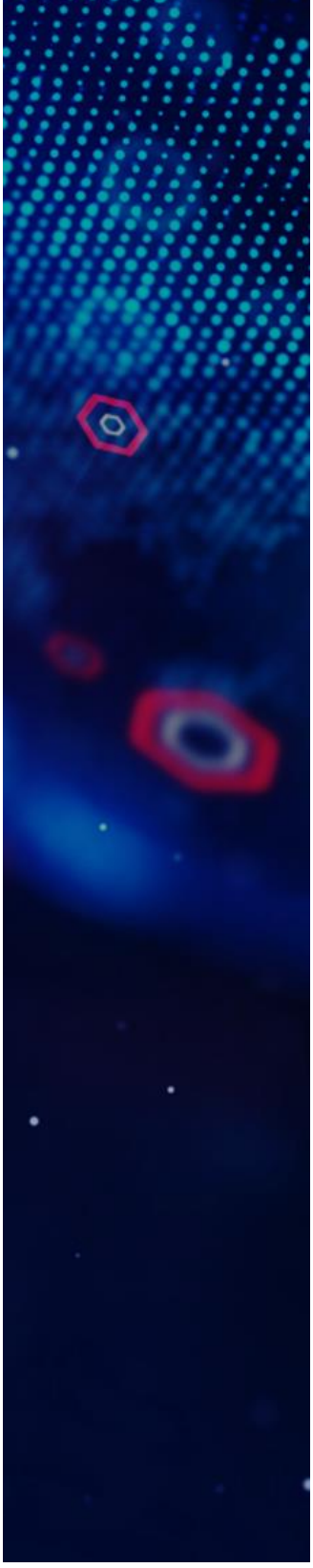
Smart Order Routing Case Study

Buy-side trade execution optimization and routing automation

www.overbond.com



Overbond



The Concept: Introduction

Electronic trading within the Fixed Income space has evolved dramatically over the last few years, the prevalence of All to All platforms has increased to complement the existing RFQ infrastructure and volumes. Execution via electronic platforms continues to rise, with 62% of European Investment Grade bonds now executed electronically and 49% of High Yield bonds (within Europe)[1].

In the Fx Market, approximately 60% of the market is also electronically executed (although the notional size tends to be much larger) and in recent years innovation has flat-lined, with electronic volumes (as a percentage of the overall market) remaining fairly constant[2].

In markets such as Fx the concept of an Order Router is not new, it allows the trader to see all the available liquidity and break orders up into smaller chunks, which then feed to multiple venues. Spreads are typically much tighter, however the desire to leave orders to achieve specific price targets still remains.

In some respects the Fixed Income world shares many characteristics with other markets, ultimately when a trader needs to execute a trade the questions they ask themselves are always the same:

- Can I trade at my desired price?
- Can I trade in my desired size?
- Can I trade within my desired timescale?

In the Fixed Income world (and particularly in Credit) Request for Quote (RFQ) and Instant Messaging platforms are the preferred execution venues, however due to liquidity constraints and historic market conventions it can be difficult to achieve best execution on larger sizes, particularly if near instantaneous execution is required.

In other markets such as equities and Fx a trader can route their order to multiple participants and now Fixed Income electronic volumes are (proportionally) approaching the same share of the market as Fx, Overbond is excited to introduce its own Smart Order Routing, specifically for the Rates and Credit Markets, with unique features such as Implied Firmness, Total Market Capacity & Dealer Inventory.

When a Buy side trader needs to execute a large order, they now have the freedom to split orders across multiple Sell side desks, which Overbond's own Liquidity, Execution & Data paper on automated trading (March 2023) found that over 60% of desks are now willing to do. The challenge so far has been around data and system integration[3], however with Overbond's latest product that becomes surmountable and Buy side traders can finally execute with the same freedom as their Fx counterparts.

[1]https://www.thetradenews.com/europes-corporate-bond-markets-are-the-most-electronic-in-the-world/
[2]https://www.bis.org/publ/qtrpdf/r_qt2212z.htm#:~:text=The%20relative%20shares%20of%20voice,continue%20to%20be%20executed%20electronically.
[3]https://www.cib.barclays/our-insights/3-point-perspective/2023-fixed-income-survey.html



Development: The process

Overbond working in conjunction with trusted partners from both the Buy and Sell side has developed a intuitive new order routing system, with AI enhanced routing logic that maximises execution probability and gives the trader full visibility of how the order will be broken down.

Phase 1 Research & Feature Development

1) Research key market indicators
2) Develop and test potential features for use in the model
3) Test features and observe meaningful correlations

Phase 2 Model Training & Fine Tuning

1) AI model pricing

Front-end interface developed to incorporate side by side visualization of the calibrated intra-day COBI pricing model and the Build Plan output by the Smart Order Routing algorithm:

- Intermediate results delivered based on live size/price information, confidence level of the modeled price, liquidity score, timescale and implied firmness
- Features such as Total Market Capacity, Dealer Inventory & Leading Indicators

2) AI model for margin optimization

- Modelling trained on a two-year record of the Buy side firm's historic executions
- Results of AI model output for out of sample dataset, including the best executable price determined by COBI-Pricing model



The Model: Key Features

Within the SOR algorithm numerous features enable the trader to achieve maximum execution efficiency, these are listed below:

a) **Total Market Capacity**
Total market capacity (TMC) is reached when there's not enough of a bond readily available in the market to fill a trade. It's the portion of the outstanding amount of a bond not tied up by buy-and-hold accounts unwilling to trade. Sell side Traders are likely to alter their margin for trade sizes beyond approaching TMC and this increases the transaction costs for Buy side firms.

To train for TMC, learning and prediction are applied to six or more months of historical data to bridge data delays and discern trade size and volume patterns.

b) **Dealer Inventory**
By tracking daily trade volumes from sources such as TRACE (and looking back over a six month period), the algorithm is able to model the change in dealer inventory. This feeds into the firmness calculation and allows the model to adjust the likelihood of achieving the “screen” price when the street is net the same way as the desired order (i.e. if the client is looking to sell and dealers are already net long, then the execution probability would be lower than if the street was net short).

c) **TCA Lookback**
By considering up to 2 years worth of real world executed trades unique to the client, the model learns which dealers are most likely to respond aggressively on the particular bond by considering their performance on similar bonds (and the exact ISIN in question), similar trade size and similar market risk / liquidity environment.

d) **Live Market Data**
Live prices, sizes and dealer axes are consumed and included in the model from multiple execution venues. Where firmness in a particular size is directly indicated (for example on All to All trading platforms), this is used directly, however when the size is unknown (for example via RFQ), then it can be modelled based on past dealer performance in similar bonds and current positioning / pricing.



The Model: Key Outputs

SOR algorithm outputs several key metrics that enable the trader to visualize the optimal execution plan ie. path to best execution comprising of number of trade chunks, with individual size and execution probability. Traders desired time of execution as well as desired protocol/venue connection inclusion and price sensitivity is considered. Specific outputs of the model are described below:

a) **Execution Probability**
Different execution venues have differing protocol's, for example an All to All platform will typically consist of an order book with firm orders (i.e. a fixed price for a specific size, good until a specific time or until cancelled). However, not all execution routes are equally, if trading via RFQ for example it can be difficult for a Buy side trader to know whether the Sell side dealer will significantly move the price for a size larger than that indicated (or even for the indicated size).
By calculating the implied firmness (or taking the actual firmness if available), Overbond can then determine an execution probability for the given size, price target and timeframe combination.

b) **Optimal Chunking**
Historically Buy side traders have been reluctant to split orders up into smaller pieces and execute across multiple dealers and venues, however this is changing. Feedback suggests that due to increasing liquidity constraints there is now a much greater willingness amongst Buy side participants to split orders up into multiple chunks.
Within the constraints set by the trader, the Overbond algorithm will split the order up into optimal chunks (for example a USD 10 million order could be split into 3 chunks, 2 million via an All to All platform with a firm bid and 2 x 4 million via RFQ platforms, specifically inviting dealers who are likely to be active in the credit and have historically provided good liquidity to the client.

c) **Optimal Timing**
Price can be paramount for any trader, however there are occasions when immediate execution at the desired price isn't viable in the size requested. Overbond's unique algorithm will suggest times when it may be more suitable to place a passive order (e.g. by placing a sell order at the target price via an All to All platform, rather than hitting a bid lower than desired).

The implementation: Back-Testing

A back-test was conducted for a buy-side trading desk that trades USD. The trading performance of the Overbond model was outputted in two examples at specific time for a specific bond for a buy order and a sell order separately. Then, as statistical test same model invocation was performed at 4 different daily time stamps for 10 consecutive trading days (40 orders for each) and output parameters are summarized on the right-hand side tables.

Buy for US251526BL24

Snapshot of available quantity on Aug 25, 2022 at 8am UTC				
ISIN	**Settle Date**	**Time**	**Direction**	**Total Size**
US251526BL24	25-Aug-22	8:00 AM	Buy	Max Available
Protocol/Venue	**Weighted Price**	**Allocation Size (000s)**		**Firm %**
All to All	100.208	1,600.00		100%
Direct				
RFQ	100.105	1,073.27		98%
OTC	99.859	7,085.39		98%
Blended	99.943	9,758.66		98.33%

Stats from Aug 17 – Aug 31, 2022		
US251526BL24 BUY	**Mean**	**Median**
OTC Quantities	6,939.202	6,984.887
RFQ Quantities	1,086.399	1,073.269
Direct Quantities		
A2A Quantities	675.536	575.000
Total Quantity	8,455.487	8,464.618
OTC Prices	99.858	99.859
RFQ Prices	100.105	100.105
Direct Prices		
A2A Prices	100.262	100.232
Weighted Price	99.907	99.909
Stats gathered at 4 daily snapshots: 8:00, 11:00, 14:00, and 17:00 UTC		

Sell for US89236TGW99

Snapshot of available quantity on Aug 22, 2022 @ 11am UTC				
ISIN	**Settle Date**	**Time**	**Direction**	**Total Size**
US89236TGW99	22-Aug-22	11:00 AM	Sell	Max Available
Venue	**Weighted Price**	**Allocation Size (000s)**		**Firm %**
All to All	99.496	1,600.00		100%
Direct	98.949	2,000.00		99%
RFQ	99.485	1,768.69		98%
OTC	99.665	6,476.73		98%
Blended	99.494	11,845.41		98.44%

Stats from Aug 17 – Aug 31, 2022		
US89236TGW99 SELL	**Mean**	**Median**
OTC Quantities	6,746.428	6,739.948
RFQ Quantities	1,769.068	1,768.800
Direct Quantities	2,000.000	2,000.000
A2A Quantities	558.500	518.000
Total Quantity	9,112.928	8,885.544
OTC Prices	99.660	99.663
RFQ Prices	99.485	99.485
Direct Prices	98.942	98.949
A2A Prices	99.391	99.485
Weighted Price	99.597	99.619
Stats gathered at 4 daily snapshots: 8:00, 11:00, 14:00, and 17:00 UTC		

The implementation: The User Interface

ISIN	XS2079079799
Tenor	7.19
Tier	1
Recomend	STRONG
Confidence	1.159
Last updated	2023-09-04 17:31:01

	Bid	Ask
Market Price	90.211	90.583
COBI Price	90.211	90.583
Market Yield	5.901	5.701
COBI Yield	5.901	5.701
Market G Spread	343.903	324.913
COBI G Spread	343.903	324.913
Market I Spread	273.827	252.042
COBI I Spread	343.903	252.042

Overbond can return all results via API and equally, users can see the routing options on the Overbond user interface widget that can be directly displayed within existing OEMS trading desk uses. The figure below shows how the results would appear to a trader using the Overbond widget.

ISIN	Settle Date	Size (MM)	Direction	Total Size	Price Limits	Yield Limits	Spread Limits	Chunk Size	Deadlines	Excluded Vendors	Included Vendors	
XS2079079799	Sep 6, 2023	20	buy	min max	min max	min max	min max	min max				BUILD PLAN / EXECUTE

Bond Description: 1 2030-11-13 | Currency: EUR | Benchmark: EU8YT=RR

Venue	Wtd Pr	Wtd Sprd	Wtd Yld	Aloc Sz	Wtd Firm %		Exec Sz	Order Tm	Exec Tm	
All-to-All	102.665	-	0.664	4.000	30.000	☑	-	-	-	⌄
Direct	104.153	-	0.573	5.000	52.000	☑	-	-	-	⌄
RFQ	102.205	-	0.659	6.000	33.333	☑	-	-	-	⌄
Blended	102.977	-	0.632	15.000	38.666	☐	0.000	-	-	⌄
OTC	-	-	-	5.000	-	☐	-	-	-	⌄

Users can see key information about the bond (such as current price, yield and Overbond Execution score, which is a measure of price confidence and liquidity) prior to building an execution plan.

Once the execution plan has been created, traders can adjust parameters, remove specific venues or even complete execution routes (e.g. exclude All to All platforms).

The weighted price (and other columns) can be expanded to see a full line by line (one line per routing option) breakdown.

Additionally if there is insufficient electronic liquidity available, the algorithm will return a list of dealers to approach, based on a TCA lookback specific to the Buy side firm in question.

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 250,000 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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