BOND LIQUIDITY SCORES METHODOLOGY

The liquidity index calculations are applicable to exchange-traded and OTC bonds as long as there is a possibility to aggregate market depth containing prices and volumes. The methodology below however has been designed specifically for the Russian/CIS bond market, which is primarily exchange-traded and has various trading modes. The calculated results are intended to be used in the Yield Map project for dynamic filtering and in other apps such as Bond Liquidity Board. The described methodology is based on best market practices offered by FI research teams Gazprombank, NB Trust and Bank BCS. We outline 2 components within the calculation: order book and total accumulated volume.

1) MARKET DEPTH COMPONENT

This component is calculated for every bond using a simple algorithm. For ease of understanding let us simulate an example using the following level 2 prices:

BOND 1 (e.g. sovereign, which is more liquid)					
Bid Size	**Bid Price**	**Bid Yld (%)**	**Ask Yld (%)**	**Ask Price**	**Ask Size**
50000	96.7	8.76	8.75	96.8	16730
120	96.4503	8.8	8.74	96.9	50000
2	96.3354	8.81	8.72	97	3600
52	96.3001	8.82	8.71	97.08	1
5000	96.3	8.82	8.71	97.0998	1

BOND 2 (e.g. corporate)					
Bid Size	**Bid Price**	**Bid Yld (%)**	**Ask Yld (%)**	**Ask Price**	**Ask Size**
11	97.5	16.1	13.21	99.9	202
5	97.36	16.35	12.92	100.15	5000
112	97.35	16.47			

The liquidity essentially indicates how fast we can execute a certain trading volume at minimum cost. Hence the cost is the bid-ask spread and the more volume we see in the level 2 space, the easier it will be to realize the our trading volume.
Here is the general formula for calculating the liquidity ratio:

$$L(t) = L(t) + \text{MIN [Bid Size, Ask Size] / [Bid-Ask Yield Spread]}$$

L(t) is the instantaneous liquidity ratio and it equals 0 at initiation of the calculation. Since we are basically trying to evaluate the rate at which the level 2 volumes can collapse upon each other, this calculation is looped and the input for the minimum volume is the next level size and the previous maximum size minus the previous minimum. The iterations stop when there is no size left on either the bid or ask side. Now let's calculate the liquidity ratio for Bond 2:

1) L(t) = 0;
2) L(t) = 0 + Min [11, 202] / [16.1 – 13.21] = 11 / 2.89 = 3.8;
3) The since we have executed the bid size of 11, we subtract it from the ask size: 202 – 11 = 191;
4) L(t) = 3.8 +Min [5, 191] / [16.35 – 13.21] = 3.8 + 5 / 3.14 = 5.39;
5) Again we have executed the bid size, so we subtract the executed size from the ask volume: 191 – 5 = 186;
6) L(t) = 5.39 + Min [112, 186] / [16.47 – 13.21] = 5.39 + 112 / 3.26 = 39.74;
7) We have no more size on the bid side, therefore we exit the iteration loop with a liquidity ratio of 39.74.

If we do the same iterations for Bond 1 we will get a much larger ratio which will be 340167857.14 indicating that Bond 1 is more liquid than Bond 2. An exception occurs in case the Bid Yield <= Ask Yield (i.e. we observe an arbitrage inequality and the spreads are either negative or equal to zero), we then ignore the step. Such situations occur fairly seldom, but they are usually caused by technical flaws within the exchange's infrastructure.

The calculation that we have performed is done for time *t*, which represents a single date. After we have calculated the liquidity ratios for all the bonds in the bond list, we can then standardize the units of measure by expressing these ratios by representing them as percentiles with the most liquid bond in our portfolio having a liquidity indicator of 100% and the least liquid bond – 0%.

Since the ultimate goal is to understand the liquidity attributed to every bond, we can capture the maximum liquidity level by reiterating the above calculations in real time throughout the day or get the tick history from TRTH using the API. As soon as the maximum intraday value for a certain bond has been identified, it will be used for the next step.

2) LIQUIDITY SCORES

a) Liquidity Index

The liquidity scores calculated in compliance with this methodology are a modification of the indicators offered by the above mentioned banks. We impose the traded volume adjustment by calculating the sum of accumulated volumes from the main trading mode and the RPS mode. The results are grouped into percentiles with 100% attributed to bonds with the largest trading volume and 0% to the least traded bond. Then we obtain an average of the indicator and volume sum values:

$$LQX(t) = [L(t)(\%) + \text{Total Accumulated Volume } (\%)] \times 0.5$$

This helps to balance out bonds that have many bids/offers, but no actual trading activity. Since there can be days when the liquidity ratio may fall out of the usual liquidity distribution of the bond, it would be better to calculate an average or take the median of these ratios for a 30 calendar days' period.

The described model considers the core liquidity factors, is not too complex to use, requires no calibration and is based on widely accepted approach with a proven track record of more than 10 years.

b) Weighted Liquidity Index

The idea is similar to the conventional Liquidity Index calculation with one difference: we use total accumulated volume as a weight, rather than an averaging component:

$$LQX_w(t) = L(t) \times \text{Total Accumulated Volume } (\%)$$

c) Liquidity Rating

A liquidity rating is used to bring down the *L(t)* component to a measurable scale. As described above *L(t)* becomes larger as quoted sizes get bigger and bid/ask spread gets smaller in the order book. To normalize the output value, we can calculate the order of the number using the following formula:

$$LQX_{rating}(t) = \log_{10}(L(t))$$

3) CALCULATION FREQUENCY

The liquidity scores are calculated and published on an EOD basis.

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