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LIQUIDITY PROTECTION RULE

The purpose of the CODA Block Liquidity Protection Rule¹ (LPR) is to prevent a CODA Block auction from moving a stock's price an unreasonable distance based on the size of the print and the liquidity profile of the stock. The rule is driven by an equation that is calibrated individually for every stock based on the pattern of its trades over the last 20 trading days. The calibration methodology is designed to reflect the typical price variance of each stock as a function of its notional turnover. The LPR takes the size of a CODA Block print as an input and returns the maximum distance the CODA Block engine will allow the auction to go up outside the NBBO as the output.

1 Trade Data Filtering

The calibration acts on all regular way trades reported to the SIP during regular market hours, exclusive of opening and closing auction volume as well as other trades that appear to be reported out of sequence or are otherwise unrelated to the prevailing market conditions.

2 Data Point Generation

For every trade, 5 windows are randomly created spanning sequential trades summing to a notional value of \$100k - \$250MM. The price variance of the trades in the window is measured, creating a large set of (window size, price variance) data point pairs.

3 Regression Calibration

All data point pairs spanning the most recent 20 trading days are aggregated and organized into bins of similar notional value. A regression runs upon the median price variance for each notional bin to generate an equation that characterizes price variance as a function of notional turnover.

4 Optimizations

Several rules are applied to ensure that the results don't offend our common sense, including but not limited to: a. Enforce monotonicity - the equation curve is flattened out if necessary to guarantee that it never has a negative slope, i.e., it never gives a smaller answer for a larger number of shares b. Not enough data - if a symbol does not trade enough to generate a statistically significant number of data points, we default to logic that hardcodes the LPR value at twice the average daily range of the stock, regardless of auction size. In such stocks, the minimum CODA Block auction size is large relative to the stock's ADV so a more granular determination of a reasonable distance to move the stock's price cannot be made.



Open: Price and size of opening print from primary market for prior trading day; 5 and 20 days averages of size only.

Close: Price and size of closing print from primary market for prior trading day; 5 and 20 days averages of size only.

VWAP: Volume Weighted Average Price of regular way trades during regular market hours (exclusive of opening & closing volume).

NBBO Median: Typical size found on one side of the NBBO. Calculated as follows: all exchange quotes are aggregated and the total size (bid size + offer size at the NBBO). The median value is divided by two and reported in shares and notional terms.

NBBO Spread: Typical NBBO spread width. Calculated as follows: all exchange quotes are aggregated and the NBBO spread width is calculated for each unique state of the NBBO. The median value is reported in dollar and notional terms.

NBBO Midpt Change: Likelihood the NBBO midpoint will change in a random 100ms window of time. Calculated by dividing the trading day into 100ms segments and counting what % of them contain NBBO midpoint change.

Please visit www.codamarkets.com & register to access the CODA Block Liquidity Protection Rule Calculator.

¹The Liquidity Protection Rule is the result of data analysis performed by ALISA (Advanced Liquidity Studies and Analytics), a data platform operated by PDQ Enterprises, LLC.

LIQUIDITY PROTECTION RULE CALCULATOR
AAPL for 11-27-2017

1.52 (bps)
0.03 (\$)

Symbol Data	11-27-2017	5-days	20-days
Open	251,096 @ \$174.97	size: 337,509	size: 393,
Close	1,734,684 @ \$174.09	size: 1,371,526	size: 1,368,205
VWAP	\$174.26	\$169.99	\$166.48
Price Range	\$1.78 / 102.14 bps	\$1.71 / 98.86 bps	\$2.29 / 133.91 bp
Largest Print	97,000	97,389	127,400
Volume	16.45MM	15.62MM	23.28MM
Notional	\$2,866.54MM	\$2,708.15MM	\$3,992.05
Trades	114,267	106,205	155,881
NBBO Median	1,090/\$189.5k	1,135/\$196k	1,015/\$17
NBBO Spread	\$0.01 / 0.57 bps	\$0.01 / 0.58 bps	\$0.01 / 0.1 bps
NBBO Midpt Change	6.55% (100ms)	6.48% (100ms)	6.94% (100ms)

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In this example, a trader has queried the Liquidity Protection Rule value for 10,000 shares of AAPL. Based on an analysis of all trades in AAPL over the last 20 days, the LPR Calculator has returned that the maximum distance outside the NBBO that the LPR will allow CODA Block to print 10,000 shares of AAPL is 1.52 basis points or \$0.03.