

Equity Market Speed Relative to Order Placement

Data Highlight 2014-02

March 19, 2014

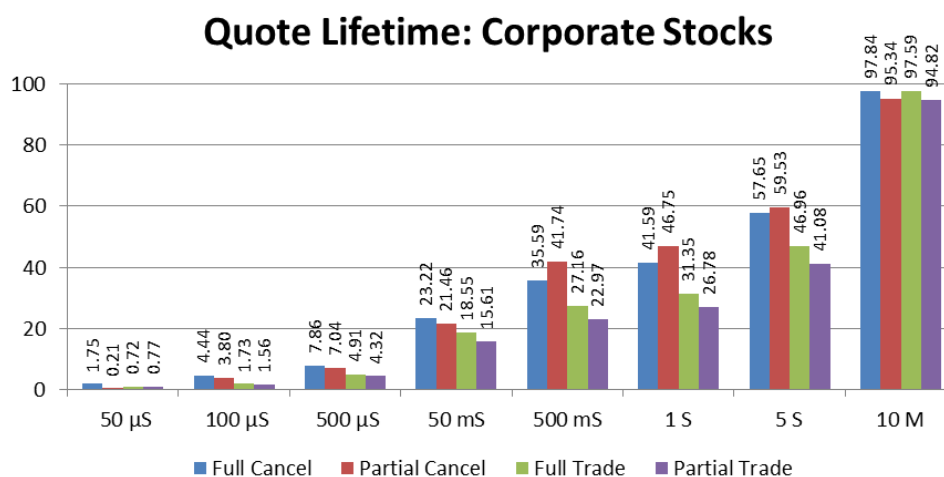
This *Data Highlight* extends the analysis of corporate stock quote lifetimes first examined in [Data Highlight 2013-05, The Speed of the Equity Markets](#), by parsing orders by their placement relative to the prevailing best bid and offer.

Background and Update of Data

[Data Highlight 2013-05, The Speed of the Equity Markets](#), provided a cumulative distribution of order lifetimes for corporate stocks traded on all exchanges for which there is sufficient data over the period of Q2 2013.¹ The chart in that *Data Highlight* showed a broad distribution of cancel and trade durations, ranging from less than 50 microseconds to over 10 minutes.

The chart below presents the same calculations updated with data from Q4 2013. The order durations for each event are similar to those observed for Q2 2013 with two exceptions:

- partial cancellations appear to be slightly faster – the distribution of times for partial cancellations is shifted to the left (41.74% of all partial cancellations occurred in 500 mS or less in Q4 2013 versus 36.9% in Q2 2013), and
- Full cancellations appear to have slowed – the distribution for full cancellations has shifted to the right (57.65% of all full cancellations occurred in 5 seconds or less in Q4 2013 versus 62.0% in Q2 2013).



¹ NYSE and NYSE MKT are excluded from the analysis. See [Quote Lifetime Methodology](#) for details.

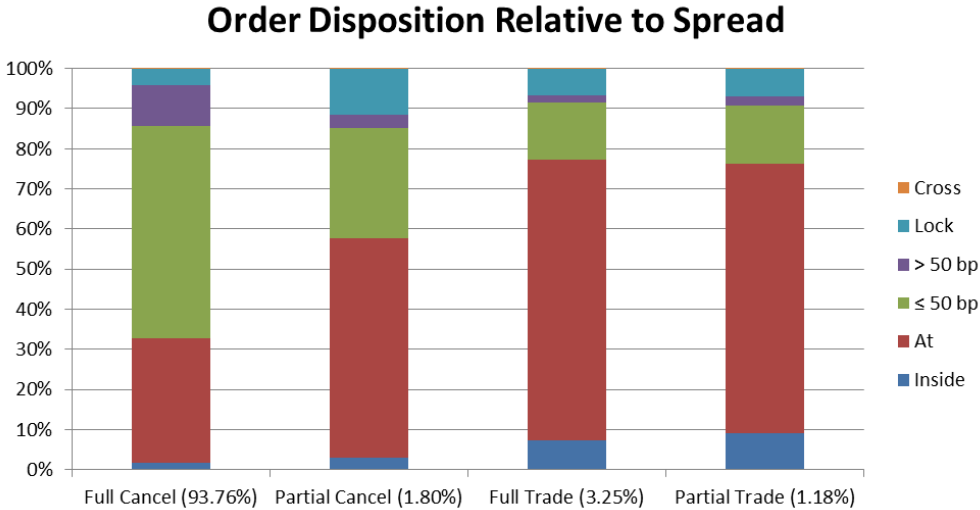
This *Data Highlight* builds upon the above analysis by examining order lifetimes as a function of order placement relative to the prevailing spread. This *Data Highlight* analyzes six outcomes for orders placed in the book:²

1. the order is placed inside the prevailing spread and makes a new market (“Inside”),
2. the order is placed at the best bid or ask price (“At”),
3. the order is placed no more than 50 basis points away from the relevant side of the market (ask +50 bp or bid -50 bp),³
4. the order is placed more than 50 basis points away from the relevant side of the market,
5. the order results in a locked market, or
6. the order results in a crossed market.

Order lifetimes are measured for every cancellation or trade and, if the prevailing bid-ask spread is positive, assigned to one of the first four possibilities based on the position of the original resting order relative to the spread. However, if the original order is placed while the market is locked or crossed, then a trade or cancellation involving that original order is assigned to the locked or crossed outcome.

Results and Analyses

The chart below shows order disposition relative to the spread for the same Q4 2013 data presented above.



² Marketable orders are generally executed immediately – they do not generate new orders for placement on the book.

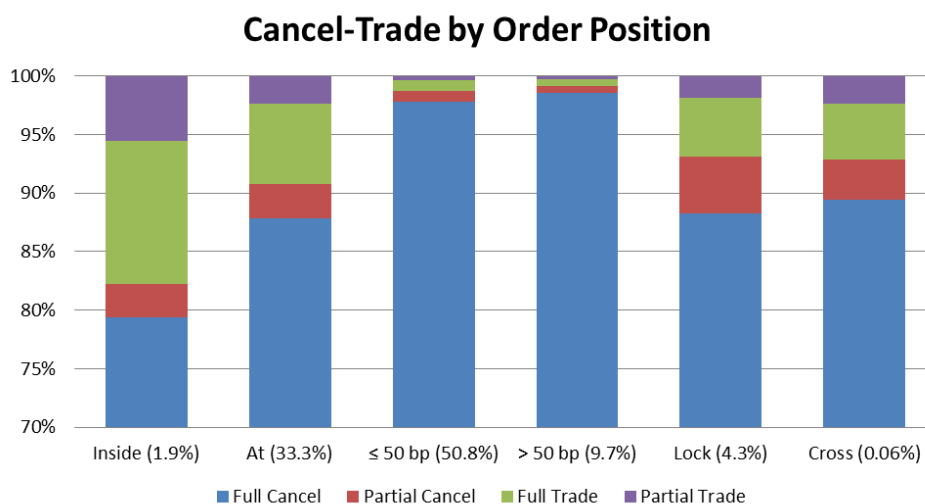
³ For a \$10.00 order price 50 bp is \$0.05. For a \$2.00 order price 50 bp is \$0.01, the minimum increment for orders priced above \$1.00. Stocks priced \$2.00 or less represent 6.6% of the sample. These stocks generate a much lower percentage of order message volume. Results with stocks priced \$2.00 or less removed from the sample are qualitatively and quantitatively similar to the results presented in this *Data Highlight*.

Approximately 95.6% of all events are cancelations and 4.4% are trades (i.e., executions resulting from an incoming marketable order interacting with a resting limit order). The distribution of these events varies relative to order placement:

- approximately 62.5% of all cancel events (full or partial) occur to orders originally placed away from the best bid or offer,⁴ whereas
- approximately 16% of all trade events (full or partial) result from interacting with an order originally placed away from the best bid or offer.⁵

The data shows that although a majority of all orders sent to the exchanges are placed outside of the prevailing spread (i.e., increased depth of book), only a small minority of these orders result in executions (most are canceled).

The next chart provides an alternative view of the same data.



The cancel-to-trade ratio varies dramatically relative to order position:⁶

- 1.9% of events occur inside the spread. Of these, 82% are full or partial cancelations and 18% are full or partial trades. The cancel-to-trade ratio is 4.6,
- 33.3% of events occur at the spread and the cancel-to-trade ratio is 9.8,
- 50.8% of events are within 50 basis points of the spread but outside of the NBBO and the cancel-to-trade ratio is 79, and

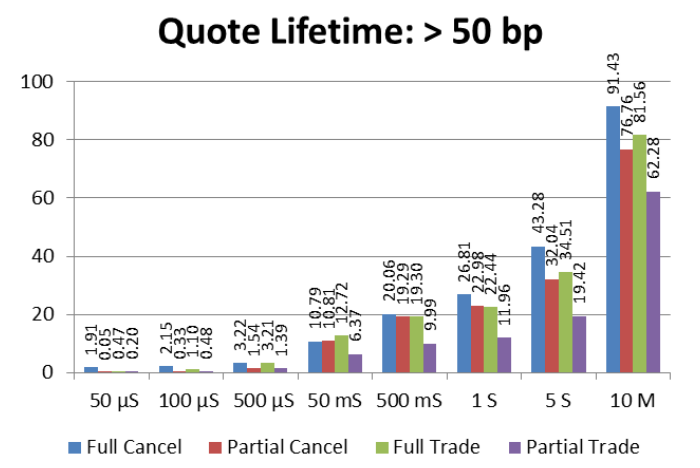
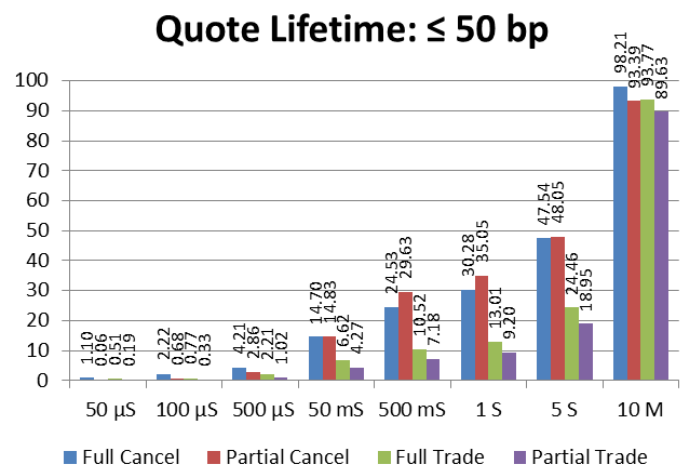
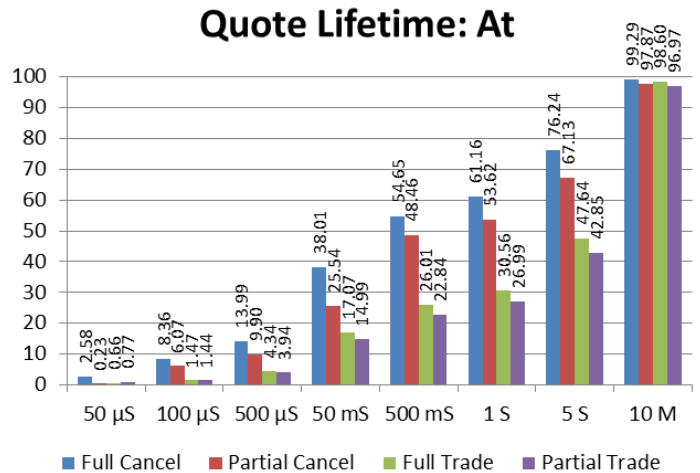
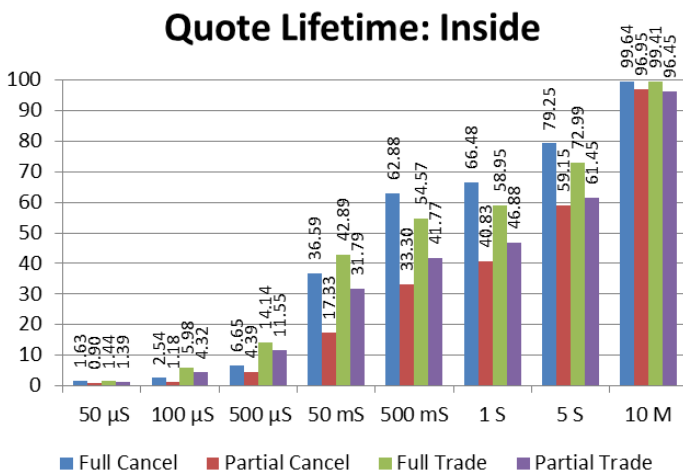
⁴ See the Appendix Table which shows a total of 59.7% of all events are cancelations of orders placed within +/- 50 bp or greater than 50 bp from the then-prevailing best bid or ask, versus 95.6% of all events being cancelations.

⁵ See the Appendix Table which shows a total of 0.71% of all events are trades against orders placed within +/- 50 bp or greater than 50 bp from the then-prevailing best bid or ask, versus 4.43% of all events being trades.

⁶ The cancel-to-trade ratio can be approximated from the chart by inspection. Numerical results can be computed from the values in the Appendix Table.

- 9.7% of events occur at prices more than 50 basis points away from the spread while the cancel-to-trade ratio is 117.
- 4.3% of events are counted when the original order occurred during a locked market and crossed markets are exceptionally rare (< 0.06% of events). The cancel-to-trade ratio during locked or crossed markets is 13.

The final set of charts provides order lifetime summaries conditioned upon order placement when the markets are not locked or crossed.



The charts show an inverse relationship between order placement relative to the best bid or ask and the speed of the ensuing trades and cancellations. While it is generally well known that the time for an order to execute tends to decline with order aggressiveness, the charts show that this is true for cancellations

as well. In the charts, the proportion of trades and cancelations at each time bin declines (the bars become smaller) as the orders move from “inside” to “at” and then beyond (there are a few exceptions for the fastest cancelations). Consider the 500 mS bin: 62.88% of all full cancelations and 54.57% of all full trades occur in 500 milliseconds or less when the order is originally placed inside the prevailing spread; the percentages are 54.65% and 26.01% when the order is at the market, 24.53% and 10.52% for orders placed within 50 basis points of the best bid or ask, and, 20.06% and 19.30% for orders more than 50 basis points away from the market. With the exception of the 19.30% for full trades of orders placed well away from the market, the speed of trader behavior decreases monotonically with distance relative to the best bid and offer. The exceptional behavior for trades could be due to inter-market sweep orders (ISO). While orders placed within a few basis points of the prevailing spread are more likely to be executed as prices change and orders further away are less likely, an ISO could remove several orders within *and* beyond 50 basis points all at once.⁷

Why This is of Interest

Analyses of order lifetime as a function of placement relative to the quoted spread permit more insights into the ultimate disposition of posted orders. As depicted in the second chart (Order Disposition Relative to Spread), over 59% of all events are full cancelations of orders outside the best bid and ask. Over 62% of all cancelations occur when the original orders are placed outside the spread. Only 0.71% of all events are executions (full or partial) of orders placed outside the best bid and ask. As a percentage of trades, these events are a much more substantial 16% (full) to 17% (partial), suggesting that orders placed outside the current spread provide some value to liquidity demanders.

The disparity in cancel and trade percentages for orders placed outside the spread is reflected in the higher cancel-to-trade ratios reported above. The quote lifetime charts show that the speed of cancelations declines for orders placed outside of the best bid or ask. Yet, fewer orders are executed on a percentage basis (16% of trades versus 62% of cancelations), suggesting that there is considerable activity outside of the best prices that is not currently accessed, and, this phenomenon cannot be attributed to extremely fast cancelation behavior.

Appendix Table

Conditional corporate stock lifetimes by order position relative to best bid and ask, Q4 2013

⁷ The exceptional trade duration behavior for orders placed well away from the market could be the result of some other market phenomena or specific to this sample.

			Percentage of trades or cancelations occurring in less than:							
	Spread	(%)	50 μ S	100 μ S	500 μ S	50 mS	500 mS	1 S	5 S	10 M
<u>Full Cancel</u>	Inside	1.54	1.63	2.54	6.65	36.59	62.88	66.48	79.25	99.64
	At	29.22	2.58	8.36	13.99	38.01	54.65	61.16	76.24	99.29
	\leq 50 bp	49.64	1.10	2.22	4.21	14.70	24.53	30.28	47.54	98.21
	> 50 bp	9.51	1.91	2.15	3.22	10.79	20.06	26.81	43.28	91.43
	Lock	3.80	3.52	9.87	20.29	46.10	60.94	65.38	73.83	97.32
	Cross	0.05	3.25	6.11	14.30	44.84	67.11	71.63	79.77	96.97
	All	93.76	1.75	4.44	7.86	23.22	35.59	41.59	57.65	97.84
<u>Full Trade</u>	Inside	0.24	1.44	5.98	14.14	42.89	54.57	58.95	72.99	99.41
	At	2.28	0.66	1.47	4.34	17.07	26.01	30.56	47.64	98.60
	\leq 50 bp	0.46	0.51	0.77	2.21	6.62	10.52	13.01	24.46	93.77
	> 50 bp	0.05	0.47	1.10	3.21	12.72	19.30	22.44	34.51	81.56
	Lock	0.22	1.03	1.89	6.69	33.87	46.16	50.23	62.08	97.21
	Cross	0.00	4.97	10.29	24.51	66.54	76.58	79.03	85.27	98.89
	All	3.25	0.72	1.73	4.91	18.55	27.16	31.35	46.96	97.59
<u>Partial Cancel</u>	Inside	0.06	0.90	1.18	4.39	17.33	33.30	40.83	59.15	96.95
	At	0.98	0.23	6.07	9.90	25.54	48.46	53.62	67.13	97.87
	\leq 50 bp	0.50	0.06	0.68	2.86	14.83	29.63	35.05	48.05	93.39
	> 50 bp	0.06	0.05	0.33	1.54	10.81	19.29	22.98	32.04	76.76
	Lock	0.21	0.31	2.21	5.78	22.01	47.55	50.54	59.01	93.02
	Cross	0.00	1.46	2.64	9.91	47.57	65.27	68.62	77.07	97.26
	All	1.80	0.21	3.80	7.04	21.46	41.74	46.75	59.53	95.34
<u>Partial Trade</u>	Inside	0.11	1.39	4.32	11.55	31.79	41.77	46.88	61.45	96.45
	At	0.79	0.77	1.44	3.94	14.99	22.84	26.99	42.85	96.97
	\leq 50 bp	0.17	0.19	0.33	1.02	4.27	7.18	9.20	18.95	89.63
	> 50 bp	0.03	0.20	0.48	1.39	6.37	9.99	11.96	19.42	62.28
	Lock	0.08	1.31	2.05	6.24	26.70	36.34	39.62	50.21	93.49
	Cross	0.00	2.66	5.15	15.66	58.13	71.62	74.76	82.74	98.38
	All	1.18	0.77	1.56	4.32	15.61	22.97	26.78	41.08	94.82
<u>All</u>		100	1.68	4.31	7.70	22.94	35.28	41.18	57.14	97.76

Notes:

1. Spread is the position of the add order relative to the prevailing bid and ask prices on the direct feeds. This is not the same as the SIP-based NBBO because the direct feeds include odd-lot orders and remainders.
2. (%) is the percentage of events by identity (column 1) and position relative to the spread (column 2).