

TCA Report

NYFIX TCA Report

Start: **26-Oct-16**
End: **26-Oct-16**

Trading Summary

Value Traded: **\$32,718,863**

Volume Traded: **6,601,655**

Number Of Orders: **1,533**

(Fills): **4,007**

Average Order Size: **\$21,343.03**

(Average Fill Size): **\$8,165.43**

Book Spread (depth): **23.72 BPS**

Book Spread (touch): **17.13 BPS**

Average Duration: **0h 15m**

Distinct Instruments: **534**

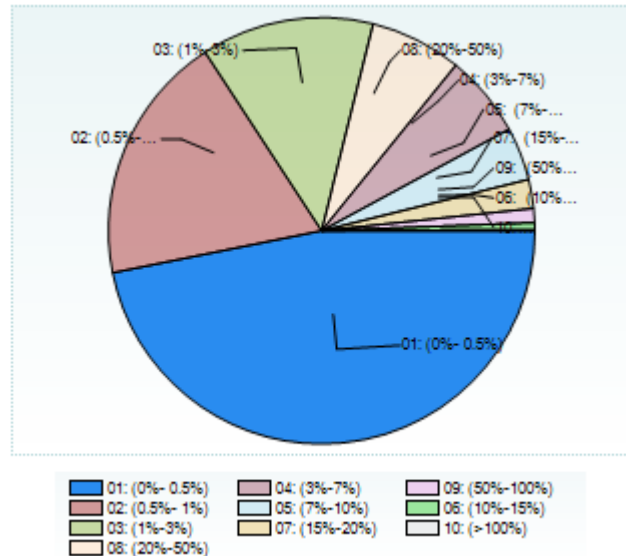
Venue Types:

Prim	MTF	Other
79.5%	8.9%	11.6%

Venues Traded:

XETR: 28.40% LSE2: 23.40% XBRU: 20.77% XUBS: 6.65% CHIX: 3.32% BATE: 3.22% XSWX: 2.18% TRQX: 1.90% BLOX: 1.08% XMCE: 1.02% XAMS: 0.85% XOSL: 0.74% KDKM: 0.67% XOTC: 0.60% DBSE: 0.52% CSCF: 0.52% XMIL: 0.43% BATD: 0.43% CHID: 0.40% XTAE: 0.40%

Percentage ADV Breakdown - By Value



Performance Summary

Implementation Shortfall - Arrival Mid: **-10.03 BPS**

Standard Deviation: **65.17 BPS**

Momentum (1 day): **19.77 BPS**

Momentum (5 day): **84.13 BPS**

Intrade Alpha: **22.60 BPS**

Avg Spread Capture: **38.72%**

Avg Spread (depth): **23.72 BPS**

Additional Benchmarks

	Average Performance	Standard Deviation
Market Daily VWAP	-5.79	64.95
Market VWAP First/Last	-4.05	20.32
Market Limit VWAP First/L	-5.36	17.31
Market VWAP Arrival/Last	4.23	47.02
Primary Daily VWAP	-4.92	65.21
Primary VWAP First/Last	-1.89	20.77
Primary VWAP Arrival/Lasi	6.53	47.98
Arrival (mid)	-10.03	65.17
First Fill (mid)	-15.60	37.99
Previous Closing Price	-35.16	178.41
Closing Price	9.11	99.95
Arrival Closing Price	12.73	108.77

Venue Performance Summary

Venue	Trades (#)	Flow (%)	Avg Trade Volume	EBBO (%)	Worse (%)	Improv (BPS)	SC (%)
XETR	1,075	28.40	522.05	87.91	12.09	2.98	41.5
LSE2	839	23.40	4,139.95	96.94	3.06	15.67	40.2
BATE	344	3.22	500.74	92.77	7.23	6.03	13.5
CHIX	294	3.32	923.57	95.29	4.71	6.51	50.4
XUBS	246	6.65	329.54	99.83	0.17	4.56	35.5
TRQX	201	1.90	914.83	99.61	0.39	7.08	52.1
CSCF	124	0.52	349.52	99.56	0.44	14.26	105.8
XOSL	121	0.74	3,677.98	100.00	0.00	72.92	81.2
XSWX	92	2.18	175.34	93.71	6.29	4.16	28.6
XMCE	91	1.02	2,724.08	92.08	7.92	13.99	29.6

Detailed Analysis and Breakdowns

Performance Breakdown by Trading Day

	# Orders	Value (\$)	Val (%)	Perf v. IS (AM)	(SD)	Perf VWAP(A-LF)	v. (SD)	Spread (touch)	Avg Dur.	Rev(15m)	PVWAP (D)	IS(AM)	IS(FFM)
26-Oct-2016	1,533	32,718,863	100.00 %	-10.03	65.17	4.23	47.02	17.13	0h 15m	-1.05	-4.92	-10.03	-15.60

Performance Breakdown by Trade Size

	# Orders	Value (\$)	Val (%)	Perf v. IS (AM)	(SD)	Perf VWAP(A-LF)	v. (SD)	Spread (touch)	Avg Dur.	Rev(15m)	PVWAP (D)	IS(AM)	IS(FFM)
1: Tiny (0-10k)	1,070	3,140,498	9.60%	3.19	138.86	28.59	107.06	26.09	0h 01m	-12.90	-2.51	3.19	-7.94
2: Small (10-50k)	344	6,863,284	20.98%	2.56	88.33	16.32	60.64	21.76	0h 04m	-3.99	6.51	2.56	-12.17
3: Medium (50-200k)	88	6,949,526	21.24%	1.62	42.24	18.15	47.26	19.53	0h 13m	-1.59	14.70	1.62	-3.22
4: Medium (200-500k)	23	4,613,911	14.10%	-7.68	25.33	-7.20	20.56	8.41	0h 10m	-1.67	7.58	-7.68	-10.45
5: Large (500-1m)	5	2,093,039	6.40%	-1.72	15.15	1.81	1.66	11.08	0h 28m	23.28	18.08	-1.72	-1.55
6: Large II (1m - 5m)	2	9,022,881	27.58%	-36.33	1.68	-8.03	0.44	4.82	0h 29m	0.00	-41.56	-36.33	-36.33
7: Block (5m +)	1	35,722	0.11%	-7.15	0.00	79.50	0.00	11.28	1h 43m	92.86	101.18	-7.15	-7.15

Performance Breakdown by Trader

	# Orders	Value (\$)	Val (%)	Perf v. IS (AM)	(SD)	Perf VWAP(A-LF)	v. (SD)	Spread (touch)	Avg Dur.	Rev(15m)	PVWAP (D)	IS(AM)	IS(FFM)
AGANDOLFO	1	5,698	0.02%	-343.22	0.00	234.43	0.00	350.35	0h 01m	-355.36	-17.59	-343.22	-156.36
KMCAREE	1	2,660	0.01%	-343.16	0.00	0.00	0.00	0.00	0h 00m	446.43	-188.41	-343.16	-324.81
MSHORT	62	12,687,990	38.78%	-28.57	29.59	-8.64	9.79	11.41	0h 25m	-2.58	-27.07	-28.57	-29.61
PERXISTG	1,327	16,165,332	49.41%	6.51	64.99	19.23	64.30	15.16	0h 05m	-0.85	5.89	6.51	-3.35
PSTRATTON	61	2,001,026	6.12%	-21.88	116.31	-2.44	60.74	18.25	0h 09m	4.73	30.68	-21.88	-25.35
SCRITCHLEY	81	1,856,156	5.67%	-13.12	110.09	10.11	35.72	53.64	0h 43m	1.85	15.30	-13.12	-15.02

Worst Performing Orders

Showing up to 10 orders, benchmark type = VWAP Mkt Interval.

Time		Instrument	Volume	Value(\$)	#Fills	%Filled	Duration	Price Achieved	IS(AM)	(BPS)	VWAP(A-LF)	(BPS)
26-Oct-16 16:21:30	S	HAGE - Heritage Printing Technology Corp	30,000	8,319	6	100.00%	12.000s	0.2773	0.3043	-885.26	0.2985	-709.68
26-Oct-16 13:53:49	B	PNE WIND AG	1,800	4,065	1	100.00%	-	2.0670	2.0810	67.28	2.0659	-5.24
26-Oct-16 16:12:03	S	DUNELM GROUP PLC ORD 1P	50,000	469,541	85	100.00%	00h 22m	769.0150	774.0000	-64.41	772.6197	-46.66
26-Oct-16 16:05:16	S	MEARS GROUP PLC ORD 1P	63,250	355,333	4	0.59%	00h 09m	460.0512	462.0000	-42.18	461.7579	-36.96
26-Oct-16 08:00:04	S	Oasmia Pharmaceutical AB	23,146	26,138	34	100.00%	01h 43m	10.0647	10.7000	-593.78	10.1185	-53.21
26-Oct-16 14:47:37	S	TUBACEX SA	13,000	37,846	10	25.96%	01h 08m	2.6647	2.6550	36.61	2.6635	4.72
26-Oct-16 14:14:18	B	GAUMONT SA GAUMONT ORD SHS	163	9,435	4	100.00%	10.000s	52.9834	52.7950	-35.68	52.8822	-19.14
26-Oct-16 08:52:24	B	FRED OLSEN ENERGY NOK20	4,077	8,191	6	100.00%	3ms	16.6287	16.5500	-47.52	16.6000	-17.26
26-Oct-16 08:19:28	S	MDXHEALTH SA MDXHEALTH ORD	7,000	36,374	18	100.00%	00h 46m	4.7563	4.7765	-42.38	4.7614	-10.89
26-Oct-16 16:00:08	B	ISHARES VI PLC (THE 'COMPANY') ISHARES JPM \$ EM BOND EUR HDG	5	568	1	100.00%	-	104.0000	104.0650	6.25	104.0282	2.72

Disclaimer

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LiquidMetrix Calculation Methodology

Benchmark Prices

The results shown in this report are calculated by comparing prices achieved by each Order with market prices and liquidity about the time of the Order. More specifically:

- The individual Trade Fills of Parent Orders are compared with lit order book liquidity (bids and offers on lit venues) at the time of each fill. Based on this, an assessment is made of whether the price of each Fill achieved the best possible price available in the market at that time. The benchmark used for this assessment is the price that would have been achieved by sending a single aggressive order with the same volume as the Trade Fill in question to the best lit venue at the time of the Fill.
- Overall performance of the Parent Order is based on an assessment of the average price achieved by the Parent Order with various metrics measured over the lifetime of the Order. These metrics include 'Implementation Shortfall' type measures based on the Arrival Price of the order and 'VWAP' type measures that compare the average price achieved in the market around the time of the Parent Order.

Results shown in this report are a combination of 'Trade Fill' level and 'Parent Order' level benchmarking.

Details by Section

Trading Summary Section

- **Value Traded** : The sum of all the notional values of all orders in the reporting period.
(Bought) : [Optional] The sum of all Buy Orders in the reporting period.
(Sold) : [Optional] The sum of all Sell Orders in the reporting period.
- **Number Of Orders (fills)**: Number of distinct orders (fills) analysed.
- **Average Order Size (Average Fill Size)**: Average notional value of each order (fill).
- **Book Spread (depth/touch)**: This is calculated by measuring, at the exact instant of each trade fill, the on-book bid/offer spread of the lit venue with the tightest spread. These values are averaged over all trades (weighted by trade value). This measure gives an indication if the trades are in liquid, low spread stocks (small number) or less liquid, high spread stocks (larger number). The value 'at touch' means that top of the book bid/offer spreads are used. The value 'at depth' means that the size of each fill is taken into account and spreads are based on 'matching down' the lit order book.
- **Distinct Instruments**: Number of distinct ISIN/CCY instruments for which trades are included in this report.
- **Average Trade Duration**: Average time (in hours) from the first fill to last fill over all orders.
- **Execution Style**: Each fill is compared to EBBO and based on this an assessment is made of whether the trade was aggressive (paying the spread), passive (capturing the spread) or mid (capturing some of the spread). A breakdown is then shown of the relative percentages of each type of trade.
- **Venue Types**: A breakdown based on whether each fill is traded on a Primary Exchange, and MTF or 'Other'. 'Other' may mean dark pools, crossing networks or any other venue that is not a Regulated Exchange or MTF.
- **Venues Traded**: A breakdown of the percentage of fills that are executed on each trading venue.
- The graph on the right will show one of four things:
 - The total value traded each day.
 - A breakdown of orders based on the size of order.
 - A breakdown of all orders based on the country of the stock traded (first two characters of the ISIN code).
 - A breakdown of all orders based on the Portfolio Manager associated with the order.

Performance Summary Section

The table on the left shows overall order performance versus a number of benchmarks (some or all may be shown). The table always shows overall average improvement (shortfall) in basis points (BPS) versus each benchmark. It also shows either a breakdown of that performance by buy/sell orders or the standard deviation of individual benchmark performances. The benchmarks available are:

- **Market VWAP First/Last Benchmark** is the VWAP price of all public trades on all venues (including MTFs) over the period of the order.
- **Market Limit VWAP First/Last Benchmark** is the VWAP price of all public trades on all venues (including MTFs) over the period of the order. For limit price VWAP orders the VWAP is based on all public trades are up to and including the limit price.
- **Primary VWAP First/Last Benchmark** is the VWAP price of all public trades on the primary listing exchange over the period of the order.
- **Primary Limit VWAP First/Last Benchmark** is the VWAP price of all public trades on the primary listing exchange over the period of the order. For limit price VWAP orders the VWAP is based on all public trades are up to and including the limit price.
- **Market Daily VWAP Benchmark** is the VWAP price of all public trades on all venues (including MTFs) on all complete trading days of the order.
- **Market Daily Limit VWAP Benchmark** is the VWAP price of all public trades on all venues (including MTFs) on all complete trading days of the order. For limit price VWAP orders the VWAP is based on all public trades are up to and including the limit price.
- **Primary Daily VWAP Benchmark** is the VWAP price of all public trades on the primary listing venue on all complete trading days of the order.
- **Primary Daily Limit VWAP Benchmark** is the VWAP price of all public trades on the primary listing venue on all complete trading days of the order. For limit price VWAP orders the VWAP is based on all public trades are up to and including the limit price.
- **Arrival (mid) Benchmark** is the mid price on the primary exchange at the 'Arrival Time' of the order. This is often referred to as 'Implementation Shortfall'.
- **Arrival (touch) Benchmark** is the touch price (bid for a sell order, offer for a buy order) on the primary exchange at the 'Arrival Time' of the order.
- **Limit Arrival (mid) Benchmark** is either the Arrival Mid Price or the Limit Price of the order, whichever is appropriate. For Buy orders: $\text{LimitArrivalMid} = \text{Min}(\text{ArrivalMid}, \text{LimitPrice})$. For Sell orders: $\text{LimitArrivalMid} = \text{Max}(\text{ArrivalMid}, \text{LimitPrice})$.
- **First Fill (Mid) Benchmark** is the mid price on the primary exchange at the time the First Fill of the order is executed.
- **Previous Closing Price Benchmark** is the previous day's closing price on the primary exchange.
- **Opening Price Benchmark** is the opening price on the primary exchange on the first day of the order.
- **Closing Price Benchmark** is the day's closing price on the primary exchange on the last day of the order.
- **Momentum 1Day** The price change in BPS in the direction of the order measured from the opening of the day prior to trading until the opening price of the day of the first fill of the order.
- **In Trade Alpha** The price change in BPS in the direction of the order measured from the price of the first fill to the price of the last fill of the order.

Below this there is a summary performance and standard deviation for the principal benchmark metric (this is chosen at report level).

The graph on the right shows the daily performances of orders versus the principal report benchmark. The solid rectangles show the mean benchmark performance in basis points (BPS) for that day coloured blue for an improvement and red for a shortfall. The thin vertical lines show 1 standard deviation above and below the mean and give an indication of the variation in order performance day by day.

Aggregate Performance Breakdown Tables

These tables summarise trading activity and performance split by different characteristics of the order such as order side (buy/sell), order size, instrument traded, country traded, etc. Note that orders for which benchmark prices are not available, for instance in the case of a VWAP order that executes instantaneously are excluded.

Each table has the same structure with the following table columns [not all will appear in all reports].

- **Aggregate** : The first column shows the 'value' for which orders are being aggregated in each row. It is different for each table shown.
- **# Orders** : The number of orders for this row of data.
- **Value(CCY)** : The total value traded for the orders in this row of data.
- **Val(%)** : The percentage of value traded for the orders in this row versus the overall order volume.
- **Perf v. [Primary Benchmark]** : Average order performance for this row versus the Primary Benchmark in basis points (BPS).
- **SD (BPS)** : Standard deviation of order performance for this row versus Primary Benchmark in basis points (BPS).
- **Perf v. [Secondary Benchmark]** : Average order performance for this row versus the Secondary Benchmark in basis points (BPS).
- **SD (BPS)** : Standard deviation of order performance for this row versus the Secondary Benchmark in basis points (BPS).
- **%Outside EBBO** : The percentage of executions in the row where the price achieved was worse than that available on another venue at the time of the trade.
- **Avg Dur.** : The average duration from First Fill Time to Last Fill Time for orders in this row.
- **Avg Ord Size** : The average size of orders in this row.
- **Avg Fill Size** : The average size of fills in this row.
- **Ord/Fill Ratio** : The average number of fills per order in this row.
- **%Trad Agg** The percentage of fills in this row that were traded aggressively (full EBBO spread was paid).

- **%Trad Pas** The percentage of fills in this row that were traded passively (full EBBO spread was captured).
- **%Trad Mid** The percentage of fills in this row that were traded at mid prices (part of the EBBO spread was captured).
- **%Trad Prim** The percentage of fills in this row that were traded on a Primary Listing exchange.
- **%Trad MTF** The percentage of fills in this row that were traded on an MTF.
- **%Trad Other** The percentage of fills in this row that were traded on a venue that is not a Regulated Exchange or an MTF.
- **SC (%)** : The average Spread Capture in % achieved over all fills in this row. Spread capture of 0.0% indicates that the fill occurred at aggressive EBBO price, a spread capture of 50.0% indicates an EBBO mid point match and a spread capture of 100.0% indicates a fill occurred at passive EBBO price. Maximum values of +/- 200% are shown.
- **Spread (depth)** : The average on-book spread in BPS over all fills in this row. The spread is weighted by fill volume, i.e. the order book is matched down.
- **Spread (touch)** : The average touch price (top of the book best bid and offer prices) on-book spread in BPS over all fills in this row.
- **Imp (BPS)** : The average amount (in basis points) that each fill improved on the price that would be achieved by sending a single aggressive order to the best venue at the time of the fill. A blue number represents an improvement a red one represents a shortfall.
- **SOR Shortfall** : The overall amount (in basis points) that fills could have been improved where a better price was possible by sending an aggressive order to a lit venue.
- **Momentum 1Day** : The price change in BPS in the direction of the order measured from the opening of the day prior to trading until the opening price of the day of the first fill of the order.
- **In Trade Alpha** : The price change in BPS in the direction of the order measured from the price of the first fill to the price of the last fill of the order.
- **Daily Alpha** : The price change in BPS in the direction of the order measured from the opening price to the closing price of the day of the first fill of the order.
- **Delay Cost** : The amount in BPS the price moves in the direction of the order between the arrival time and the first fill time. A negative value means that the order suffered ie the price rose between arrival and first fill for a buy order.
- **Delay Time** : The time in seconds between the arrival time and the first fill time.
- **Opportunity Cost** : The amount in BPS the price moves in the direction of the order between the open time and the arrival time. A negative value means that the order suffered ie the price rose between decision and arrival for a buy order.
- **Mean Reversion x Minutes** : The amount in BPS that the market price reverts against the direction of the order following x minutes after the last fill time and price. Where times extend after market hours, the closing price is used.
- **Participation VWAP (X)** : Performance of this order versus the market VWAP price over a period starting from arrival time of the order until the time the full order would have been executed using a participation rate of x% of overall lit continuous market volume.
- **Market Participation Rate** : The rate in % at which this order executed versus the total volume traded on continuous lit markets over the same period.

For aggregate performance tables based on fills rather than orders such as Venue (Trades) the following columns are displayed

- **[Aggregate]** : The first column shows the 'value' for which trades are being aggregated in each row. It is different for each table shown.
- **[# Trades]** : The number of trades for this row of data.
- **[Value(CCY)]** : The total value traded for the trades in this row of data.
- **[% Better]** : The percentage value traded that executed at a price better than benchmark price.
- **[% Equal]** : The percentage value traded that executed at a price equal to benchmark price.
- **[% Worse]** : The percentage value traded that executed at a price worse than benchmark price.
- **[% Success]** : The percentage value traded that executed at or better than the benchmark price.
- **[% N/B]** : The percentage value traded for which a benchmark price was not calculated (see the performance summary section for details on what kinds of trades are not benchmarked).
- **SOR (CCY)** : The total value obtained adding all shortfalls (trade prices worse than market) for all trades on this row (see performance summary section for more detail).
- **SOR(BPS)** : The SOR value above as a BPS fraction of total value traded.
- **Imp(CCY)** : The total value of all price improvements, averaged over all trades in this row (see performance summary section for more detail).
- **Imp(BPS)** : Price improvement value above as a BPS fraction of total value traded.
- **SC (%)** : The average spread capture in % over all trades in this row.
- **Spread (BPS)** : The average on-book spread in BPS over all trades in this row.
- **Avg Trade Size** : The average trade size defined as total value traded divided by number of trades over all trades in this row.
- **TWAM 1s (BPS)** : Average executed price performance versus a time weighted average mid price taken 1 second before and after the time of the trade over all trades in this row.
- **TWAM 5s (BPS)** : Average executed price performance versus a time weighted average mid price taken 5 seconds before and after the time of the trade over all trades in this row.
- **TWAM 15s (BPS)** : Average executed price performance versus a time weighted average mid price taken 15 seconds before and after the time of the trade over all trades in this row.
- **SEC Eff Sprd** : The effective spread as defined by the SEC using best bid and offer touch prices and averaged by number of shares traded over all trades in this row. Note, we recommend this value should only be used when averaging over trades for the same instrument.
- **SEC Qtd Sprd** : The average touch price spread as defined by the SEC and averaged by number of shares traded over all trades in this row. Note, we recommend this value should only be used when averaging over trades for the same instrument.
- **SEC Qtd Sprd** : The effective spread / quoted spread ratio as defined by the SEC over all trades in this row. Note, we recommend this value should only be used when averaging over trades for the same instrument.

Best/ Worst / Largest Orders Tables

These tables provide a list of the best / worst / largest orders in the reporting period.

Each table has the same structure with the following table columns [not all will appear in all reports].

- **Time** : The 'Arrival Time' of the order.
- **Buy/Sell** : Shows if the order was a buy (B) or sell (S).
- **Instrument** : The instrument traded.
- **Volume** : Total Volume (number of shares) of the order.
- **Value(CCY)** : The total value traded (based on fills).
- **% Filled** : The percentage of the original order size that was filled.
- **#Fills** : The number of fills.
- **Duration** : The total time between the First Fill and the Last Fill of the order.
- **%Part** : The average market participation rate for the order between First Fill Time and Last Fill Time. A maximum value of 100% is shown.
- **Price Achieved** : The average price achieved by the order.
- **[Benchmark]** : The benchmark price for the order. The benchmark type shown is based on the Primary Benchmark chosen for the report.
- **(BPS)** : Improvement (blue) or shortfall (red) in basis points of the achieved order price versus the benchmark price.
- **SC%** : The average spread capture in % of all fills of the order versus EBBO prices. Maximum values of +/- 200% are shown.
- **Spread** : The average spread on the primary market at the time of each fill of the order. The value is shown in basis points (BPS).