



Retail Off-Book Share Trading in the UK

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Overview

A significant portion of equity trading by UK retail private investors happens 'off-book'. Retail trades are often executed as part of an RFQ style auction conducted on a network of liquidity providers, commonly referred to as RSPs (Retail Service Providers). This process of trading, from the Retail Investor's point of view is typically:

- The Retail Investor requests a quote to trade a certain quantity of a stock via her Retail Broker. This request is usually initiated via her Retail Broker's Internet dealing screens rather than a telephone these days.
- The Retail Broker polls an RSP network, typically consisting of 5-20 RSPs, for quotes on behalf of the investor. The RSPs will each respond with prices to deal. The Retail Broker generally selects the best quote received from the RSP network within a certain time (usually a second or two) and shows this price to the retail investor as an offer to deal.
- The Retail Investor gets between 15-30 seconds to decide whether to deal or not. If the price is not appealing, she can re-request a further quote straight away or at a later time.

The process has a couple of attractions to the Retail Investor. One of these is certainty on price. The investor gets a firm offer to deal at a fixed price (effectively a free option) for 15-30 seconds. The other advantage is that by convention, the prices offered by the liquidity providers in an RSP network will be generally at least as good as prices on the visible order books of the main market (London Stock Exchange). Off book retail trading via RSPs has operated like this for a number of years.

Post MiFID however, there have been some large changes in how stocks are traded in Europe, specifically,

- Prices and liquidity have fragmented over multiple venues with the entrance of the MTFs (Multi-lateral Trading Facilities).
- There has been a lowering of tick sizes and a general tightening of spreads, especially in more liquid stocks in the last year.
- There have been a number of new liquidity providers entering the market such as Citadel, GetCo and Knight. These new entrants began by principally quoting on the primary exchanges / new MTFs but more recently have begun to also quote prices via RSP networks.

Given these recent changes, it is useful to analyse how the prices being obtained by Retail Investors trading off-book on RSP networks in London compare to the best prices available against both the main market (LSE) on its own (VBBO LSE) and also to the newer consolidated best LSE/MTF EVBBO prices. There have been numerous public discussions recently relating to how well orders from European Retail Investors are exposed to 'the market' and the quality of prices they are achieving.



The London retail market structure is a little different to mainland Europe, but this white paper endeavours to provide some objective information on the quality of prices being achieved in the UK for off-book RSP trades versus the best prices on the LSE/MTF order books.

Let's start by describing the set of trades we will use to conduct the study.

The Data Set

For the purposes of this white paper we will use a publically available (counterparty anonymous) data set, namely all trades that were reported to the PLUS trade reporting venue over the week of 12-16th April 2010. We will only consider trades for LSE listed stocks and have excluded some of the larger deals, deals in non GBP currency and deals inside intraday auction periods or other non-continuous trading periods, where insufficient on-book liquidity was available to trade. To measure price improvement we classify the 'side' (buy/sell) of the aggressor of the trade, based on the mid-point price on the primary market (LSE) at the time of trade.

The data set consists of around 140,000 trades with a value traded of a little under £1 billion.

The majority of trades reported to PLUS are 'retail' in nature, most are the result of RSP auctions, hence they provide a good public data set to analyse UK retail trades. The results we demonstrate in this article are also very similar and consistent with other analysis we have done on private data sets where all counterparties are known.

Benchmarking Methodology

We take each PLUS reported trade and then compare the price reported to PLUS with historically re-built, full depth order books of all exchanges (LSE and MTFs) that had visible volume for that stock at the exact time of the trade. We then 'match' each trade's volume against the visible order book liquidity as if an aggressive order of that size were sent to market. We present two sets of results, one where we match the trade only against liquidity from the main market (LSE), which we will refer to as **VBBO**, and another where we match against the combined liquidity on all lit venues (consolidated LSE/MTF order book) which we will refer to as **EVBBBO**.

For comparison with other studies, we also present results where instead of benchmarking by matching the full volume of each trade against order books, we simply use the best price (touch price) at the time of each trade (we refer to these 'touch' benchmarks as **BBO** for the LSE and **EBBO** for consolidated LSE/MTFs). Touch price benchmarks are somewhat unfair / unrealistic as they take no account of the size of the order being executed. They are, nevertheless, often used and quoted in other studies where full depth re-built books are not available. It is interesting to note the difference in results we have found between 'volume-weighted' and 'touch price' benchmarks, especially as there have been some recent suggestions to use some form of EBBO touch price as the basis of a



consolidated tape for Best Execution analysis in Europe. Our results show that this may give misleading Best Execution results.

Price Improvement Analysis

1. Price Improvement versus London Stock Exchange (VBBO)

The basic results of benchmarking around 140,000 PLUS trades versus LSE prices using volume weighted prices (VBBO) are shown below:

Number of Trades	Value Traded	%Better than VBBO	% Equal Best	% Worse than VBBO	P/L (BPS)	Average LSE Spread
140,529	£941.74m	86.81%	6.63%	6.56%	14.01	66.26

To summarise these results

- Approximately **86.8% of the time the prices achieved by Retail Investors and reported to PLUS are better than** the best price available on the LSE. 6.5% of the time the prices match exactly the prices on the LSE
- Approximately **6.6% of the time the prices reported on PLUS were worse than** the price available on the LSE. (We refer to these trades as best execution ‘outliers’)
- Averaged over all trades, the prices achieved on PLUS were **14.01 BPS (0.14%) better than** the prices available on the visible LSE order books.
- The bid offer spread on the LSE at the time of each reported trade averaged over all trades in the data set is 66.26 BPS. So, another way of seeing the price improvement figure above is that of the 66.26 BPS average spread available, 14.01 BPS (about 20%) is captured by the aggressive side of each off-book RSP trade.

Clearly these results are averaging over many different stocks, ranging from trades in the most liquid FTSE-100 stocks that have average spreads of a few basis points to infrequently traded AIM stocks with on-book spreads usually measured in the hundreds of basis points. The table below splits the 140,000 trades into groups based on the bid/offer spread on the LSE at the time of each trade so we can see what is happening with different groups of stocks:

Spread Range	Value Traded	% Num of Trades Worse Than Benchmark	Average Spread	Average Basis points Price Improvement	Spread Capture
0-5 BPS	£125.08M	12.83%	3.4	0.47	13.7%
0-10 BPS	£247.17M	8.46%	7.5	1.14	15.2%



10-25BPS	£257.94M	7.68%	15.7	2.86	18.2%
25-50 BPS	£105.17M	4.44%	34.8	7.25	20.9%
50-100 BPS	£73.63M	3.43%	70.1	15.81	22.6%
100-250 BPS	£71.54M	2.20%	160.1	31.53	19.7%
>250 BPS	£61.30M	1.28%	584.0	129.43	22.2%
ALL	£941.74M	6.56%	66.3	14.01	

The number of best execution ‘outliers’ ranges from about 12% of trades for the lowest spread stocks down to just 1% for stocks with the widest spreads.

Also, as would be expected, the average price improvements versus the LSE get larger as the LSE spread gets larger. The price improvements rise from **just half a basis point up to over 100 basis points** for the highest spread stocks. The spread capture obtained by Retail Investors (price improvement divided by spread) rises from about 13% for the most liquid (low spread) stocks and up to almost 22% for the less liquid ones.

The conclusion is when compared with LSE on book prices, the prices obtained on RSP networks are **better** majority of the time and on average this equates to around 14 BPS (0.14%). One caveat is that the price improvement is smaller for low spread stocks (typically FTSE-100) but even in this case the improvement is still more than 10% of the bid offer spread.

Next we see what happens if we also include liquidity from the MTFs.

2. Price Improvement versus European VBBO

This time we compare the reported PLUS trades not with only LSE prices but instead use the European VBBO i.e. the consolidated liquidity from all lit order books. The headline results are shown below with the figures for LSE only shown for reference.

	%Better	% Equal Best	% Worse	P/L (BPS)	Average Spread
European VBBO	79.25%	7.31%	13.43%	11.77	61.42
LSE only	86.81%	6.63%	6.56%	14.01	66.26

- The price improvement overall trades drops from 14.01 BPS for LSE only to 11.77 BPS for LSE/MTFs. This is still a very clear price improvement but it shows that averaged over the time/size of the PLUS trades, **EVBBO prices are about 2.24 BPS better than LSE only prices.** [We will say more about this later. The main difference between VBBO and EVBBO prices is more due to the extra liquidity provided on multiple venues rather than better absolute touch prices].
- The number of times the price achieved is worse than what can be achieved by trading on the lit book rises quite sharply from 6.56% for LSE only to 13.43% for LSE/MTFs .



- The average EVBBO spread over all PLUS trades is 61.42 BPS as opposed to 66.26 BPS for the LSE only. This means that although the overall price improvement has dropped, the spread capture figure drops to a smaller degree and is still close to 20%.

If we again split the results into bands based on EVBBO spreads at the time of each trade we can see how different types of stock fare against EVBBO:

Spread Range	% Trades Worse Than Benchmark	Average Spread	Basis points Improvement	Spread Capture
0-5 BPS	25.25%	3.28	0.10	3.05%
5-10BPS	16.63%	7.34	0.56	7.59%
10-25BPS	14.36%	15.74	1.95	12.41%
25-50BP	10.10%	35.51	5.74	16.17%
50-100 BPS	6.31%	70.17	12.60	17.95%
100- 250 BPS	3.26%	162.55	29.02	17.85%
250BPS+	1.44%	595.80	128.30	21.53%
ALL	13.43%	61.42	11.77	

Conclusions we can draw from this are:

- Many of the 'new' outliers (prices worse than benchmark) that appear when including the MTFs happen with **the most liquid stocks**. There are now around 25% of prices that are 'worse' than EVBBO for stocks with the lowest spread as compared to around 13% for LSE alone.
- Spread capture relative to EVBBO for stocks with small spreads is just 3%. This is much lower than the spread capture relative to LSE, which is 13.7%.

So the main two impacts of matching against a consolidated LSE/MTF benchmark price rather than LSE only is that

- The benchmark prices to beat become, on average, around two and a quarter BPS 'better' and
- The number of outlier trades against the EVBBO benchmark, especially for low spread stocks, rises significantly.

However, **for stocks with on-book spreads of more than 10 BPS, UK investors still receive a good price improvement over on-book prices even after taking the MTFs into account**. So trading on the RSP networks still significantly beats trading using a smart order router that immediately routes aggressive orders to the best European order book.

So if the Retail Investor is offered by their Retail Broker a guarantee to simply match European EVBBO price, this would be a worse deal than they are currently getting through trading via the RSP network.



3. Why Touch Prices are misleading

Our analysis so far has used benchmarks based on the price that would be achieved by sending an aggressive order (or orders) to market and then receiving whatever price results from matching ‘up’ the book(s). This is realistic in that it will not, for instance, benchmark an order for 25,000 shares against a ‘best’ touch price that is for only 100 shares. As tick sizes have gotten smaller and competition intensified between venues in recent years, it is common to only have small volumes quoted with the best prices and so care should be taken when using touch prices.

However, mainly for historical reasons and the technical ease with which touch price benchmarking can be done, it is still common for some Best Execution analysis and studies to be based on ‘touch prices’ regardless of the size of the order being benchmarked. For comparative purposes, it is therefore interesting to see the effect of using a ‘touch price’ benchmark rather than the more realistic volume based one we have used in the previous sections.

The table below shows the results comparing EVBBO (volume weighted) and EBBO (touch price) benchmarks for trades in the PLUS data set. We have split the results by the size of the trade being benchmarked.

Trade Size	% of Value Traded	EBBO % Trades Worse Than Benchmark (touch prices only)	EVBBO % Trades Worse than Benchmark	EBBO Basis points Improvement (touch prices only)	EVBBO Basis points Improvement
0-1K	1.91%	11.46	11.07	34.86	41.74
1-5K	17.36%	14.27	12.73	14.83	22.85
5-10K	17.56%	17.89	14.19	6.29	13.54
10-25K	25.06%	22.78	16.55	1.84	9.71
25K-50K	15.18%	31.23	21.73	-1.82	6.02
50-100K+	11.79%	36.14	24.73	-2.23	4.67
100+	11.15%	37.93	21.92	-2.44	6.68
ALL	100.00%	15.97	13.43	3.99	11.77

In summary

- Overall, for all trades, **using touch prices rather than volume matched prices causes the ‘apparent’ price improvement to drop from 11 BPS to just 4 BPS.** So based on the touch price method Retail Investors do not seem to beat the market price by nearly as much.
- As might be expected the effect of using touch prices is even more severe as we look at larger order sizes. **For orders > £25K, using touch prices as a benchmark leads to an impression of prices achieved being worse than benchmark prices,** i.e. a negative price improvement is shown. Also the number of best execution outliers using touch prices only, goes up to over 1/3 rd of all orders for deals greater than £25K.



- The smallest orders (<1K) are less affected in terms of number of best execution outliers, but even here there is a marked change in the overall price improvement rate indicating that that the value available to trade at EBBO touch price can often be less than £1,000.

Clearly, results obtained using a benchmark based on simple touch prices are markedly different to those obtained by correctly matching order sizes to available liquidity. This implies that the volume available at best prices is often less than the size of a typical retail order.

Using a touch price benchmark gives the impression of more outliers and a lower overall price improvement. However, this is misleading as the touch price benchmark is not achievable for medium / larger order sizes assuming they are to be executed by sending aggressive orders immediately to market.



4. Consolidated Order Book Or Best Venue?

The measure we have used for EVBBO is to consolidate the liquidity from all order books on the LSE and the MTFs and assume that an aggressive order can be sent that will make use of **all** of the liquidity available on all venues. In practice this might be a little unrealistic. From the technical perspective this benchmark assumes that to achieve the benchmark prices, a smart order router would have to split each individual order into multiple clips, one for each venue and to then send these clips to each venue and assume all will ‘hit’ the visible liquidity. There is an increased risk that one or more of these market orders will ‘miss’ the liquidity requiring re-submissions. Even assuming all orders get filled on all venues, from a pure cost point of view, splitting orders like this will lead to more complex clearing / back office situations and associated fees/costs.

A different ‘Europe wide’ measure we could use to benchmark prices is, rather than taking all liquidity from all venues, we assume that we will send a single aggressive order to the venue with the best price available (taking into account any matching up the book required).

If we use this (Single best venue EVBBO) benchmark as opposed to the earlier (multi-order EVBBO) benchmark we get the results below. (Previous results for LSE VBBO are also shown for comparison.)

LSE VBBO % Trades Worse than Benchmark	Single best venue EVBBO % Trades Worse than Benchmark	EVBBO % Trades Worse than Benchmark	LSE VBBO Basis point improvements	Single Best venue EVBBO Basis points Improvement	EVBBO Basis points Improvement
6.56	12.18	13.43	14.01	13.71	11.77

The interesting point to note is that **the price improvement using the ‘Single best venue’ EVBBO is only about 0.25BPS worse than using the LSE VBBO price only**. This indicates that most of the benefit in terms of price improvements over the LSE provided by MTFs comes through the extra liquidity available to hit at best prices rather than purely better prices on the MTFs. So, to take full advantage of EVBBO prices it is really necessary to split orders and send them to multiple venues, not to just send a single order to the apparently best venue.

It also means that a broker promising to ‘match the price of the best venue in Europe’ is not offering as good a deal as one that is offering to match the best price of the consolidated European order book.

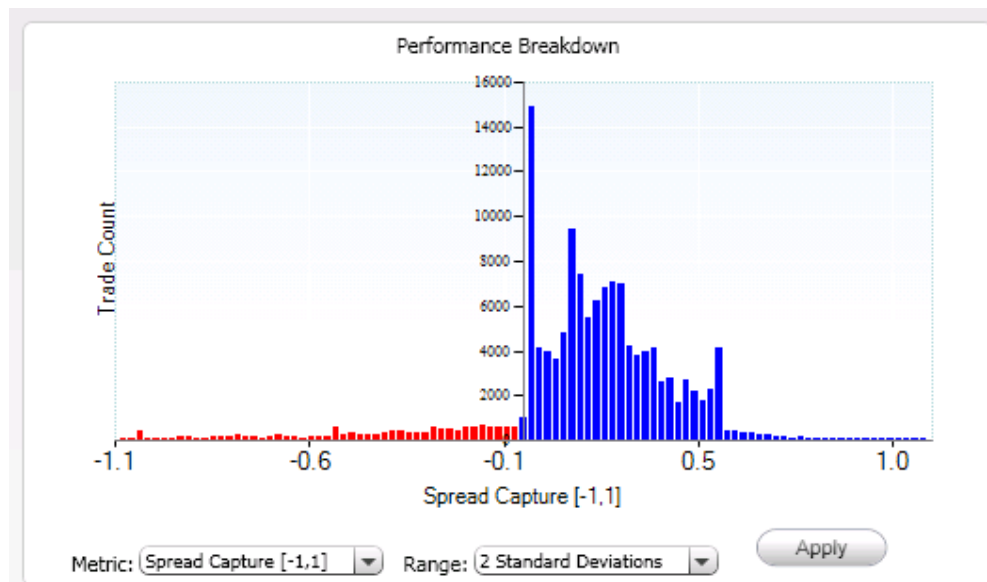


5. Trade by Trade Analysis

To provide a clear picture of the overall price improvements offered on RSP networks we have shown aggregated results of many thousands of trades. Whilst this gives a clear overall idea of the average amount of price improvement a Retail Investor may obtain by using RSP networks, we do lose some of the detail on how price improvements vary trade by trade.

A good way of visualising how the prices achieved on RSP networks and reported on PLUS compare with EVBBO prices on a trade by trade basis is to take the 'spread capture' of each trade and then show a histogram showing how the spread captures varies.

Spread capture is a metric that measures the price achieved relative to the benchmark price. A value of 0.0 for spread capture for a buy trade indicates the trade occurred at exactly the market offer benchmark price. A value of 0.5 for spread capture indicates that the trade occurred at market benchmark mid price. A value of 1.0 means the trade occurred at bid price. A negative number implies a trade occurring at a price worse than the offer.



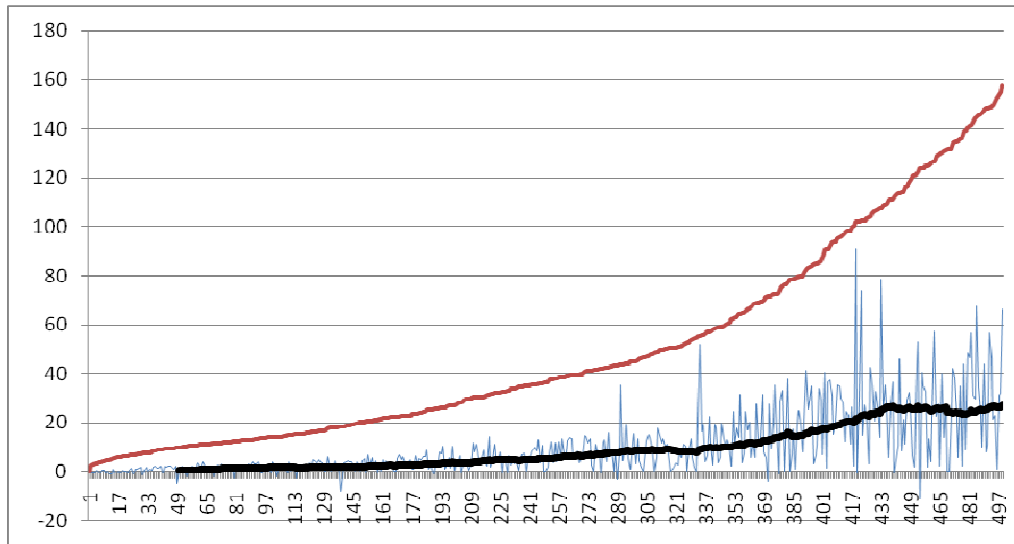
The chart above shows the distribution of the spread capture of all PLUS reported trades versus European VBBO.

So, as we reported earlier around 13% of trades are shown in red having negative spread captures (i.e. they were executed at 'worse than market' prices).

The remaining 87% or so of trades are at or better than VBBO. There is a broad peak centred around a spread capture of about 0.25, and narrow spikes at touch price and then a very sharp tail off after mid-price (0.5).



Another good way of seeing how price improvements vary for instruments with different spreads is the graph below:



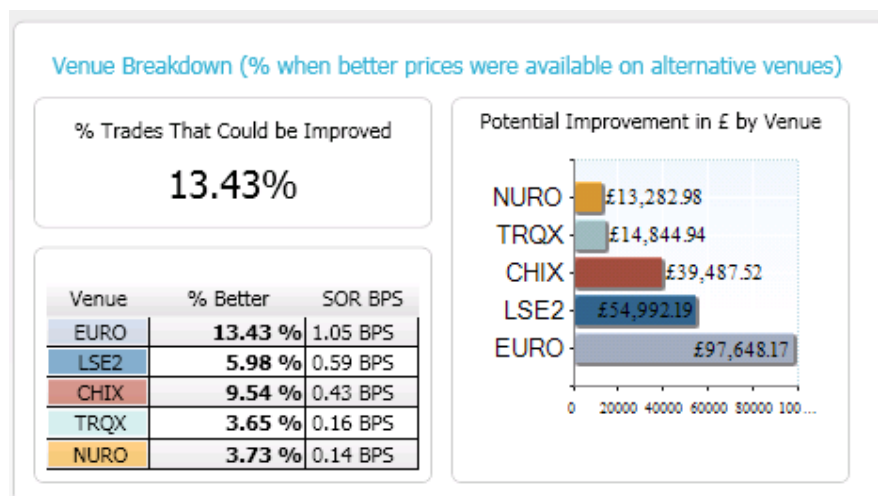
Here we have taken the price improvements for the first 500 instruments with the lowest on-book spreads (x-axis) and plot the average spreads of each instrument (red line) and the average price improvement offered (light blue line). The instruments have been ordered by spread ascending, the thick black line shows a moving average of the price improvements (which are individually quite noisy).

This graph shows that the price improvement offered is dependent on the spread of the instrument traded but the relationship is not a fixed ratio and tails off at around 30 BPS.



6. Which Trading Venues offer 'Better' Prices most often?

As we have shown earlier about 13% of PLUS trades reported are worse than European VBBO. It is interesting to consider, in these cases, which were the trading venues that were offering better prices (taking order size into account)? The chart below shows on a venue by venue basis, which venue could offer better prices:



'EURO' is the consolidate European order book, the other rows in the table show individual trading venues and how often the prices on each venue individually were apparently better than the price reported to PLUS.

CHI-X offer the greatest number of price improvements by number of trades (9.54% of the time the price on CHI-X was better than the PLUS reported price). LSE however, offers the greatest overall improvement potential by value improved (0.59BPS).



Summary

In conclusion, here is a summary of our findings:

- Most off-book UK retail trades **happen at prices better than** those available to aggressive orders sent to the LSE. The overall price improvement achieved by Retail Investors on RSP networks in the UK is about 14 BPS (0.14%) representing an improvement of about 20% of the bid/offer spread.
- About **6% of off-book RSP trades happen at prices worse than LSE**, most of these outliers are in stocks with low on-book spreads (<10 BPS).
- Using a benchmark based on the combined LSE/MTF (EVBBO) best prices as opposed to LSE (VBBO) only, changes these results slightly, lowering the price improvement achieved by Retail Investors from 14 BPS to just under 12 BPS.
- Using the combined LSE/MTF EVBBO price measure the number of trades at worse than benchmark prices rises to about 13%. So using RSP networks, **87% of trades happen at a price as good as or better than consolidated LSE/MTF EVBBO**.
- **Touch price based metrics give significantly different results**. The number of apparent outliers shoots up especially for any orders greater than £10,000. The overall average price improvement achieved drops from 12BPS to just 5PS when using touch prices. This indicates that the value available at touch on lit venues is frequently less than the typical UK retail order size and as such **a simple EBBO touch price may not be meaningful or fair in any best execution analysis**.
- The amount of the spread offered to retail investors as price improvement compared to the on-book prices varies based on the size of the on-book spread. UK Investors are offered the most 'spread capture' for stocks that have spreads of over 25 BPS and somewhat less for stocks with smaller spreads (though still some).
- There is a considerable difference between using a benchmark based on sending a single order to the venue with the best price in Europe and splitting the order and hitting liquidity on all venues. **Most of the advantage offered by multiple venues seems to come not purely from better touch prices but from more liquidity at similar best prices on multiple venues**.
- In cases where better prices were available, CHI-X offered better prices most frequently (9 % of the time) with the LSE second. This is not necessarily surprising as many RSP deals are currently 'priced off' the LSE best price as a benchmark so LSE would have fewer better prices.



Overall the results indicate that any offer by a Broker to match ‘the best European on-book price’ would actually result in a considerably worse deal for UK investors than the current option of trading via an RSP network. Of course, if the broker offered a large price improvement relative to the best on-book price at the time of the trade this may result in a better deal overall, but the price improvement offered would have to be quite large for any non FTSE-100 stocks (or any stocks with on-book spreads greater than 25 BPS). An offer by a Broker to price improve the best market price by 20% of the on-book spread would achieve about the same prices as retail investors currently enjoy.

Note, the exact meaning of ‘best price’ is important. An offer to match the best EBBO touch price would actually be quite generous for orders > £25K but not so good for smaller orders. Also, an offer to match the *single* best European venue would be much less generous than offering to match the EVBBO consolidated price across all venues. However, in practical terms SVBBO is a probably more achievable and realistic measure than EVBBO.

Caveats

There are a couple of caveats with these results.

- PLUS is only a subset of UK retail off book trading so the results presented here are somewhat biased in terms of the trades we have selected to benchmark.
- The method we have used to classify the ‘aggressive’ side of the deal may not always be accurate. If liquidity providers offer prices that ‘cross’ over the LSE mid price and offer prices better than LSE mid price, then our results will tend to slightly underestimate the price improvements achieved from the point of view of the Retail Investor.
- Timestamps are an issue. We use the timestamps for trades as reported by Plus but given the high frequency nature of price changes nowadays, where BBO prices can change on an exchange hundreds of times a second, it is likely that many, if not most, of the worse price ‘outliers’ we report are really just ‘noise’ caused by micro-second price fluctuations. So the fairly high figures of outliers (13%) for liquid stocks versus EVBBO may not really be as significant as first appears. More relevant perhaps, are the overall average price improvement figures which will tend to cancel out timing issues by averaging over tens of thousands of trades.
- Also, the times we use for benchmarking are the times the deal was executed, as reported to PLUS and not the time the RSP makes the quote. This will also inflate the number of outliers, but will have little effect on overall price improvements assuming no adverse selection.

Even given the caveats above, as we stated earlier, the results we present here are consistent with the results we obtain using private data sets where timestamps are more precise and counterparties (and hence aggressor/liquidity provider status) are known exactly.