SIX Swiss Exchange

Trading InfoSnack #13: Struck in the Middle (With You)

20 December 2023

Struck in the Middle (With You)

Quick Summary

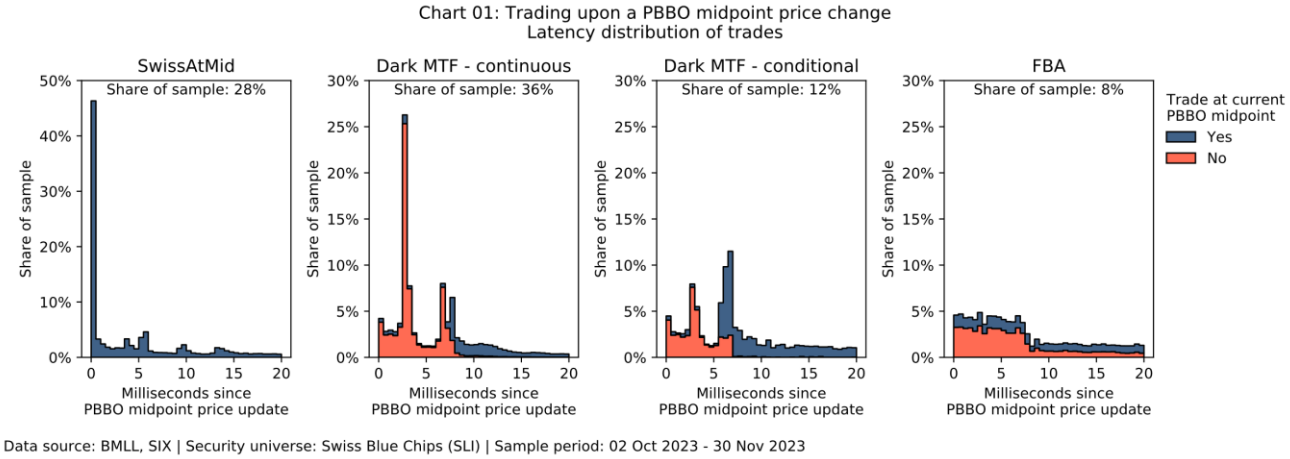
- Circa 90% of liquidity on dark-continuous, dark-conditional and frequent batch auction orderbooks executes or intends to execute at a price point that is equal to the Primary's Best Bid / Offer (PBBO) mid-point price
- On London-based dark-continuous books 36% of trades are executed within the first 20 milliseconds (ms) following a PBBO mid-point price change, whereas for dark-conditional enabled books and frequent batch auction (FBA) books the shares are12% and 8% respectively
- Stale-price executions are detected across all London-based venue types with the total proportion of stale-price trades being 26% for dark-continuous, 5% for dark-conditional and 4% for FBA
- Whilst being mechanically able to price-form, circa 75% of Frequent Batch Auction trades occur at the current PBBO mid-point price, suggesting a high degree of mid-point pegged liquidity
- Cumulative LIS market share in the first second post a PBBO mid-point price change accounts for approximately a third of total LIS trades and is dominated by SwissAtMid and CBOE LIS

Introduction

The sourcing of mid-point liquidity is a key facet of equity market trading in Europe. For the liquidty taker, the opportunity to save half the spread is attractive and for the liquidity poster, reduced market impact (depending on the trading mechanism) and the potential to trade in greater size helps to offset giving up half the spread. To this end, the vast majority of non-displayed (i.e. dark) and frequent batch auctions orderbooks offer some form of matching at the prevailing PBBO mid-point, the total turnover executed through such mechanisms (at all price points) represents up to 17% of daily liquidity across European markets so far in 2023. As such, exploring the price and liquidity dynamics surrounding mid-point moves is crucial to optimising liquidity sourcing.

Order execution patterns around mid-point moves (<20ms)

When executions occur on mid-point enabled orderbooks surrounding PBBO mid-point price changes, the resulting trade distribution can be plotted according to: (i) time since the PBBO mid-point price change occurred;and (ii) whether trades occurred at the 'new' (current) or the 'old' (stale) mid-point price. Chart 02 below summarises this from the time of PBBO mid-point price change (T=0ms) out to 20 milliseconds (T=20ms), across venue types for Swiss Blxue Chips in Q2 2023. Trades occurring at the current PBBO mid-point price are illustrated in blue and trades occurring at the stale PBBO mid-point price are illustrated in red. When considering each panel of Chart 02 (below) from left to right several observations can be made.



For SwissAtMid, 28% of all trades (both LIS and Non-LIS) are executed within 20ms of a mid-point price change, with executions only ever occurring at the current PBBO mid-point price[1].

For executions on Dark-Continuous MTFs, 36% of all trades occur within 20ms of a mid-point price change, with 71% of such trades occurring at a stale PBBO mid-point price[2]. The most significant peaks of order executions occurring in-line with the microwave geo-latency (at 2.8ms) and fibre geo-latency (7ms) from Zurich to London, with the magnitude of the microwave latency peak suggesting that geo-latency arbitrage is a key driver of these executions which leads to significantly higher post-trade price reversion[3].

For executions on Dark-Conditional MTFs, 12% of the trades occurs within 20ms of a PBBO mid-point price change, with 39% of such trades occurring at astale PBBO mid-point and the most significant peaks again occurring in-line with the microwave and fibre latencies from Zurich to London. This may seem a curious result given the non-continuous nature of conditional order executions, however this is likely due to (i) some conditional-enabled venues allowing continuous firm-order executions below LIS and (ii) the effect of market data geo-latency back to conditional order enabled venues in London causing executions on already 'running' firm-up phases to occur at a stale price.

For Frequent Batch Auctions (FBAs), 8% of the trades occurs within 20ms of a PBBO mid-point price change, with 47% appearing to occur at a stale PBBO mid-point price[4]. Whilst a relatively small overall proportion of trades, it is a somewhat curious result given the non-continuous nature of FBAs. This could simply be interpreted as evidence of FBAs simply matching within an EBBO rather than a PBBO spread (on or off mid-point). However, the step change in volume and price distribution of trades at 7ms (i.e. the one-way fibre latency between Zurich and London) suggests that these are largely executions occurring at a stale price due to geographic market data latency. In addition to this, the absence of the characteristic 'double-peak' of stale-price executions as observed with dark-continuous MTFs is to be expected given the non-continuous and randomised end to FBAs, which would serve to spread stale price executions more evenly across time-points (i.e. smooth the peaks) within the one-way geo-latency time horizon (i.e 0-7ms following a PBBO mid-point price change). Interestingly, the overall proportion (%) of trades executed within 20ms of a PBBO mid-point price change has doubled since the introdution of the Accept Or Cancel (AOC) order validity type in FBAs,

[1] Due to the fact that SwissAtMid works on the same atomic matching cycle as the primary central limit order book (CLOB) for Swiss Equities.

[2] For some Dark Conditional and FBA venues, given that matching can occur away from PBBO, a 'stale price' is defined as an execution occurring away from the current PBBO mid-point price but within 7ms (i.e. the one-way geo-latency between ZHR and LDN) of a PBBO mid-point price change.

3 As described in Trading InfoSnack 09 on Stale Prices. Link: trading-infosnack-09.pdf (six-group.com)

[4] For some Dark Conditional and FBA venues, given that matching can occur away from PBBO, a 'stale price' is defined as an execution occurring away from the current PBBO mid-point price but within 7ms (i.e. the one-way geo-latency between ZHR and LDN) of a PBBO mid-point price change.

with the shape of the distribution and proportion executed at a stale PBBO mid-point price also evolving[5]. An AOC validity in combination with a Dark-to-FBA sweep order would technically give participants an opportunity to try and secure stale PBBO mid-point liquidity in a dark-continuous book and then receive an indication (i.e. order accepted not cancelled) of whether there is further liquidity available at a stale PBBO mid-point in an already running FBA[6]. Whether such stale PBBO mid-point liquidity was then subsequently secured would depend on the auction dynamics and its end time relevant to the PBBO price change and the one-way geo-latency time-horizon.

Cumulative order execution patterns around mid-point moves

Of course the first 20ms post a mid-point price change only tells part of the story, and as such examining the same trade distribution and mid-point price categorisation dynamics across different trading mechanisms and time horizons provides additional insight. Chart 02 below summarises this on a cumulative basis for different execution mechanisms across three time horizons: <20ms post PBBO mid-point price change; <1s post PBBO mid-point price change; and across all trades post the PBBO mid-point price change but prior to a new PBBO mid-point price being set. For time-point, the proportion of trades at either the current PBBO mid-point, a stale PBBO mid-point[7] or Off PBBO mid-point is illustrated, with the share (%) of the total sample indicated above each column. In considering each panel (left to right), the following observations can be made.

For SwissAtMid, no order executions occur at a stale PBBO mid-point price and circa 45% of all trades executed are done so within the first second following a PBBO mid-point price change. For London-based dark-continuous venues, circa 26%of all trades executed occur at a stale PBBO mid-point price, with 71% of executions within the first 20ms occurring at a stale price, and 45% of executions within the first second occurring at a stale price. This is particularly relevant given that approximately 57% of all trades on London-based dark-continuous venues occur within the first second following a PBBO mid-point price change. For London-based dark-conditional venues, approximately 5% of all executions occur at a stale PBBO mid-point price, with 40% of executions within the first 20ms occurring at a stale price and 11% of executions within the first second occurring at a stale price. It is worth noting here that venue classification has a considerable effect here, with some conflation between London-based venues that offer both firm and conditional matching under the same MIC code. When instead cutting the trade data by size bucket (i.e. sub-LIS vs LIS), the observed proportion of stale price executions is comparably small[8]. For FBAs, approximately only 4% of all executions occur at a stale PBBO mid-point price with 44% of all trades occurring within 1s of a PBBO mid-point price change. However, it is interestg to note that 75% of all FBA executions occur at the current PBBO mid-point price. This is perhaps counterintuitive when considering that FBAs typically trade within an EBBO (rather than a PBBO) spread and that they are mechanistically capable of being price-forming. As such, this observation potentially highlights the significant overlap between EBBO & PBBO, and also that there is most likely a significant amount of liquidity participating in FBAs that is pegged to the 'mid' in some way.

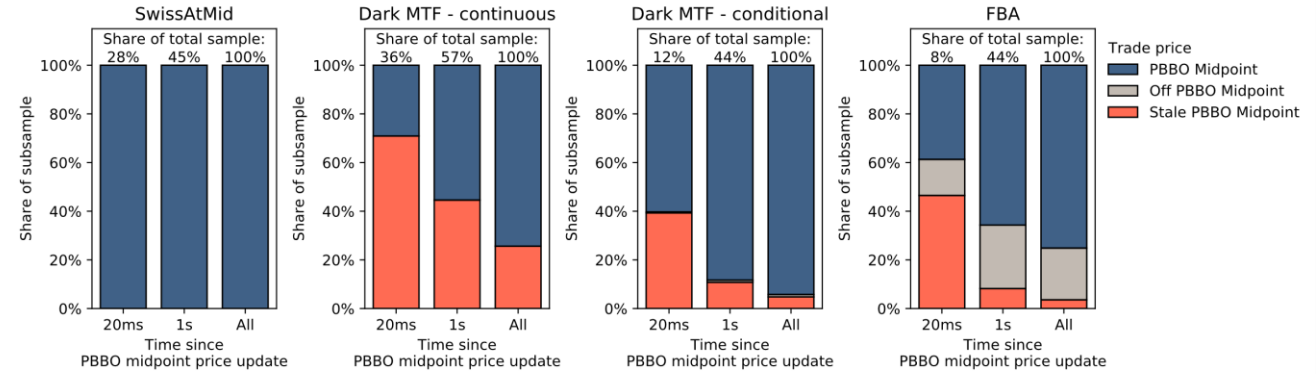
[5] Chart not shown, but can be made available as a supplement on request.

[6] Venues that operate a market model where auction starts are triggered by the first order received (rather than the first match), are likely to have a higher proportion of auctions 'running' across PBBO mid-point price changes.

[7] Where: (i) trades occur on a PBBO mid-point price referencing venue but not at the current PBBO mid-point price; or (ii) trades occur within the one-way fibre latency between Zurich and London (i.e. less than 7ms).

[8] Chart not shown, but can be made available as a supplement on request.

Chart 02: Trade price distribution of trades upon a PBBO midpoint price change



Data source: BMLL, SIX | Security universe: Swiss Blue Chips (SLI) | Sample period: 02 Oct 2023 - 30 Nov 2023
Methodology: Trade prices are called stale if the trade does not occur at the prevailing PBBO midpoint price or the trade occurs within 8 milliseconds upon a PBBO midpoint price change in case a trading venue does not match at the PBBO midpoint price.

Cumulative LIS market share around mid-point moves (<20ms; and <1s)

Chart 03 below, provides an illustration of how cumulative LIS market share changes across venues over two time horizons (<20ms; and <1000ms), following a PBBO mid-point price change. This yields insight into both the share of liquidity each venue possesses at a given time-point, including where it achieves its 'peak' share.

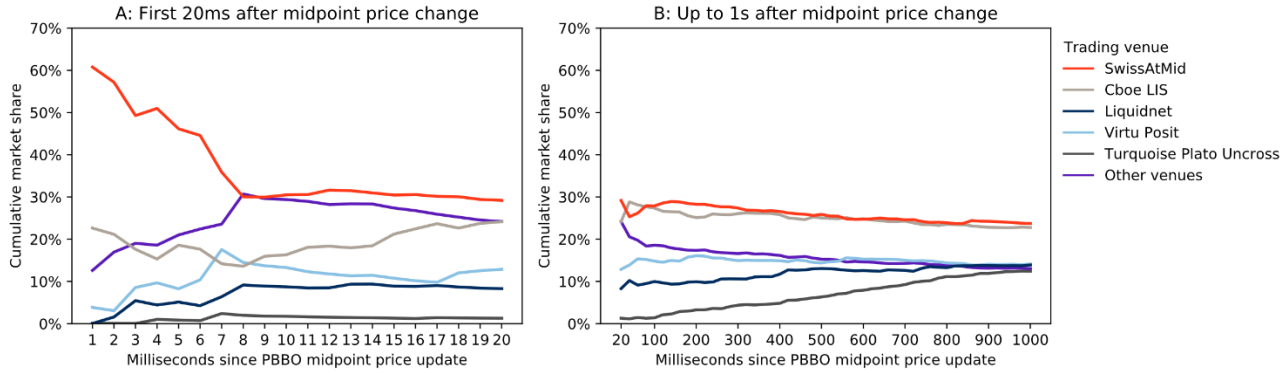
Looking firstly at the panel on the left, the significant initial market share of SwissAtMid is driven largely by resident out-of-limit LIS liquidity returning back into limit and immediately beginning to execute against contra liquidity. It is worth noting that simultaneous to immediate firm-order executions (post PBBO mid-point price change) that firm-up requests on conditional orders resting in SwissAtMid will also be being immediately generated (i.e. at T=0) and arriving in London around 6.5ms to 7ms later. Subsequent to this, at around 7ms to 8ms (again the one-way fibre geo-latency between Zurich-London plus additional market data latency hops) market share for most other venues exhibits a step-change as the PBBO mid-point price begins to be reflected in London and triggers orders to spring back into limit and begin executing at the new mid-point price.

Examining the panel on the right, over a longer time horizon (out to 1 second post PBBO mid-point price change), it can be seen that SwissAtMid and CBOE LIS possess the two highest cumulative market shares consistently across each time-point. Both of these venues show significantly higher cumulative market share than each of the other venues. Of the other venues, perhaps the most striking observation to note is that Turquoise's cumulative market share is consistently the lowest until it converges with Liquidnet, Posit and 'Other' venues at the 1 second time-point. This is most likely an artefact of its matching mechanism, which can take up to 1 second to run and execute.

The above observations yield some important considerations for the routing of LIS (block) orders. Firstly, that a significant proportion of LIS liquidity (a third of all LIS trades) is executed within the first second following a PBBO mid-point price change. Thus, tapping into this liquidity window should be an important part of participants overall block routing strategy. The execution and/or conditional matching opportunities immediately following a PBBO mid-point price change, should be of particular interest to those participants that aim to 'silo' out of limit orders in a single venue in order to reducing mid-point driven 'race-conditons'. Further to this, mid-point moves are likely to be a key trigger for participants to restart a 'staggering-out' of conditional orders to

venues. Based on internal analysis, the mean time 'out-of-book' from conditional order cancellation to reposting across all participants is <500ms (with the median <200ms). The above suggests that 'staggering-out' processes should take into consideration venues with high cumulative LIS market shares post mid-point price changes. Similarly, for those participants that wait before responding when multiple firm-up requests are received (i.e. during race conditions), it would also seem relevant to consider the (1 second post mid-point move) cumulative LIS market share of venues when responding.

Chart 03: Cumulative LIS market share of dark venues



Data source: BMLL, SIX | Security universe: Swiss Blue Chips (SLI) | Sample period: 02 Oct 2023 - 30 Nov 2023

Concluding Remarks

The insights described above yield some important considerations for trading participants seeking mid-point liquidity. Across alternative on-book trading mechanisms, the PBBO mid-point price is a highly relevant and desirable execution point, with circa 90% of non-displayed and FBA trades executing or intending to execute at a price-point equal to the PBBO mid-point price. However, the nature of a geographically fragmented trading landscape, with competing venues operating in different countries, means that stale-price executions not only occur but in some cases are driven by arbitrage seeking behaviour. From the data presented above, it is clear that stale-price executions are observable across each type of non-displayed and FBA mechanism where the matching engine sits geo-graphically distance from the primary CLOB. Given that the level of stale-price executions can be more pronounced for certain mechanism types (i.e. dark-continuous venues), and that (as previously shown[9]) this can be detrimental to execution performance, it is in participants interests to take this into consideration when routing orders. Further to this, it can be seen that whilst FBAs provide a mechanism which negates immediate liquidity removal, some level of stale-price executions can still be observed. In addition to this, it is interesting to note that the vast majority of FBA trade executions occur at price point that is equal to the current PBBO mid-point price, suggesting a high degree of FBA liquidity is pegged-to-mid. From an LIS liquidity perspective, the results above indicate that the time-horizon post mid-point change are important. Further to this, the evolution of cumulative LIS market shares across venues, across appropriate time-horizons should be noted, particularly when pooling out-of-limit orders, prioritising their 'stagger out'and when responding to firm-up requests receieved during 'race conditions'. Overall this analysis underscores the continued relevance of PBBO mid-point liquidity for the market as a whole.

Food for thought.

[9] As described in Trading InfoSnack 09 on Stale Prices. Link: trading-infosnack-09.pdf (six-group.com)

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