



The Swiss Stock Exchange

Trading InfoSnack #09: Stale prices and the price of being stale

23 September 2021

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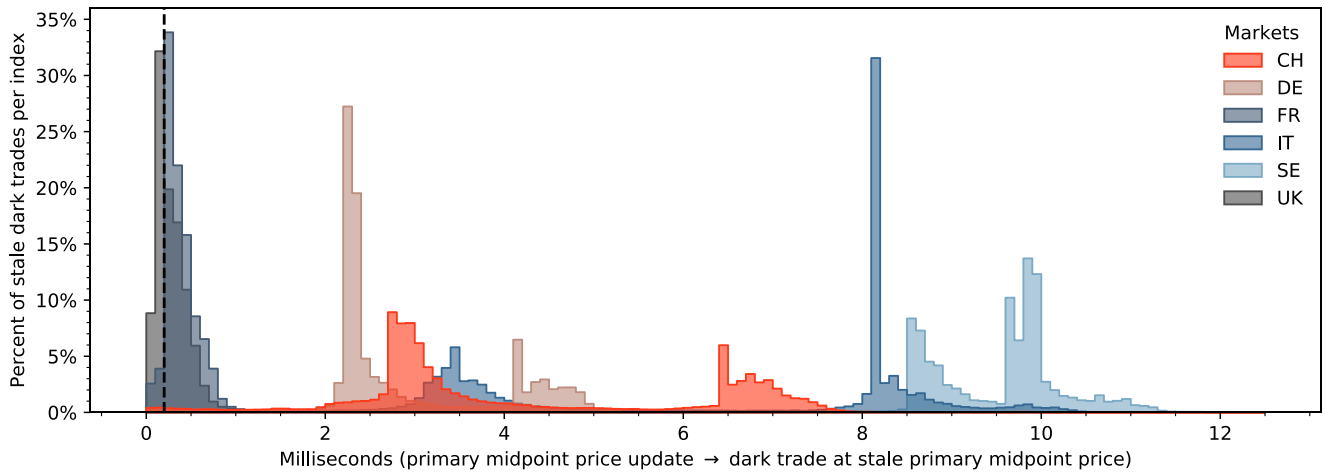
Dark trading mechanisms have become an integral part of the European liquidity landscape and offer trading participants the ability to mitigate market impact, particularly when trading in block size. In terms of execution price in dark trading solutions, the prevailing PBBO midpoint price is a core benchmark and reference price at which a significant proportion of orderflow intends to interact. Given the depth and share of daily liquidity on the CLOBs of the primary exchanges, the PBBO midpoint is a robust indicator of the current price at which securities are trading. As such, it is worth evaluating what proportion of trading activity actually occurs at this price, whether it intends to and what the causes and effects of trading away from this benchmark are.

Overall, dark trading (i.e. trading without pre-trade transparency) accounts for about 10% of order book volume in European equities. Whilst this volume is fragmented across several dark venues and dark market mechanisms, much of this volume intends to trade at the prevailing midpoint price – either PBBO or EBBO. In either scenario, given the share and depth of daily liquidity associated with primary CLOBs and the proportion of time that EBBO is equal to the PBBO (circa 87%), the PBBO midpoint provides a robust indication of the actual current price at which securities are trading. As such, analysing for the proportion of trades occurring away from the PBBO midpoint across dark trading venues yields some interesting insights.

Chart 01 illustrates the latency distribution of dark trades on London-based MTFs, for selected EU blue chip universes, that occur away from the PBBO midpoint in 100 microsecond time buckets¹. Comparing the distributions across different EU Blue Chip indices, a double peak is evident for those markets (CH, DE, IT, SE) where the matching engine for the primary CLOB is located in a different region to the matching engines of MTFs also offering trading in the relevant securities. This double peak is characteristic of the differences in data latency (from the primary CLOB to London-based MTFs) across the two main connectivity options namely, microwave and fibre. Unsurprisingly, we see just one peak between 0-1ms for both UK and French securities given that the matching engines for the primary CLOB for both of these security universes are located within Greater London. Despite this, a significant proportion (25%) of dark trades on MTFs in UK and French ISINs occur at prices away from the PBBO midpoint and as such can potentially be considered to have occurred at a 'stale price' – most likely due to cross-London latency between primary CLOB and MTF matching engines.

¹ To account for the maximum allowable divergence of timestamps between primary exchanges and MTFs according to MiFID II, a trade is only considered 'stale' if it occurs more than 200 microseconds after an update to the PBBO midpoint price. The dashed vertical line at 200 microseconds in Chart 01 and Chart 02 shows this lower bound.

Chart 01: Latency distribution for dark trades at stale* prices in European Blue Chips



Data sources: BMLL, SIX | Securities: European Blue Chips | Venues: Dark MTFs | Sample period: 01 Jul 2021 - 31 Aug 2021
 * Trade prices are called stale if the trade does not occur at the prevailing PBBO midpoint price

To further explore this trend and to probe what proportion of trades occurring away from the PBBO midpoint are truly 'stale' (i.e. they intended to execute at the PBBO midpoint), we examine in more detail the distribution of trades in Swiss Blue Chips that occur away from the PBBO midpoint on a per venue basis. Table 01 (below) provides a per-venue picture of the proportion of dark trading activity occurring away from the PBBO midpoint in Swiss Blue Chips. It is worth noting upfront that SwissAtMid operates on the same atomic matching cycle as the SIX Swiss Exchange CLOB, and as such trades never occur away from the PBBO midpoint price. When scanning across the other (anonymised) dark MTFs trading Swiss Blue Chips, it can be seen that there is a relatively high proportion of executions occurring away from the PBBO midpoint price.

Table 01: Dark trades executed away from the PBBO midpoint price in Swiss Blue Chips

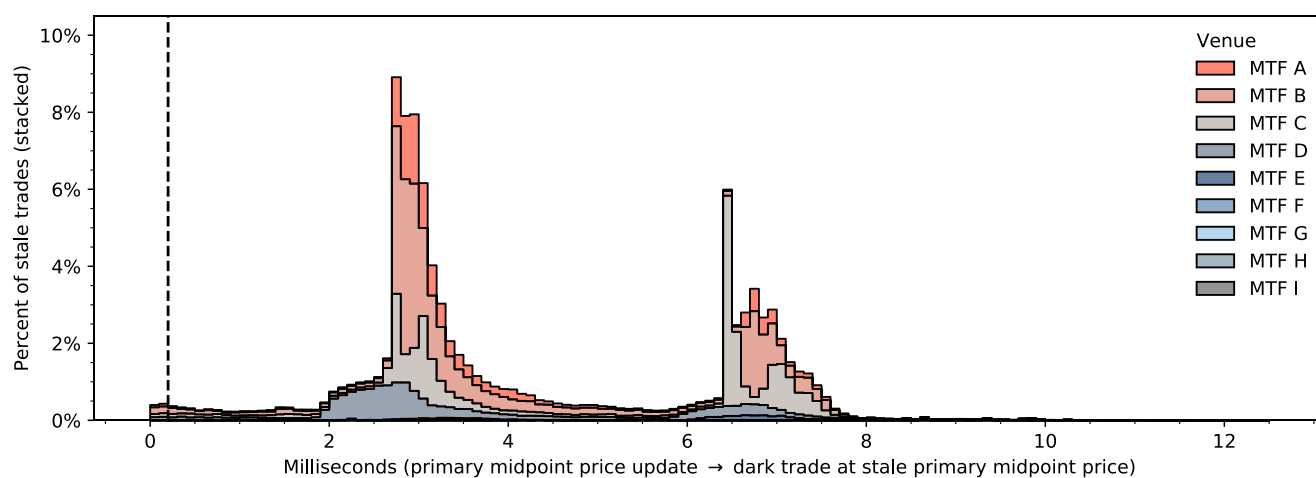
Venue	Share of trades	Share of turnover
Dark MTFs	28%	16%
- MTF A	41%	37%
- MTF B	27%	24%
- MTF C	29%	25%
- MTF D	28%	21%
- MTF E	52%	27%
- MTF F	3%	2%
- MTF G	17%	17%
- MTF H	3%	3%
- MTF I	0%	0%
SwissAtMid	0%	0%

Data sources: BMLL, SIX | Securities: Swiss Blue Chips | Venues: Dark MTFs | Sample period: 01 Jul 2021 – 31 Aug 2021

In terms of explaining the relatively high proportion of trading activity that occurs away from the PBBO midpoint price on MTFs, three factors need to be acknowledged: (i) the venue's market model and rules surrounding allowable execution price; (ii) the choice of reference price adopted for any midpoint matching (i.e. PBBO v EBBO midpoint); and (iii) inter-venue geographical latency. It is clear that a venue's market model has an influence, given that (whilst anonymised) the figures on Table 01 suggest that venues offering conditional order functionality typically show a much smaller proportion of trades executing away from the PBBO midpoint. With respect to the choice of

reference price (PBBO v EBBO midpoint), we acknowledge that PBBO and EBBO were equal greater than 87% of the time (across the sample period) for Swiss Blue Chips and as such this is likely to only be a minor driver of trading activity away from the PBBO midpoint. Finally with respect to the impact of inter-venue geographical latency, Chart 02 (below) suggests that a large proportion of trades occurring away from the PBBO midpoint intended to execute at that benchmark and as such can be truly considered as executing at a 'stale price'. The rationale for this (with reference to Chart 02) is two-fold: (i) there is high correlation between two peaks of trading activity away from the PBBO midpoint and the observed market data latency between Zurich and London via microwave (approx 2.8ms) and fibre (approx 6.5ms); and (ii) the sum of the distribution of trades in time buckets around these latency benchmarks (i.e. both the 2-4ms and 6-8ms bucket) accounts for circa 85% of trading activity away from the PBBO midpoint. This supports a hypothesis that the majority of dark trading activity occurring away from the PBBO midpoint on London based MTFs is truly 'stale' (i.e. it intended to execute at the current midpoint but instead traded at a 'stale' price due to geographical latency).

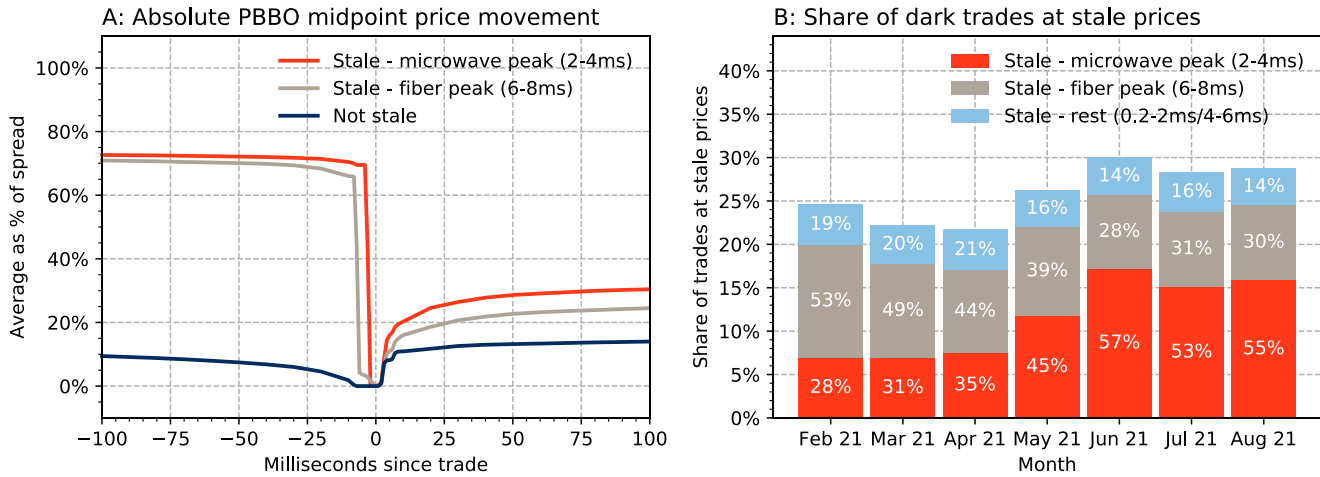
Chart 02: Latency distribution for dark trades at stale* prices in Swiss Blue Chips



Data sources: BMLL, SIX | Securities: Swiss Blue Chips | Venues: Dark MTFs | Sample period: 01 Jul 2021 - 31 Aug 2021
 * Trade prices are called stale if the trade does not occur at the prevailing PBBO midpoint price

Whilst the above 'stale price' execution trends are interesting and benefit from the precision and hindsight of post-trade data analysis, a key question arises: is there a negative impact when trading at a stale price? The answer of course is that it depends on what side of the trade you are on relative to the direction of the actual PBBO midpoint price update. Despite this, we can derive some insights into the impact of trading at stale prices by calculating separate reversion curves for trades occurring at the two clearly defined latency peaks for microwave and fibre connectivity indicated in Chart 02 and comparing these against the reversion observed for trades occurring at 'non-stale' prices – as per Chart 03A.

Chart 03: Do stale* prices matter? The case of Swiss Blue Chips



Data sources: BMLL, SIX | Securities: Swiss Blue Chips | Venues: Dark MTFs | Sample period: 04 Feb 2021 - 31 Aug 2021
 * Trade prices are called stale if the trade does not occur at the prevailing PBBO midpoint price

The three reversion curves presented on Chart 03A, illustrate that post-trade price reversion is about 2 times higher for trades occurring at 'stale' prices than those occurring at 'non-stale' prices when considering the absolute PBBO midpoint price movement 100ms after an execution and expressing it as a percentage of the spread. Further to this, the highest reversion is observed for executions that coincide with the first latency peak on Chart 02 (labelled "Stale - microwave peak (2-4ms)" in Chart 03). Further to this, Chart 03B shows that the overall share of dark MTFs trades executed at 'stale' PBBO midpoint prices increased from about 24% in February 2021 to about 29% in August 2021. Attributing this distribution to the two latency peak buckets, Chart 03B also reveals an evolution in the share of 'stale' price executions across these two buckets, with the share of 'stale' prices executed within 2-4ms of a PBBO midpoint update almost doubling from about 28% in February 2021 to 55% in August 2021.

Pulling all of the above observations together, we can draw some overarching conclusions about the dark trading ecosystem. Firstly, that the proportion of trades executed away from the PBBO midpoint is significantly more pronounced on certain types of MTFs (i.e. continuous midpoint books as opposed to conditional order enabled venues). Secondly, that the distribution of stale trading activity correlates well with the observed geographical latencies for different types of connectivity between the location of the primary CLOB and the location of MTF venues (i.e. predominantly London). Thirdly, that trades occurring at 'stale' prices appear to suffer from a significantly worse reversion profile than trades occurring at 'non-stale' prices. Food for thought.

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