

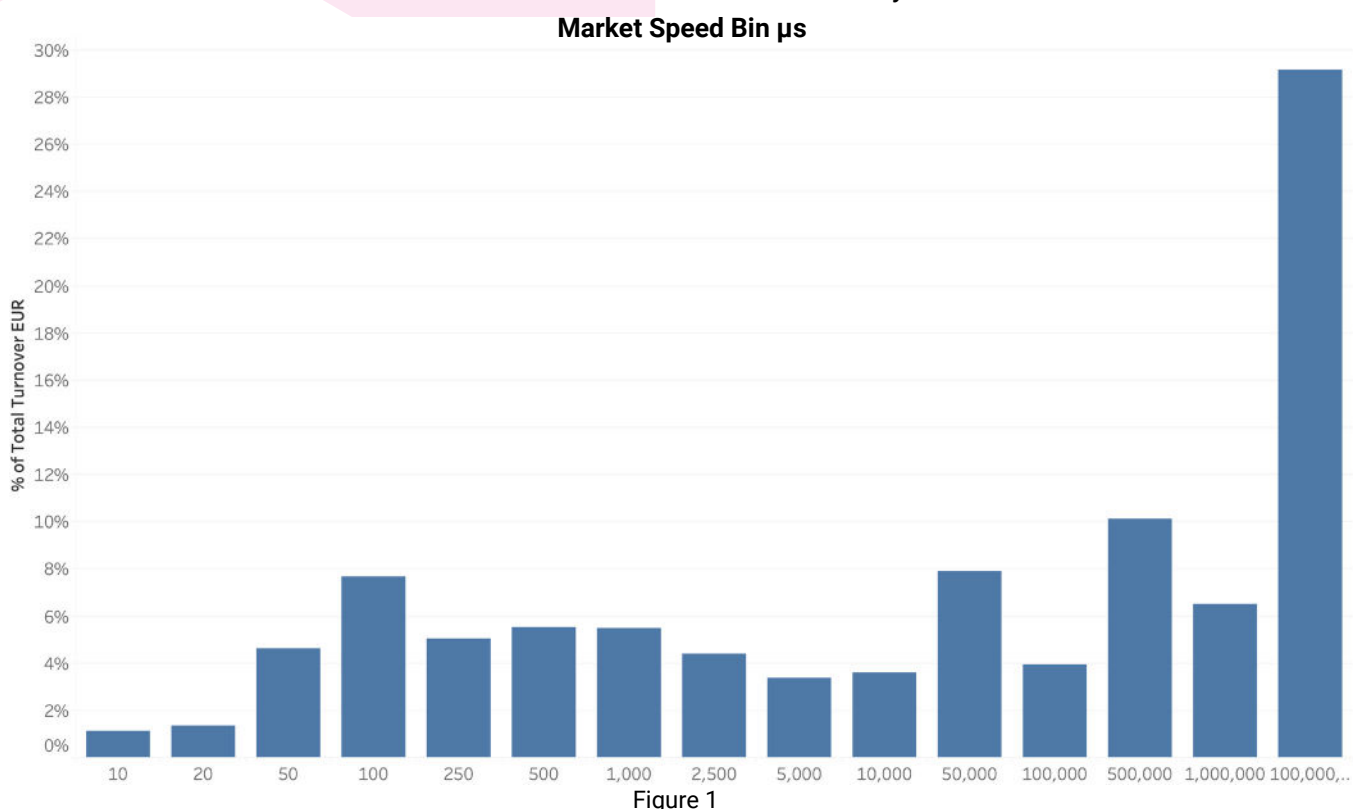


How fast is the market?

Do some traders have an advantage over others.....and does it matter?

An often overlooked question is how fast are equity markets? Or perhaps more poignantly, how much of the market operates at high speed? Working with independent consultant Duncan Higgins, the team at big xyt took an electron microscope to our granular highly accurate public market data to find out.

The team analysed every continuous lit market execution from Aquis, Cboe CXE/BXE, LSE and Turquoise during December 2020 for the top 350 UK stocks. We measured the time between the execution and the last relevant order book change. Figure 1 shows the distribution of this lit market activity across various time buckets.



The FCA established 500 μ s as a speed benchmark in their January 2020 latency races paper. That is 200 times faster than the one tenth of a second after the gun in which a sprinter will be deemed to have false started.

Using the FCA benchmark, we found that 25% of turnover would be deemed as fast trading. This is defined, in this analysis, as where the period of time between a trade and the prior relevant order book update is less than the 500 μ s boundary.

Figure 2 (below) shows the same data as Figure 1 but with activity exceeding one second removed from the chart to enable us to zoom in on the detail, with the turnover percentages remaining unchanged.

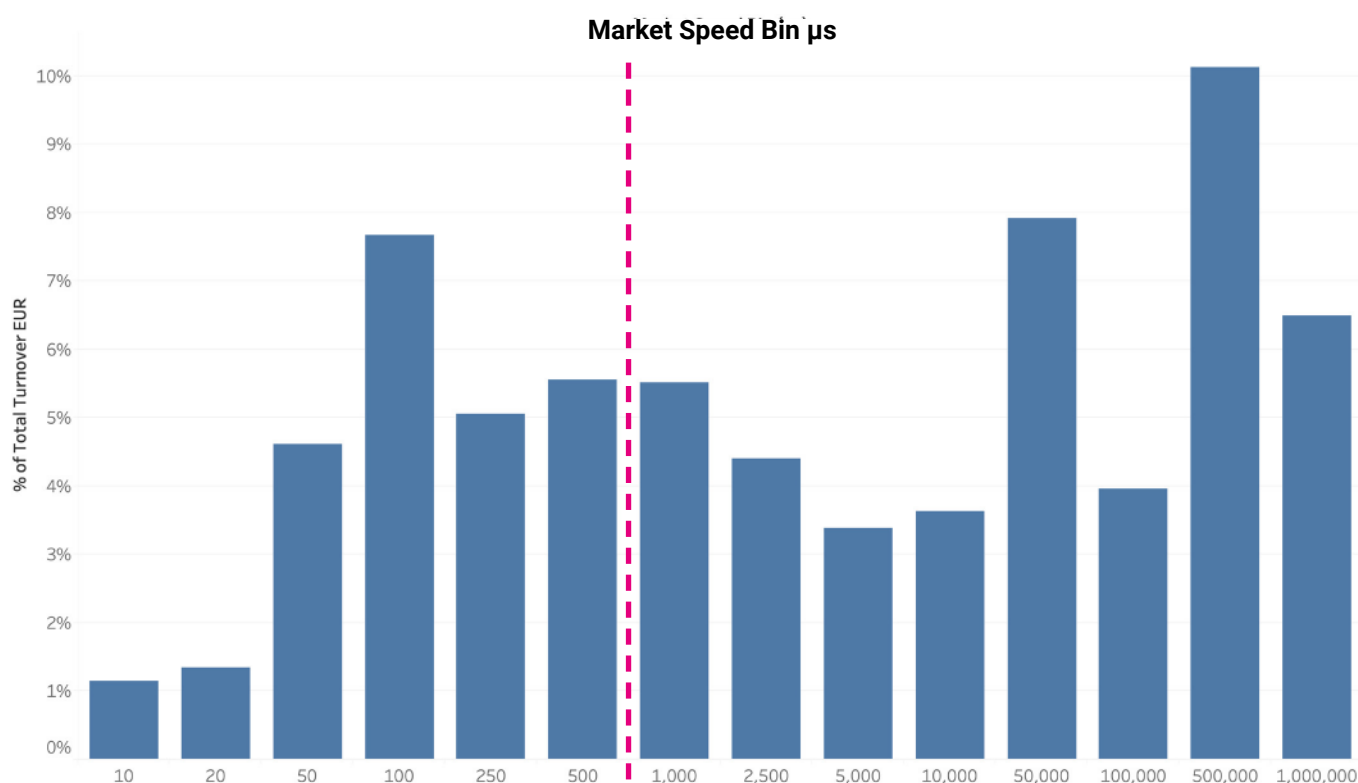


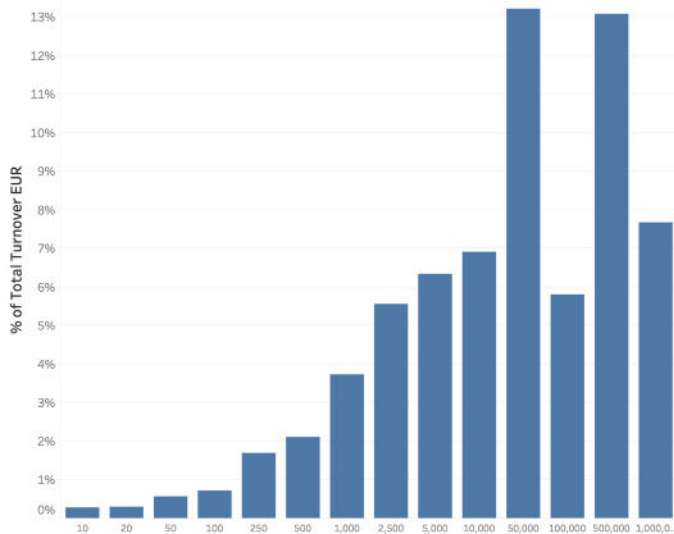
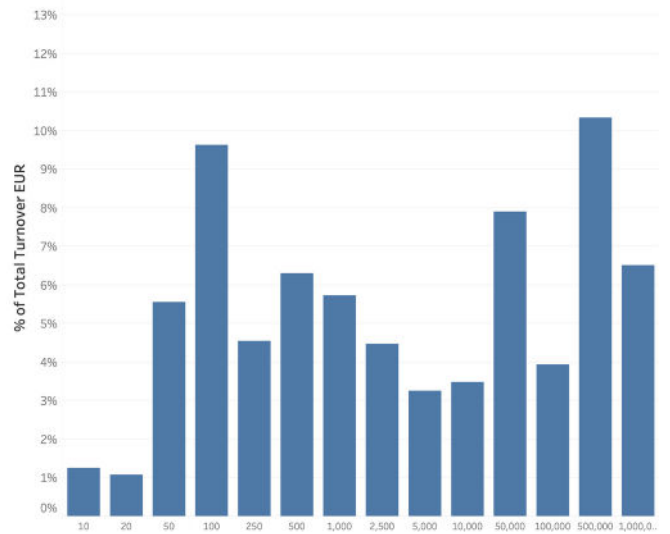
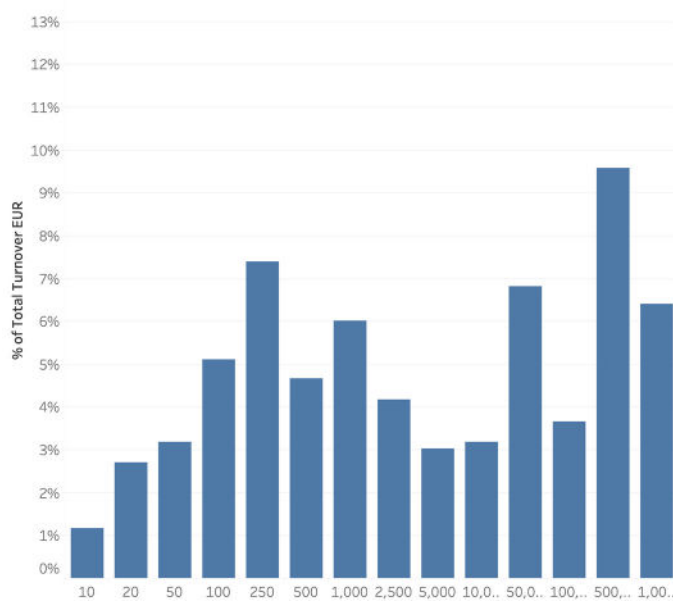
Figure 2

Is this speed consistent across exchanges?

As a next step, we considered the speed of activity on each lit trading market to measure, for each execution, the time from the last relevant order book change on that venue. The comparative results below are enlightening.

In these results we've excluded all activity where there is a gap between an order book change and a subsequent trade of over one second. However, the volume percentages reflect this excluded activity.

Figure 3a (next page) shows the results for one venue which shows very low levels of trade volumes where the time between the trade and prior order book change on that venue is less than one millisecond. Figure 3b shows the distribution on a second venue which demonstrates much higher activity levels at sub-millisecond timeframes, with significant peaks at 50 and 100 μ s. Figure 3c shows the results for a third venue which differs from both Figures 3a and 3b with a smaller low latency peak occurring at 250 μ s.

Market Speed Bin μ s

Figure 3a
Market Speed Bin μ s

Figure 3b
Market Speed Bin μ s

Figure 3c

Clearly different venues are not homogeneous as to their participants and liquidity, and these venues exhibit different spreads and market shares.

While considering this we believe these differences can be better explained by understanding the microstructure details that underlie each venue.

Are fast markets random or a reaction to events?

As part of this analysis we also examined whether the speed of markets is simply the result of a set of interactions occurring at a similar time, or if there is a clear relationship between order book events and the trades which follow.

Figure 4 (below) shows the distribution of activity occurring before an order book trade regardless of time. It can be clearly seen that the most frequent events occurring prior to a trade are increases and decreases of the size of the bid or offer.

Top of book event occurring prior to trade execution



Figure 4

If we narrow our analysis further and only consider the fastest 25% of activity on the market, where the prior order book event is less than 500 μ s before the trade, we can see a very different pattern emerging in Figure 5 (next page).

Now we can see that changes to the price that narrow the spread are the most frequently occurring events.

As part of this granular analysis, we grouped together any trade occurring within 500 μ s of another trade on the same venue and looked for the most relevant order book event occurring in the 500 μ s prior to the first trade in a group.

Top of book event occurring within 500µs prior to trade execution



Figure 5

Taking this one step further we separately considered the market changes preceding a buy or sell trade in the market. The results for fast buy trades are shown in Figure 6 (next page), with the most frequent prior event being a lowering of the offer price. Figure 7 (next page) shows fast sell trades where the most frequent prior event is an increase to the bid price.

When we examined these in full granularity, breaking down the activity by time bucket as shown in Figure 8 (page after next), we can see significant peaks in this activity taking place at 50 and 100µs.

Top of book event occuring within 500µs before offer is lifted



Figure 6

Top of book event occuring within 500µs before bid is hit



Figure 7

Quote State	Market Speed Bin (μ s)					
	10	20	50	100	250	500
AskDecrease	2.39%	2.11%	9.87%	14.05%	5.56%	3.51%
AskIncrease	0.16%	0.18%	0.45%	0.66%	0.75%	0.64%
AskSizeDecrease	0.83%	0.92%	3.04%	5.06%	3.58%	5.24%
AskSizeIncrease	0.30%	0.29%	0.89%	1.66%	1.54%	1.76%
BidDecrease	0.07%	0.06%	0.18%	0.30%	0.48%	0.49%
BidIncrease	0.42%	0.52%	1.76%	3.89%	2.52%	2.74%
BidSizeDecrease	0.06%	0.07%	0.20%	0.44%	0.53%	1.23%
BidSizeIncrease	0.46%	0.63%	2.60%	5.36%	3.33%	6.19%

Quote State	Market Speed Bin (μ s)					
	10	20	50	100	250	500
AskDecrease	0.38%	0.52%	1.72%	3.75%	2.36%	2.68%
AskIncrease	0.05%	0.04%	0.15%	0.28%	0.46%	0.53%
AskSizeDecrease	0.07%	0.08%	0.24%	0.49%	0.60%	1.22%
AskSizeIncrease	0.45%	0.64%	2.65%	5.42%	3.36%	6.34%
BidDecrease	0.17%	0.16%	0.47%	0.69%	0.76%	0.65%
BidIncrease	2.52%	2.17%	9.84%	13.98%	6.65%	3.58%
BidSizeDecrease	0.80%	0.84%	2.48%	4.74%	3.44%	5.28%
BidSizeIncrease	0.29%	0.27%	0.83%	1.63%	1.56%	1.73%

Figure 8

In conclusion

UK equity markets operate at an extremely rapid pace with 25% of turnover occurring within 500 μ s of a prior order book event. The various lit exchanges show significant differences, with one venue showing very little high-speed activity relative to others.

Importantly, the fast activity we observed is not just due to the random arrival of orders in the book. We observed a high volume of ultra-fast activity which is specifically in response to price improving orders having arrived in the order book.

Given the high volumes of this activity we suggest that measuring the impact of these activities on order execution should be a priority for firms executing in the market.

The big xyt team can do complex analysis at the most granular level across markets. Please get in touch to find out how we can help.



About big xyt

big xyt provides independent smart data and analytics solutions to the global trading and investment community, enabling firms to process and normalise large data sets on demand and in real time, in order to analyse execution performance, comply with regulatory standards, and reduce the complexity and costs of technology and operational requirements.

Our clients include major global investment banks, buy-side firms (asset managers, hedge funds, pensions, indexers), leading exchanges, trading venues, and regulatory bodies.

Navigating fragmented markets remains a challenge for participants needing easily digestible information on trading analysis. The big xyt analytics platform responds to these market challenges, and provides clients access to transparent, accurate and normalised data.

big xyt has created a global ecosystem for tick data analytics covering more than **120 trading venues**, across **Equities, ETFs, FX, Futures and Options**. Our unique technology normalises trade conditions of venues allowing consistent aggregations of trading volumes, comprehensive analysis, and delivery of results in a flexible and customisable format.

big xyt's innovative analytics solutions are relevant for a broad range of use cases including strategy development, performance trends and analysis, back testing, quantitative research, and regulatory changes. The platform delivers information through a convenient and interactive user interface, and can be easily connected to our cloud-based platform via APIs.

big xyt is wholly owned by its founders and employees, which means there is no conflict of interest when evaluating your execution needs or analysing broker performance.

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