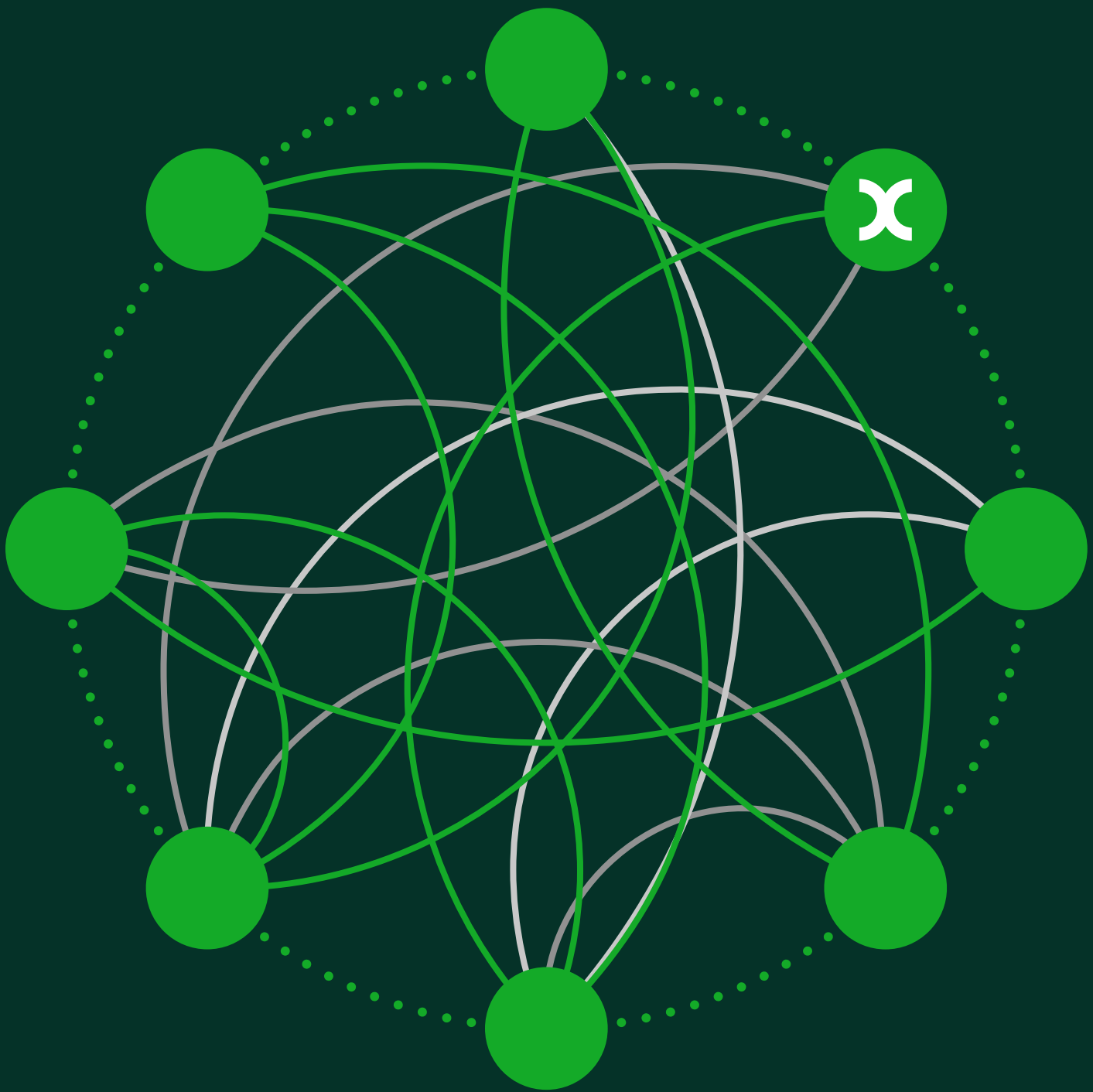
The functioning of equity trading markets in the UK

—

Implications for an equity Consolidated Tape

October 2024



Contents

Figures and Tables

Executive summary

How are UK secondary equity markets functioning?

A well-functioning secondary equity market is expected to provide end-investors with sufficient liquidity and price formation, the ability to trade at efficient cost, innovation, choice across trading mechanisms, and resilient market infrastructure.

As far back as the introduction of the 2007 Markets in Financial Instruments Directive (MiFID), there were concerns that trading across multiple competing venues, while beneficial in terms of lower trading fees and greater choice for end-users, could result in higher implicit costs of trading if it becomes more difficult for market participants to search for liquidity.

Concerns about liquidity fragmentation have since been central to much of the policy debate in UK equity markets, including recent discussion regarding an equities consolidated tape (CT).

How concerned should policymakers be about fragmentation? The empirical evidence suggests that, over the long run, UK secondary equity markets have performed well overall in terms of costs. In particular, end-investor implicit costs in UK equities have remained stable over the last six years, and have fallen since MiFID I. This suggests that brokers have (for the most part) been able to find the best available trading opportunities across a range of trading venues and mechanisms, and that overall *trading* fragmentation did not lead to *liquidity* fragmentation and higher implicit costs.

Despite this, policymakers have an important role to play in ensuring markets continue to function well for end-investors. Specifically, when making their trading choices, traders do not factor in the wider benefit that trading on 'lit' venues (those with pre-trade transparency) has on price formation and the quality of the market as a whole. This can be referred to as a negative market externality: when trading away from 'lit' venues, traders do not take into account the potential negative effect on price formation from an overall market perspective.

Trading away from Central Limit Order Books (CLOBs) is not necessarily detrimental to overall market quality, and having access to different types of venues provides investors with choice that can lead to better outcomes, especially if the liquidity would not exist otherwise (e.g.

larger orders). However, if the share of lit trading becomes too low, it may have detrimental effects on the price-formation process.

There is evidence that trading volumes on UK CLOBs have thinned in the last one–two years. While this does not appear to have caused an observable decline in end-investor implicit costs, this may raise concerns about market quality and highlights the need for further analysis. For example, it would be useful to obtain a clear understanding of the types of order flow being directed to each type of venue. Such an analysis requires data that is not in the public domain, and therefore may need to be undertaken by, or at the request of, the FCA.

In the remainder of our report, we assess what type of CT could be beneficial and improve market functioning. It is important to clarify that a potential *pre-trade* CT does not address the aforementioned potential concerns about trading away from CLOBs. A CT does not intend to do so, but rather attempts to address a different issue: improving market functioning by reducing search costs for traders so that traders can more easily search for liquidity across multiple lit venues.

There seems to be a perception that, in particular, smaller players may lose out in the current market structure because they may not use data (particularly pre-trade data) from all trading venues. Therefore, they may not be informed about liquidity on certain trading venues and may not access these for trading. However, this perception is not supported by the empirical evidence. Our analysis shows that a real-time *pre-trade* tape is unlikely to improve market functioning, and that there are mechanisms that could even lead to a negative impact of a CT on market quality. Conversely, a *post-trade* tape may have broader benefits for the market, and is associated with a wider range of use cases.

Would a pre-trade CT improve market functioning?

We first analyse whether traders would start using a pre-trade CT and, if so, whether their use of a CT would improve market functioning. Our analysis indicates that a significant proportion of brokers already multi-home across UK lit venues, and therefore already consume consolidated pre-trade (and post-trade) data for equities.[1] This is consistent with the

[1] 'Multi-homing' is a commonly used term in the literature on the economics of platforms. If a user joins only one platform (e.g. a trading venue), they are said to be 'single-homing'. A user who joins more than one platform is 'multi-homing'. The FCA would be well-placed to undertake similar 'multi-homing' analysis of its own, either by conducting a survey of trading participants, or using its transaction reporting data.

finding noted above that MiFID I did not lead to an increase in implicit costs in UK equities.[2]

Thus, the key question is whether traders that currently consume a limited amount of data would switch to using a CT, and whether that would improve market quality. Our analysis shows that this is not the case, for three reasons. First, fragmented trading does not always mean fragmented liquidity. A majority of participants trading across multiple venues means that even traders not connected to multiple venues still benefit from the broader liquidity pool. Second, quotes published on a pre-trade CT will not be accessible to a trader unless they have invested in the connectivity (and speed) to access fast moving liquidity. In other words, even in circumstances where better prices (or volumes) were available elsewhere, smaller players would not necessarily be able (or fast enough) to access this liquidity; and becoming faster would come at a cost. Third, although retail investors may not currently consume pre-trade data from lit venues, a CT is unlikely to lead to better outcomes for these users. Retail order flow in the UK is already segmented via the RSP system, meaning that a pre-trade CT (based on prices across various CLOBs) may provide a misleading benchmark for them.

In undertaking a cost–benefit analysis, the FCA would also need to consider the set-up and operational costs of a CT (which will vary according to the latency, depth, and operational resilience required of the tape). There may also be trade-offs between the different individual objectives of the CT. For example, if traders use the CT *in addition* to existing proprietary feeds, for example as a backup data feed, this will not lead to lower search costs for users. Conversely, if traders use the CT as their primary data feed (without, for example, also accessing proprietary feeds), this would raise additional questions regarding market resilience as it introduces a single point of failure.

What is the future landscape for UK equities trading?

Although the complex economic forces mean it is hard to make predictions with certainty, there are clearly mechanisms that could lead to a negative impact of a CT on market quality.

For example, if investors use a CT for ex-post monitoring of execution quality, some (smaller) brokers may decide to send orders to trading

[2] It also suggests that access to consolidated data is not the obstacle currently preventing liquidity from shifting to alternative venues in the event of an outage on a significant venue.

mechanisms with less pre-trade transparency that can at least match the consolidated best bid and best offer (BBO), rather than choosing to incur the upfront cost of connecting to all lit trading venues.

To assess if this will have an impact on overall market functioning, any economic analysis must capture the effects of both fragmentation *and* segmentation (e.g. the separation of 'uninformed' order flow from the rest of the market).

As discussed, trading away from CLOBs is not necessarily detrimental to overall market quality, but if the share of lit trading becomes too low, it may have detrimental effects on the price-formation process. This in turn creates the risk of trading (in and outside the lit venue) against prices of eroding quality.

Moreover, a natural strategy from venue operators (or brokers) is to attempt to segment order flow (e.g. invite 'uninformed' investors to trade away from lit venues). Segmentation can be beneficial for the individual end-investor, but it can eventually lead to wider spreads and higher price impacts, as fewer 'uninformed' investors on lit venues means the remaining traders face higher risks from providing liquidity on those venues (adverse selection). This can prompt further segmentation thereby further reducing the liquidity in lit venues and potentially negatively affecting price formation (and, as explained, this then creates the risk of trading against prices of eroding quality).

When assessing the case for a CT, it will be important to ensure that it does not create circumstances where the mechanisms for segmentation in UK equity markets do not benefit end-investors or the wider market.

Ultimately, assessing the effect of fragmentation and segmentation on market quality requires a clear understanding of the types of order flow being directed to each type of venue (e.g. the parent order size, type of investor, and the broker handling the order). The FCA would be well-placed to undertake such an analysis as part of its broader assessment of the potential effects of a CT.

1 Introduction

1.1 Objectives and our approach

UK equity markets have seen significant changes in their structure over the last fifteen years, driven by the introduction of competition, regulatory changes, and technological developments.

Six years on from the implementation of MiFID II[3] and four years since the UK's withdrawal from the EU, there continues to be an active policy debate around the current functioning and future direction of travel of UK equity markets.

In this context, the Financial Conduct Authority (FCA) is consulting on a proposed framework to establish a consolidated tape (CT) for equities in the UK.[4] This consultation forms part of the wider Wholesale Markets Review undertaken by HM Treasury, which was established with the aim of improving the UK's regulation of secondary markets, taking advantage of new freedoms following the UK's withdrawal from the EU.[5]

There are different design options for an equities CT. When designing the final framework, the FCA will ultimately need to assess the magnitude of the benefits associated with a pre- and post-trade CT, from the perspective of the market, its participants, and the wider economy.

Our report informs as to whether and how these potential benefits are likely to materialise. The FCA must then balance any expected benefits against the projected costs of setting up and running an operationally resilient tape,[6] which will vary according to the latency and depth of data provided. In the context of a cost–benefit analysis (CBA), the CT may also lead to transfers between market participants. While redistributive effects would be included in a CBA, they may not affect the net benefit of a policy intervention.[7]

In its work to date, the FCA has emphasised that the market structure and the nature of trading data for equities are significantly different to those for bonds (where the FCA has confirmed its final scope for the CT

[3] The second Markets in Financial Instruments Directive.
[4] Financial Conduct Authority (2023), 'The framework for a UK Consolidated Tape, CP23/15'.
[5] See HM Treasury (2021), 'Wholesale Markets Review: Consultation', July, https://assets.publishing.service.gov.uk/media/60dc9322e90e07717d1cb1a7/WMR_condoc_FINAL_OFFICIAL_SENSITIVE_.pdf.
[6] These activities would include establishing and operating the necessary connectivity, processing, storage, and back-up infrastructure, as well as the administration and governance mechanisms.
[7] For an overview of the FCA's CBA methodology see FCA (2024), 'Statement of policy on cost benefit analyses', July, https://www.fca.org.uk/publication/corporate/statement-policy-cba.pdf.

and is developing the tender process). Therefore, it is useful to take stock and assess the broader functioning of UK equity markets six years on from the introduction of MiFID II.

The objective of this report, commissioned by the London Stock Exchange Group (LSEG), is to contribute to the wider policy debate around the functioning of UK secondary equity markets, and to inform as to the potential impact of different types of CT for equities in the UK.

In preparing this report we have drawn from a range of sources, including:

- an extensive review of the academic and policy literature on financial market microstructure;
- empirical analysis using a range of data sources, including data provided by LSEG, BMLL and Virtu;
- interviews with market microstructure and technical experts, as well as academics;
- insights from Oxera's own extensive work in capital markets for regulatory authorities, market participants and financial market infrastructure providers.[8]

1.2 Structure of the report

This report is structured as follows.

- Section 2 provides an overview of UK secondary equity market functioning, setting out the role of equity trading and describing key trends in trading activity.
- Section 3 provides an economic framework for assessing the impact of different types of equity CTs on market functioning, and analyses the available empirical evidence.
- Section 4 discusses the future landscape for UK equity trading.

The appendices contain some additional supporting material, including further background information, empirical analysis, and methodological notes.

[8] This includes, among other things, Oxera (2019), 'The design of equity trading markets in Europe', report prepared for the Federation of European Securities Exchanges; Oxera (2020), 'Primary and secondary equity markets in the EU', report prepared for the European Commission; Oxera (2021), 'The landscape for European equity trading and liquidity', report prepared for the Association of Financial Markets in Europe (AFME).

2 Overview of UK secondary equity market functioning

Key messages

- A well-functioning UK equity market is expected to provide end-investors with sufficient liquidity and price formation, the ability to trade at efficient cost, innovation, choice across trading mechanisms, and resilient market infrastructure. Following the introduction of MiFID in 2007, alternative trading venues were established by new entrants to compete with the regulated markets for order flow by tailoring trading mechanisms to the needs of different types of equity trader. The increased competitive pressure has resulted in lower trading fees, new service propositions, and greater choice for end-users overall.

- This section provides an empirical analysis of the functioning of UK equity markets, focusing on the use of different trading mechanisms and measures of market quality over time. Our analysis shows that end-investor implicit costs (as measured by implementation shortfall) have remained stable over the last six years, and have fallen since MiFID I. This suggests brokers have (for the most part) been able to find the best available trading opportunities across a range of trading venues and mechanisms. In other words, overall *trading* fragmentation has not led to *liquidity* fragmentation and higher implicit costs. However, there is evidence that trading volumes on UK Central Limit Order Books (CLOBs) have thinned in the last one–two years.

- In the debate about the functioning of equity trading markets, potential concerns were raised about smaller players losing out since they may not use data from all trading venues. Therefore, they may not be informed about liquidity on certain trading venues and may not access these for trading. Our analysis shows that this is not supported by the empirical evidence. Even in circumstances where better prices (or volumes) were available elsewhere, smaller players would not necessarily be able (or fast enough) to access these volumes (and becoming faster would come at a cost). We explain this in more detail in section 3.

- As at Q4 2023, lit continuous volumes were 30%, with trading in auctions accounting for a similar share of activity (around 21%). Bilateral agreement mechanisms operated by market participants such as SIs and OTC trading now account for around 22%. Individual traders have their own preferences when executing trades depending on their priorities as to factors such as explicit costs, implicit costs, immediacy, and certainty of execution. In making their trading choices, traders consider their own private benefit *without* factoring in the wider benefit that trading on lit venues has on price formation (and therefore the quality of the market as a whole). The presence of this 'externality', and the importance of price formation for well-functioning markets emphasises the role for policy-makers in designing and monitoring the structure and performance of equity trading markets.

2.1 What is the role of secondary equity markets

Secondary equity markets are where investors buy and sell shares in listed companies.[9]

By providing organised places and mechanisms for the trading of shares, equity markets fulfil two core, related, functions:[10]

- the provision of liquidity—enabling traders to buy and sell assets;
- price formation—the process of determining the price of an asset in the market.

These market functions allow investors to enter and exit positions, and to rebalance their portfolio to manage their financial risks according to their personal preferences. They also provide an efficient information-gathering process that ensures that market participants can make informed investment decisions. The direct beneficiaries of liquidity and an effective price-formation process are the investors, fund managers, and publicly listed firms that make decisions based on those prices.

A well-functioning secondary market is one that is accessible, efficient, liquid, fair and resilient. In particular, it is expected to:

- support price formation, so that market participants can efficiently price the value of the stock at any point in time;
- provide sufficient accessible liquidity, so that orders can be executed within a short timeframe at a price close to the stock's mid-price (i.e. low implicit costs);
- be competitive, with venues actively competing to attract order flow, helping to drive down the explicit costs of trading and deliver better outcomes to end users;
- deliver choice and innovation to the benefit of end-investors;
- perform well in times of stress and be able to withstand external shocks or disruption.

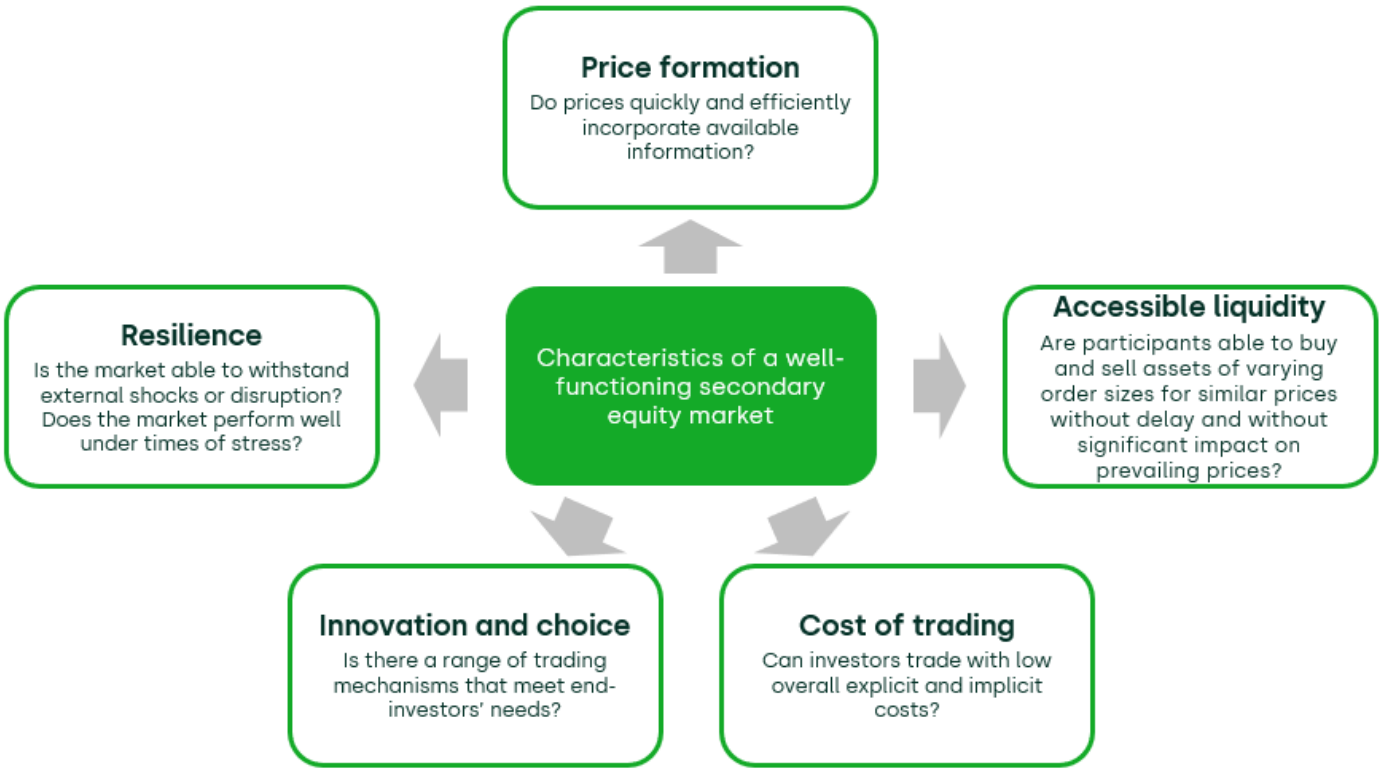
Some of these characteristics are interlinked. For example, competition for order flow among trading venues helps to reduce explicit costs of trading, while also providing innovation and choice. Similarly, having a

[9] In this report the terms 'investors' and 'traders' are mainly used interchangeably, though in some cases a subtle distinction can be made which we flag as necessary.
[10] See, for example, Oxera (2019),'The design of equity trading markets in Europe', prepared for the Federation of European Securities Exchanges, March; Petram, L.O. (2011), 'The world's first stock exchange: how the Amsterdam market for Dutch East India Company shares became a modern securities market, 1602-1700', PhD thesis; O'Hara, M. (2003), 'Presidential Address: Liquidity and Price Discovery', *Journal of Finance*, **58**:4, pp. 1335–54.

broad and diverse range of participants can promote market resilience, price formation and competition for liquidity provision.

Moreover, a well-functioning market should cater to a wide range of end-users, including smaller investors.

Figure 2.1 Characteristics of a well-functioning equity market



Source: Oxera.

2.1.1 How does trading take place?

Within the broader landscape of equity market participants, a number of people and firms are involved in equity trading. The process of investors buying and selling securities is underpinned by a complex structure and a longer value chain.[11]

[11] The trading value chain is also underpinned by a post-trade value chain, including clearing and settlement, as well as custody and safekeeping services. We do not discuss the post-trade value

Trading venues

Trading venues are the typical meeting place for investors in equity markets. They bring together buyers and sellers and establish prices to match demand for liquidity with available supply of liquidity.

The economic characteristics of trading venues are influenced by regulation as well as competition between venue operators. These characteristics include the below.

- **Nature of liquidity provision**—in quote-driven venues, every transaction is facilitated by a designated dealer who is required to quote prices at which they will buy or sell a particular stock. Liquidity may be provided by a single dealer, or multiple dealers. In order-driven venues, participants can interact directly with each other on a multilateral basis, and trades are arranged according to specific rules regarding which buyers and sellers are matched (and at which prices).
- **Intermittency**—some venues may match buyers and sellers on a continuous basis, while some venues organise trading during a specific window (e.g. a call auction).
- **Segmentation**—some venues may seek to limit access to a specific type of participant (e.g. investors trading large blocks, or retail investors).
- **Pre-trade transparency**—venues can differ in the amount of information they publish regarding current prices and volumes of trading interests (pre-trade transparency). 'Lit' venues provide a high degree of pre-trade transparency, while 'dark' venues provide no pre-trade transparency.

In 2007, the Markets in Financial Instruments Directive (MiFID) framework opened up competition in equity trading and introduced a range of trading mechanisms. In 2018, MiFID II introduced further rules and changes to the mechanisms available to investors. Table 2.1 below provides an overview of the trading mechanisms in the UK, as well as their level of pre-trade transparency.

chain in this report. For an analysis, see Oxera (2011), 'Monitoring prices, costs and volumes of trading and post-trading services', Report prepared for the European Commission, https://www.oxera.com/wp-content/uploads/2018/03/Oxera-report-on-trading-and-post-trading-May-2011-3.pdf.

Table 2.1 Overview of trading mechanisms

	Description	Pre-trade transparency
Lit order book	Trades generated by lit orders executing on electronic open limit order book, excluding trades executed during an auction period.	Orders (prices and volumes) are visible prior to execution.
Auction	Trades executed during an auction period operated by electronic open limit order book (e.g. scheduled auctions used to set the opening price for subsequent periods of continuous trading or to create the closing price).	Various. Some venues publish the indicative uncrossing price and the quantity executable at that price. Some venues make orders visible during the call period.
Periodic auction	Trades occurring on a market operated as a periodic, frequent or hybrid auction. Typically these mechanisms operate alongside continuous trading and are distinct from the auctions described above.	Indicative uncrossing price and quantity executable at that price.
Dark	Trades executing under the MiFID Reference Price Waiver (RPW) or Large-in-Scale (LIS) Waiver.	None.
Off-book on-exchange (OBOE)	Trades reported under the rules of an exchange, which may be as a result of trading on quotes from market makers or over-the-counter (OTC) trades reported under the rules of a regulated market.	Various.
Systematic internaliser (SI)	Trades executed by a Systematic Internaliser (SI), defined under MiFID II as an investment firm that, on an organised, frequent systematic and substantial basis, deals on own account when executing client orders outside an RM, an MTF or an OTF without operating a multilateral system.	SIs are required to make firm public quotes (bid and offer prices and volumes) in sizes of at least 10% of the standard market size. Quotes in volumes above standard market size do not have to be made public.
Over-the-counter (OTC)	Trading that occurs between two parties away from a trading venue and not under the rules of a trading venue that are reported through an Approved Publication Arrangement (APA).	None.

Note: 'Off-book on-exchange' trades can be reported to a range of reporting venues, not just the London Stock Exchange.
Source: Oxera.

Brokers and dealers

To trade on a trading venue directly, investors need to become a member of the venue and set-up the connectivity required to send trading instructions to the venue.[12] These (largely) fixed costs mean that trading directly on a venue is not an option that will be attractive to every type of investor for commercial or regulatory reasons. Therefore, to execute trades, investors can instead rely on the services of a broker.

A broker is an intermediary who executes orders on behalf of clients. They act as an agent for the client, meaning that they do not trade with the client themselves, but instead execute trades by routing them to be executed elsewhere. In the simplest model, the client sends their trade to the broker who then executes it on the exchange on the client's behalf. However, in reality, there are many trading venues and other execution mechanisms requiring the broker to make a complex decision where to execute the client's trade.[13]

Brokers in the UK (as well as those in most other countries) are subject to best execution obligations which require them to take all sufficient steps to obtain, when executing orders, the best possible results for their clients. Factors that brokers need to take into account when deciding where to execute a client's order include price, costs, speed, likelihood of execution and settlement, nature, or any other consideration relevant to the execution of an order.[14]

Investors (or their brokers) can also decide to send their trade to a dealer who will act as a counterparty to the client (i.e. taking the other side of the trade). Dealers act as principals, determining the price at

[12] For example, to become a member of the London Stock Exchange, a firm (individuals cannot become members) must (i) be authorised by a regulator in an eligible jurisdiction; (ii) comply with the rules of the exchange; (iii) have appropriate clearing and settlement arrangements in place; (iv) establish connectivity. For more details, see London Stock Exchange, 'Membership', https://www.londonstockexchange.com/equities-trading/membership?tab=how-to-join, accessed 12 December 2023.

[13] Brokers can also provide retail investors with Direct Market Access to the London Stock Exchange enabling them to place orders directly on the order book. For institutional investors who are not members of the London Stock Exchange, brokers can also facilitate Sponsored Access. This provides the institutional investor with a direct technical connection to the order book, enabling them to execute low latency strategies. See London Stock Exchange, 'Direct Market Access', https://www.londonstockexchange.com/personal-investing/tools/direct-market-access, accessed 17 May 2024 and London Stock Exchange, 'Sponsored Access', https://www.londonstockexchange.com/equities-trading/sponsored-access, accessed 17 May 2024.

[14] Best execution is covered under COBS 11.2A in the FCA Handbook. See: https://www.handbook.fca.org.uk/handbook/COBS/11/2A.html.

which they are willing to buy or sell the shares and taking on the risk of the trade.

Some firms act as both brokers and dealers, deciding whether to route the order for execution elsewhere or to execute it directly for their own account. In these cases, the decision of where to execute will be driven by the firm's best execution obligation.

As with trading mechanisms, there is a wide variety of broker–dealer business models that aim to cater to different end-investor needs. For example, brokers may vary in size, target customer segment (i.e. retail vs institutional clients), level of technological sophistication, trading style (e.g. 'high-touch' vs electronic trading) and equity market segment (e.g. small-cap stocks). The largest players may compete across all segments of the market.

Brokers and dealers can also vary in their level of interconnectedness, with larger players typically in the centre of the network and smaller niche players at the periphery. The level of interconnectedness and the position of each broker–dealer in the overall market structure will depend on the costs associated with connecting to each venue, as well as the search frictions associated with finding a counterparty.[15]

End investors

At the end of the value chain are end-investors. Broadly speaking, end-investors in equity markets can be split into:

- institutional investors—including pension funds, insurance companies, hedge funds and other asset managers, who hold equities on behalf of households and governments;
- retail investors—consisting of individuals and households holding equities directly.

2.1.2 Investor preferences

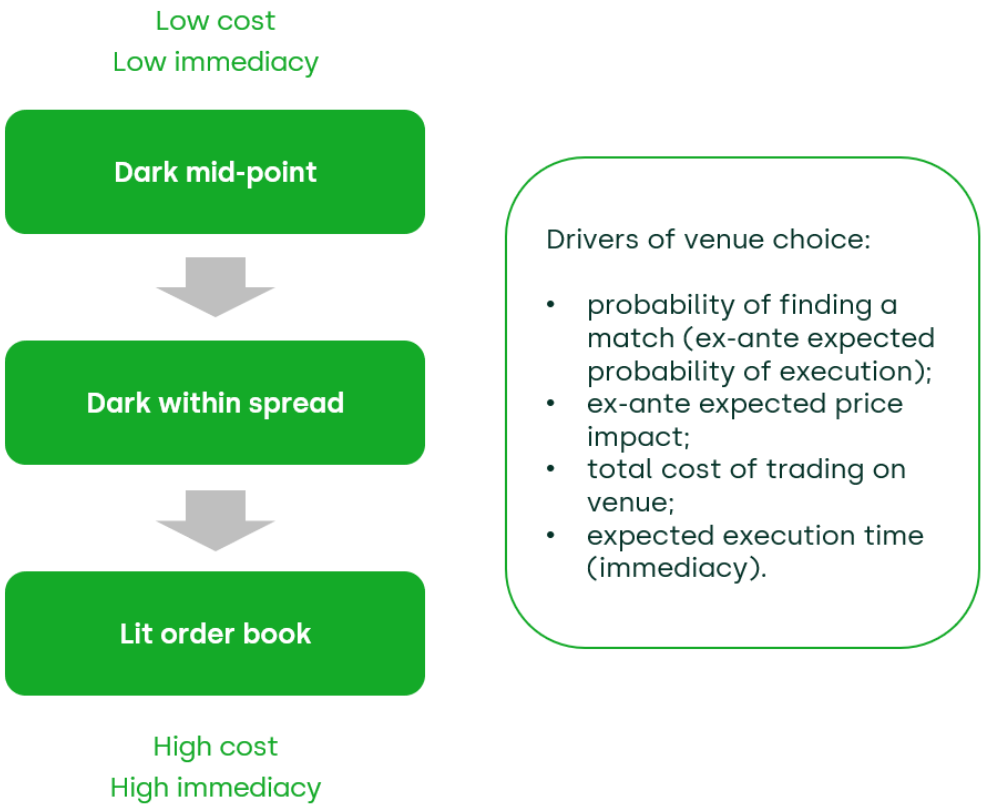
Trading on a lit venue contributes to the price-formation process which benefits the market as a whole. However, individual investors have their own objectives and preferences when executing trades. This will depend on their priorities as to factors such as explicit costs, implicit costs, immediacy, and certainty of execution.

According to the pecking-order theory, investors may, in the first instance, prefer to use dark trading venues that offer the lowest cost

[15] Li, D. and Schürhoff, N. (2019), 'Dealer networks', *Journal of Finance*, **74**:1, pp. 91–144.

(explicit and implicit).[16] However, the probability of execution and immediacy of these venues is often lower. As certainty and immediacy of order execution become more important and the opportunity cost of failing to execute trades increases, investors may prefer to trade on lit venues. Lit venues offer immediate execution, but this can come at higher cost.

Figure 2.2 Pecking order of trading venues



Note: This figure shows the typical pecking order for trades. Trading venues offering dark trading at the midpoint are at the top. Trading venues offering dark trading within the spread (but not at the midpoint) are in the middle. Lit venues are at the bottom. 'Dark' in this figure refers to a trade in a venue without pre-trade transparency.
Source: Oxera.

[16] In this context, costs refer to the total trading costs for market participants. This includes explicit costs such as trading fees, as well as implicit costs such as the bid–ask spread and price impact of the trade (which depends on the amount of information leakage). Some dark venues offer additional price improvement relative to lit venues by executing trades at the midpoint of the best bid and offer with reference to the primary exchange. For an empirical study of the pecking order of trading venues in US equity markets, see Menkveld, A.J., Yueshen, B.Z. and Zhu H. (2017), 'Shades of darkness: A pecking order of trading venues', *Journal of Financial Economics*, **124**:3, pp. 503–34. For a UK focused study, see Neumeier, C. (2023), 'Banning dark pools: Venue selection and investor trading costs', *Journal of Financial Markets*, **65**:1, pp. 1–18.

In this context, investors, particularly those looking to execute large trades for which price impact is expected to be greatest, will want to trade in the dark if allowed. The pecking order theory also highlights that investor preferences over venues change over time, depending on factors such as market volatility.[17]

Investors preferences over trading venues also depend on the actions of other investors. In particular, choices of trading venues are influenced by two economic forces: network effects and information asymmetries.

- In general, the more investors there are in the market competing to buy or sell at or near the current price, the narrower the spread between the bid and offer and thus the lower the cost of trading.[18] This means, all other things being equal, traders will prefer to send orders to venues where other investors are located.
- However, 'uninformed' traders will also consider the risk they run of trading with 'informed' traders and thus incurring losses (adverse selection costs).[19] The higher the risk they perceive, the less willing they will be to trade on a given venue. Conversely, 'informed' traders can profit from the information they hold by finding less-informed participants to trade with.

The second economic force helps to explain why, despite the potential network effects of trading on lit venues, 'uninformed' investors may prefer to trade on other venues, where they are more likely to encounter other 'uninformed' traders, and where adverse selection costs of providing liquidity are lower.

In making these choices, investors consider their own private benefit without factoring in the wider benefit that trading on lit venues has on the quality of the market as a whole (which can be referred to as a market externality).[20] The presence of this externality and the

[17] For example, Ibikunle and Rzayev (2023) use the high-volatility shocks caused by the COVID-19 pandemic in early 2020 as an exogenous event to test the effects of volatility on the share of lit and dark trading in Europe. They find that high volatility is linked to a significant shift of trading from dark venues to lit venues. See Ibikunle and Rzayev (2023), 'Volatility and dark trading: Evidence from the Covid-19 pandemic', *The British Accounting Review,* 55:4, pp. 1-23.
[18] Equivalently, the more investors trading on a dark venue, the higher the likelihood of execution.
[19] 'Informed traders' are those who trade in order to profit from private information about the value of stock, whereas 'uninformed traders' are motivated to trade by a need to rebalance portfolios and smooth their consumption streams over time. An 'informed' trader will buy when the value of the stock is higher than the available price, and vice versa. Thus an 'uninformed' trader will lose out when trading with an 'informed' trader.
[20] Investors (individually) and traders consider their own private benefit without factoring in the wider benefit when making trading decisions, but as a group investors are concerned with ensuring markets function well.

importance of price formation for well-functioning markets emphasises the role for policy-makers in designing and monitoring the structure of equity trading markets.

2.2 Trends in UK equity markets

In this section, we provide a brief overview of the equity trading landscape in the UK. We discuss some of the key trends in usage and liquidity associated with different types of trading mechanisms, as well as metrics of overall market quality.

The analysis in sections 2.2.1 and 2.2.2 focuses on ordinary shares of UK-domiciled companies.[21] Trading volumes are adjusted to remove trades flagged as 'non-price forming' or 'not contributing to the price discovery process', see Appendix A1 for further details.[22]

We also discuss some of these trends (growth in auctions, SI trading and implementation shortfall metrics) in more detail in Appendix A2.

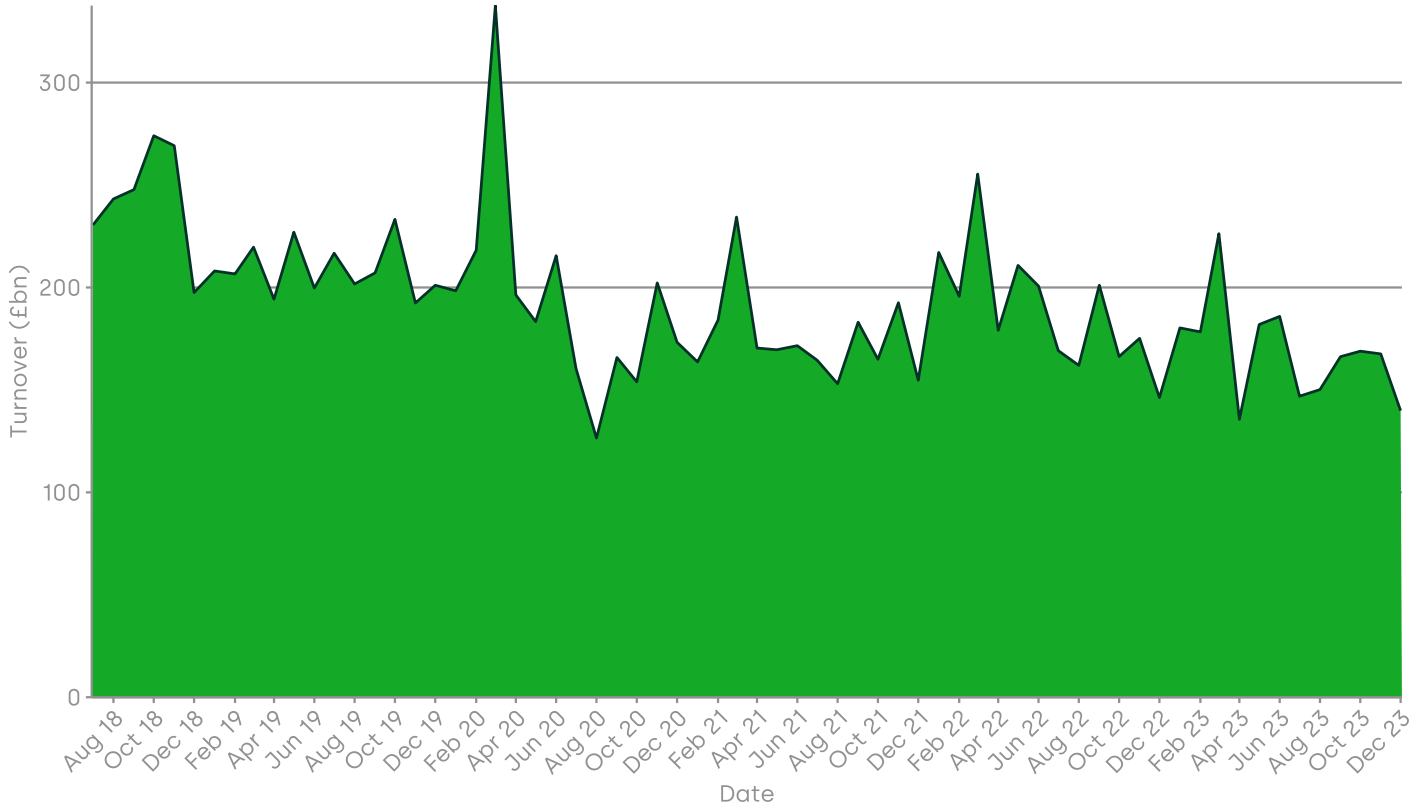
2.2.1 Overall trends in trading mechanisms

Figure 2.3 below shows the monthly turnover of trading in UK shares, after removing non-price forming trades.

[21] We proxy for UK-domiciled companies based on the first two letters of the ISIN (i.e. only including shares with a 'GB' ISIN). We indicate in a chart's footnote when this filter is applied. The purpose of this filter is to control for the effect of shifts in trading activity in EU shares after Brexit. We also exclude other equity-like instruments such as ETFs, depository receipts, convertible notes, ETNs, and ETCs.

[22] Some reported transactions that are flagged as over-the-counter (OTC) and SI trades are, in fact, technical transactions, such as collateral transfers, give-ups and give-ins, and inter-affiliate trades undertaken for operational purposes. While technical trades may be relevant from a supervisory and/or post-trading perspective, they do not represent an economic trading interest. For a discussion of applying filters to trade data, see Oxera (2021), 'The landscape for European equity trading and liquidity', report prepared for AFME.

Figure 2.3 Turnover of trading in UK-domiciled shares (price forming trades), July 2018–December 2023



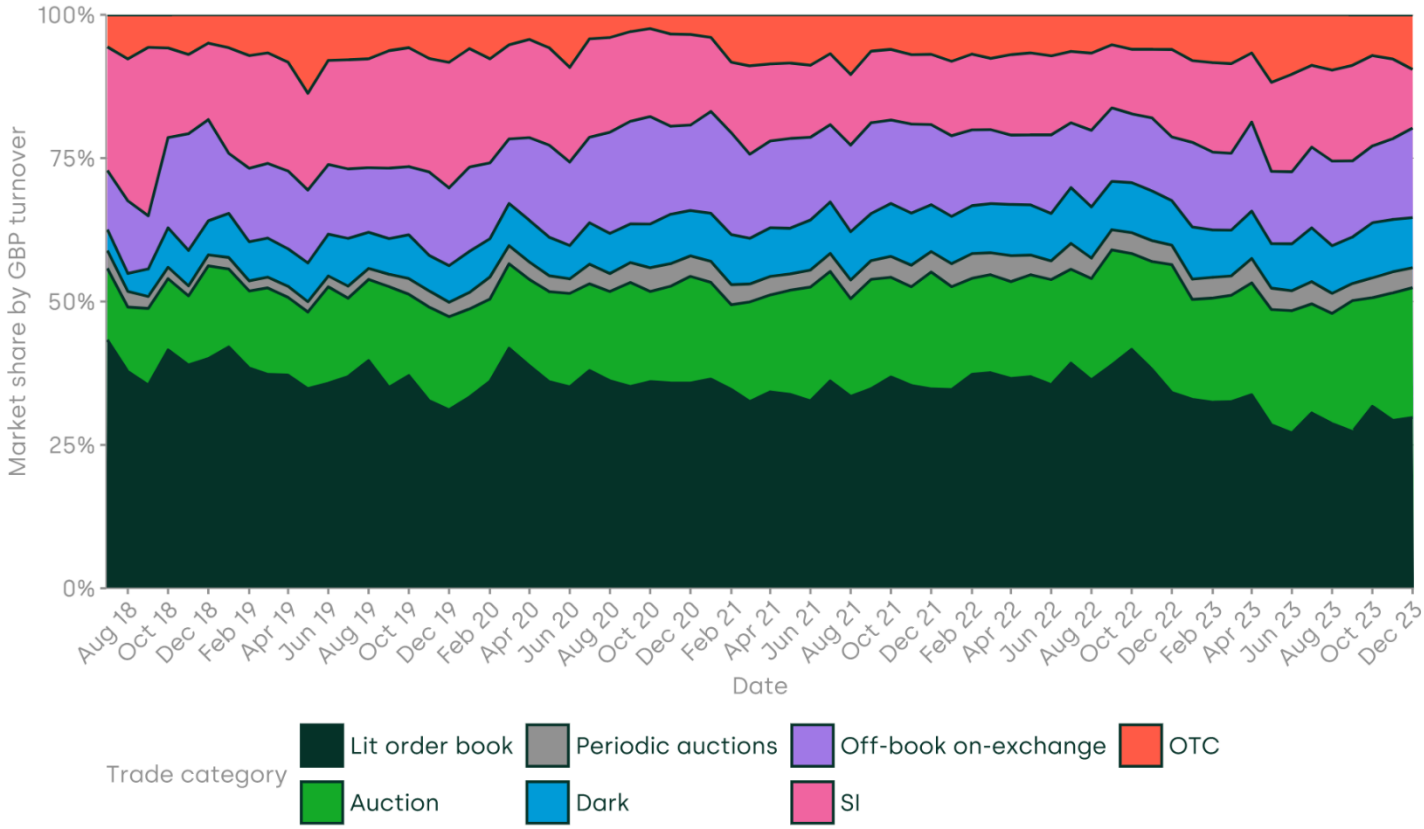
Note: Only trades on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
Source: Oxera analysis of LSEG Market Share Reporter data.

The average monthly (price forming) turnover of trading in UK shares between July 2018 and December 2023 was £192.6bn. However, this has been a downwards trajectory, with the total (price forming) turnover decreasing from £2.5tn in 2019 to £2.0tn in 2023.

Monthly (price forming) turnover has also fluctuated significantly, with the highest turnover traded in March 2020 (£337.6bn) at the beginning of the COVID-19 pandemic, and the lowest turnover traded in August 2020 (£126.5bn). The end of the Brexit transition period on 31 December 2020, after which UK trading venues became third-country venues under EU law, did not have a significant impact on the turnover of trading in ordinary shares of UK-domiciled companies.

Figure 2.4 below shows the distribution of trading in UK shares across different trading mechanisms.

Figure 2.4 Distribution of equity trading in UK-domiciled shares on UK venues by trading mechanism, July 2018–December 2023



Note: Only trades on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
Source: Oxera analysis of LSEG Market Share Reporter data.

As this figure shows, 'on-venue' trading has accounted for 77% of overall trading volumes since July 2018 and consists of the following.

- On average, lit order books accounted for 37% of the monthly turnover traded in the period 2018–22. The share of trading on lit venues gradually decreased throughout 2023 to 30% in Q4 2023.
- Opening, intraday, and closing auctions have accounted for a growing share of trading activity, from around 13% in 2018 to around 21% in Q4 2023. Periodic auctions have a much lower share, but have increased uptake over the same period. We discuss trends in auctions in more detail in Section 2.2.3.
- Dark trading, which consists of trades executed on venues under the reference price waiver (RPW) or the large-in-scale (LIS) waiver has accounted for between 3% and 10% of the monthly turnover traded since 2018. The increase in September 2018 was likely the result of the EU Double Volume Cap (DVC) mechanism

being revoked for the first wave of stocks.[23] The DVC mechanism was suspended by the FCA in 2021, however, as shown in Figure 2.4, this does not appear to have led to a material increase in on-venue dark trading.[24]

- Off-book on-exchange (OBOE) trades, which include retail trades executed under the RSP system, fluctuated between 10% and 20% of the value traded over the period.

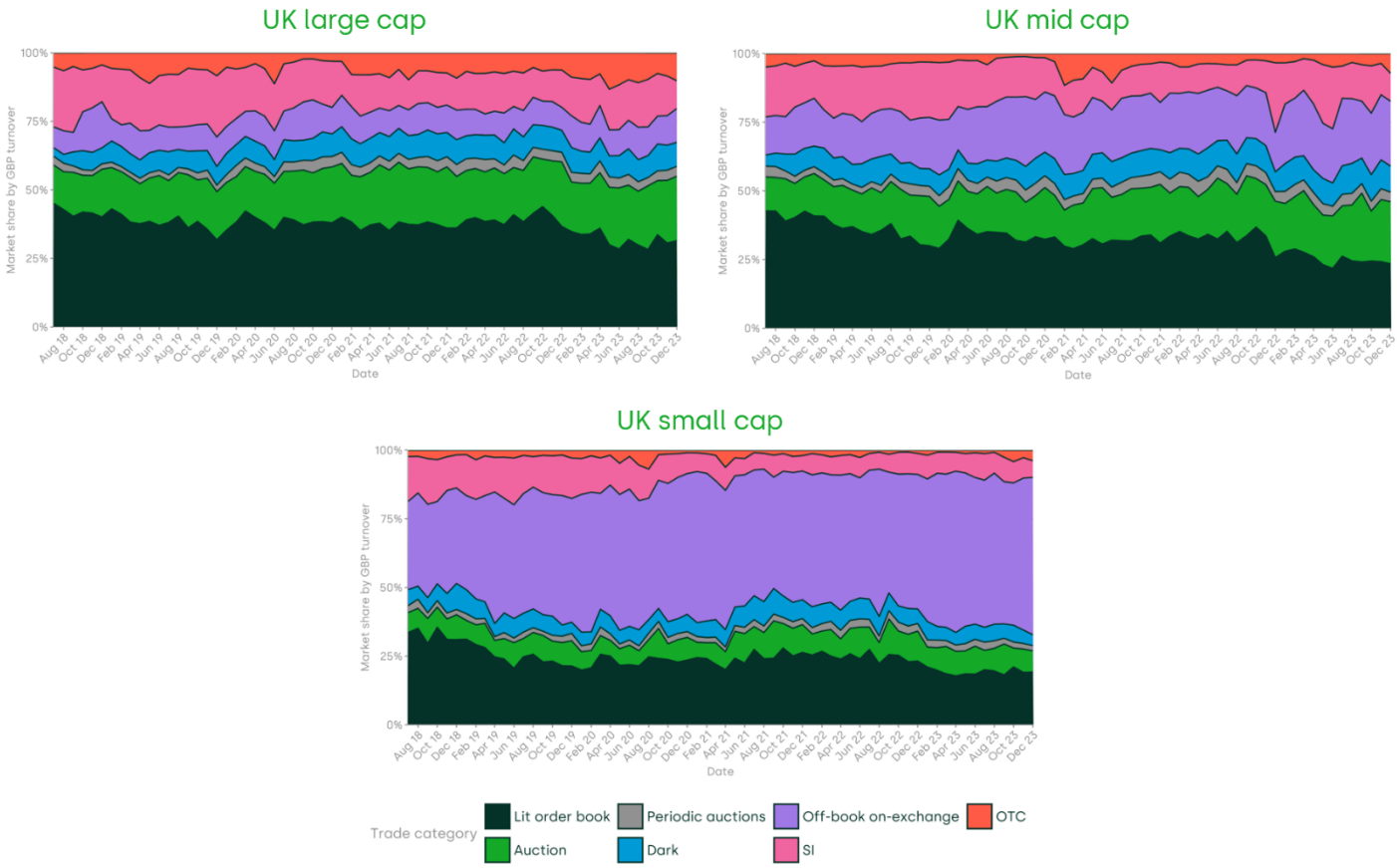
In addition to 'on-venue' trading activity, there are two 'off-venue' trading mechanisms. As Figure 2.4 shows:

- SI trading accounted for 16% of the value traded over the period;
- OTC trading accounted for 7% of the value traded over the period.

Figure 2.5 below shows how this picture varies across different segments of the UK equity market.[25] As this figure shows, OBOE trading is a more significant trading mechanism for smaller capitalisation stocks.

[23] The Double Volume Cap (DVC) mechanism, which first applied to EU equities in March 2018, ended for a number of instruments in September 2018. See ESMA (2019), 'DVC mechanism – impact on EU equity markets', ESMA Report on Trends, Risks and Vulnerabilities, https://www.esma.europa.eu/sites/default/files/trv_2019_1-dvc_mechanism_impact_on_eu_equity_markets.pdf.
[24] See Financial Conduct Authority (2021), 'Update on the Double Volume Cap', 4 March, https://www.fca.org.uk/news/statements/update-double-volume-cap.
[25] The compositions of the indices used are as at 31 December 2023, which does not necessarily reflect if a company was part of the index at the time of a given trade. As we filter to UK-domiciled ordinary shares, index constituents that are not UK-domiciled are excluded.

Figure 2.5 Distribution of equity trading in the UK by trading mechanism for different segments, July 2018–December 2023

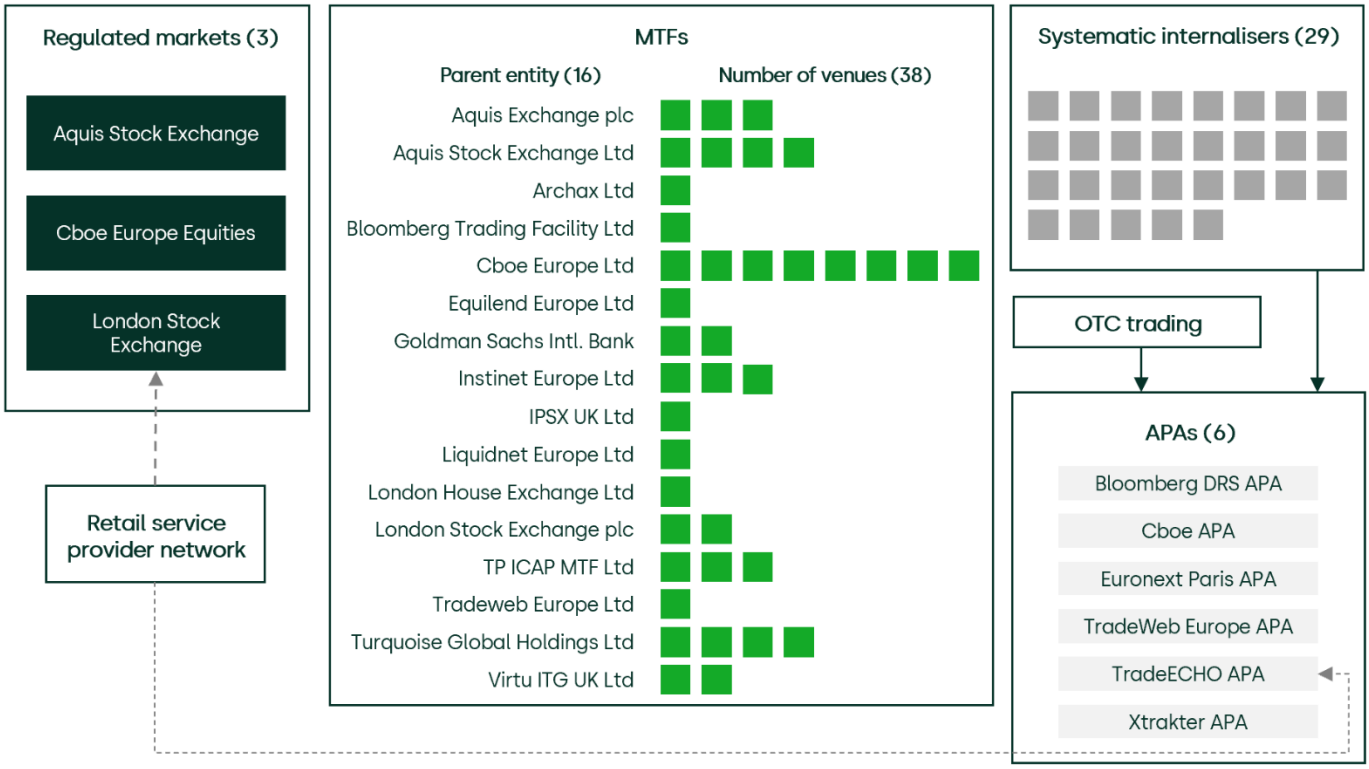


Note: The categories 'UK large cap', 'UK mid cap', and 'UK small cap' are based on the constituents of the FTSE 100, FTSE 250, and FTSE Small Cap as at 31 December 2023. Only trades on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
Source: Oxera analysis of LSEG Market Share Reporter data.

2.2.2 Trends in trading venue shares of trading activity

There is a diverse range of RMs, MTFs, SIs, and APAs authorised in the UK by the FCA. Figure 2.6 below provides an overview of the entities that are authorised in the UK, and the trading venues they operate.

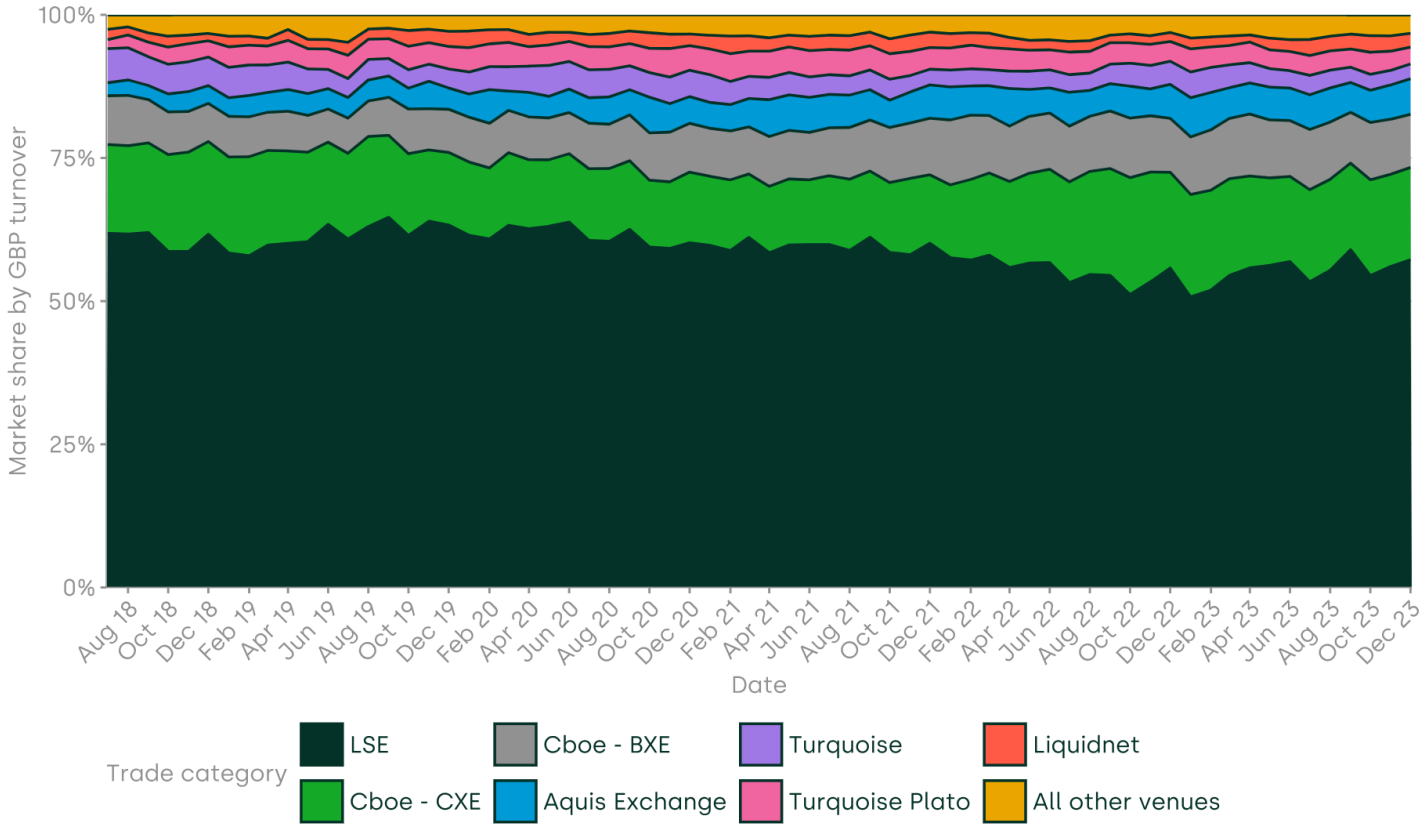
Figure 2.6 UK trading landscape



Note: The figure includes all MTFs and SIs with authorisation for the MiFID instrument classes 'Shares' and 'ETFs', and all authorised APAs. Not all of these firms will offer trading in UK equities.
Source: Financial Conduct Authority (2024), 'DRSP, MTF, OTF, SI and DR Register', https://register.fca.org.uk/s/resources#Other_registers, accessed 23 January 2024; Financial Conduct Authority (2024), 'Recognised Investment Exchanges', https://register.fca.org.uk/s/search?predefined=RIE, accessed 23 January 2024.

Figure 2.7 below shows how trading of UK-domiciled shares is distributed among UK trading venues.

Figure 2.7 Distribution of trading by UK trading venue, on-book trades, July 2018–December 2023



Note: Only on-book trades (lit order book, auction, periodic auction, dark) on UK trading venues are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares.
Source: Oxera analysis of LSEG Market Share Reporter data.

The LSE is by far the largest trading venue accounting for 59% of trading activity for the period being considered. LSEG also operates Turquoise and Turquoise Plato, accounting for an overall share of trading of 67%.

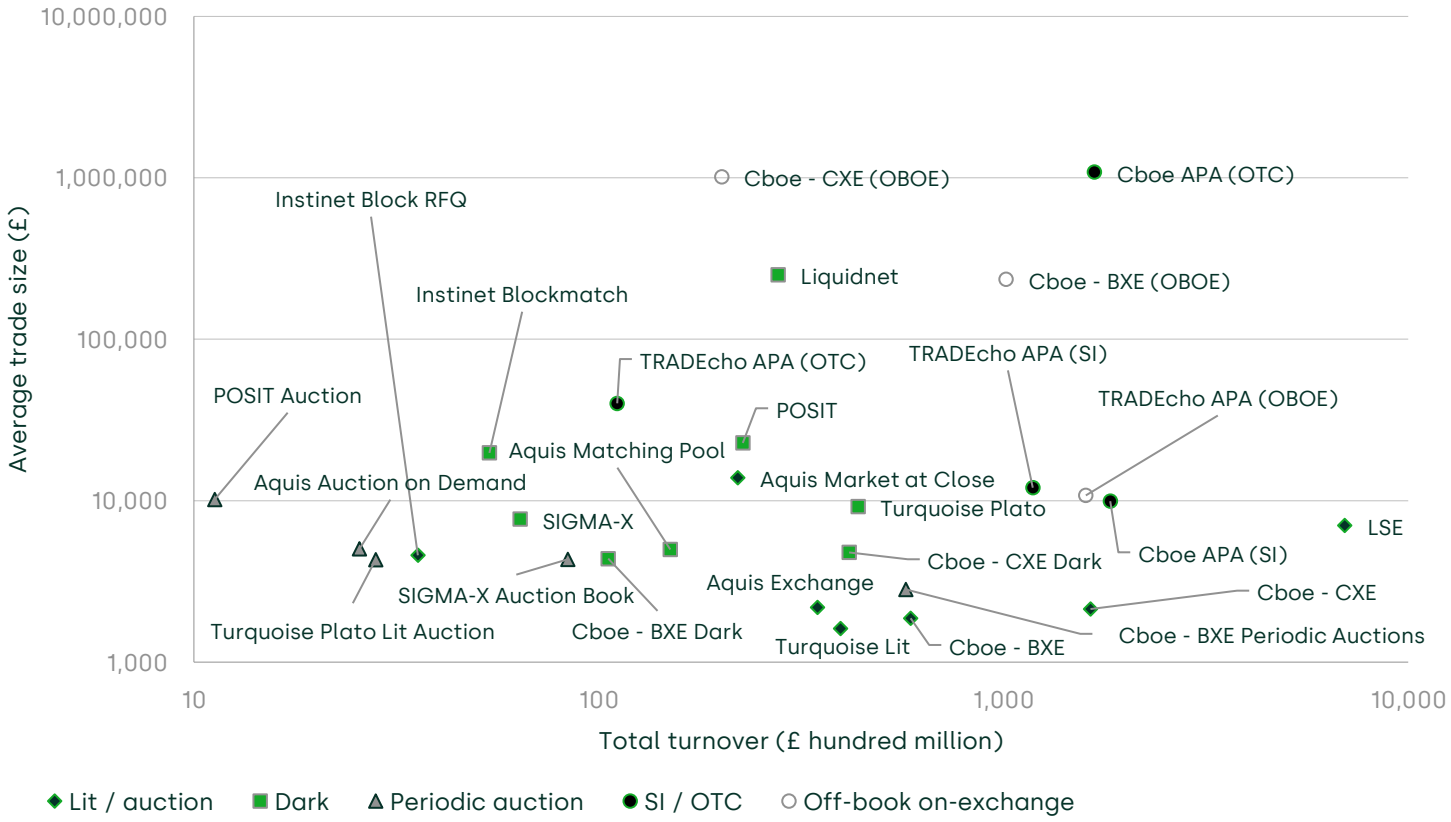
Cboe, which operates Cboe–CXE and Cboe–BXE is the next largest, with a share of 23%.

The share of Aquis Exchange is 5%, while that of Liquidnet is 2%. The remaining venues account for a total share of 3%.[26]

[26] When considering all ordinary shares traded on UK trading venues, regardless of their country of domicile, between July 2018 and December 2020 LSE and Cboe–CXE have the largest shares (28% and 29% respectively). In the period January 2021–December 2023, the share of Cboe–CXE decreased to 18%, while LSE's increased to 48%. This change is driven by the end of the Brexit transition period on 31 December 2020, after which UK trading venues became third-country venues under EU law.

As Figure 2.8 below shows, there is also significant heterogeneity in the average trade size executed on each UK trading venue.[27]

Figure 2.8 Total turnover and average trade size by UK trading venue, log scales, 2023



Note: Average trade size is calculated as GBP turnover/number of trades. Both axes are non-linear (log scales). Only trades on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
Source: Oxera analysis of LSEG Market Share Reporter data.

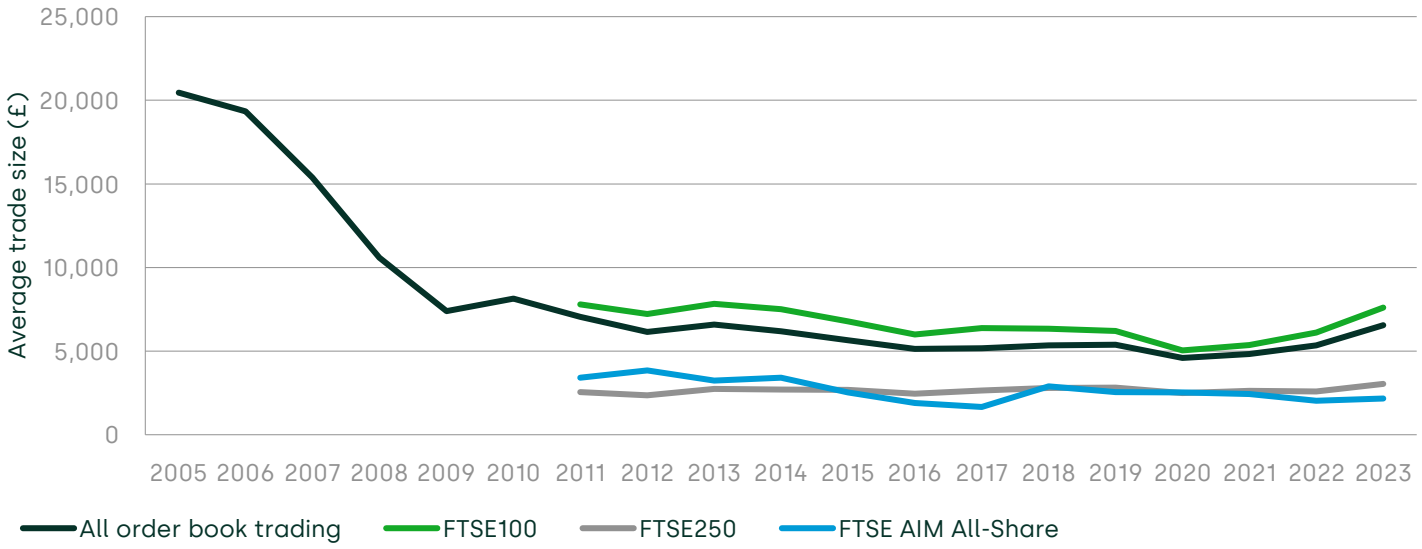
Typically, we would expect to see that venues with lower pre-trade transparency have higher average trade sizes. This is because, as explained in Section 2.1.1 above, investors looking to execute large trades, for which price impact is expected to be greatest, may prefer to trade in dark venues if allowed. The data in Figure 2.8 supports this.

[27] The average trade size is calculated by dividing the total turnover in 2023 by the number of trades in 2023.

- Several of the venues with the largest average trade sizes (e.g. Liquidnet, POSIT and Instinet BlockMatch) predominantly cater to large institutional investors.[28]
- The next-largest average trades were SI and OTC trades reported to TRADEcho APA and Cboe–APA.
- The average trade size on the various UK lit venues ranged from £1,616 on Turquoise to £7,015 on LSE.

As Figure 2.9 shows, the average trade size on the LSE CLOB decreased significantly during the early 2000s (which coincided with the growth of electronic and algorithmic trading), continued to decrease at a slower rate in 2010–20, and increased slightly in 2020–23 (primarily due to higher trade sizes for large-cap FTSE100 shares).

Figure 2.9 Average trade size on LSE CLOB, 2005-23



Note: Segment-level data is not available before 2011.
Source: Oxera analysis of LSEG statistics, https://www.londonstockexchange.com/reports?tab=market-summary.

2.2.3 Trends in metrics of market quality

As explained in section 2.1 above, a liquid market enables participants to buy and to sell securities of various order sizes without delay and without significant impact on prevailing prices. Given the complex and

[28] See, for example, Instinet, 'BlockMatch', https://www.instinet.com/blockmatch, accessed 17 May 2024.

multifaceted nature of liquidity, there are various metrics to gauge the liquidity of a market.

In this section, we describe some of the trends in different liquidity metrics for UK equity markets. Overall, we examine trends in the following metrics:

- the quoted bid–ask spread—the difference between the bid and ask prices (measured in basis points);
- quoted depth—the volume of shares available to purchase at the best prices;
- sweep to fill—the spread associated with executing a round-trip in a given trade size (taking into account the volume-weighted price for larger orders that cannot be executed at the best price);
- implementation shortfall—a measure of implicit costs based on 'slippage' (i.e. the difference between the final volume-weighted price achieved by a broker and the prevailing price when they started trading);
- intraday price volatility—the degree of variation in traded prices.

Quoted bid–ask spreads

Figure 2.10 below shows how quoted UK bid–ask spreads have evolved since MiFID II. The average bid–ask spreads for FTSE100 stocks have remained broadly stable since 2018, with the exception of a significant spike in March 2020 (coinciding with the first set of COVID-19 lockdowns in the UK), after which spreads returned to a slightly higher level. The smaller spike at the end of February 2022 coincided with the beginning of the war in Ukraine.

However, average bid–ask spreads for FTSE250 stocks have increased steadily since 2022. This suggests that, while liquidity 'at touch' has remained stable for the largest companies, liquidity has deteriorated for mid-cap companies in recent years.

Figure 2.10 Average quoted bid–ask spread, January 2018–December 2023

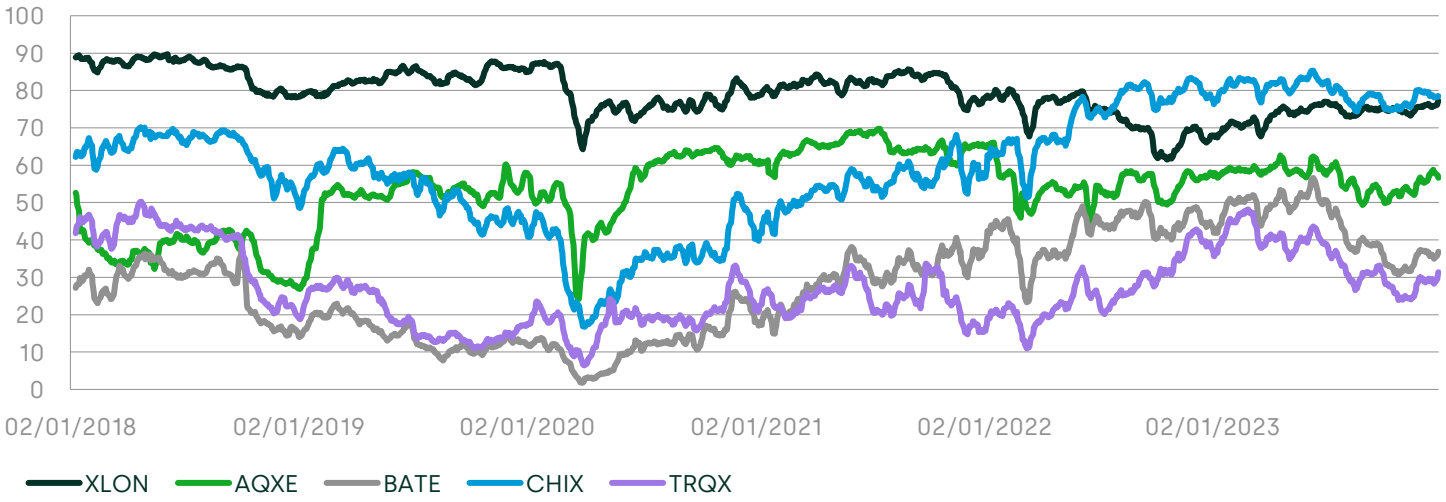
Note: 'Bid–ask spread' refers to the difference between the best bid and best ask prices, where the best price has been computed across all five order books. Bid–ask spreads represent the simple average across all stocks in the index. The figure shows simple moving average over seven days.
Source: BMLL Technologies.

This period of largely flat bid–ask spreads between 2018 and 2020 follows a longer-term gradual reduction over the period between MiFID I and MiFID II. For example, previous analysis conducted by Oxera noted that average UK bid–ask spreads fell from around 17bps in Q1 2010 to around 9bps at the time that MiFID II was implemented in Q1 2018.[29]

Figure 2.11 shows the presence at EBBO (i.e. the percentage of time that the venue offers prices equal to the consolidated best bid and best ask prices) for five UK CLOBs. Over the last six years, the LSE has had the highest presence at the EBBO. In more recent years the Cboe–CXE order book presence at EBBO has increased to match that of the LSE.

[29] See Figure A9.4 in Oxera (2020), 'Primary and secondary equity markets in the EU', Report prepared for the European Commission, https://www.oxera.com/wp-content/uploads/2020/11/Oxera-study-Primary-and-Secondary-Markets-in-the-EU-Final-Report-EN-1.pdf.

Figure 2.11 Time at EBBO for FTSE100 stocks (%), January 2018–December 2023

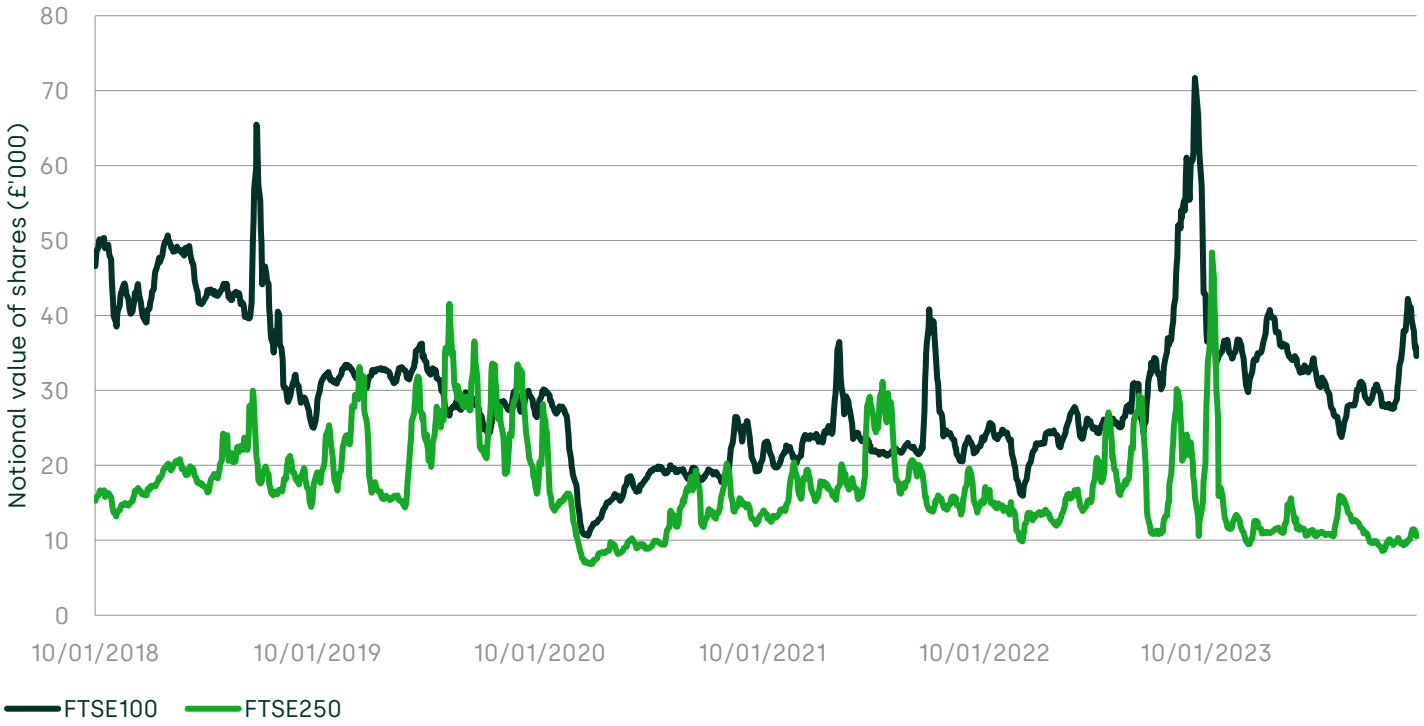


Note: Percentage of time during the continuous trading period where there is at least one order equal to the European best bid price, and simultaneously at least one order equal to the European best ask price. Each series in the chart reflects an individual Market Identifier (MIC) code. 'XLON' refers to London Stock Exchange. 'AQXE' refers to Aquis Exchange. 'BATE' and 'CHIX' refers to the BATS and Chi-X CLOBs operated by Cboe. 'TRQX' refers to Turquoise. The figure shows simple moving average over seven days.
Source: BMLL Technologies.

The bid–ask spread represents the cost of immediate consumption of liquidity at the best prices available on the market. This metric expresses the transaction cost only for those who wish to execute a marginal trade in the market, and does not provide information about how many units of the stock can be executed at the best quotes.

Figure 2.12 shows the average quoted depth at the best ask price for FTSE100 and FTSE250 stocks. This figure shows that quoted depth in FTSE100 shares declined overall from around £42,000 on average in 2018 to around £30,000 in 2019. Quoted depth fell sharply during March 2020, then increased throughout the period 2020-22. Quoted depth in 2023 was around £34,000 on average.

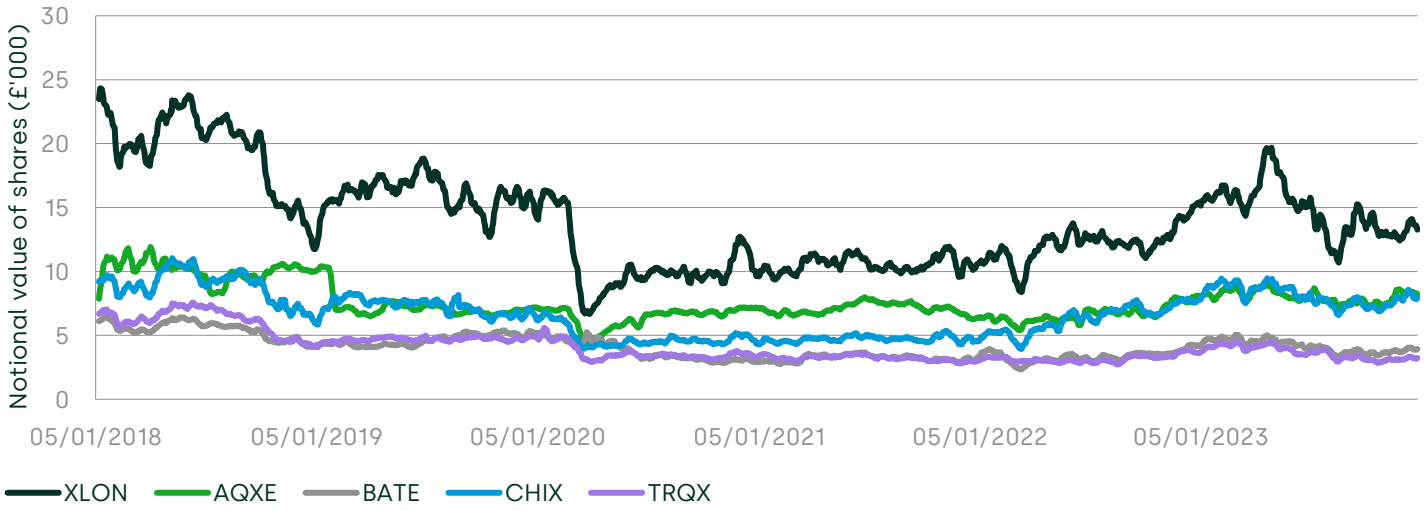
Figure 2.12 Average depth at best ask price, January 2018–December 2023



Note: Best ask price refers to the lowest ask price across all five order books. The figure shows simple moving average over seven days.
Source: BMLL Technologies.

The fluctuations in overall market depth have primarily been driven by changes in quoted depth on the LSE CLOB. This is not entirely surprising given LSE's position as the largest lit trading venue in the UK. As shown in Figure 2.13 below, the quoted depth on other UK lit venues has followed a broadly similar path over time.

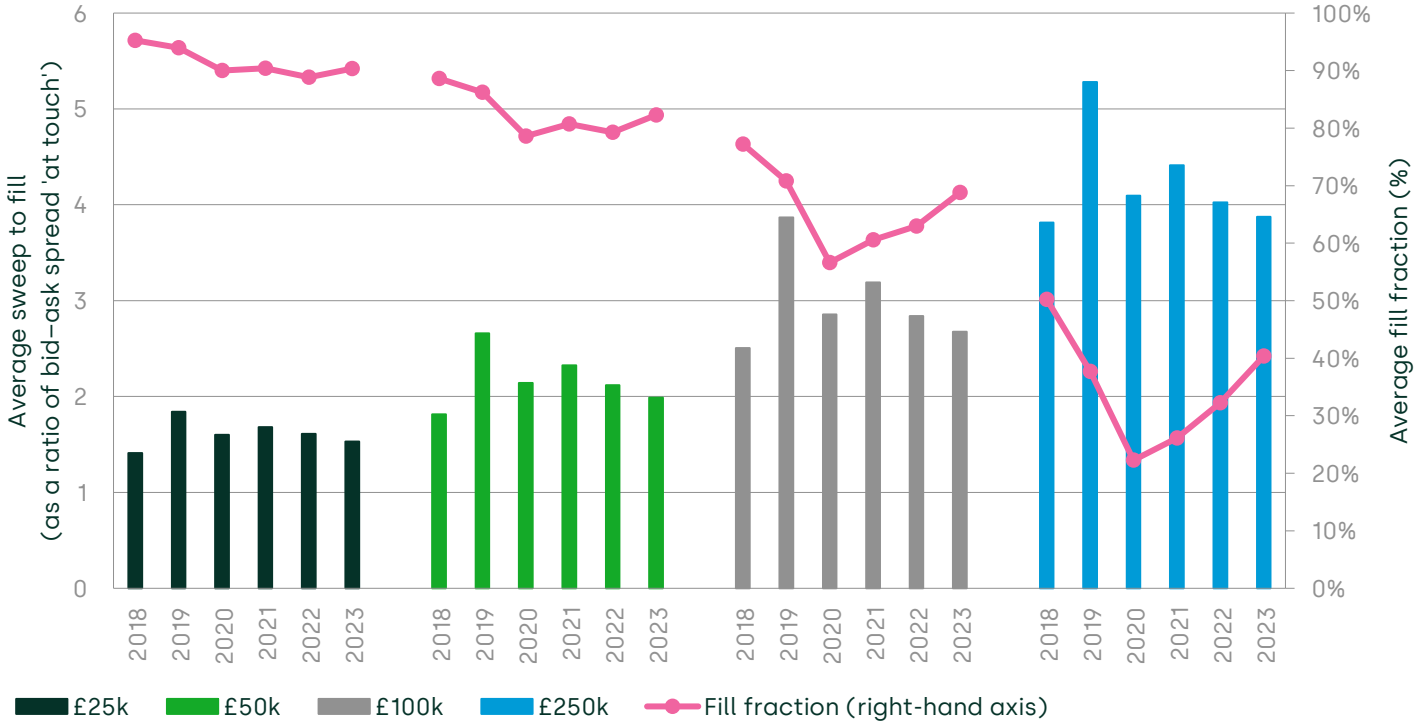
Figure 2.13 Average depth at best ask price (FTSE100 stocks), January 2018–December 2023



Note: Each series in the chart reflects an individual Market Identifier code (MIC). 'XLON' refers to the London Stock Exchange. 'AQXE' refers to Aquis Exchange. 'BATE' and 'CHIX' refer to the BATS and Chi-X CLOBs operated by Cboe. 'TRQX' refers to Turquoise. In this chart best ask price refers to the lowest ask price available at that venue. The figure shows simple moving average over seven days.
Source: BMLL Technologies.

Figure 2.14 provides a combined measure of quoted breadth and quoted depth for FTSE100 stocks, based on BMLL's 'sweep to fill' metric. This figure shows the hypothetical spread for orders of various sizes, expressed as a ratio of the bid–ask spread 'at touch', as well as the probability of being able to fill an order of that size.

Figure 2.14 Average sweep to fill (FTSE100 stocks), 2018–2023



Note: Sweep-to-fill is calculated as the difference between weighted average prices on each side of the book for a given order size at a given point in time. The sweep-to-fill values in the chart represent the annual average sweep-to-fill, conditional on it being possible to execute an order of that size based on available depth. The fill fraction reflects the probability of being able to execute an order of that size at any point during market hours. The lower the fill fraction, the less representative is the sweep-to-fill metric.
Source: BMLL Technologies.

The average sweep to fill ratio has generally increased between 2018 and 2021 but has fallen since 2021. The average ratio in 2023 remains higher compared to 2018. For example, the average bid–ask spread for a £50k order size was around 1.8x the bid–ask spread 'at touch' in 2018 and around 2x in 2023. The average fill fraction for filling larger order sizes has also fallen slightly over the period (e.g. from 89% to 82% for £50k order sizes), suggesting that the feasibility of executing larger orders in one go via a CLOB has reduced relative to 2018.

Figure 2.15 Average sweep to fill (FTSE250 stocks), 2018–2023

Note: Sweep-to-fill is calculated as the difference between weighted average prices on each side of the book for a given order size at a given point in time. The sweep-to-fill values in the chart represent the annual average sweep-to-fill, conditional on it being possible to execute an order of that size based on available depth. The fill fraction reflects the probability of being able to execute an order of that size at any point during market hours. The lower the fill fraction, the less representative is the sweep-to-fill metric.
Source: BMLL Technologies.

When considering FTSE250 stocks (Figure 2.15), the sweep to fill ratio has decreased relative to 2018. The fill fraction is systematically lower than for FTSE100 stocks, suggesting that it is more challenging to source liquidity in large order sizes for mid-cap stocks.

Implementation shortfall

While quoted breadth and depth are important metrics of liquidity that are frequently used by market participants, such metrics have several drawbacks.

Firstly, in a landscape of multiple trading venues, traders may duplicate orders (across platforms), meaning that quoted depth across markets is likely to lead to an overestimation of available liquidity.[30]

Secondly, if the size of the order is larger than the available volume posted at the best quote, then a trader faces a choice between:

- sending the order all at once, thus trading against quotes at successively worse prices (i.e. 'walking the book'), or;
- splitting the 'parent' order into a number of smaller 'child' orders and executing across a longer trading horizon.

Executing a trade in stages can create gains or losses depending on how the market price of the security moves (price risk). Therefore, the quoted liquidity metrics above do not capture the total implicit costs faced by investors who slice and dice larger orders over an extended period of time.

Implementation shortfall (IS) measures the slippage from the arrival price (measured in basis points) calculated as the difference between the weighted-average client execution price and the price at arrival timestamp for the parent order.[31] This measure combines the impact of the prevailing spread, the impact on the price while the order is being executed, as well as any in-trade price momentum.

Previous Oxera analysis noted that, when considering the long-run pre-MiFID II trends in IS, there has still been an improvement in implicit costs over time, albeit to a lesser extent than for bid–ask spreads. In the UK, IS fell from 44bps in the first half of 2009 to 33.6bps in the first half of 2019 (as measured by data taken from Virtu's Global Peer Database).[32]

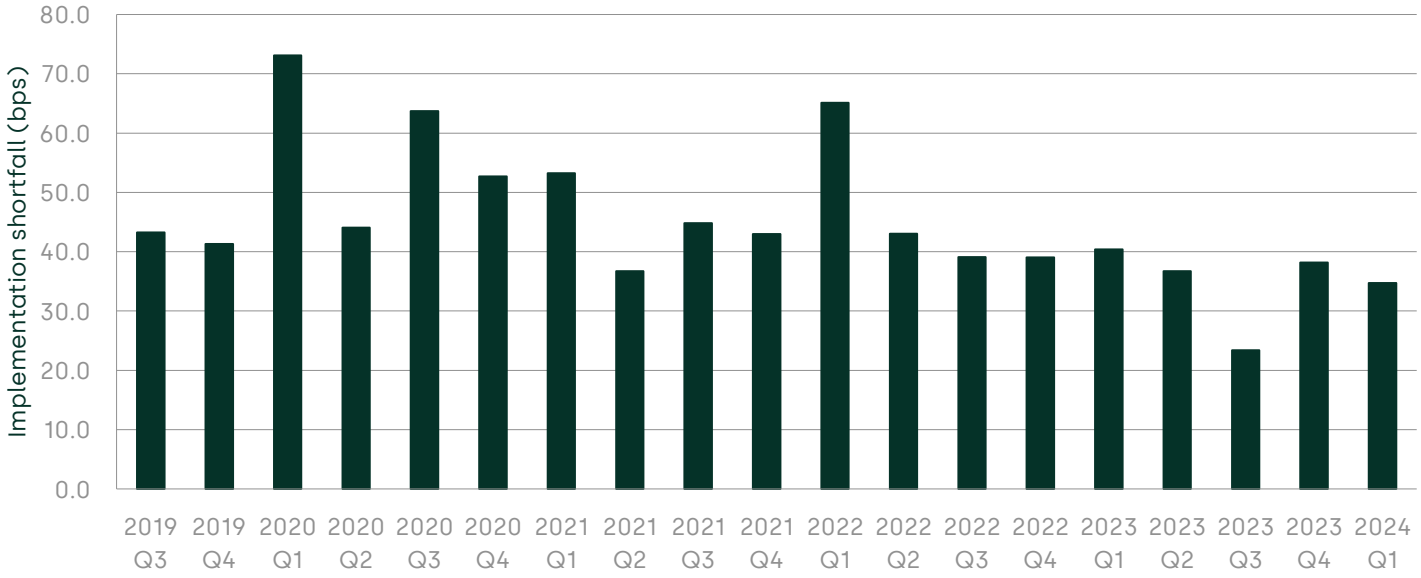
[30] For example, analysis by ESMA in 2016 found that 20% of orders were duplicated orders, and in 24% of trades the trader immediately cancelled unmatched duplicated orders. This duplicated order behaviour was primarily concentrated among HFTs. Further analysis in 2020 found that around 4% of consolidated depth consisted of 'ghost liquidity'. See ESMA (2016), 'Order duplication and liquidity measurement in EU equity markets', ESMA Economic Report, https://www.esma.europa.eu/sites/default/files/library/2016-907_economic_report_on_duplicated_orders.pdf; Degryse, H., De Winne, R. Gresse, C. and Payne, R. (2020), 'Cross-venue liquidity provision: high-frequency trading and ghost liquidity', ESMA Working Paper, https://www.esma.europa.eu/sites/default/files/library/esma_wp_4_2020_hft_and_ghost_liquidity.pdf.

[31] In other words, the difference between the weighted average price actually achieved for an investor's trade, and the prevailing last price obtained in that security prior to the investor starting to buy (or sell) it.

[32] This reduction is likely to capture some of the impacts from the global financial crisis. However, when taking into account the pre-financial crisis period, the same Oxera study noted a reduction in implementation shortfall across the EU of a smaller scale—from 39.3bps in the first half of 2004 to 31.7bps in the first half of 2019. Oxera (2020), 'Primary and secondary equity markets in the EU',

Figure 2.16 below shows how the IS costs for UK-listed equities have evolved in more recent years, again based on data taken from Virtu's Global Peer database.[33]

Figure 2.16 Implementation shortfall for UK listed equities, Q3 2019–Q1 2024



Note: Implementation shortfall captures slippage from arrival price, measured in basis points. This is calculated as 10,000 * (weighted-average client execution price - price at arrival timestamp) / (price at arrival timestamp). Positive values mean executed prices are worse than arrival price (trading cost).
Source: Oxera analysis of Virtu Global Peer Database.

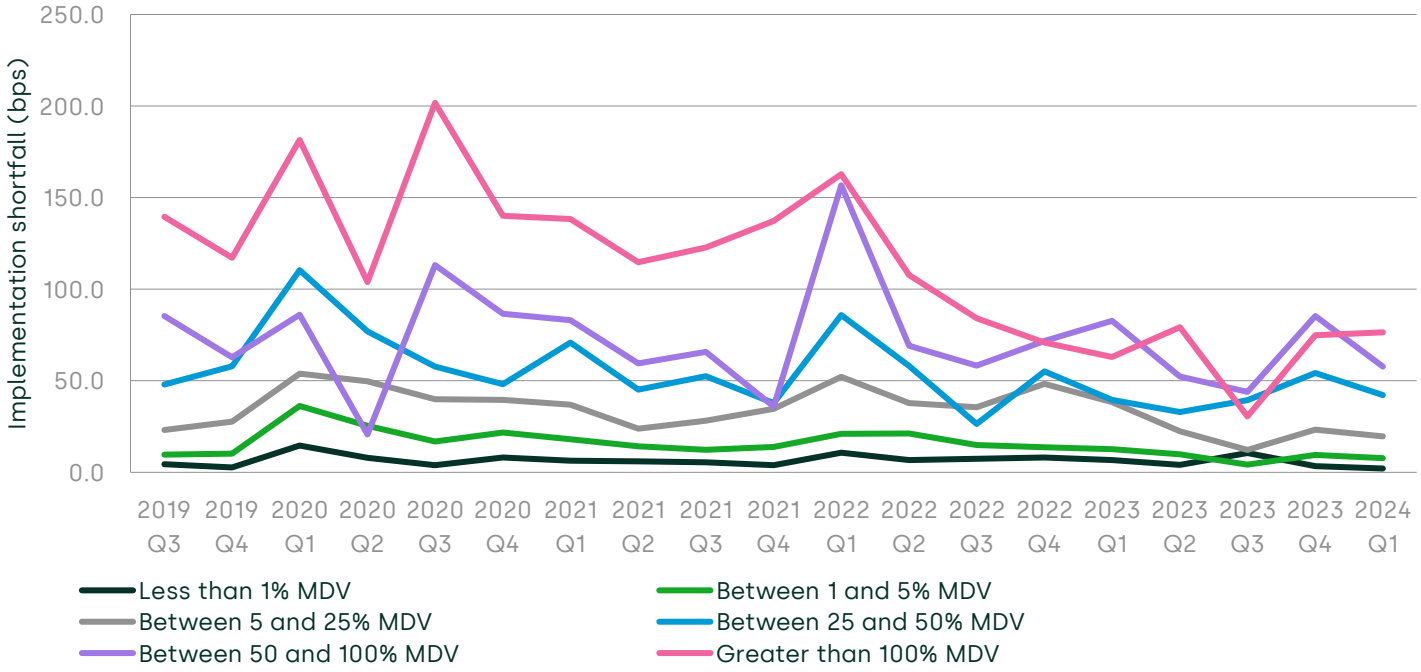
IS costs for UK equities have remained broadly stable over the period, with the exception of spikes in Q1 2020 and Q1 2022, mirroring the spikes in quoted liquidity noted above.

Report prepared for the European Commission, https://www.oxera.com/wp-content/uploads/2020/11/Oxera-study-Primary-and-Secondary-Markets-in-the-EU-Final-Report-EN-1.pdf.

[33] Source disclaimer (from Virtu): 'Many factors influence transaction cost including order size, volatility, and spread. Virtu's peer universe includes a variety of firm types trading orders of all sizes in various market conditions. Virtu's Peer commission numbers represent a blend of both execution-only and fully bundled rates. Investment firms represented in the Virtu peer universe follow diverse trading strategies. Trading performance for firms employing different trading strategies may not be directly comparable.'

Figure 2.17 shows how the overall IS has varied for different-sized orders. There has been a pronounced fall in the IS costs associated with the largest orders (those larger than the median daily volume traded).

Figure 2.17 Implementation shortfall for UK listed equities by order size, Q3 2019–Q1 2024



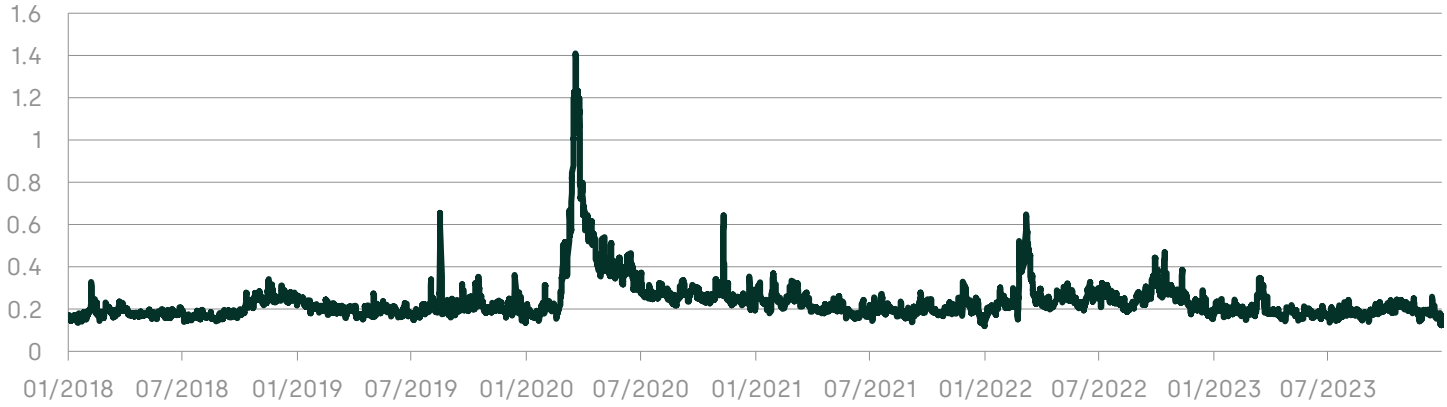
Note: MDV refers to the median daily volume traded in the 21 days prior to the order. Implementation shortfall captures slippage from arrival price, measured in basis points. This is calculated as 10,000 * (weighted-average client execution price - price at arrival timestamp) / (price at arrival timestamp). Positive values mean executed prices are worse than arrival price (trading cost).
Source: Oxera analysis of Virtu Global Peer Database.

Volatility

Finally, Figure 2.18 below shows how intraday volatility has evolved for FTSE100 stocks since 2018. Intraday volatility has followed a similar trend to the bid–ask spread shown in Figure 2.10. The spikes in August 2019, March 2020, and March 2022 coincided with a trading outage on the LSE, the first COVID-19 lockdown in the UK, and the beginning of the war in Ukraine, respectively.[34]

[34] The link between bid–ask spreads and price volatility is well-described in the academic literature. One of the costs faced by liquidity providers are inventory costs arising from the risk of adverse

Figure 2.18 Intraday volatility (FTSE100), Jan 2018–Dec 2023



Note: Intraday volatility calculated as annualised log volatility sampled at one-minute intervals. The figure shows simple moving average over a nine-hour period.
Source: BMLL Technologies.

2.3 Summary

We began this section by briefly outlining the role of secondary equity markets, noting that a well-functioning market should facilitate price formation and liquidity (allowing end-investors to trade at low cost) while also promoting innovation and choice for end-investors, and performing well in times of stress.

Following the introduction of MiFID in 2007, alternative trading venues emerged to compete with the LSE for order flow, meaning that UK equity trading fragmented across a range of different venues and mechanisms.

Since MiFID II, trading in UK equities has remained fragmentated across a wide range of trading mechanisms, each competing to meet different investors' needs. As at Q4 2023, lit continuous volumes were 30%, while trading in auctions accounted for a similar share of activity (around 21%). Off-book on-exchange trading (including RSP trades and large negotiated blocks of stocks) now accounts for circa 14% of market volumes, while bilateral agreement mechanisms operated by market

price movements when holding a security before a position can be unwound. These costs must be recovered by liquidity providers through the bid–ask spread, hence (all else being equal) greater price volatility will lead to increased spreads. See, for example, Stoll, H.R. (1978), 'The supply of dealer services in securities markets', *The Journal of Finance*, **33**:4, pp. 1133–51.

participants such as SIs run by brokers and liquidity providers and OTC trading now accounts for around 22%.[35]

What has this meant in terms of outcomes for end-investors in UK equities? The evidence shown above suggests that the current market structure is working well overall. Investor implicit costs (as measured by implementation shortfall) fell significantly since the introduction of MiFID, and have remained broadly stable over the last six years.[36] In other words, trading fragmentation has not led to liquidity fragmentation.

However, even if the UK market is working well overall, a natural question for policymakers is whether the current market structure is working for all types of user. As we discuss in the following section, the downward trend in implicit costs has been driven by brokers (particularly larger players) multi-homing across venues and investing in smart order routers to access the best-available liquidity. Not all brokers will incur the fixed costs of multi-homing, and the equilibrium will be a tiered market. This is potentially the case for smaller players, who may find that a subset of venues provides the best prices most of the time, and that some liquidity is not accessible to 'slower' participants. We discuss this further below in the context of the CT.

[35] Oxera analysis of LSEG Market Share Reporter data. Only trades on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
[36] There is evidence that quoted bid–ask spreads have increased for mid-cap stocks since 2022, and that quoted depth has 'thinned' for large-cap and mid-cap stocks since 2018.

3 What type of CT could improve equity market functioning?

Key messages

- This section analyses what type of CT (i.e. pre- or post-trade) could improve market functioning'. Analysis of use cases for consolidated data shows that the majority of functions within brokerage and fund management firms require consolidated post-trade data (particularly end-of-day data), while real-time pre-trade data is primarily required for front-office trading functions.

- Our analysis shows that a post-trade tape may be beneficial, but that a real-time pre-trade tape is unlikely to improve market functioning. The main rationale for a pre-trade CT under MiFID II was to ensure search costs are low for traders (including retail investors) in a landscape with multiple venues and fragmented trading. Consequently, when assessing the likely impact of a pre-trade CT on market quality, it is important to consider how a CT is likely to affect search costs for traders.

- We first analyse whether traders would start using a CT, and if so whether their use of a CT would improve market functioning. Our analysis indicates that a significant proportion of brokers already multi-home across UK lit venues, and already consume consolidated pre- (and post)-trade data for equities. This is consistent with the findings discussed in section 2 suggesting that overall trading fragmentation since MIFID I has not led to liquidity fragmentation in UK equities.

- It is unlikely that traders already consuming equivalent data would switch to using a pre-trade CT for execution purposes, particularly due to the latency it introduces. Some traders may switch from proprietary feeds to a CT (if the lower latency were not an issue for them), but the information set available to them would not change as they already consume consolidated data. Therefore, there would not be an impact on market quality.

- The key question, then, is whether traders that currently consume a more limited amount of data would switch to using a CT, and whether that would be beneficial for them and improve market quality. In the debate, the assumption seems to have been that this would bring significant benefits. Our analysis shows that this is not the case, for three reasons. First, fragmented trading does not always mean fragmented liquidity. A majority of participants trading across multiple venues means that even traders not connected to multiple venues still benefit from the broader liquidity pool. Second, better prices (visible in a pre-trade CT) will only be accessible to a trader if their brokers invest in the capabilities to be able to quickly process pre-trade data, and in the connectivity (and speed) to access fast-moving liquidity. Such investments are unlikely to be worthwhile as brokers already benefit from the broader liquidity pool, and brokers always have the option of routing more complex trades to larger brokers (who have already invested in the relevant capabilities and connectivity). Third, although retail investors may not currently consume pre-trade data from lit venues, a CT is unlikely to lead to better outcomes for these users. Retail order flow in the UK is already segmented via the RSP system, meaning that a pre-trade CT (based on prices across various CLOBs) may provide a misleading benchmark for them.

- While this section focuses on assessing the potential benefits of a CT, any CBA must also consider the project costs of setting up and running an operationally resilient CT. These costs may vary according to the precise scope of the CT.

3.1 What is the UK consolidated tape for equities?

A consolidated tape (CT) refers to a data feed which collates and disseminates market data, such as prices and volumes in a financial instrument, from various sources. It aims to provide a comprehensive picture of the trading activity taking place across multiple trading venues and OTC.

A CT may vary across a number of dimensions:

- coverage—the type of instruments included in the CT as well as the type of venues that contribute data;
- latency—a 'real-time' CT will disseminate data as soon as technically possible, but a CT may publish data with a delay from anywhere between a few seconds and several days;
- type of data—a CT may contain post-trade data (i.e. prices and volumes associated with transactions that have taken place), pre-trade data (i.e. prices and volumes of orders or advertised quotes on lit venues), or a combination of both.

Pre-trade data can be displayed at the level of individual orders, or aggregated to show the available volume at a given price level. A common pre-trade metric is the BBO, which refers to the best available prices for both directions of a trade.[37] A pre-trade CT may distribute these metrics for each venue separately, or may undertake further aggregation to produce a single order book or consolidated BBO. The latter will require the CT to ensure that messages from each venue are disseminated in the same format,[38] and to merge data from each venue based on the message timestamp. In each case, there is a trade-off between the level of standardising and processing undertaken, and the degree of latency added by the CT.

Figure 3.1 Types of pre-trade data

Level 1 data

Total volumes shown at the best bid and offer.

Bid	
Vol.	Price
15	1.27

Offer	
Vol.	Price
20	1.32

Bid	
Vol.	Price
10	1.30

Offer	
Vol.	Price
18	1.31

Time

Level 2 data

Depth of order book shown

Bid	
Vol.	Price
15	1.27
12	1.25
7	1.24

Offer	
Vol.	Price
20	1.32
16	1.33
10	1.35

Bid	
Vol.	Price
10	1.30
15	1.28
9	1.25
7	1.24

Offer	
Vol.	Price
18	1.31
20	1.32
10	1.33
10	1.35

Order-level data

All individual messages sent to order book shown.

Order	Type	Vol.	Price
1	BID	10	1.30
2	OFFER	8	1.31
3	CANCEL	15	1.27
4	OFFER	10	1.31
5	BID	15	1.28
6	CANCEL	3	1.25
7	CANCEL	6	1.33

Note: The above stylised example is based on a CLOB, in which pre-trade data reflects the volumes and prices posted by liquidity providers on both the bid and offer side of the book.
Source: Oxera.

In 2023, as part of the UK government's Wholesale Markets Review (WMR), the FCA published two consultation papers on its proposed

[37] This is referred to as Level 1 data, as it shows the top level of the order book.
[38] Protocols such as FIX MMT provide a common standard for post-trade data reporting, however pre-trade data may be transmitted differently by each venue. See Oxera (2009), 'What are the benefits of the FIX Protocol?', December.

framework for a UK CT for bond market data. These consultation papers also included a discussion chapter on a proposed CT for equities.

Table 3.2 below shows the proposed scope of the UK consolidated tapes for bonds and equities at the time of writing, based on the FCA's consultation papers.

Table 3.2 FCA proposals regarding UK consolidated tapes for bonds and equities

	Bonds	Equities
Instrument coverage	All MiFID categories of bonds (except for ETNs and ETCs) that are admitted to trading, or traded on, a trading venue in the UK.	All MiFID equity instruments (incl. shares, depository receipts, certificates, ETFs, and similar instruments) that are admitted to trading, or traded on, a trading venue in the UK. ETNs and ETCs may also be included.
Venue coverage	All UK trading venues and APAs. New venues and APAs must send data to a Consolidated Tape Provider no later than six months after the start of their operations.	All UK trading venues and APAs covering UK equities, taking adequate and timely account of entry and exit of relevant firms.
Latency	Trading venues should send data to the CT in 'as close to real-time as is technically possible'. The CT should publish data in real time as soon as is technically possible after receiving it.	Not yet decided.
Type of data	Post-trade data (i.e. prices, volumes, and descriptive flags) only. Cleaned, historical post-trade data will be available as a separate, bespoke subscription service.	Not yet decided. Some respondents have suggested that pre-trade data should include at least five levels of order book data with venue attribution. Some respondents were opposed to including pre-trade data in the CT.
Format	Two machine-readable forms (API and CSV) and a human-readable form (GUI)	Not yet decided.

Note: UK trading venues and APAs are understood to refer to all FCA-authorised trading venues and APAs.
Source: Financial Conduct Authority (2023), CP23/15; Financial Conduct Authority (2023), CP23/33.

This section summarises the different potential use cases for a CT and presents an economic framework for assessing potential *benefits* to end-investors and market quality. In the context of a CBA, the FCA must also consider the projected *costs* of setting up and running a CT.

The activities involved in a CT will include establishing and operating the relevant connectivity, data storage, administration, and governance processes. For example, ESMA has highlighted four criteria that data transmission infrastructure should adhere to.[39]

- Performance—this includes latency, throughput, connection setup time optimisation and scalability.
- Reliability—this may include error detection and correction mechanisms as well as recovery mechanisms.
- Security—this may include systems to maintain data confidentiality, user authentication and authorisation.
- Compatibility—this may include steps to ensure that the relevant infrastructure uses open-source solutions, and can interoperate with other technologies.

Each of these activities will be associated with upfront investment and operating costs, which may vary according to the precise scope of the CT. Moreover, the operator would need to incur costs to ensure the CT's broader operational resilience, particularly if the CT became heavily relied on by users and/or identified as a critical national infrastructure.

Estimating the precise magnitude of these costs can be challenging—however, the FCA may be able to use information collected in the context of the bonds CT tender process to inform as to the lower bound of these costs for an equities CT.[40]

The rest of this section is structured as follows:

- section 3.2 describes the various use cases that have been identified for consolidated pre- and post-trade data;
- section 3.3 sets out an economic framework for assessing the benefits of an equity CT;
- sections 3.4 and 3.5 discuss whether an equity CT is likely to have an effect on overall market quality;
- section 3.6 summarises our analysis.

[39] ESMA (2024), 'MiFIR Review Consultation Package: technical standards related to Consolidated Tape Providers and DRSPs, and assessment criteria for the CTP selection procedure', May, https://www.esma.europa.eu/sites/default/files/2024-05/ESMA74-2134169708-7225_-_MiFIR_MiFID_Review_-_CP_on_CTPs_and_DRSPs.pdf.

[40] Firms taking part in the auction to supply the bonds CT will bid a maximum average price per user, which will be based on their best predictions of the costs to set up and operate the CT infrastructure. The FCA may also be able to compare the cost levels implied by these (binding) auction bids to any cost estimates previously obtained, as a measure of the level of 'optimism' or 'pessimism' bias it should expect for the equities CT costs.

3.2 Potential users of a pre- and post-trade equity CT

Before discussing the economic framework for assessing the benefits to end-investors of a CT, we first outline the use cases that have previously been identified for consolidated pre- and post-trade data.

Table 3.3 and Table 3.4 below set out the various use cases for different types of trading data according to the specific function within the value chain, based on analyses conducted by Adamantia and Market Structure Partners.[41]

Table 3.3 provides a breakdown of the type of data used by each function, depending on whether the use case requires pre- or post-trade data, as well as the level of latency required.

[41] These analyses were both conducted in the context of an EU CT.

Table 3.3 Use cases for equity data

	Pre-trade data			*Post-trade data*		
Function	RT	D	HIST	RT	D	HIST
Front office						
Pre-trade analysis						
Display order books	✓			✓		
Liquidity analysis	✓		✓	✓		✓
Trading opportunities	✓		✓	✓		✓
Instrument pricing	✓		✓	✓		✓
In-flight management	✓		✓	✓		✓
Other front-office functions						
Issuance				✓	✓	✓
Asset allocation					✓	✓
Portfolio management	✓		✓		✓	✓
Back-up data source	✓		✓	✓		✓
Funding and collateral management				✓	✓	✓
Middle and back office						
Post-trade processes and valuations				✓		✓
Best execution analysis		✓			✓	✓
Transaction cost analysis		✓	✓		✓	✓
Performance measurement			✓		✓	✓
Regulatory, audit and control		✓	✓		✓	✓
Risk						
Liquidity and market risk management		✓	✓		✓	✓
Credit/counterparty risk					✓	
Operational risk	✓		✓	✓		✓
Price reconciliation					✓	✓
Risk oversight			✓			✓

Note: RT refers to real-time data, D refers to delayed (i.e. intra-day and end-of-day data), HIST refers to historical data. The table above is a simplified version of the table originally published by Adamantia. A tick indicates that the given function requires the given category of data.
Source: Oxera, based on Adamantia (2022), 'The case for a viable Consolidated Tape on Equity (Part II)', October, https://www.adamantia.paris/post/the-case-for-a-viable-consolidated-tape-on-equity-part-ii.

Table 3.4 provides a more granular breakdown of the type of data used and an estimate of how important the data is for each use case.

Table 3.4 Demand for pre-trade, post-trade, and historical CT data by function

Function	*Pre-trade order events*	*Pre-trade quotes*	*Administrative events*	*Post-trade real-time*	*Post-trade EOD*	*Historical data (incl. pre-trade order events)*
Issuance	✓✓	✓✓	✓	✓	✓	✓✓✓
Asset allocation	✓	✓	✓	✓	✓✓✓	✓✓
Portfolio / investment management	✓	✓	✓	✓	✓✓✓	✓✓
Pre-trade analysis	✓✓✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓
In-flight management	✓✓✓	✓	✓✓✓	✓✓✓		✓
Post-trade analysis	✓✓	✓	✓✓	✓✓✓	✓✓✓	✓✓✓
Middle-/back-office & valuations				✓	✓✓✓	✓✓
Funding & collateral management					✓✓✓	✓✓
Market surveillance	✓	✓	✓	✓	✓✓✓	✓✓✓
Risk management					✓✓✓	✓✓✓
Performance measurement					✓✓✓	
Regulatory oversight	✓	✓	✓✓	✓✓	✓✓✓	✓✓✓
Audit					✓✓	✓✓
Reduced data processing for environmental reasons	✓✓	✓✓	✓✓	✓✓		✓✓✓

Note: ✓ refers to 'functions that may occasionally use the data or where CT data is a nice to have'; ✓✓ refers to functions where 'the data can be important'; ✓✓✓ refers to functions 'that have the greatest need of the data on a regular basis'. Analysis based on interview feedback given to Market Structure Partners.
Source: Market Structure Partners (2020), 'The study on the creation of an EU consolidated tape', September, https://www.marketstructure.co.uk/wp-content/uploads/Full-Report--The-Study-on-the-Creation-of-an-EU-Consolidated-Tape.pdf.

These use case analyses demonstrate three important points.

- Firstly, almost all the functions described above require some form of consolidated ***post-trade*** data, but not all require consolidation of ***pre-trade*** data. The level of latency required for this data varies across function. End-of-day data is

important for a wide range of use cases, while real-time post-trade data is important for front office functions.

- Secondly, a significant proportion of the overall use cases that have been identified for consolidated trading data relate to mid- and back-office functions. These use cases include activities such as transaction cost analyses (i.e. ex post analytics comparing the prices a broker obtained relative to a benchmark), managing the collateral owed to a central clearing counterparty (CCP) or OTC counterparty, and calculating the overall value of a fund.
- Thirdly, real-time pre-trade data is primarily required for front-office functions, such as pre-trade analysis and in-flight management. Where mid- and back-office use cases (including best execution analysis) require pre-trade data, they primarily require delayed (which is available without cost), end-of-day or historical pre-trade data.

Although not captured in the analysis above, we note that there is also significant variation across market participants in terms of total spend on data, due to differences in size as well as the relative importance of different use cases. Indeed, analysis conducted by the FCA found that the median investment bank paid around £2.1m for trade data (across all asset classes) in 2021, compared with under £50,000 for asset managers.[42]

The use case analysis described above gives a broad indication as to the types of data used by different functions within the typical equity trading value chain, as well as the relative costs to users of purchasing such data. In the context of a CT, such use cases also serve as a useful starting point for thinking about the potential impacts on end-investors and market quality as a whole. We turn to this in the following section.

3.3 Economic framework for assessing potential benefits to end-investors and market quality

3.3.1 Objectives of the CT

In section 2.1 we described how a well-functioning equity market should provide users with sufficient liquidity and price formation, the ability to

[42] Financial Conduct Authority (2023), 'Wholesale trade data review: Findings Report', March, https://www.fca.org.uk/publication/corporate/wholesale-trade-data-review-findings-report.pdf.

trade at low cost, innovation, choice across trading mechanisms and resilient market infrastructure.

The FCA has articulated several objectives for the proposed UK CTs (for both bonds and equities) that are linked to improved functioning of UK financial markets, including:[43]

- encouraging greater participation in financial markets through a clearer understanding of liquidity, thereby protecting consumers' interests;
- aiding price formation through a clear, consistent picture of liquidity in markets;
- assisting with the resilience of markets by allowing the market to adapt more easily in circumstances in which a significant trading venue suffers an outage;
- encouraging competition for the provision of market data between the provider of the CT and existing data vendors for the provision of aggregated trade data;
- increasing the size and liquidity of the UK financial markets by ensuring that the regulatory framework takes account of progress in other comparable jurisdictions.

In order to assess which design of CT best meets the objectives above, we must consider the mechanisms by which a CT could be expected to improve outcomes for end-investors and market quality as a whole. This is the focus of the rest of the section.

3.3.2 What does the current landscape look like?

The analysis described in section 2 highlighted that the market structure for UK equities is significantly different from that of other financial instruments, such as bonds. The majority of bond trading in the UK and EU takes place in OTC markets. Although around 30% of total volume in European corporate bonds is traded on electronic platforms, many of these venues report trades in different ways, and a significant amount of activity takes place via voice trading.[44]

In contrast, a large proportion of equities are traded on transparent trading platforms that report detailed transaction data which is used by

[43] FCA (2023), The framework for a UK Consolidated Tape, CP23/15.
[44] Financial Times (2023), 'Corporate bond trading enters the 20th century', November, https://www.ft.com/content/dcad0646-757e-4c4a-b336-4e12adc8bcfd.

market participants to inform their trading decisions. In other words, there is already a higher degree of transparency.

The availability of data from lit venues explains why some commercial providers (such as LSEG Data & Analytics, Bloomberg, big xyt, Virtu and BMLL) have developed their own versions of equity CTs.[45]

While it is clear that the quality of some publicly available post-trade data for equities in the UK could still be improved, the FCA set out a number of changes to post-trade reporting regulations in May 2023, which are focused on addressing these outstanding data quality issues.[46] In other words, some of the transparency benefits that have been identified for a bonds CT do not apply to the same degree in UK equity markets.[47]

So, what is potentially the problem? In 2007, the MiFID framework introduced competition in equity trading. Since then, alternative trading venues were established by new entrants to compete with the regulated markets for order flow by tailoring trading mechanisms to the needs of different types of equity trader (as described in the previous section). The increased competitive pressure has resulted in lower trading fees, new service propositions, and greater choice for end-users overall.[48] However, a market landscape with competition between trading venues *can* result in fragmented liquidity. Whether this arises depends on the

[45] For example, big xyt offers a 'Real-time Analytics' service, which it describes as 'a high-quality, consistent and normalised dataset of European trades and EBBO (European Best Bid and Offer Prices) benchmark prices'. BMLL offers a 'Millisecond Consolidated Best-Bid-Offer' which shows the top ten price levels of a consolidated lit order book, aggregated by size, for all equity markets across Europe on a historical basis. See big xyt, 'Real-time Analytics', https://big-xyt.com/real-time-analytics/, accessed 18 January 2024; BMLL, 'BMLL Data Feed', https://www.bmlltech.com/our-range-of-products/bmll-data-feed/millisecond-cbbo, accessed 18 January 2024.

[46] Market participants have previously expressed concerns about the challenges that investment firms face when reporting their SI and OTC activity. In particular, participants have noted that: (i) the system of post-trade reporting flags does not always provide sufficient information to identify technical transactions (e.g. intra-group transfers, give-up/in transactions) or other types of non-price forming transactions (e.g. benchmark and portfolio trades); (ii) ambiguity around the interpretation of flags means that different firms adopt different standards, resulting in less comparable reporting; (iii) there is a lack of clarity regarding which counterparty has the obligation to ensure that an OTC trade is made public. Financial Conduct Authority (2023), 'Improving equity secondary markets', Policy Statement PS23/4, https://www.fca.org.uk/publication/policy/ps23-4.pdf.

[47] For example, the UK government's wholesale markets review consultation notes that '...standardisation, or a lack thereof, is a more significant issue for fixed income markets. Additionally, because of flaws in the current transparency regime for fixed income and derivatives markets, there is less visibility on liquidity.' HM Treasury (2021), 'Wholesale Markets Review: Consultation', July, https://assets.publishing.service.gov.uk/media/60dc9322e90e07717d1cb1a7/WMR_condoc_FINAL_OFFICIAL_SENSITIVE_.pdf.

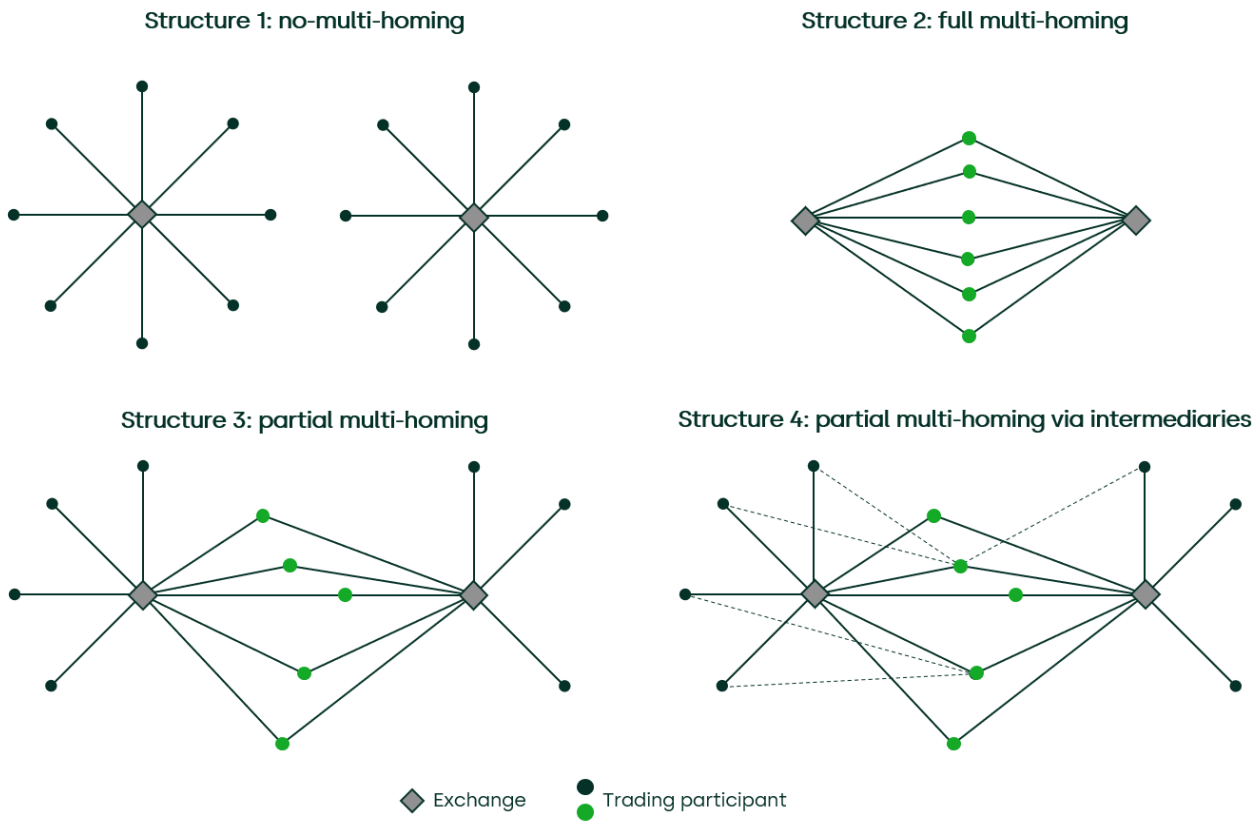
[48] See, for example, section 12 in Oxera (2020), 'Primary and secondary equity markets in the EU', Report prepared for the European Commission, https://www.oxera.com/wp-content/uploads/2020/11/Oxera-study-Primary-and-Secondary-Markets-in-the-EU-Final-Report-EN-1.pdf.

interconnectedness of the different trading venues. Fragmented trading does not always mean fragmented liquidity.

Figure 3.2 below sets out some stylised examples as to how different pools of liquidity can be connected.

- In structure 1, all participants connect to a single trading venue, participants on different venues cannot interact with each other. Trading fragmentation results in fragmentation of liquidity.
- In structure 2, all participants connect to both trading venues (referred to as full 'multi-homing'). While trading takes place across both venues, there is still effectively a single pool of liquidity.
- In structure 3, some participants multi-home across both trading venues, but some participants only connect to one venue. There may still be one pool of liquidity if the multi-homing traders account for a substantial proportion of trading activity.
- In structure 4, there is still partial multi-homing, but participants connected to a single venue may still route orders to the other venue via relationships with other trading participants (the dashed lines). As with structure 3, there is a single liquidity pool.

Figure 3.2 Examples of different market structures



Note: Dark green dots represent participants who only connect to a single venue. Light green dots represents participants who connect to both venues.
Source: Oxera.

When MiFID I was being implemented, there was already a concern that trading fragmentation could result in liquidity fragmentation (e.g. a market structure closer to structure 1 above than structure 2), thereby increasing the implicit costs of trading, as it could become more difficult for market participants to access liquidity across multiple venues.

As the stylised examples above suggest, fragmentation of trading is unlikely to lead to a worsening of liquidity, as long as the following two conditions hold:

- search costs for traders (i.e. the costs of identifying the strategy to execute their order at the best possible price) are low;[49]

[49] For a summary of the literature on search costs in financial markets, see Weill, P.O. (2020), 'The search theory of OTC markets', *Annual Review of Economics*, **12**, pp. 747–73.

- a sufficient number of traders multi-home, either via direct membership of venues or indirectly via relationships with other trading participants.

The two conditions above are interlinked. If search costs are too high, market participants may ration the information they consume as well as the number of venues they choose to connect to.

Consequently, one of the main justifications for a CT under MiFID II was to reduce search costs for traders by providing a comprehensive picture of trading activity across the various trading venues in the EU. In doing so, the objective was to ensure that participants did not 'under-consume' trading data. Policymakers were particularly concerned about effects on smaller players, including retail investors.[50]

From a policy perspective, the key questions when assessing the likely impact of a CT are therefore: (i) to what extent do the conditions above hold; (ii) how is a CT likely to affect search costs for traders in practice?

In the rest of this section, we discuss the evidence regarding these two questions. In particular, we note that a CT is unlikely to be used for trading and therefore is unlikely to lead to a reduction in search costs.

3.3.3 How would a consolidated tape affect search costs and market quality?

As noted above, equity markets are already characterised by a high degree of transparency, particularly relative to bond markets. When considering the potential impact of a CT on search costs, it is important to assess the *incremental* effect that a CT would have on the information environment of traders.

In this context, traders can be categorised into three groups.[51]

- Existing users of data for which the CT would be an imperfect substitute **(group one)**—some traders may require data that

[50] More recently, the European Commission has linked its proposals for an EU CT to its objective for a single integrated EU financial market, stating that 'a lack of access to data by all market participants is a significant barrier to cross-border investments and is one of the main reasons why national markets remain fragmented along national lines instead of integrating into a single, globally competitive CMU [Capital Markets Union]'. We note that the rationale of linking smaller member state capital markets together is less relevant for the UK post-Brexit. See European Commission (2021), 'Impact assessment report accompanying the Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 600/2014 as regards enhancing market data transparency, removing obstacles to the emergence of a consolidated tape, optimising the trading obligations and prohibiting receiving payments for forwarding client orders'.

[51] A given market participant may require a combination of the three use-case types.

could not be provided by a CT, meaning that users are unlikely to switch from existing proprietary feeds. In this case, a CT will not impact search costs because the user will not switch to exclusively using the CT.

- Existing users of data for which the CT would be a close substitute **(group two)**—some traders will already consume the same data that could be provided by a CT. Assuming the CT is provided at a lower cost than data that can currently be obtained (including switching costs), then users may switch to using the CT instead. In this case, a CT might reduce the user's search costs but would not have any incremental effect on the information available to the user.
- Marginal data users **(group three)**—some traders currently consume a more limited set of data than provided by the CT, but *might* consume the CT data if it were available at a lower cost and was easier to access than can currently be obtained. In this case, a CT may reduce the user's search costs and increase the amount of information available to the user.

From an overall market quality perspective, marginal data users are the most important group. Indeed, price formation and liquidity are most likely to be affected *if* this group includes participants who currently only consume data from a subset of venues, but would make different trading decisions if they had access to data from all venues. This could involve submitting orders to new venues (subject to having the required membership and connectivity), or submitting orders at different prices, sizes, and times.

As discussed in section 2.1.1, many participants do not interact directly on trading venues, but send their order to a broker who is responsible for making the final order routing decisions. In this case, a CT may bring *direct* market quality benefits if the *broker* is a marginal data user.

A CT may bring *indirect* market quality benefits if the end-investor is a marginal data user, and uses a CT to inform their longer-term broker selection decisions.

Marginal users may also consist of firms (either brokers or end-investors) who are not currently active in UK equity markets, but would choose to enter the market (and thus compete for liquidity provision) if the CT led to lower search costs.

For group two, the availability of a CT may reduce search costs associated with the data that users already consume but is unlikely to produce any market quality benefits, as these participants will

ultimately be consuming the same data following the introduction of a CT (and therefore would not be making different trading decisions).

Finally, as we noted in section 3.2, a significant proportion of the overall use cases that have been identified for consolidated trading data relate to mid- and back-office functions that are unrelated to day-to-day trading decisions.

Independent of market quality effects, there may still be overall benefits for end-investors if group two users and 'non-trading' use cases switch to using a CT. These may consist of the below.

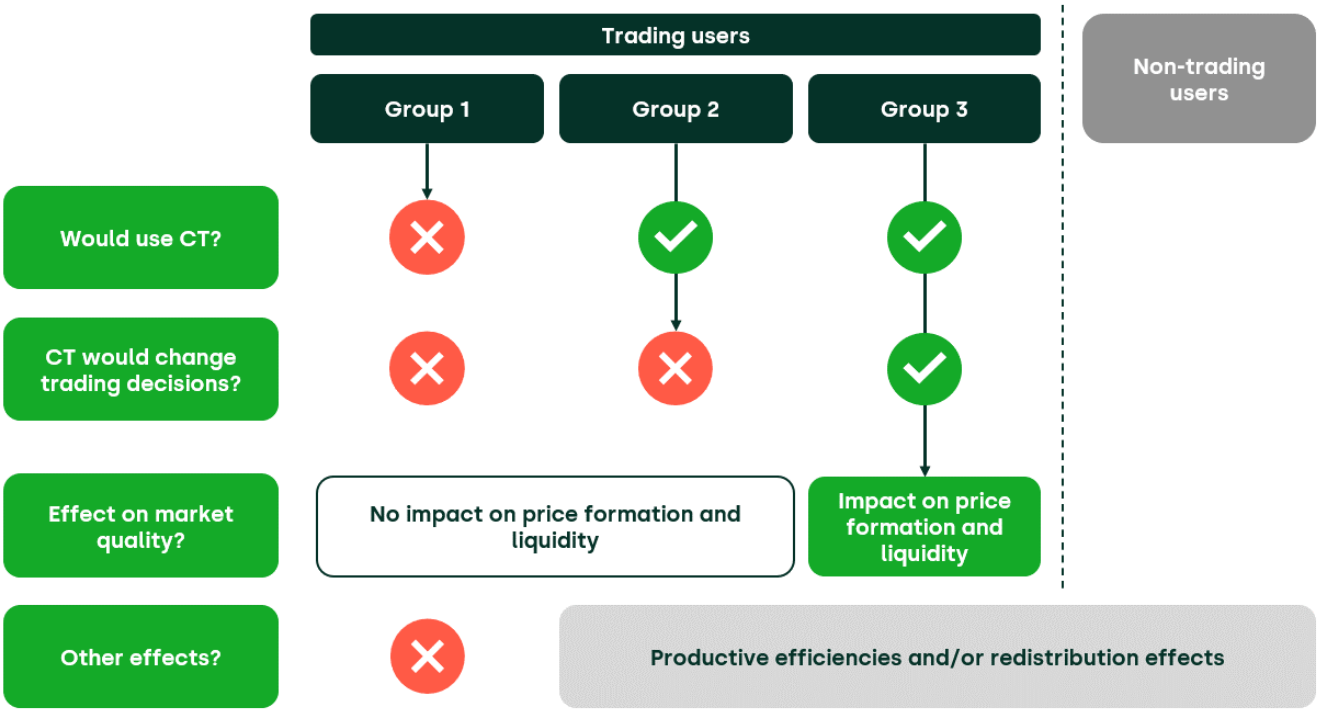
- Productive efficiencies—given the fixed costs associated with aggregating and normalising data-feeds from various trading venues, there are likely to be some economies of scale associated with the production of a CT. A single CTP may be able to provide a CT at a lower overall cost than multiple, smaller competing providers.
- Redistribution effects—venues, technology firms, and data vendors currently generate revenues from providing proprietary data-feeds and consolidated order books. If the CT were to result in a reduction of revenues earned by these firms, this effectively represents a transfer between participants.[52] Overall outcomes to end-investors would depend on whether these firms responded by changing fees for other services (e.g. venue charging higher trading fees, vendors charging more for ancillary services).

In both cases, the magnitude of benefits to end-investors would also depend on the degree to which reduced costs to intermediaries were passed down the value chain.

The framework we have described above is summarised in Figure 3.3.

[52] A cost–benefit analysis would also need to take into account whether lower market data fees would cause venues to re-optimise their prices, leading to higher fees for other services (e.g. trading fees).

Figure 3.3 Mechanisms by which a CT might benefit end-investors



Source: Oxera.

The above framework focuses on whether users would *switch* to a CT and how this might affect the information set and trading decisions of market participants. The same logic also applies in the scenario where users consume a CT *in addition* to the proprietary data feeds that they already consume (e.g. as a back-up feed). If the CT does not increase the information available to the user, then they will not make different trading decisions and the CT is unlikely to affect price formation and liquidity.[53]

Moreover, in the event that the CT is consumed in addition to proprietary feeds (i.e. no switching), there will not be any benefits to end-investors in terms of productive efficiencies or redistribution effects.

[53] The same point applies to the FCA's resilience objective for the CT. If the CT does not provide a trader with additional information relative to the proprietary feeds that they already consume, then it is unlikely to lead to different trading decisions in the event of market disruption (e.g. a venue outage).

3.4 Which venues do brokers connect to?

Any market quality benefits from a CT will be associated with marginal traders (group three) who currently consume data from a limited set of trading venues. If these traders were to consume a CT, and as a result made different trading decisions, then a tape may have an impact on overall liquidity and price formation.

From a public policy perspective, a relevant question is how material is this group of market participants?

While it is not possible to comprehensively map out the pre- and post-trade data consumption information of each market participant with public data, we can consider which different participants are active on different trading venues in the UK. If a significant number of participants 'multi-home' across different trading venues (see Figure 3.2), then it is likely that these participants already consume pre- and post-trade data from each venue.[54] In other words, the existing network structure of UK equity markets will inform as to how likely market quality benefits are to materialise as the result of a CT.

The only publicly available source of information regarding the connectivity landscape is the best execution policies published by firms handling client orders.[55] These policies typically set out a list of venues that the firm can access for a given asset class. Although there are some limitations in using these documents (as we discuss below), one advantage is that they include venues that firms access both directly, as well as indirectly via other brokers.

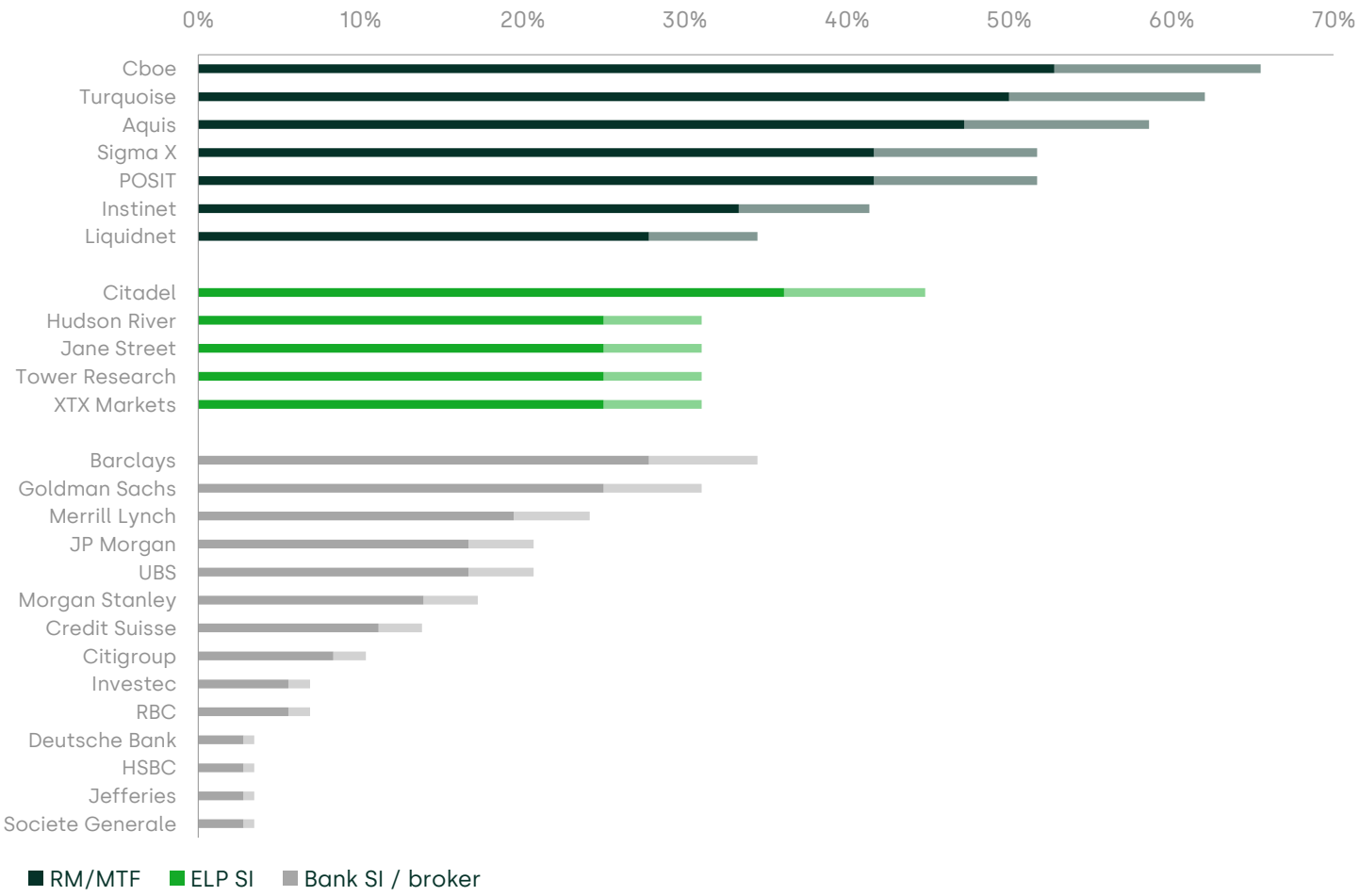
Figure 3.4 and Figure 3.5 below show the prevalence of execution venues, counterparties and executing brokers used by firms active in UK equities, based on a random sample of LSE member firms. In both charts, the execution venues are grouped into three categories: (i) Regulated Markets and MTFs; (ii) electronic liquidity provider (ELP) SIs; (iii) bank-operated SIs and other brokers.[56]

Figure 3.4 shows the distribution for a sample of member firms active on SETS (the CLOB used for UK equities). Figure 3.5 shows the distribution

[54] This was noted by the FCA in its Trade Data Review. See Financial Conduct Authority (2023), 'Findings Report: Trade Data Review', March, para. 2.28, https://www.fca.org.uk/publication/corporate/wholesale-trade-data-review-findings-report.pdf.
[55] The specific order routing decisions of individual market participants are commercially sensitive and are not publicly available. Moreover, most trading venues and systematic internalisers are not required to publish lists of members or connected participants. LSE and Aquis Stock Exchange publish lists of member firms on their respective websites.
[56] Table A2.1 provides a list of FCA-authorised systematic internalisers.

for a sample of member firms who are registered for 'off-book trading' only.

Figure 3.4 Venues used by LSE member firms active on SETS



Note: Analysis based on a random sample of 50 member firms listed as active on the SETS order book, as at November 2023. The darker colour bar represents the percentage of brokers connecting to a given venue, including those brokers who do not report any venues in the denominator. The full bar represents the percentage of brokers connecting to a given venue, after excluding brokers who do not report any venues.
Source: Oxera analysis of published best execution policies.

The best execution policies highlight a number of points. Of the members active on SETS (the CLOB operated by LSE):

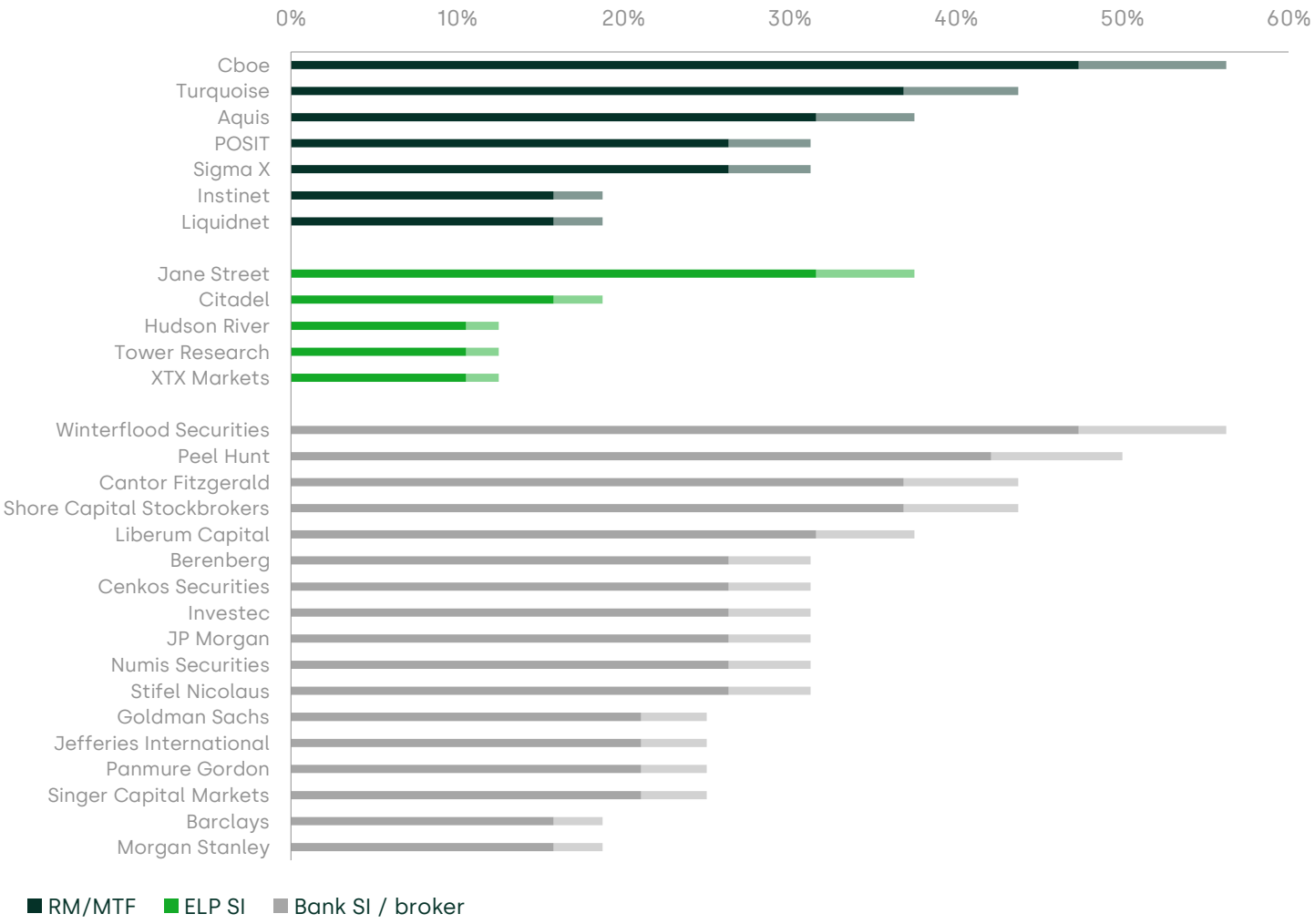
- around half also route orders to Cboe, Turquoise and Aquis, with a smaller proportion routing orders to Sigma X, POSIT, Instinet and Liquidnet;

- around 45% also route orders to at least one ELP that is authorised to act as an SI, with Citadel being most frequently cited;
- around 45% also route orders to a bank-operated SI or broker.

Several firms' policies also note that the broker will first attempt to match client orders against internal sources of liquidity before sending to an external venue, provided that it does not disadvantage the client.

For the members that are only active in 'off-book trading', the proportion routing orders to other RMs and MTFs is slightly lower relative to the members who are active on SETS. This is not surprising given that: (i) firms that have incurred the cost of establishing connectivity to the LSE CLOB via order management systems are likely to be capable of connecting to other trading venues; (ii) a high proportion of 'off-book trading only' members are retail brokers. These firms frequently note in their best execution policies that they predominantly route customer orders via the RSP system offered by the LSE.

Figure 3.5 Venues used by 'off-book only' LSE member firms



Note: Analysis based on a random sample of 25 member firms listed as active on 'off-book trading', but not listed as active on the 'SETS order book', as at November 2023. The darker colour bar represents the percentage of brokers connecting to a given venue, including those brokers who do not report any venues in the denominator. The full bar represents the percentage of brokers connecting to a given venue, after excluding brokers who do not report any venues.
Source: Oxera analysis of published best execution policies.

There are some important caveats to these results.

- The findings only provide a partial picture of UK equity markets, as the methodology omits proprietary trading firms (which do not handle client orders, and therefore do not publish a best

execution policy), as well as brokers that are not members of the LSE.[57]

- Not all best execution policies sampled include a list of execution venues, counterparties and executing brokers. These firms are still included in the denominator, meaning that proportions reported in the darker bars above are an underestimate of the true value.
- The lists of venues provided by best execution policies are not generally provided at the level of the individual trading mechanisms (such as the Market Identifier Code). For example, it is not possible to identify whether a broker submits orders to a bank-operated SI directly (in which case the bank acts as a counterparty), or is using the bank as an execution broker.[58]
- While a broker may have access to all venues, the end-investor can impose restrictions and specific conditions (e.g. specifying the venue to use). As discussed above, if the broker has discretion over the order execution, what matters from a market quality perspective is whether they are able to observe prices and liquidity across each venue. If the end-investor is responsible, then their information set also matters.

Nonetheless, the analysis of best execution policies highlights that around half of sampled LSE brokers multi-home across all other UK lit venues (Cboe, Aquis and Turquoise).

In the context of the CT, this means that a significant proportion of brokers likely already consume pre- and post-trade data from all lit venues. This corresponds to the group two use cases described above. Usage of the tape by these users will not produce significant market quality benefits.

Moreover, the fixed costs associated with venue connectivity and smart order routing infrastructure mean that brokers who do not multi-home will generally be smaller, and will account for a small proportion of total liquidity. Even if these small brokers were to connect to all venues as a result of having access to a pre-trade CT, the impact on overall trading

[57] Given that the LSE is the primary listing venue for most UK equities, the latter set of brokers is likely to be small.
[58] Similarly, the best execution policies frequently provide the name of the venue operator (e.g. 'Aquis'), but do not specify which trading mechanisms or markets are used (e.g. Aquis Stock Exchange, Aquis MTF, Aquis Auction on Demand or Aquis Matching Pool). In some cases, each trading mechanism is accessible under the same connectivity arrangement and membership.

volumes is likely to be small, given the concentrated nature of trading activity.

The relatively high level of multi-homing implied by the best execution policies above is consistent with the overall picture of falling implicit costs (as measured by implementation shortfall) since the introduction of MiFID in 2007 (see section 2.2.3). The combination of brokers' multi-homing across venues and their use of smart order routers would serve to reduce search costs and ensure that trading fragmentation has not led to liquidity fragmentation.

3.5 Is a CT likely to be used for trading?

As described in section 3.2 above, the use cases in which consolidated real-time pre-trade data are most required are front-office trading activities.

Section 3.4 also highlighted that a significant proportion of brokers in UK equity markets already connect to multiple trading venues, and likely already consume data from these venues via proprietary feeds (meaning that the availability of a pre-trade CT will not affect their trading decisions and, by extension, price formation and liquidity).

Nonetheless, it is useful to consider whether a CT is a close substitute for proprietary data feeds when used for trade execution purposes. If trading users would not switch to using a CT (i.e. most traders sit within group one), then a CT will not produce significant benefits. If, conversely, there are a material number of traders who would switch from proprietary feeds to using a lower cost CT (i.e. group two), then, even if there are no benefits in terms of market quality, end-investors may benefit from the productive efficiencies and redistribution effects described above.

However, it is unlikely that a pre-trade CT would be used for trading purposes, particularly due to the latency that a CT introduces. A CT must collect data from venues (which may have matching engines located in different data centres), undertake some normalising and processing of the underlying data, then distribute it onto users. This naturally introduces some latency relative to participants who receive data directly from exchanges.

In particular, for non-display trading uses, such as smart order routers and high-frequency trading algorithms, the latency delay associated

with a CT means it is unlikely to be substitutable for the existing proprietary data-feeds they already consume directly from exchanges.[59]

What ultimately matters in this context is whether, by the time an order or quote is available on the CT and an investor decides to act upon it, it is actually still accessible on the source market.

While the latency differentials associated with a tape will be small in absolute terms,[60] consuming data with small latency delays relative to other participants can cause a trader to see prices and volumes that are materially different from the 'current' state of the order book.

Several studies have sought to provide insight into the speed of equity markets, and to quantify the time lag after which trading information becomes stale. Three notable example are listed below.

- Aquilina et al. (2022) use detailed analysis of electronic messages transmitted to and from the LSE CLOB to describe the level of latency arbitrage (i.e. traders attempting to 'pick off' stale quotes by relying primarily on their speed in transmitting orders) in UK equities.[61] Here, the authors find that 22% of trading volume in FTSE100 stocks takes place following a 'latency-arbitrage race' to reach the CLOB first.[62] The authors also find that, in such races, the time difference between the winning order and the next fastest is approximately 5-10 microseconds.
- Analysis in an EU context conducted by Cboe found that a pre-trade CT with a 15ms latency would accurately reflect the current bid/offer prices of French and German large- and mid-cap stocks for more than 99% of the time during the course of the trading day (see Table 3.5 below).

[59] Another dimension of a CT that would influence its substitutability with proprietary feeds is the depth of pre-trade data available. However, the depth of a pre-trade CT can ultimately be determined by the FCA in its final technical specification. A number of participants have proposed that a pre-trade CT should include five levels of order book data (i.e. the five best prices) from each venue.
[60] For example, in February 2024, the two US pre-trade tape providers incurred average processing times of 18.4 and 13.6 microseconds respectively. This does not include the (significantly larger) geographic latency associated with data travelling from the venue location to the location of the tape provider. See: https://www.ctaplan.com/metrics; https://www.utpplan.com/metrics.
[61] Aquilina, M., Budish, E. and O'Neill, P. (2022), 'Quantifying the high-frequency trading "arms race"', Quarterly Journal of Economics, 137:1, pp. 493-564.
[62] The authors document that between August and October 2015, there were 537 races per day for FTSE 100 stocks, lasting 81 microseconds on average, with a modal duration of 5-10 microseconds. The authors find that such latency-arbitrage races are considerably less frequent for FTSE250 stocks, only occurring 70 times a day.

- Analysis conducted by LSEG focusing on instances of price updates in FTSE100 stocks found that a 10ms[63] delay would lead to prices that differed from the true price on the LSE CLOB by 14% of the spread on average, and volumes that differed from the true volumes by 38% on average.[64] Figure 3.6 below gives an example of the distribution of pricing 'misses' for Shell shares on one day in March 2023.

Table 3.5 Proportion of trading day for which EBBO accurately reflects current prices based on various latencies

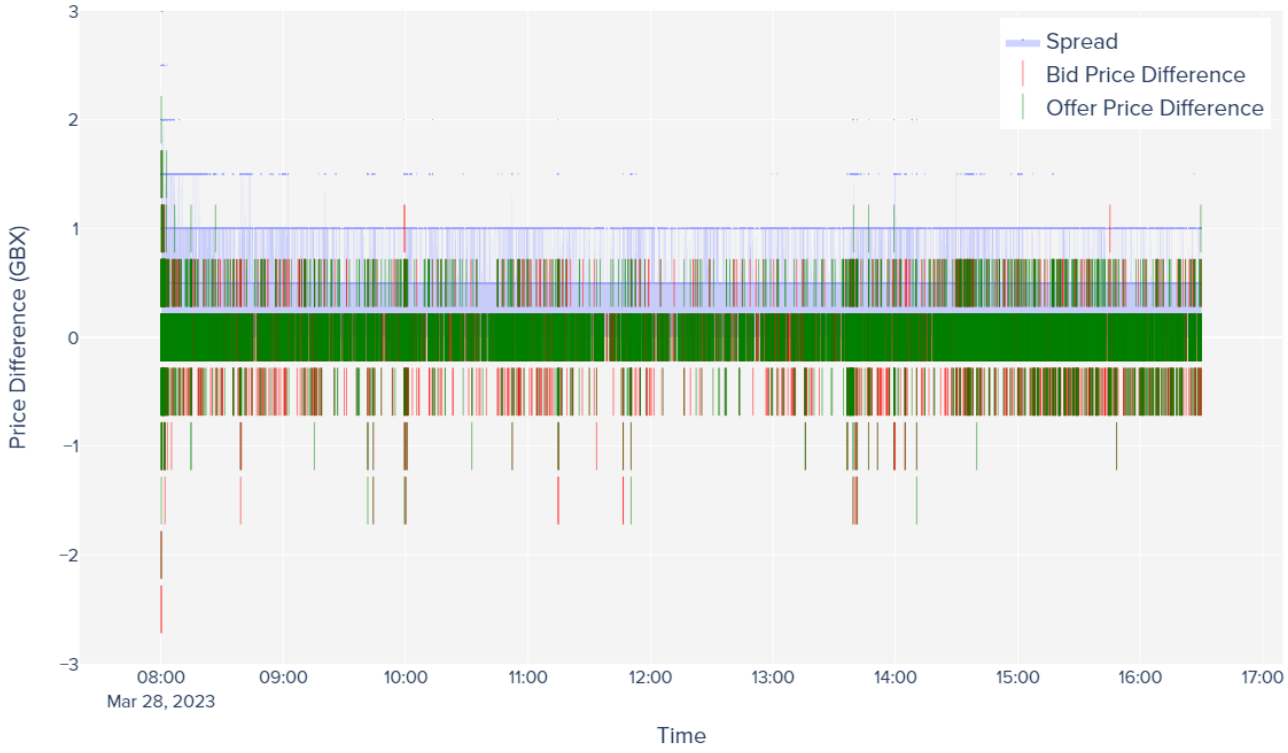
Index	7ms	15ms	50ms	1s	1min	15min
DE40	99.5%	99.1%	97.5%	74.6%	2.1%	0.0%
DEM50	5	99.4%	98.9%	90.4%	20.9%	1.8%
FR40	99.6%	99.2%	97.9%	77.1%	4.9%	0.0%
FRN20	99.8%	99.7%	99.3%	90.2%	12.4%	0.0%

Source: Cboe (2023), 'Mission Possible', 23 April, https://www.Cboe.com/insights/posts/mission-possible/.

[63] We note that in its impact assessment accompanying its proposed amendments to MiFIR, the European Commission concluded that a target latency for the CTP between 200 and 300 milliseconds from execution timestamp would be a satisfactory compromise between CT accuracy and operational costs. See European Commission (2021), 'Impact assessment report accompanying the Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 600/2014', https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2021:0346:FIN:EN:PDF.

[64] This analysis therefore focuses on the accuracy of the tape during periods of activity on the CLOB. See LSEG (2024), 'A UK consolidated tape for equities: the view from the London Stock Exchange', April, https://images.communications.lseg.com/Web/LSEG/%7B60a30aaf-e4c4-4f70-a6bf-941330f53f33%7D_A_UK_Consolidated_Tape_for_Equities_-_The_View_from_the_London_Stock_Exchange.pdf.

Figure 3.6 Differences in quoted prices on LSE CLOB for Shell plc shares after 10ms, 28 March 2023



Source: LSEG (2024), 'A UK consolidated tape for equities: the view from the London Stock Exchange', April, Figure 16, https://images.communications.lseg.com/Web/LSEG/%7B60a30aaf-e4c4-4f70-a6bf-941330f53f33%7D_A_UK_Consolidated_Tape_for_Equities_-_The_View_from_the_London_Stock_Exchange.pdf.

In a fragmented trading landscape, we can also think about how long it takes for prices to adjust on one venue in response to a change on another venue. For example, Table 3.6 below sets out the estimated minimum time it would take for a change on the main UK trading venue CLOBs to be reflected in the another. This example assumes that a trader co-located next to the Cboe matching engine (located at the Equinix LD4 data centre in Slough) observes a change on the Cboe CLOB and then submits a corresponding order to the LSE CLOB in order to either 'pick off' stale quotes, or to update the quotes that they previously posted.

Table 3.6 Estimated minimum time for the LSE CLOB to respond to a price change on Cboe CLOB

	Time	Source
One-way latency from Equinix LD4 (Slough) to LSE Hosting (City of London)	275µs	Estimate provided by LSE
Minimum observed reaction time of a fast HFT	29µs	Aquilina et al. (2022)
Average LSE roundtrip processing time	70–75µs	Estimate provided by LSE
One-way latency for LSE multicast market data message to reach traders in LSE Hosting	<5µs	Estimate provided by LSE
Total time	**385µs**	

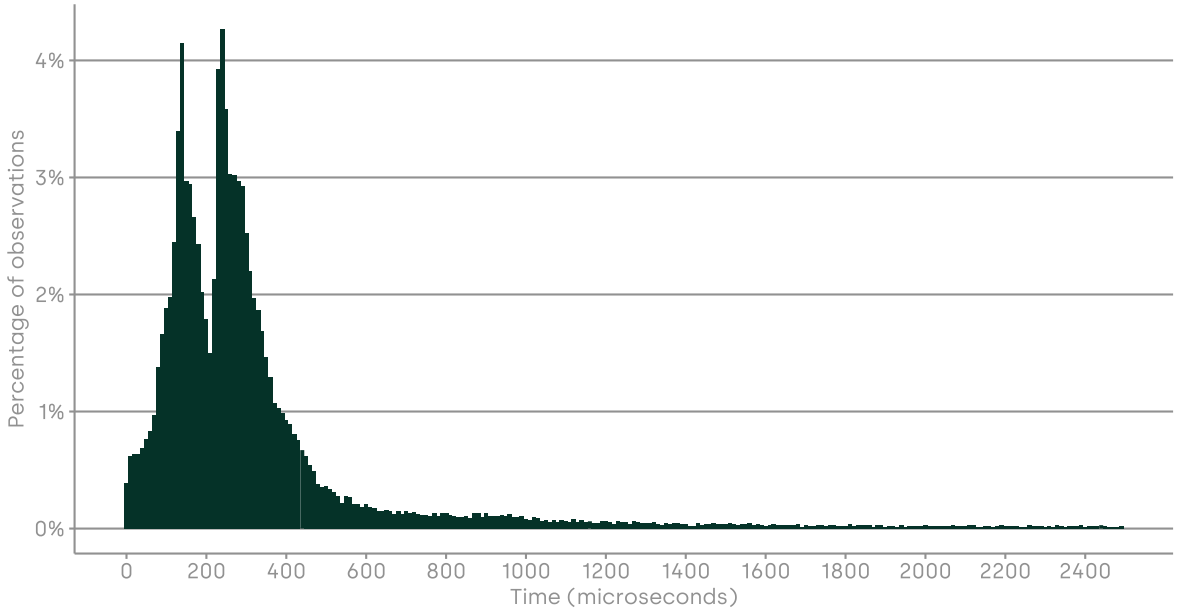
Source: Oxera, based on estimates provided by LSE and Aquilina, M., Budish, E. and O'Neill, P. (2022), 'Quantifying the high-frequency trading "arms race"', Quarterly Journal of Economics, 137:1, pp. 493-564.

The above breakdown suggests that it may take as little as 400 microseconds for a change in the Cboe CLOB to cause a change to the LSE CLOB that can be observed by market participants.

This appears to be consistent with evidence regarding the speed of price changes across lit venues. Based on a simplified version of the methodology applied by Ryazev, Ibikunle and Steffen (2023),[65] we compute the latency between a price-changing trade observed on Cboe and a subsequent trade on LSE that takes place at the same new price (and vice versa). Figure 3.7 below shows the distribution of time lags based on a sample of six stocks over a total period of two months.

[65] Ryazev, K. Ibikunle, G. and Steffen, T. (2023), 'The market quality implications of speed in cross-platform trading: Evidence from Frankfurt-London microwave', *Journal of Financial Markets*, **66**, pp. 1–24.

Figure 3.7 Time required for traded prices to align between Cboe and LSE in 2023



Note: Data from March and August of 2023. 'Price changing' trades are defined as trades executed at a price different from the previous executed trade (across LSE, Cboe, Aquis, Turquoise, and Sigma-X).
Source: Oxera analysis of LSEG tick history data.

Figure 3.7 suggests that, following a price-changing trade on one exchange, it usually takes around 240 microseconds for a trade on the other exchange to take place at the same price. There is also another peak in alignment time at 140 microseconds, and most price adjustments across Cboe and LSE take place within 1 millisecond.[66]

For 'slow' traders that are less sensitive to latency, such as display-based users (including retail traders), the time lag of a CT relative to exchange proprietary feeds will not be as problematic. Indeed, the time it would take for a human trader to read, process and act on displayed trading data is an order of magnitude slower than the latency required

[66] It is not always the case that the price 'alignment' on the second venue is the result of traders observing and responding to the trade on the first venue. Indeed, any 'alignment' quicker than 100 microseconds cannot be the result of messages published by the first venue. The 'alignment' shown in Figure 3.7 will also be the result of different traders sending coincidental orders that cause the prices on both venues to adjust at similar times, or a single trader sending simultaneous orders to both LSE and Cboe CLOBs. In the latter case, traders may time the release of orders so that they arrive at the same time. The difference in exchange timestamps will reflect the 'jitter' (i.e. variation in the delay of messages as they traverse the network).

to win a 'trading race', as well as the latency delay that might be introduced by a CT.[67]

However, in the context of the framework we set out in section 3.3, the relevant question from a market quality perspective is whether a CT has an incremental effect on the information set of display trading users *and* whether this induces such users to make different trading decisions. For example, Figure 2.11 shows that during 2023, the best bid and offer prices on LSE corresponded to the consolidated EBBO between 70 and 80% of the time for FTSE100 stocks. In other words, if display trading users are currently consuming only a direct feed from the LSE, they will already be observing the best prices 70–80% of the time.

A pre-trade CT would provide incremental information regarding overall quoted depth in the market. However, as LSEG's analysis demonstrates, these volumes change significantly after a short period of time, meaning that they are not accessible to 'slow' traders.

In sum, when assessing the potential impact of different CT designs on market quality, policymakers should start by thinking about how the CT will affect the information set of trading users. In the case of UK equity markets, the available empirical evidence discussed in this section suggests that a pre-trade CT is unlikely to bring significant market quality benefits. A large proportion of trading activity comes from traders who already consume consolidated data and therefore the incremental effect on information sets of a CT will be limited for these users. It is unlikely that a pre-trade CT will be used for execution purposes, where SORs require proprietary data feeds in order access liquidity.[68]

These conclusions are also relevant when considering whether a pre-trade CT would assist with the resilience of markets.[69] For the same reasons as set out above, if a large proportion of users already consume

[67] For context, the blink of a human eye takes around 300–500 milliseconds. The average reaction time taken to respond to a visual stimulus is around 250 milliseconds. See Kwon, K-A., Shipley, R.J., Edirisinghe, M., Ezra, D.G., Rose, G., Best, S.M. and Cameron, R.E. (2013), 'High speed camera characterisation of voluntary eye blinking kinematics', *J R Soc Interface*, **10**:85; Jain, A., Bansal, R., Kumar, A. and Singh, K.D. (2015), 'A comparative study of visual and auditory reaction times on the basis of gender and physical activity levels of medical first year students', *International Journal of Applied and Basic Medical Research*, **5**:2.

[68] This appears to be consistent with feedback outlined in a report published by the LSEG. See: LSEG (2024), 'A UK consolidated tape for equities: the view from the London Stock Exchange', April, Figure 16, https://images.communications.lseg.com/Web/LSEG/%7B60a30aaf-e4c4-4f70-a6bf-941330f53f33%7D_A_UK_Consolidated_Tape_for_Equities_-_The_View_from_the_London_Stock_Exchange.pdf.

[69] For example, the FCA notes that a CT might allow the market to adapt more easily in circumstances in which a significant trading venue suffers an outage. FCA (2023), 'The framework for a UK Consolidated Tape', CP23/15.

consolidated data (or otherwise would not use the tape for order routing), then they are unlikely to make different trading decisions in the event that there is an outage at their venue of choice.

In the event that some traders did use a CT as a primary feed for trading purposes (without, for example, also accessing proprietary feeds), this would raise additional questions regarding market resilience as it introduces a single point of failure. For example, an outage of the CT would prevent those traders from observing prices or quotes on their chosen venues, which may cause disruption on the venues themselves.[70] Therefore, given the potential impacts of a CT outage, the operator would need to incur additional costs to ensure the CT's broader operational resilience.

There may be a small subset of users (particularly smaller brokers and retail investors) who do not currently consume data from all lit venues, for whom a CT will change their information available. However, it is not the case that a CT will lead to better outcomes for these smaller users. In particular:

- best execution rules in the UK do not require brokers to connect to all possible venues;
- in the UK, where retail order flow is segmented via the RSP system, a pre-trade CT may ultimately provide a misleading benchmark for retail traders.

We discuss both of these points in more detail in the context of a comparison with the US CT structure in Appendix A3.

3.6 Summary

In its objectives, the FCA positions the CT as a tool for giving investors a better picture of transactions in UK equities, thereby aiding price formation, increasing liquidity, and improving market functioning. This reflects policymakers' original aims for a CT at the time MiFID was introduced, when there were concerns that the search costs associated with fragmented trading would lead to fragmented liquidity.

To assess whether a CT would meet those objectives, the FCA must ultimately ask who currently consumes the type of data a CT would offer (and for what purpose), would the user switch to using a CT, and

[70] The precise implications for resilience also depend on whether the CT consumes data directly from venues' existing market data feeds, or whether the CT consumes data in a dedicated feed. In the latter scenario, a failure of either the venue direct feed or the dedicated CT feed would lead to some participants having access to data and others not having access.

what would the effect of switching be? The answers to these questions will vary depending on the specification of the CT itself.

We started this section by describing the potential users of a pre- and post-trade CT, based on current demands for consolidated trading data. This has been examined by several previous studies. The key takeaways of these reports are that: (i) consolidated post-trade data has a wider number of use cases across the value chain than pre-trade data; (ii) real-time pre-trade data is typically required for front-office trading purposes (such as in-flight execution management).

This explains why a number of participants have called for the FCA to prioritise the development of a post-trade tape. As noted by the FCA itself, there has been more debate around the merits of a pre-trade equity CT, where the primary use case is trading.

Following the economic framework set out in this section, price formation and liquidity are most likely to be affected if traders switch to using a CT, *and* the CT leads to an incremental change in their information environment, *and* as a result the participant makes different trading decisions.

To assess whether this is likely to be the case for a pre-trade CT, it is helpful to look at which traders are currently consuming consolidated pre-trade data (and from which venues). This data is not publicly available, however the FCA would be well-positioned to undertake such an analysis, either by conducting a survey of trading participants, or using its transaction reporting data. Our own analysis of broker's publicly available execution policies indicates that at least half route customer orders to all the main CLOBs in the UK. This includes the largest market participants, who account for the overwhelming majority of trading activity on the LSE.

This finding is also consistent with the empirical evidence we described in section 2, showing that the fragmentation of trading following MiFID did not result in significant increases in implicit costs (as measured by implementation shortfall).

More broadly, it is unlikely that traders would switch to using a pre-trade CT for execution purposes, particularly due to the latency that a CT introduces. As the empirical analysis in this section shows, for participants seeking to access liquidity in fast-moving markets, consuming data with small latency delays relative to other participants can cause a trader to see prices and volumes that are materially different from the 'current' state of the order book.

Not all trading participants care about getting low latency data—particularly retail investors—but as the US case study highlights, a CT may not be the right benchmark for retail traders who are benefitting from segmented order flow.

4 Future landscape for UK equity trading

Key messages

- Traders make trading choices considering their own private benefit without factoring in the wider benefit that lit venues have on price formation (and therefore market quality as a whole). Therefore, individual trading decisions may result in too much trading away from lit venues than would be beneficial from an overall market perspective. This 'externality' emphasises the need to assess whether interventions could negatively impact the price-formation process, directly or indirectly (for example through a change in the behaviour of traders).

- This section explores whether a CT could have a negative impact on price formation. Although the complex economic forces mean it is hard to predict the impact of a CT with certainty, there are mechanisms that could lead a CT to have a negative impact.

- For example, if investors start using a CT for ex post monitoring of execution quality, some (smaller) brokers may now decide to send orders to trading mechanisms that can provide (at least) as good a price as the consolidated BBO, rather than incurring the cost of connecting to all trading venues. This could include a dark MTF referencing the consolidated BBO midpoint and SIs, who may be able to match or improve against the consolidated BBO. The impact of this on the market can be captured in terms of an increase in fragmentation and segmentation.

- *Fragmentation*—trading away from CLOBs is not necessarily detrimental to overall market quality, and having access to different types of venues provides investors with choice that can lead to better outcomes. This is particularly the case if alternative mechanisms draw out latent liquidity that would not be traded otherwise (e.g. large orders). However, if the share of lit trading gets too low, it may have detrimental effects on the price-formation process. This in turn creates the risk of trading (in and outside the lit venue) against prices of eroding quality.

- *Segmentation*—although segmentation of order flow (e.g. sending 'uninformed' order flow to alternative venues) may be beneficial for end-investors, having proportionally more 'informed' traders on CLOBs increases adverse selection costs for remaining traders, which can eventually lead to wider spreads and higher price impacts as well as further segmentation (thereby further reducing the liquidity in lit venues and potentially negatively affecting price formation). Segmentation can be beneficial, but only if it is designed to ensure end-investors get the benefits.

- Assessing the effect of fragmentation and segmentation on market quality requires an understanding of the types of order flow being directed to each venue. Such an analysis requires data that is not in the public domain, and therefore may need to be undertaken by, or at the request of, the regulator.

4.1 Impact on liquidity landscape

The FCA has noted that it will further consider the potential impact of a CT on liquidity in CLOBs, execution quality and stability of UK equity markets.[71] If, as a result of the CT, there is a significant shift away from lit trading mechanisms, there could be a negative effect on the price-formation process.

As shown in section 2.2, despite remaining relatively stable in the years following MiFID II, the share of trading taking place on CLOBs gradually decreased throughout 2023, with a pronounced shift towards closing auction trading.

Lower intraday trading on CLOBs is not necessarily detrimental to overall market quality, and having access to different types of venues provides investors with choice that can lead to better outcomes. However, if the share of lit trading gets too low, it may have detrimental effects on the price-formation process. This in turn creates the risk of trading (in and outside the lit venue) against prices of eroding quality.

In this section, we briefly discuss the potential market quality impacts of more trading away from CLOBs, and whether a tape could lead to more trading away from CLOBs.

4.1.1 Impact of more trading away from CLOBs

A well-functioning secondary market is one that supports price formation so that market participants can efficiently price the value of the stock at any point in time. Lit trading venues, such as CLOBs, support the price-formation process as the order flow to the CLOB, including limit orders, conveys private information. However, when making order routing decisions, traders do not factor in the wider benefit that trading on lit venues has on price formation. Therefore, individual trading decisions may result in too much trading away from lit trading venues than would be beneficial from an overall market perspective.

What influences the amount of trading that takes place away from CLOBs and the impact this has on overall market quality? In section 2.1 we discussed the economic factors that affect traders' execution venue decisions, including the role of information asymmetries in pushing different types of traders towards different venues. The implications of trading fragmentation for the efficiency and stability of equity markets

[71] Financial Conduct Authority (2023), 'The framework for a UK consolidated Tape, CP23/33', paras 8.1 and 8.12.

stem in part from the way different venues segment information and order flow in the market.

For example, following the pecking order theory we described in section 2.1, CLOBs provide an attractive option for traders who prioritise fast and certain execution, while midpoint dark MTFs provide an attractive option for investors who prioritise lower implicit costs. Similarly, 'uninformed' investors may wish to trade amongst themselves away from CLOBs in venues where they can benefit from lower adverse selection costs of liquidity provision.

This self-selection can be observed empirically in UK equity markets. In a recent working paper Hagströmer and Menkveld (2023) analyse the UK equity market and find that dark pools, SIs, and periodic auctions (trading mechanisms with zero or partial pre-trade transparency) together contribute at most 0.34% to price discovery, despite representing roughly 30% of the trading activity in their sample.[72]

Overall, self-selection between venues can reduce the noise within prices and order flow on CLOBs, improving price discovery. However, having proportionally more 'informed' traders on CLOBs increases the adverse selection costs for remaining 'uninformed' traders which can eventually lead to wider spreads and higher price impacts.[73]

The academic literature describes how trading away from lit venues can have a non-linear effect on market quality, whereby volumes shifting from lit venues at high levels can have detrimental effects. Table 4.1 summarises various empirical studies that investigate this relationship.

[72] The authors filter out OTC trades from their analysis. Hagströmer, B. and Menkveld, A.J. (2023), 'Trades, quotes, and information shares', February, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4356262.

[73] Zhu, H. (2014), 'Do dark pools harm price discovery?', *Review of Financial Studies*, **27**:3. Bayona et al. (2023) build on Zhu (2014) by developing a two-period model that models the lit exchange as a limit order book instead of a dealer market. They find that when market conditions are such that the informed trader migrates to the dark pool and the uninformed trader stays in the exchange, the existence of the dark pool harms price informativeness. See Bayona, A., Dumitrescu, A. and Manzano, C. (2023), 'Information and optimal trading strategies with dark pools', *Economic Modelling*, **126**:1, pp. 1–22.

Table 4.1 Empirical studies of market quality impacts of trading away from lit venues

Academic paper	Methodology	Findings
Comerton-Forde and Putniņš (2015)	Authors analyse the effect of dark/block trading on price discovery using data from the Australian Stock Exchange.	Dark trading leads to partial segmentation of informed and uninformed traders. This increases adverse selection risk in the lit market leading to wider bid–ask spreads. Low levels of dark trading are either benign or beneficial to informational efficiency. However, information efficiency begins to deteriorate when dark trading in a given stock exceeds approximately 10% of dollar volume.
Aquilina et al. (2016)	Authors analyse the prevalence of trades that occur at stale reference prices on UK dark pools, their costs, and impacts on different market participants.	Of all dark midpoint trades analysed, 3.54% reference a stale price. This proportion increased over time from 3.36% in 2014 to 4.05% in June 2015. In 96% of cases, HFTs are on the side of the trade that benefits from the trade being executed at a stale price.
Foley and Putniņš (2016)	Authors utilise restrictions of dark trading in Canada and Australia as a natural experiment to analyse the causal impact of dark trading on liquidity and informational efficiency.	Dark trading at prices that are either side of the midpoint (i.e. at the bid and ask), in moderate levels, is beneficial to liquidity and informational efficiency. It tends to lower quoted, effective, and realised spreads, and reduces price impact measures of illiquidity. Conversely, they do not find consistent evidence that dark trading at the midpoint of the lit NBBO has a significant effect on market quality. While it may benefit some aspects of market quality, it can be harmful to others.

Academic paper	Methodology	Findings
Farley et al. (2018)	Authors exploit a large exogenous shock to dark trading in the USA that arises from the SEC's 'Tick Size Pilot' enacted in October 2016 to identify the causal effect of changes in dark trading volume on market quality.	A 34% reduction in dark trading did not affect transaction costs, and there is only marginal evidence that it affected price efficiency.
Ibikunle et al. (2021a)	Authors exploit the implementation of the double volume cap under MiFID II to investigate the impact of dark trading on liquidity and informational efficiency.	Restricting dark trading is associated with higher transaction costs on lit venues, due to market makers becoming less incentivised to post competitive quotes in lit venues after dark trading is restricted. Limiting dark trading also tends to reduce informational efficiency.
Ibikunle et al. (2021b)	Authors investigate the impact of dark trading on adverse selection in the UK equity market using data for 288 UK stocks traded across the LSE, BATS Europe, Chi-X Europe, and Turquoise.	Consistent with Zhu (2014) adverse selection risk falls, and liquidity is enhanced in the aggregate market as dark trading increases. There is also a reduction in noise in the price discovery process and an improvement in informational efficiency in the aggregate market. However, the observed relationship is non-linear, meaning that at higher levels dark trading could harm market quality.[1] The threshold at which dark trading starts to negatively impact market quality is estimated to be approximately 14% (9% for the highest trading stocks and 23% for the lowest trading stocks).[2]
Neumeier et al. (2023)	Authors investigate the relationship between transaction costs and venue choice using transaction level data from institutional trade executions in the UK equity market.	For a given institutional investor, a higher share of trading on midpoint dark pools is associated with lower execution costs. The probability of trading via a midpoint dark pool decreases significantly over the order life-cycle as immediacy becomes more important, consistent with the pecking-order theory of venue choice.

Note: [1] As informed trader concentration increases in the lit market, volatility widens the exchange spread and encourages more liquidity traders to migrate to the dark pool, increasing the adverse selection risk for the aggregate market.
[2] The authors caution a strict interpretation of the estimated thresholds because: (i) dark trading in the London market is yet to consistently attain the estimated thresholds; (ii) they could be sensitive to the estimation approach used; (iii) single point estimates for stock groups could be misleading.
Source: Comerton-Forde, C. and Putniņš, T.J. (2015), 'Dark trading and price discovery', *Journal of Financial Economics*, **118**:1, pp. 70–92; Aquilina, M., Foley, S., O'Neill, P. and Ruf, T. (2016), 'Asymmetries in dark pool reference prices', FCA Occasional Paper 21, September; Foley, S. and Putniņš, T.J. (2016), 'Should we be afraid of the dark? Dark trading and market quality', *Journal of Financial Economics*, **122**:3, pp. 456–81; Farley, R., Kelley, E.K. and Puckett, A. (2018), 'Dark trading volume and market quality: a natural experiment', 13th Annual Mid-Atlantic Research Conference in Finance (MARC) Paper, March; Ibikunle, G., Li, W., Mare, D. and Sun, Y. (2021a), 'Dark matters: The effects of dark trading restrictions on liquidity and informational efficiency', *Journal of International Financial Markets, Institutions and Money*, **75**:1; Ibikunle, G., Aquilina, M., Diaz-Rainey, I. and Sun Y. (2021b), 'City goes dark: Dark trading and adverse selection in aggregate markets', *Journal of Empirical Finance*, **64**:1, pp. 1–22; Neumeier, C., Gozluklu, A., Hoffmann, P., O'Neill, P. and Suntheim, F. (2023), 'Banning dark pools: Venue selection and investor trading costs', *Journal of Financial Markets*, **65**:1, pp. 1–18.

For a policymaker assessing whether fragmentation away from CLOBs is harmful for market quality, one important consideration that will affect such an assessment is whether the shift in trading volumes is self-reinforcing.

- If an increase in the number of traders executing on alternative venues away from CLOBs increases the available liquidity and probability of execution for those traders, while liquidity worsens on the lit market, this will prompt a further shift 'off-exchange'.[74]
- If 'informed' traders also leave CLOBs to trade on dark venues, 'uninformed' traders will subsequently exit these dark venues to avoid encountering 'informed' traders, acting as a natural braking mechanism constraining the share of alternative venues.

In response to this, some alternative venues compete by limiting the access of 'informed' traders. This includes the RSP system (which is limited to retail investors) and SIs (who have some discretion over which investors can access their liquidity).

[74] This is the network effect we described in section 2.2.

In both the RSP system and SIs, the liquidity provider faces lower adverse selection costs than liquidity providers on lit venues, allowing them to potentially provide better prices to end-investors.[75]

There are several implications of this for policymakers.

- Firstly, measuring market quality when trading is fragmented *and* order flow is segmented is more challenging than a market where trading is just fragmented between RMs and MTFs. Where order flow is segmented and some trading takes place on venues that are not accessible to all investors, prices on different venues can become more dispersed.
- Secondly, assessing the effect of fragmentation and segmentation on market quality requires an understanding of the types of order flow being directed to each venue. Such an analysis is not possible using public trading data.

4.1.2 Would a tape lead to more trading away from CLOBs?

In the previous sub-section, we discussed the broader questions of market design that the regulator must consider.

In the context of the FCA's CBA, the relevant issue in the first instance is the incremental effect it might have on the share of CLOB trading. In other words, are there traders who currently route orders to a CLOB but would choose to send those orders to a dark venue or off-exchange if they had access to a CT?

As we discussed in section 3, it does not appear that most market participants will use a CT for trading purposes, so it is unlikely to lead to different trading decisions by these participants. This is principally because they require low-latency data for trading and already rely on proprietary feeds from trading venues (for which the CT is an imperfect substitute).

[75] Aramian and Norden (2023) examine the determinants of SI markets shares and costs. The authors find that SI trades have a lower price impact (as a proxy for the degree of informed trading). This leads the authors to conclude that: 'the small price impacts of SI trades show that the cost of providing liquidity reflected in the realized spread captures a large fraction of the average effective spread. The large realized spread indicates that SIs are successfully making a profit by earning the spread and avoiding informed traders.' Although not discussed by the authors, one implication of this finding is that, as the volume traded through SIs increases, the risks associated with internalisation may decrease, allowing the SI to offer even better prices, and so on. See Aramian, F. and Norden, L.L. (2023), 'Costs and benefits of trading with stock dealers: the case of systematic internalizers', *European Financial Management*, pp.1–31

Nonetheless, there may be a subset of investors for whom the CT could change their information set, leading them to change their trading decisions.

One of the potential use cases of the CT noted in section 3 is for investors to monitor the quality of execution received from their brokers. The CT may enable investors, who have not previously consumed consolidated market data, to better assess ex post whether their broker provided best execution, and to put pressure on their brokers if they have not.

To meet best execution requirements, such brokers may decide to connect to additional lit venues. However, as discussed in section 2.1.1 and Appendix A3 (in the context of the US market), connecting to additional venues is associated with a number of fixed costs (incl. membership fees and IT connectivity) in addition to the proprietary market data feeds that would be required for trading.

In such a scenario, some brokers (e.g. smaller brokers) may decide to send their clients' orders to trading mechanisms that can provide at least as good a price as the consolidated BBO, without connecting to all trading venues.

- MTFs operating using the RPW match trades at the midpoint of the current bid and offer prices of the reference trading venue.[76]
- SIs have a degree of discretion as to the price at which they execute client orders, and, as explained in the previous section, may execute orders at a better price than quoted on lit venues.[77] This includes execution of orders at midpoint within the current bid and offer price.[78]

[76] The reference trading venue is the trading venue where that financial instrument was first admitted to trading or the most relevant market in terms of liquidity. For UK equities, this is likely to be the LSE. See 'Regulation (EU) No 600/2014 of the European Parliament and of the Council', Article 4, https://www.legislation.gov.uk/eur/2014/600/article/4.

[77] Subject to the relevant rules. See 'Regulation (EU) No 600/2014 of the European Parliament and of the Council', Article 15, https://www.legislation.gov.uk/eur/2014/600/article/15.

[78] Prior to the UK's exit from the EU and the subsequent enactment of the Financial Services and Markets Act 2023, SIs were only able to execute Large in Scale trades at the midpoint. Currently, SIs are allowed to execute at the midpoint for any trade size, subject to best execution obligations. See 'Regulation (EU) No 600/2014 of the European Parliament and of the Council', amended by virtue of Financial Services and Markets Act 2023, Article 17a, https://www.legislation.gov.uk/eur/2014/600/article/17a; HM Treasury (2022), 'Wholesale markets review: consultation response', 1 March, pp. 10–11. 'Current bid and offer price' is not explicitly defined, but SI quotes must reflect prevailing market conditions. The prices published by a systematic internaliser shall be deemed to reflect prevailing market conditions where they are close in price, at the time of publication, to quotes of equivalent sizes for the same financial instrument on the most relevant market in terms of liquidity. See 'Commission Delegated Regulation (EU) 2017/587', Article 10, https://www.legislation.gov.uk/eur/2017/587/article/10.

The price improvement that MTFs and SIs can offer relative to the CT price may help smaller brokers to meet their best execution requirements. This could lead more brokers to connect to dark MTFs and SIs, or to send more order flow to them. However, although this may look attractive to some brokers, executing client orders at the midpoint on MTFs or SIs does not guarantee best execution. In the UK, firms must consider factors beyond price such as cost, speed, likelihood of execution and settlement, and size when considering their best execution requirements.[79] For example, MTFs may not offer the same immediacy as lit trading venues. Moreover, depending on the nature of the order, the bid and offer implied by the CT might not necessarily reflect the best price available (e.g. if the order flow is 'uninformed').

If MTFs (and SIs) were to be allowed to reference the consolidated UK BBO produced by the CT, this may make MTFs and SIs even more attractive to brokers.[80] This could result in the share of trading on dark MTFs and SIs increasing further.[81]

Alternatively, brokers may just route their orders through larger brokers who are connected to more venues. This would increase the level of intermediation in the market (this already occurs today to some degree, as discussed in section 3.4). Whether this leads to better execution outcomes for the investor depends on the costs associated with using an additional intermediary.

Assessing the significance of this mechanism may be informed by an assessment of the types of order flow that brokers are currently directing to each venue, and the motivation for doing so. Such an analysis is not possible using public trading data, however the FCA would be well-placed to undertake such an exercise.

[79] Financial Conduct Authority, 'COBS 11.2A Best execution – MiFID provisions', https://www.handbook.fca.org.uk/handbook/COBS/11/2A.html.

[80] Under current rules, dark MTFs operating under the reference price waiver take the price from a single reference trading venue. The reference trading venue is the trading venue where that financial instrument was first admitted to trading or the most relevant market in terms of liquidity. For UK equities, this is likely to be the LSE. See 'Regulation (EU) No 600/2014 of the European Parliament and of the Council', Article 4, https://www.legislation.gov.uk/eur/2014/600/article/4.

[81] We note that this is difficult to test empirically based on historic data because post-MiFID II, dark MTFs were not permitted to use a reference price based on multiple venues. Prior to the introduction of MiFID II, some MTFs did calculate prices based on the midpoint of the European Best Bid and Offer (EBBO). For example, Instinet BlockMatch used an EBBO calculated using consolidated BBO prices of the major UK-based lit MTFs and primary markets. See European Securities and Markets Authority (2015), Waivers from pre-trade transparency: CESR positions and ESMA opinions, 21 August, https://www.esma.europa.eu/sites/default/files/library/2015/11/2011-241g_u_compilation_of_esma_opinions_and_cesr_positions_on_pre-trade_waivers_21082015.pdf; Financial Conduct Authority (2016), 'Asymmetries in dark pool reference prices', OP 21, September, Annex 4.

A1 Non-price forming trades

In section 2, we described the distribution of trading among various trading mechanisms in UK equity markets. We noted that OTC, SI, and off-book on-exchange transactions flagged as 'non-price forming' or 'not contributing to the price discovery process' by LSEG Market Share Reporter were removed from the dataset. These transactions include technical transactions, such as collateral transfers, give-ups and give-ins, and inter-affiliate trades undertaken for operational purposes. While technical trades may be relevant from a supervisory and/or post-trading perspective, they do not represent an economic trading interest.[82]

In this appendix, we briefly describe the proportion of non-price forming transactions in the dataset, and present the results for all transactions (i.e. including non-price forming transactions).

Table A1.1 sets out the mapping from the taxonomy used by LSEG Market Share Reporter to the category of trades reported in section 2.

Table A1.1 Classification of trade types

Trade type	Oxera category	Flagged as 'non-price forming' or 'not contributing to price discovery process'	Flagged as LIS
On Book - Lit	Lit order book	No	No
On Book LIS	Dark	No	Yes
Auction	Auction	No	No
Dark RFPT	Dark	No	No
Periodic Auctions	Periodic auctions	No	No
On Exchange Immediate	Off-book on-exchange	No	No
On Exchange Non Immediate	Off-book on-exchange	No	No
On Exchange NTW Immediate	Off-book on-exchange	No	No
On Exchange NTW Non Immediate	Off-book on-exchange	No	No

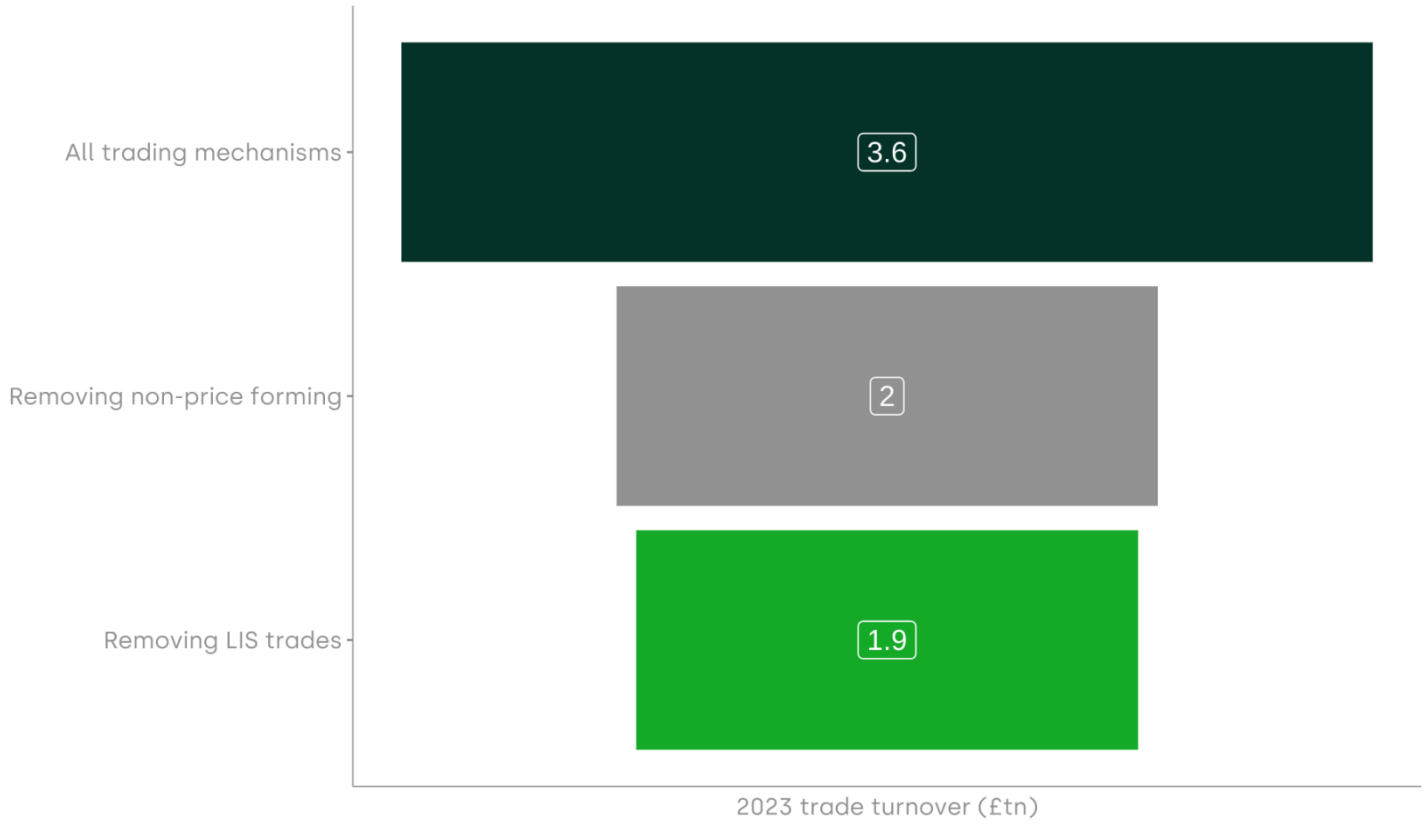
[82] For a discussion of applying filters to trade data, see Oxera (2021), 'The landscape for European equity trading and liquidity', report prepared for AFME.

Trade type	Oxera category	Flagged as 'non-price forming' or 'not contributing to price discovery process'	Flagged as LIS
On Exchange LIS Deferred	Off-book on-exchange	No	Yes
On Exchange NPFT/TNCP	Off-book on-exchange	Yes	No
OTC Immediate	OTC	No	No
OTC Non Immediate	OTC	No	No
OTC LIS Deferred	OTC	No	Yes
OTC NPFT/TNCP	OTC	Yes	No
SI Immediate	SI	No	No
SI Non Immediate	SI	No	No
SI LIS Deferred	SI	No	Yes
SI NPFT/TNCP	SI	Yes	No

Source: Oxera classification of trade types in LSEG Market Share Reporter data.

Figure A1.1 shows the effect on volumes of removing 'non-price forming' transactions in 2023.

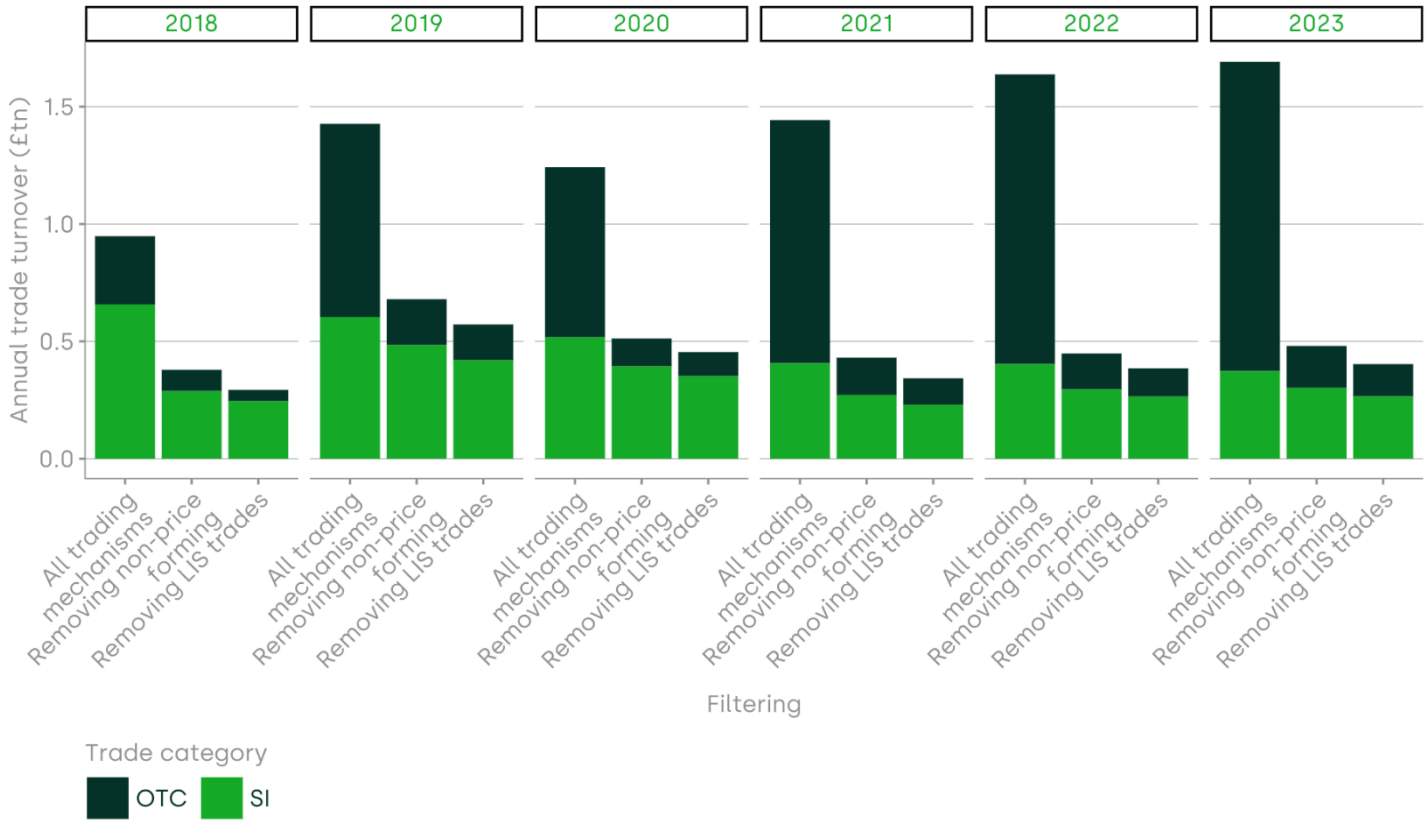
Figure A1.1 Turnover after filtering non-price forming and LIS trades, 2023



Note: Only trades that were traded on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares.
Source: Oxera analysis of LSEG Market Share Reporter data.

Figure A1.2 shows the effect of filtering non-price forming transactions and LIS trades for each year from 2018 to 2023. As this figure shows, the volume of OTC transactions flagged as non-price forming has increased substantially since 2018.

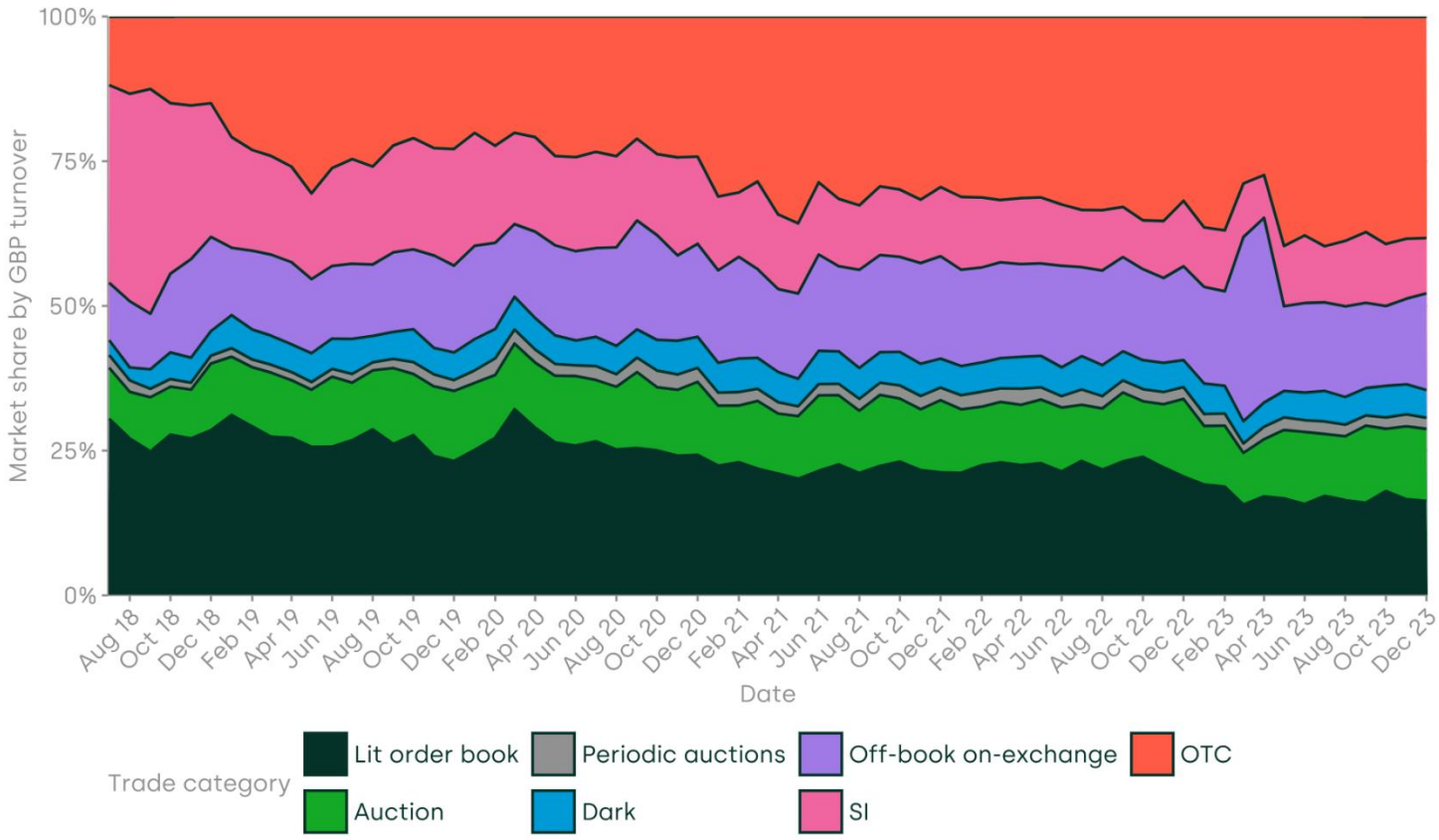
Figure A1.2 SI and OTC trades, effect of removing non-price forming and LIS trades, July 2018–December 2023



Note: Only trades that were traded on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares.
Source: Oxera analysis of LSEG Market Share Reporter data.

Figure A1.3 shows how the shares of different trading mechanisms have evolved if all transactions (including non-price forming transactions) are included. Unsurprisingly, the share of OTC and SI trading is significantly higher once non-price forming transactions are included, accounting for approximately 50% of trading activity in Q4 2023.

Figure A1.3 Distribution of equity trading in the UK by trading mechanism, July 2018–December 2023



Note: Only trades that were traded on UK trading venues or reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares.
Source: Oxera analysis of LSEG Market Share Reporter data.

A2 Specific trends in UK equity markets

In this appendix, we provide further detail on some specific trends in UK equity markets:

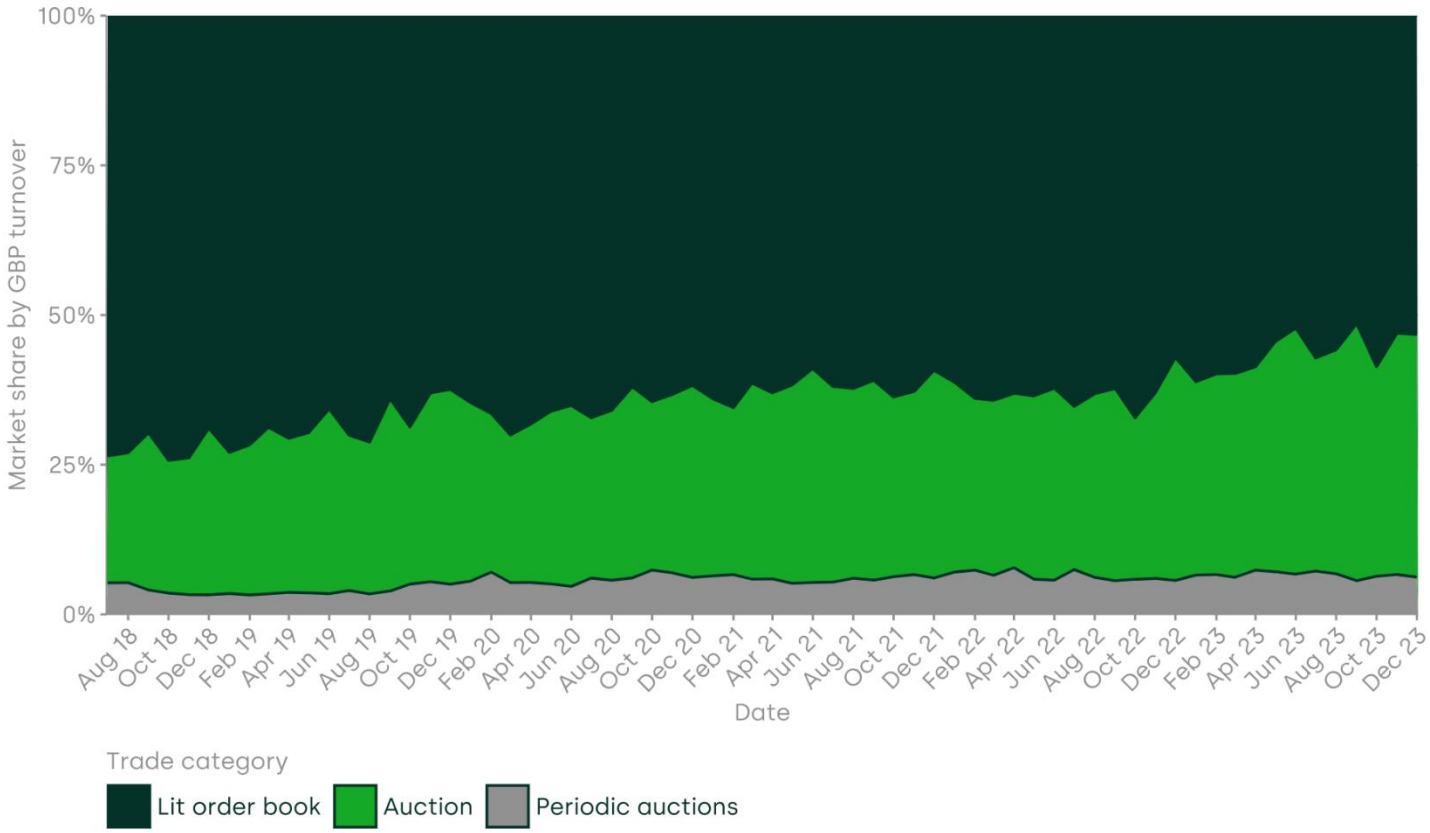
- in section A2.1 we discuss the growth of auction trading;
- in section A2.2 we discuss the role of SI trading;
- in section A2.3 we present some further data on implementation shortfall trends;
- in section A2.4 we present the trends in trading mechanisms for all ordinary shares traded on UK venues.

A2.1 The growth of auction trading

Figure A2.1 below shows how the share of auction trading mechanisms relative to lit order books has increased since 2018. While this volume primarily consists of trades executed via the closing auction at the LSE, there are a number of alternative closing mechanisms.[83] These mechanisms primarily execute trades using the LSE closing price.

[83] Examples include Aquis Market-at-Close, Turquoise Plato Trade-at-Last and Cboe Closing Cross (3C).

Figure A2.1 Share of auctions relative to lit order book trading, July 2018–December 2023



Note: Only trades on UK trading venues are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Auction trades include those executed on the LSE opening, intraday and closing auctions, as well as trades executed via Aquis Market at Close. It does not capture all trades on venues which use the LSE closing auction price, including Turquoise Plato Trade-at-Last and Cboe Closing Cross.
Source: Oxera analysis of LSEG Market Share Reporter data.

The growth in the share of trading taking place via auction mechanisms, which is documented in a number of other financial centres, has been attributed to a number of factors:[84]

- the growth of index investment and the use of low-cost Exchange Traded Funds (ETFs),[85] which often make use of the

[84] See, for example, Raillon, F. (2019), 'Growing importance of the closing auction in share trading volumes', AMF Risk & Trend Mapping, October, https://www.amf-france.org/sites/institutionnel/files/2020-02/growing-importance-of-the-closing-auction-in-share-trading-volumes.pdf; Bogoussslavsky, V. and Muravyev, M. (2023), 'Who trades at the close? Implications for price discovery and liquidity', *Journal of Financial Markets*, **66**; Aramian, F. and Comerton-Forde, C. (2023), 'Closing mechanisms in European Equities', Working paper.

[85] As at December 2022, index tracker funds accounted for 21% of the UK fund market by assets under management (excluding ETFs), compared with around 5% in 2008. In October 2023, the value of equity ETFs listed on the LSE was £678bn. See The Investment Association (2023), 'Investment

price in the closing auction for rebalancing and benchmarking purposes;[86]
- best execution rules and requirements to perform Transaction Cost Analysis (TCA) make auction trading attractive to participants;
- traders participating in auctions to avoid interacting with HFTs;
- brokers preferring to close positions via a closing auction due to the increased costs of holding positions overnight;
- network effects associated with liquidity, incentivising traders (including execution algorithms) to concentrate trading at the closing auction.

Although not reflected in the chart above, some SIs also guarantee the execution of orders at the primary exchange closing auction price—Aramian and Comerton-Forde (2023) find that around 21% of total trading volume at the market close in the UK consists of such trades.[87] This points further to the importance of the closing auction as a price-formation mechanism in UK markets.

Investors who trade at the closing auction can benefit from liquidity being concentrated at a single point in time, potentially resulting in better execution outcomes.[88] However, to the extent that liquidity decreases throughout the rest of the trading day, investors who need to trade intraday may have to contend with lower market depth, higher bid–ask spreads and worse execution outcomes.

Figure A2.2 compares intraday 'lit' volumes in 2023 to 2018. As this figure shows, trading volumes at all points in the day have decreased relative to 2018, with the exception of the market closing period.

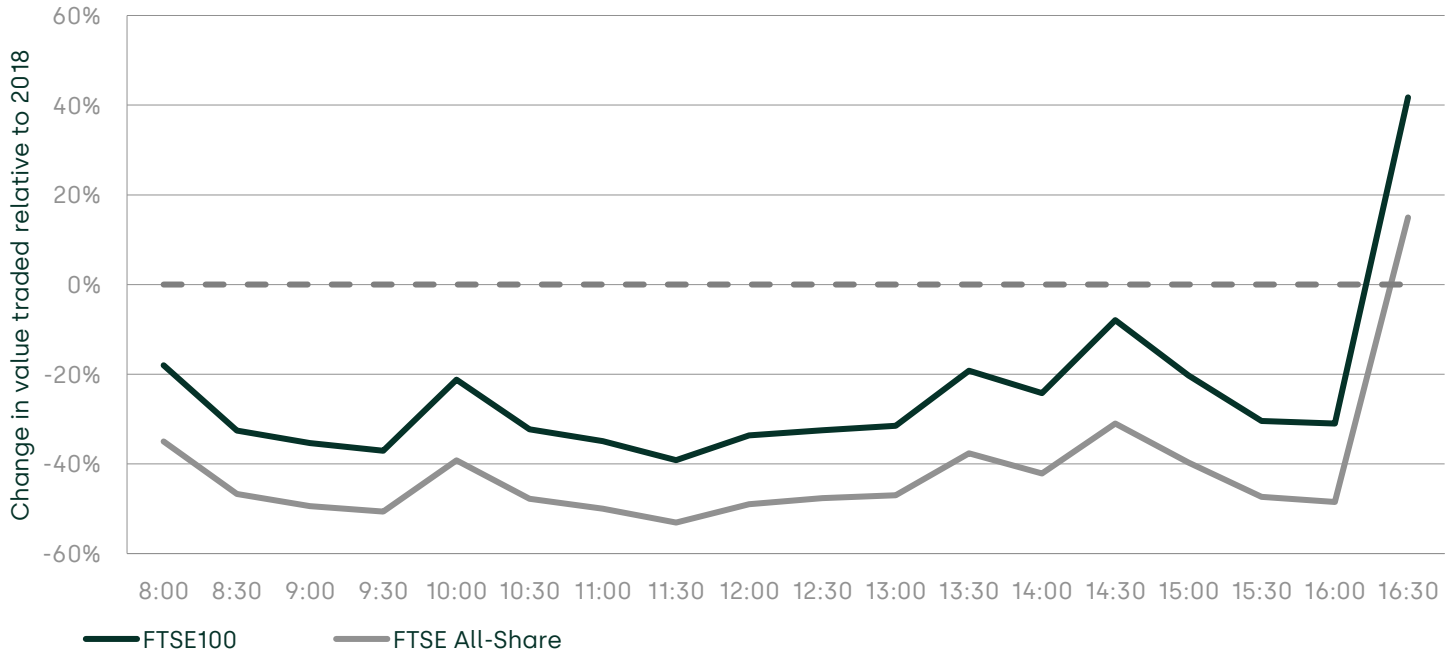
Association Annual Survey 2022-2023', https://www.theia.org/sites/default/files/2023-10/Investment%20Management%20in%20the%20UK%202022-2023_0.pdf; Lipper Alpha Insight (2023), 'UK ETF market report: October 2023', https://lipperalpha.refinitiv.com/reports/2023/11/uk-etf-market-report-october-2023/.

[86] For example, analysis by LSEG over a three-month period between May 2020 and July 2020 found that the largest closing auction took place on the same day as the MSCI semi-annual index rebalance on 29 May, and the second largest took place on the same day as the FTSE Quarterly UK Index Review on 19 June. See LSEG (2021), 'Lifting the lid on the close', London Stock Exchange Trading Insights White Paper, https://www2.lseg.com/l/6522/2021-02-19/44k71d/6522/16137309850tmW7j1I/LSE_WhitePaper_TradingInsights_LiftingtheLid_Final.pdf.

[87] Aramian, F. and Comerton-Forde, C. (2023), 'Closing mechanisms in European Equities', Working paper.

[88] See discussion about network effects in section 2.1.2.

Figure A2.2 Intraday volume change, 2018 vs 2023



Source: BMLL Technologies.

A2.2 The role of SI trading

As noted in Section 2.2.1, SI trading in UK equities accounted for 16% over the period 2018–23, with the monthly share fluctuating between 10% and 29%.

Table A2.1 shows the list of financial institutions authorised by the FCA to operate equity SIs.

Table A2.1 Parent organisations of equity SIs authorised by the FCA

Barclays Capital Securities Limited	Goldman Sachs International	Jefferies International Ltd	Société Générale
BNP Paribas[2]	HSBC Bank Plc	Joh. Berenberg, Gossler and Co. KG	Susquehanna International Securities Limited - UK Branch[2]
Citadel Securities (Europe) Limited	Hudson River Trading Europe Ltd	Macquarie Capital (Europe) Limited	Tower Research Capital Europe Limited
Citigroup Global Markets Limited	Investec Bank PLC[1]	Merrill Lynch International	Trading 212 UK Limited
Credit Suisse International	J.P. Morgan Securities plc	Morgan Stanley & Co. International Plc	UBS AG
Deutsche Bank AG	Jane Street Financial Ltd	RBC Europe Limited	XTX Markets Limited[1]

Note: [1] SI is an approved SI for 'shares' only. [2] SI is an approved SI for 'ETFs' only.
Source: FCA register of approved MTFs, OTFs, DRSPs and notified SIs, as at 21st January 2024. Financial Conduct Authority, 'Historic Copies of DRSP, MTF, OTF, SI and DR Register files (CSV), https://register.fca.org.uk/s/search?predefined=DRSP.

The SIs listed in Table A2.1 above can be split into two broad categories: Electronic Liquidity Providers (ELPs) and bank SIs.

ELP SIs consist of algorithmic and high-frequency trading firms, such as Citadel Securities and XTX Markets, which provide quotes in equities outside of regulated markets and MTFs.

Bank-operated SIs typically consist of a bank's central risk book providing liquidity to brokers' investor order flow, either via smart order routers or via human trading desks. In practice, there is a degree of vertical integration between the broker and SI level of the value chain, as a bank's own smart order router can route client orders to the bank's own SI. For example, in describing its smart order router (SORT), Morgan Stanley explains the following:[89]

For client orders, SORT is designed to capture a contemporaneous snapshot of external displayed markets, external SIs and certain Morgan Stanley internal sources of liquidity, such as Morgan Stanley's Systematic Internalisers "MSSI" and "MESI"…. based on its view of

[89] Morgan Stanley (2023), 'Morgan Stanley's EMEA Cash Equity Order Handling & Routing Frequently Asked Questions', https://www.morganstanley.com/content/dam/msdotcom/en/institutional-sales/pdf/msco/MS_EMEA_Equity_Order_Handling_and_Routing_FAQs.pdf.

liquidity available internally at prices equal to or better than the EBBO… SORT may access such liquidity by sending an immediate-or-cancel ("IOC") or day order.

While we detail the overall share of UK SI trading in Section 2.2.1 above, the share of trading taking place on individual SIs is not observable using public data.[90] Analysis of the French equity market conducted by the Autorité des marchés financiers (AMF) found that bank/broker SIs accounted for 76% of overall SI trading in French equities in 2019, while ELP SIs accounted for 24%.[91]

The same AMF paper noted that the average size of bank SI transactions was €62,000 compared with €12,000 for Euronext and €10,000 for ELP SIs, suggesting that ELP SIs and bank/broker SIs cater to different types of liquidity demand. However, the regulator also found that median size of transaction for both types of SI (€5,900 on bank/broker SIs and €5,200 on ELP SIs) was similar to that that of Euronext Paris (€6,000).

This finding is also borne out in the UK data, where the mean size of SI trades in 2023 (£10,570) was slightly higher than the mean trade size on the London Stock Exchange in 2023 (£7,015).[92]

Since MiFID II, there have been changes to the rules regarding SI prices.

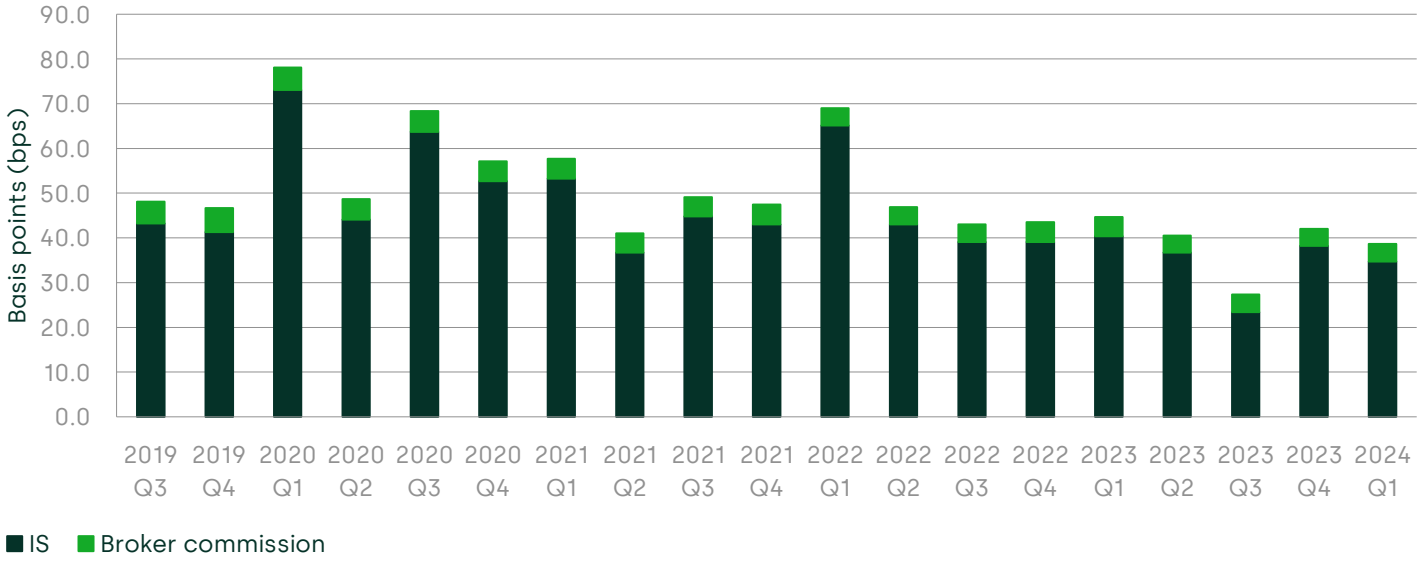
- Prior to June 2020, SIs were permitted to offer price improvement less than the minimum price increment permitted by lit venues (the tick size).
- Between June 2020 and August 2023, the MiFID tick-size regime was extended to cover SI quotes and execution prices for orders below the LIS threshold. This prevented SIs from offering very small (sub-tick) price improvements, and from executing trades at midpoint prices.
- In August 2023, the UK FSMA Act rescinded the ban on SIs executing trades at midpoint prices.

[90] APAs do not report the name of the specific SI on which a trade took place.
[91] Lucas, I. (2020), 'Quantifying systematic internalisers' activity: their share in the equity market structure and role in the price discovery process', May, https://www.amf-france.org/sites/institutionnel/files/2020-06/202005_etude_internalisateurs_integrale_va.pdf.
[92] Oxera analysis of LSEG Market Share Reporter data. Average trade size is calculated as GBP turnover/number of trades. Only trades reported to UK APAs are included. We filter to UK-domiciled (based on the first two characters of the ISIN) ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.

A2.3 Further implementation shortfall trends

Figure A2.3 below shows the trend in buy-side trading costs (comprising both implementation shortfall and broker commissions) between Q3 2019 and Q1 2024. As noted in section 2.2.3, IS costs for UK equities have remained broadly stable over the period, with the exception of spikes in Q1 2020 and Q1 2022. Average broker commissions have fallen slightly from around 5bps in Q3 2019 to around 4bps in Q1 2024.

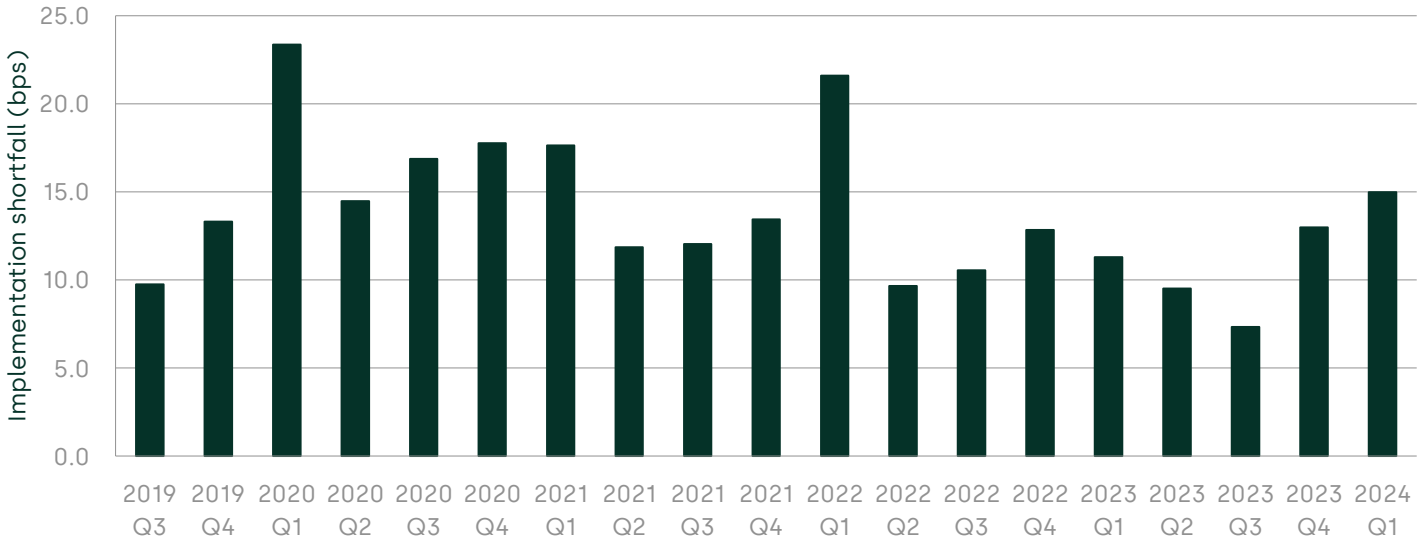
Figure A2.3 Implementation shortfall and broker commissions for UK listed equities, Q3 2019–Q1 2024



Note: Implementation shortfall captures slippage from arrival price, measured in basis points. This is calculated as 10,000 * (weighted-average client execution price - price at arrival timestamp) / (price at arrival timestamp). Positive values mean executed prices are worse than arrival price (trading cost).
Source: Oxera analysis of Virtu Global Peer Database.

Figure A2.4 shows how the broker implementation shortfall has followed a similar trend to overall IS over the same period, but increased slightly. Broker IS reflects the slippage between the broker arrival price and the execution price for a trade—in other words the cost of trading once an order has been routed to the broker. Buy-side trading desks may split an overall parent order into multiple child orders, each routed to a different broker.

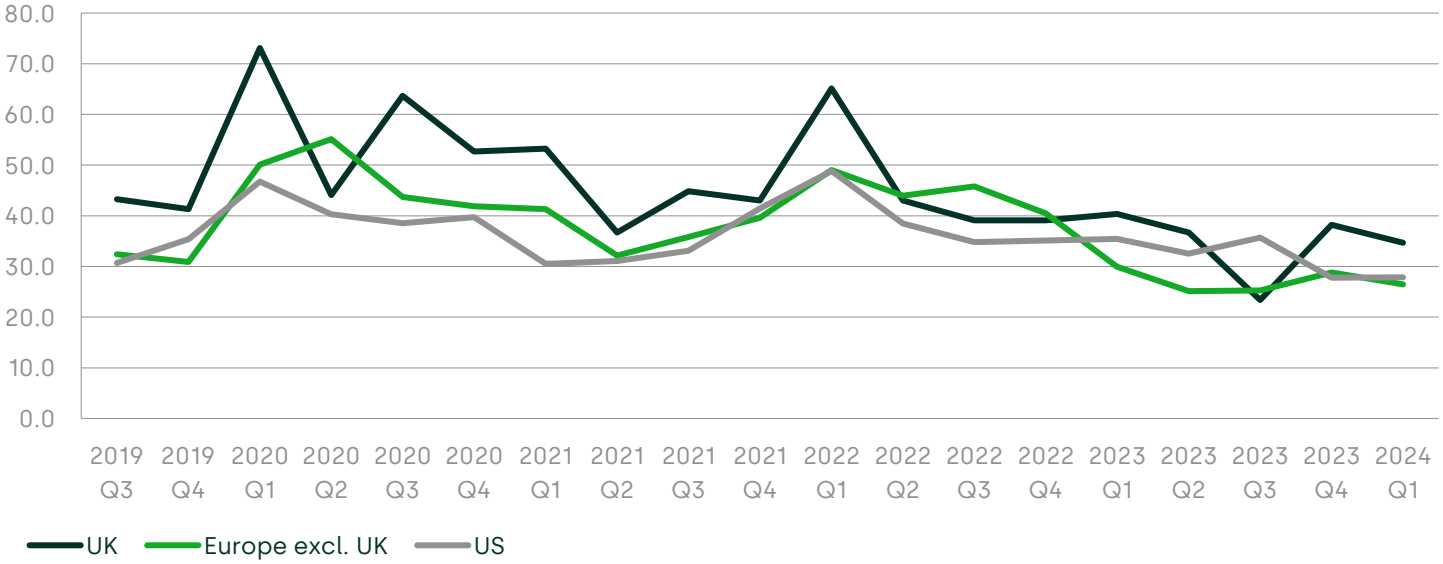
Figure A2.4 Broker implementation shortfall for UK-listed equities, Q3 2019–Q1 2024



Note: Implementation shortfall captures slippage from arrival price, measured in basis points. This is calculated as 10,000 * (weighted-average client execution price - price at time of transmission to broker) / (price at time of transmission to broker). Positive values mean executed prices are worse than arrival price (trading cost).
Source: Oxera analysis of Virtu Global Peer Database.

Finally, Figure A2.5 shows how the recent trend implementation shortfall for UK-listed equities compares with other financial centres. As this figure shows, IS for UK-listed equities has followed a broadly similar trend to US and EU-listed equities, but experienced higher peaks in Q1 2020 and Q1 2022.

Figure A2.5 Implementation shortfall by region, Q3 2019–Q1 2024

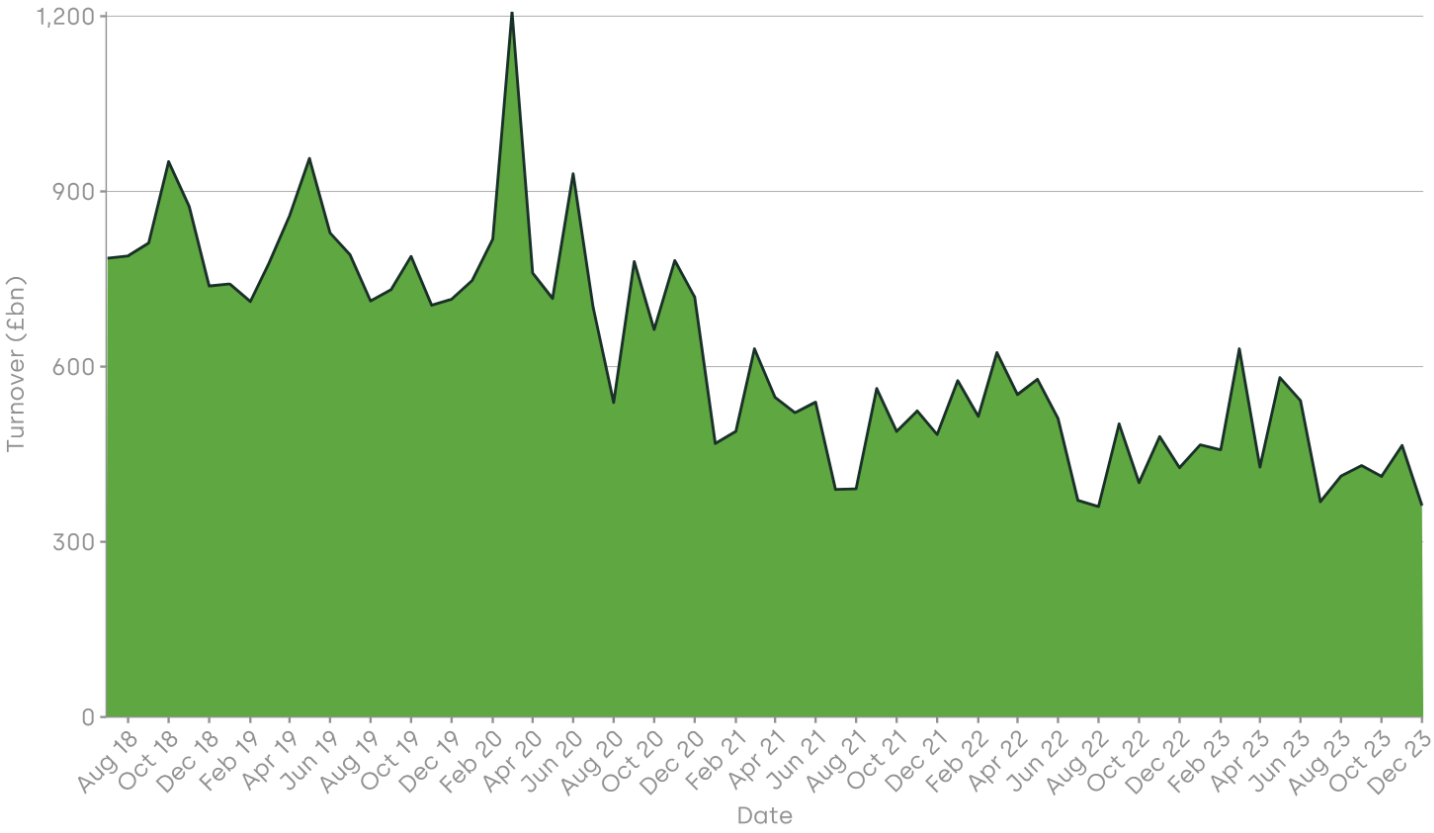


Note: Implementation shortfall captures slippage from arrival price, measured in basis points. This is calculated as 10,000 * (weighted-average client execution price - price at arrival timestamp) / (price at arrival timestamp). Positive values mean executed prices are worse than arrival price (trading cost). For aggregate Europe figures, the calculation collects all orders for the in-scope countries and performs a weighted average at the order level.
Source: Oxera analysis of Virtu Global Peer Database.

A2.4 Trends in trading mechanisms

Figure A2.6 shows the monthly trading turnover of all ordinary shares (regardless of domicile) traded on UK venues, after removing non-price forming trades.

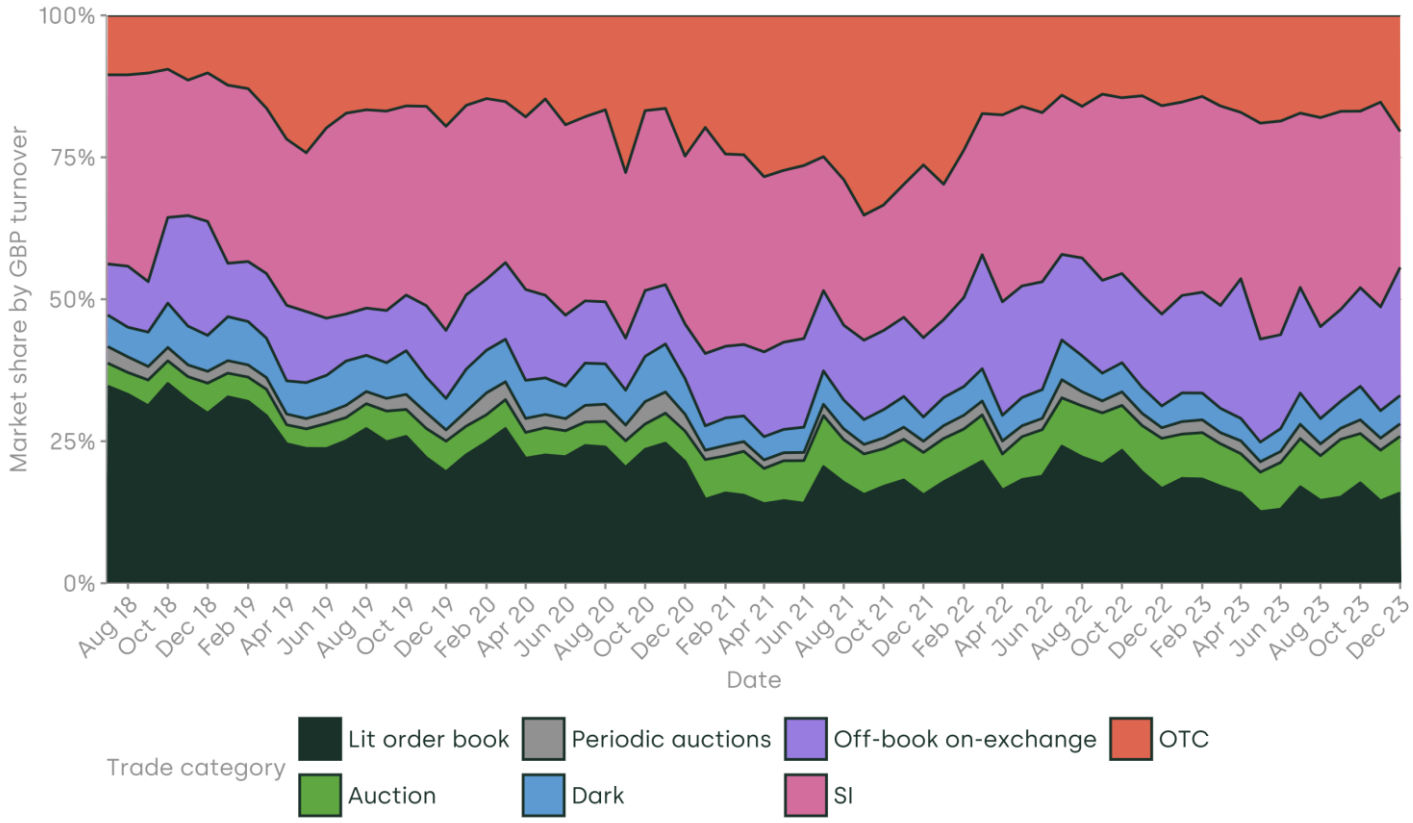
Figure A2.6 Turnover of trading on UK venues (price forming trades), July 2018–December 2023



Note: Only trades on UK trading venues or reported to UK APAs are included. We filter to only include ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
Source: Oxera analysis of LSEG Market Share Reporter data.

Figure A2.7 below shows the trends in the distribution of different trading mechanisms for all ordinary shares (regardless of domicile) traded on UK venues.

Figure A2.7 Distribution of equity trading in all ordinary shares on UK venues by trading mechanism, July 2018–December 2023



Note: Only trades on UK trading venues or reported to UK APAs are included. We filter to only include ordinary shares. Trades flagged as 'non-price forming' or 'not contributing to the price discovery process' are excluded.
Source: Oxera analysis of LSEG Market Share Reporter data.

Compared with Figure 2.4 which considers only UK shares, the share of SI and OTC trading is significantly higher (around 50%) when overseas shares are included in the analysis. The reduction in the share of lit order book trading between December 2020 and January 2021 may have been driven by the end of the Brexit transition period and the different approaches taken by the ESMA and FCA to the Share Trading Obligation (STO).

A3 Comparison with the US CT

The USA is often cited as the main example of an equity market with an established pre-trade consolidated tape.[93] In this appendix, we discuss the lessons that can be drawn from US equity markets, and the relevance of the US tape when considering the potential impact of a tape in the UK.

In particular, we identify the following key takeaways.

- In section 3.3 we explained that the primary objective of the CT under MiFID II was to reduce search costs for traders in a fragmented trading landscape. However, trading data is only one element of the search costs that traders must incur. In order to actually access liquidity, traders must connect to the venue (see Figure 3.2). While best execution rules in the UK do not require brokers to connect to all possible venues, Reg NMS in the USA provides for de facto connectivity to all venues that contribute to the US CT.
- Retail traders have been cited as a group for which a pre-trade CT would be beneficial. However, the degree to which a pre-trade CT benefits retail traders is highly contingent on the market structure for retail trading. In the UK, where retail order flow is segmented via the RSP system, a pre-trade CT may ultimately provide a misleading benchmark for retail traders.

A3.1 How the US consolidated tapes function

The various consolidated tapes in the USA pre-date the electronification of equity trading, however the precise scope and context of their operation has changed over time.

Currently, US equity tape data is disseminated to investors and market participants through a centralised consolidation model with an exclusive Securities Information Processor (SIP) for each stock instrument, centrally collecting market data transmitted from each venue and then redistributing the consolidated market data to market participants. Box A3.1 provides further details as to how the various equity CTs work in the USA.

[93] See, for example, Financial Conduct Authority (2023), 'CP23/15: The framework for a UK consolidated Tape', para. 8.23; UK Finance (2023), 'UK Finance response to FC CP23/15', September.

Box A3.1 The equity CTs in the USA

The current US equity CT structure

A CT for equities was first introduced in 1975, however the current CT framework was established by the SEC in 2005 when it adopted Regulation National Market System (Reg NMS). The Reg NMS rules address both the content of, and the means by which, data is collected, consolidated, and disseminated.

For each stock that is traded on an exchange (regardless of where it is listed), the exchange is required to provide certain pre- and post-trade data to the designated exclusive Securities Information Processor (SIP) for that stock. SIPs are responsible for the collection, consolidation, and dissemination of data. Equity Data Plans (EDPs) provide the regulatory framework for the administration of the data and set the terms for the operation of the SIPs.

There are three tapes in the USA, regulated by three different EDPs and operated by two SIPs. A given stock is only covered by one of three tapes.

The Securities Industry Automation Corporation is the SIP for Tape A (securities listed on the NYSE) and Tape B (securities listed on exchanges other than NYSE or Nasdaq). The CTA Plan and CQ Plan are the EDPs for Tapes A and B. Nasdaq is the SIP for Tape C (covering Nasdaq-listed securities). The UTP Plan is the EDP for Tape C.

The information that is made available by the SIPs includes:

- the price, size, and exchange of the last sale;
- each exchange's current highest bid and lowest offer, and the shares available at those prices;
- the national best bid and offer (i.e. the highest bid and lowest offer currently available on any exchange).

Exchanges are also permitted to sell their own proprietary market data feeds, which include lower latency data, as well as data not provided under the EDPs (e.g. depth of book

data).

The SEC's market data infrastructure proposals

In 2020, the SEC proposed several changes to the rules regarding the US equity CT.

- Amendments to the governance models of each EDP to reduce the voting power of exchanges and provide other market participants with voting membership on the EDP operating committee.
- Replacing the exclusive SIP model with a 'competing consolidators' model, in which exchanges must make data available to any firm that wishes to develop a consolidated market data feed, either to offer commercially or for internal use.
- Expanding the scope of the consolidated tape to include five price levels of depth of book data, auction data, and data on odd-lot quotations.

Source: Securities and Exchange Commission (2020), 'Market Data Infrastructure: Proposed rule', https://www.sec.gov/files/rules/proposed/2020/34-88216.pdf; Securities and Exchange Commission (2020), 'Market Data Infrastructure: Final rule', https://www.sec.gov/files/rules/final/2020/34-90610.pdf; Securities and Exchange Commission (2020), 'Notice of Proposed Order Directing the Exchanges and the Financial Industry Regulatory Authority to Submit a New National Market System Plan Regarding Consolidated Equity Market Data', https://www.sec.gov/files/rules/sro/nms/2020/34-87906.pdf.

Some market participants will separately obtain consolidated market data without using the SIP tape, either by using proprietary or third-party hardware and software to create their own version of a consolidated feed, or by using consolidated data from independent aggregators. These feeds are generally provided at lower latency than the SIP tapes.

There has been some debate in policy and academic literature regarding the significance and impact of latency differentials between participants relying on SIP tapes and those using faster proprietary data-feeds.

- Hasbrouck (2019) undertakes an empirical analysis quantifying the relative contribution to price discovery provided by direct

feeds relative to the SIP tape.[94] This paper finds that, at a one-second resolution, direct feeds and the SIP tape appear to be informationally equivalent, but at the high resolutions (down to ten microseconds), direct subscribers' information dominates the SIP tape.

- Ding et al. (2014) analyse the magnitude and length of price dislocations between the SIP and an NBBO calculated using proprietary feeds, finding that price dislocations averaged 3.4 cents and lasted on average 1.5 milliseconds.[95]
- Bartlett and McCreary (2019) test the extent to which HFTs engage in latency arbitrage by exploiting stale SIP prices using their own faster connections.[96] This paper finds that 97% of SIP trades priced at the SIP NBBO ultimately match a hypothetical zero-latency NBBO, suggesting that there are limited opportunities to exploit stale tape prices.

The SEC has expressed concerns that the SIP tape is too slow relative to direct feeds, concluding that 'the latency differentials between SIP data and proprietary data, are meaningful, and market participants believe these differentials impact their ability to trade and their order execution quality'.[97] Ultimately, these concerns led the SEC to propose replacing the exclusive SIP model with multiple tape providers as a way of reducing the latency differentials.

A3.2 Might the UK market evolve in the same way as the US market?

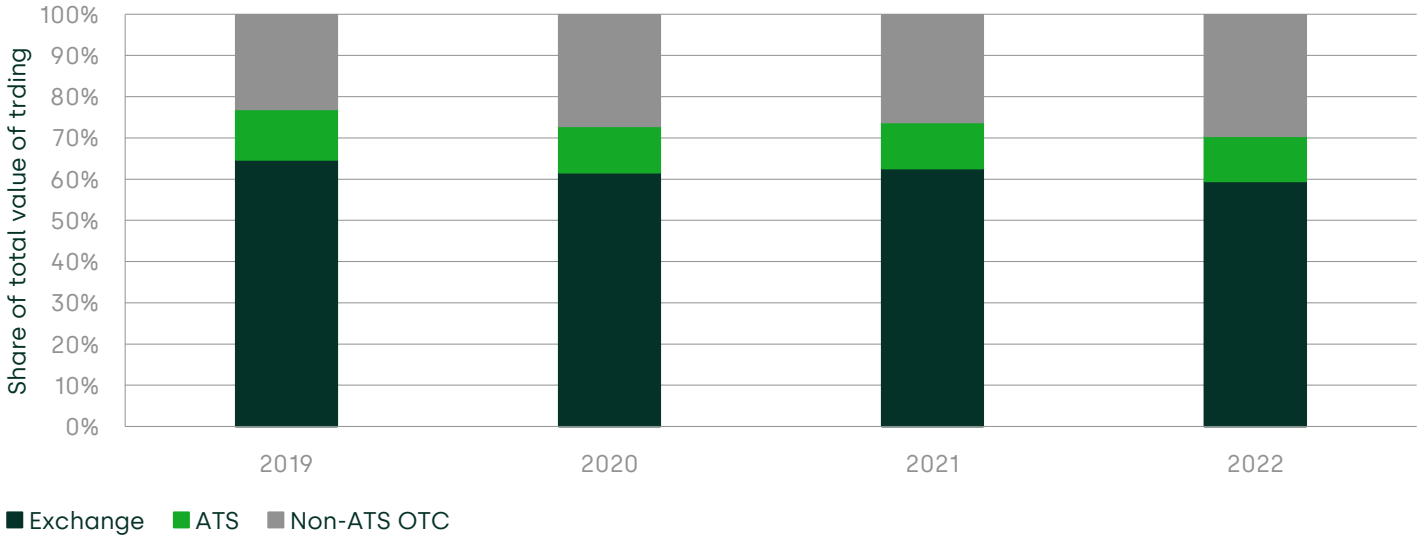
As in the UK, the US equity trading landscape is fragmented. In the USA, there are 24 registered securities exchanges, of which 18 are participants in the consolidated tape plans.[98] In addition to these exchanges, there are 53 alternative trading systems (ATSs) for equities,[99] of which 32 were active in facilitating trading of NMS stocks in Q3 2023. Trading can also take place via a large number of OTC dealers

[94] Hasbrouck, J. (2021), 'Price discovery in high resolution', *Journal of Financial Econometrics*, **19**:3, pp. 395–430.
[95] Ding, S., Hanna, J. and Hendershott, T. (2014), 'How slow is the NBBO? A comparison with direct exchange feeds', *Financial Review*, **49**, pp. 313–332.
[96] Here, the authors estimate how much traders lose by trading at stale SIP prices by comparing trades at prices matching the SIP-generated NBBO with an NBBO calculated in a world without any reporting latencies. Bartlett III, R.P. and McCrary, J. (2019), 'How rigged are stock markets? Evidence from microsecond timestamps', *Journal of Financial Markets*, **45**, pp. 37–60.
[97] Securities and Exchange Commission (2020), 'Market Data Infrastructure: Proposed rule', https://www.sec.gov/files/rules/proposed/2020/34-88216.pdf.
[98] See Securities and Exchange Commission (2024), 'National Securities Exchanges', https://www.sec.gov/fast-answers/divisionsmarketregmrexchangesshtml; NYSE Group (2024), 'Data: consolidated tape', https://www.nyse.com/data/cta; Unlisted Trading Privileges (2024), 'Participants', https://www.utpplan.com/participants.
[99] FINRA lists 53 equity ATSs as at January 2024. However, only 32 were reported as active in Q3 2023. See FINRA (2024), 'Equity ATS firms', https://www.finra.org/filing-reporting/otc-transparency/ats-equity-firms; FINRA (2024), 'ATS transparency data quarterly statistics', https://www.finra.org/filing-reporting/otc-transparency/ats-quarterly-statistics.

who report their trades to the Financial Industry Regulatory Authority (FINRA).

As shown in Figure A31 below, approximately 60% of the value of trading in NMS stocks takes place on registered exchanges, compared with around 10% on ATSs and 30% OTC. In Q3 2023, the three largest ATSs (UBS ATS, Intelligent Cross, and Sigma X2) accounted for approximately 5% of all trading volume.[100]

Figure A3.1 Trading in NMS stocks by venue type, 2019–22



Source: FINRA (2023), 'FINRA Industry Snapshot 2023', February, https://www.finra.org/sites/default/files/2023-04/2023-industry-snapshot.pdf.

Although the data on shares above presents a similar picture in terms of fragmentation, there are two notable differences between the equity market structure in the USA compared with the UK.

A3.2.1 The Order Protection Rule (OPR)

In both US and UK equity markets, brokers have a duty to obtain best execution for their customers' orders. However, the US equity market is also characterised by the existence of an order protection rule (OPR) which is designed to prevent 'trade-throughs' (see Box A3.2).

[100] Oxera analysis of FINRA data, SIFMA data.

Box A3.2 The Order Protection Rule in the USA

Rule 611, also known as the Order Protection Rule (OPR), was introduced in 2005 as part of Reg NMS to protect investors from 'trade-throughs'. A trade-through occurs 'when one trading centre executes an order at a price that is inferior to the price of a protected quotation, often representing an investor limit order, displayed by another trading center'.[1]

Under the OPR, a protected quotation refers to a quote at the prevailing BBO on a given venue, provided that it is immediately and automatically accessible. However, the OPR does not protect quotes at prices that are higher (lower) than the best offer (bid).

The OPR requires trading centres to 'establish, maintain, and enforce written policies and procedures that are reasonably designed to prevent trade-throughs…'.[2] Where any better-priced protected quotation is available at another exchange, the exchange where the initial order was placed will automatically route the order to where the better price is available. If the routed order is not filled or not filled in its entirety, the balance will be returned to the initial exchange for execution.[3]

Source: [1] Securities and Exchange Commission, '17 CFR PARTS 200, 201, 230, 240, 242, 249, and 270', p.22, https://www.sec.gov/files/rules/final/34-51808.pdf. For example, consider an investor who sends a market buy order to Nasdaq for one share of Apple Inc. If the investor's market order executed on Nasdaq for $100 when the order could have executed on Cboe for $99 a trade-through would have occurred and the investor would not have received the readily best available price in the market. [2] Securities and Exchange Commission, '17 CFR PARTS 200, 201, 230, 240, 242, 249, and 270 ', pp. 23–4, https://www.sec.gov/files/rules/final/34-51808.pdf. [3] NYSE Group (2019), 'NYSE Guide, Regulation, Rule 0., New York Stock Exchange, Regulation of the Exchange and its Member Organizations', p. 210, https://www.nyse.com/publicdocs/nyse/regulation/nyse/NYSE_Rules.pdf.

By requiring inter-connectivity at the venue level, to allow for onward routing of certain order types, the OPR effectively consolidates the top

level of the various exchange order books into a single universally accessible order book.

The UK does not have an equivalent to the OPR, and brokers are solely responsible for obtaining best execution on behalf of their customers. Thus a market participant is not guaranteed to access a price, unless they (or their brokers) are connected to all venues.

A3.2.2 Retail trading landscape

In both the UK and the USA, retail order flow is segmented from the rest of the market. By segmenting orders with more 'benign' characteristics from other types of order flow (that are associated with higher adverse selection costs), market makers can offer prices that are more reflective of the costs associated with providing liquidity to a given type of counterparty. This can generate cost savings to the individual broker and/or better prices for the investors whose order flow is more 'benign'.

In the USA, retail brokers tend to sell their order flow to a wholesale broker, who then decides to execute orders internally or to send them to the public exchanges. This is referred to as payment for order flow (PFOF).

The wholesale broker will typically provide retail orders with some price improvement relative to the NBBO. There has been some debate about the magnitude of this price improvement. However, in 2022, the SEC proposed that certain retail orders be subject to competition for order flow, concluding that the level of price improvement offered by wholesale brokers fell short of what would be expected under order-by-order competition.[101]

Table A3.1 shows the average price improvement offered to retail trades, based on SEC analysis. This data shows that the majority of trades in S&P stocks received some price improvement, with an average improvement of 1.47bps.

[101] See Securities and Exchange Commission (2022), 'Proposed rule: order competition rule', https://www.sec.gov/files/rules/proposed/2022/34-96495.pdf.

Table A3.1 Wholesaler execution quality for NMS stocks, Q1 2022

	All	S&P500	Non-S&P500	ETFs
% shares executed at NBBO	8.38%	5.86%	10.97%	10.69%
% of trades executed with price improvement	89.85%	93.33%	85.43%	87.93%
Conditional amount of price improvement (bps)	2.54	1.47	6.16	0.99
% shares executed at midpoint	31.69%	32.47%	28.46%	33.44%
% shares executed with <0.1 cent price improvement	18.64%	16.62%	20.58%	20.64%
% shares executed at sub-penny prices (excl. midpoint)	47.60%	46.82%	47.03%	49.68%

Source: See: Securities and Exchange Commission (2022), 'Proposed rule: order competition rule', https://www.sec.gov/files/rules/proposed/2022/34-96495.pdf, Table 7.

Several exchanges in the USA have also introduced on-exchange retail liquidity programmes with the aim of competing for marketable retail order flow with internalising brokers. However, despite offering price improvement to retail trades, these mechanisms have attracted a small volume of total order flow (less than 0.1% of all US-listed securities trades).[102]

In practice, wholesale brokers typically pay around $0.001 per share for retail order flow.[103] These payments are one of the factors that have

[102] Two notable examples of these programmes are the Retail Liquidity Program of the New York Stock Exchange (NYSE RLP) and the Retail Price Improvement program of the Nasdaq Stock Market (NASDAQ RPI). The combined share of the two programs are based on the findings of two SEC papers. Trades executed in the NYSE RLP accounted for less than 0.1% of consolidated NYSE-listed volume in 2016–17. Executed trades on the NASDAQ RPI accounted for 0.05% of total consolidated volume in US-listed securities in the last quarter of 2017. See Securities and Exchange Commission (2019), 'Order Granting Accelerated Approval of a Proposed Rule Change, as Modified by Amendment No. 1, to Make Permanent the Retail Liquidity Program Pilot', 15 February; Securities and Exchange Commission (2019), 'Notice of Filing of Proposed Rule Change to Make Permanent the Pilot Program for the Exchange's Retail Price Improvement Program', 9 May.

[103] See, for example, Schwarz, C., Barber, B., Huang, X., Jorion, P. and Odean, T. (2023), 'The "actual retail price" of equity trades', Working paper.

enabled retail brokers in the USA to offer zero commission trading to end-investors.[104]

In the UK, PFOF arrangements are prohibited. Instead, retail trades are executed within a Retail Service Provider (RSP) network, which enables specialist market makers to act as counterparties to retail orders via a 'request for quote' (RFQ) trading model. When a broker submits a retail order to an RSP hub, RFQs are sent to a number of RSP market makers. These market makers are not obliged to supply quotes, and there is no minimum price improvement requirement.

In effect, the US and UK markets differ in the relative balance of implicit vs explicit costs for retail investors. In the USA, payment for order flow internalisation has enabled retail investors to trade with low explicit costs. Conversely, the UK market structure aims to minimise implicit costs for retail investors by ensuring that their orders are subject to competition for order flow.

What does this mean for the CT? In the USA, the SIP tapes (combined with the OPR) provide an important mechanism to ensure that retail investors do not obtain worse prices than those available elsewhere in market, despite the lack of competition for their captive order flow. In the UK, good outcomes for retail investors rely on competition between RSP market-makers bargaining down quoted spreads to a level that reflects the lower costs of providing liquidity to segmented 'benign' order flow. In this case, a market-wide CT covering all venues would provide a misleading benchmark to a retail investor.[105]

[104] Analysis by the SEC found that PFOF payments in Q1 2022 accounted for around 10% of retail broker revenue on average. For one retail broker, PFOF payments accounted for 54% of revenues. Securities and Exchange Commission (2022), 'Proposed rule: order competition rule', https://www.sec.gov/files/rules/proposed/2022/34-96495.pdf.

[105] Some participants have argued that RSPs frequently provide more liquidity at the touch price than is available on the LSE's SETS order book. This would further support the view that a market-wide CT (based on publicly quoted volumes on lit venues) would not provide an accurate benchmark to retail investors. As it is not possible to identify RSP trades within the public data, we are unable to confirm whether this is the case. See Financial Conduct Authority (2022), 'Improving equity secondary markets', CP22/12, https://www.fca.org.uk/publication/consultation/cp22-12.pdf.

Contact

Reinder Van Dijk
Partner
+44 (0) 20 7776 6614
reinder@oxera.com

oxera.com