

Would Reg NMS be beneficial for Europe? Ensuring the resilience of European equities trading

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Executive summary

European policy makers and regulators are considering changes to the regulatory framework for securities markets. Since the introduction of MiFID I, European markets regulation has been harmonised, however Switzerland's loss of equivalence in July 2019, and the United Kingdom's (UK) exit from the European Union (EU) in January 2021 has led to divergence in regulations across Europe. The UK's Wholesale Markets Review in June, and the European Securities and Markets Authority's (ESMA) MiFID/R Review Consultation Paper in July points to the likelihood of increased regulatory fragmentation. The UK is pursuing a principles-based approach with an emphasis on best execution, and the EU appears to be moving toward more prescriptive regulation. Both the UK and EU are moving toward the creation of a consolidated tape, which may potentially facilitate a more prescriptive approach.

The United States (US) approach to securities regulation is highly prescriptive. This paper examines the US regulatory framework, Regulation National Market System (Reg NMS), outlines its strengths and weaknesses, and considers whether the application of a more prescriptive approach might be beneficial for Europe. The paper concludes that while Reg NMS offered benefits to the US market, it is not a suitable framework for the European market.

Reg NMS redefined the way the US equities market operates. Introduced in 2007, it comprises a highly prescriptive set of rules which aim to promote competition between markets whilst ensuring the markets are linked together in a unified system enabling interactions between buyers and sellers. Its goal was to enhance the liquidity and efficiency of the equities market. It comprises twelve rules, eight of which pre-existed the implementation of Reg NMS. The central plank of Reg NMS is Rule 611, which promotes intermarket competition and price protection by prohibiting "trade-throughs" – the execution of trades at prices inferior to those publicly displayed on another venue. The rule offers price protection only to orders at the "top of the book" but not to other orders deeper in the book. The other elements are: (i) the access rule which imposes restrictions on the fee that a venue can charge to access the market; (ii) market data rules which ensure appropriate market data are available to make informed and timely routing decisions; and (iii) the sub-penny rule which sets the minimum price variation, and prohibits orders being displayed at smaller increments.

The US markets are widely regarded as the deepest and most liquid markets in the world. Some market observers attribute this to Reg NMS – but this was also true prior to the introduction of Reg NMS. Others argue that the depth of liquidity is despite Reg NMS, rather than because of it. Today, the US market is extremely fragmented. There are 16 exchanges, 32 dark pools and over 200 wholesale market makers. The 16 exchanges, 12 of which are owned by three companies, account for approximately 58% of trading activity. The largest single venue accounts for around 16% market share, and the smallest nine venues account for less than 2% each. The 32 dark pools account for 13% market share, and the remaining 30% is executed over the counter, which includes most retail order flow. The main difference in the exchange trading models are their fee structures. The dark pools, which include both Alternative Trading Systems (ATS) and Single Dealer platforms (SDP) offer more variation in their trading models and unlike exchanges are not required to offer "fair access" so are able to segment order flow. Exchange fee models are extremely complex and there has been a proliferation of order types offered by exchanges.

Academic literature evaluating the overall impact of Reg NMS shows that it was beneficial for market quality. However, its impact depends on stock size: large market capitalisation stocks were the main beneficiaries of the rule changes; while small-cap stocks experience lower turnover, larger trade sizes, larger spreads and worse pricing efficiency relative to larger firms.

Empirical and theoretical research also examines the impact of individual rules within Reg NMS. Empirical research shows that the trade-through and access rule potentially introduce frictions, especially for large institutional traders. Traders frequently choose to manage their own routing decisions rather than rely on exchange routing mandated by Reg NMS because they can achieve better execution outcomes due to faster execution and the ability to avoid routing fees. The complexity of order types provides advantages to short-term informed traders over uninformed and long-term informed traders. The access and sub-penny rules advantage dark pools over exchanges incentivising the use of dark venues. Exchange fee structures are anti-competitive and exchange rebates create potential conflicts of interest for brokers.

Theoretical research shows the trade-through rule distorts competition between venues, benefiting illiquid venues by providing an implicit subsidy, encouraging excessive fragmentation. The model predicts that the introduction of a trade-through rule in an already fragmented market, such as those in Europe, will reduce welfare.

The perceptions of buy-side and sell-side traders are mostly aligned with the academic evidence, but also offer additional insights. Traders believe that Reg NMS improved market quality and contributed to making the market more resilient. However, other factors including Regulation Systems Compliance and Integrity, closing auction contingency plans and testing, a single Central Counterparty Clearing House (CCP) and the fact that no single venue dominates market share are considered more important for market resilience than Reg NMS.

Traders indicate that the trade-through rule makes it easier to demonstrate best execution and acts as an important guardrail. However, its prescriptive nature reduces flexibility in managing order flow. European traders indicate that despite the absence of a trade-through rule, they are reluctant not to take liquidity available at the best price – but will do so when their transaction cost analysis points to this being beneficial. Traders unanimously agree that there is too much fragmentation in the US and that the trade-through and market data rules allow new venues to launch without offering any additional value to the market. Traders value the flexibility offered by MiFID II, enabling them to evaluate the offering of a new operator without being forced to immediately connect. The decision on whether to connect to a new venue is guided by their best execution policies. Traders also comment negatively on the complexity of the exchange fee models, and proliferation of order types in the US, but are positive about the innovation that is offered by ATSS, which have more flexibility in how they operate.

Despite recognising the value of Reg NMS to the evolution of the US markets, traders have mixed views on whether it can offer benefits in Europe. Even those in favour of elements of the framework saw considerable practical challenges for such an approach. Imposing highly prescriptive rules uniformly across many different countries, with different local markets and regulators is one obstacle that would be difficult to overcome. The introduction of a trade-through rule is particularly problematic. If such a rule is introduced, should all existing and new venues be protected? From a practical perspective, traders indicated only venues offering universal post-trade interoperability could viably be included. Some traders suggest a minimum market share requirement should be imposed to prevent a proliferation of venues and to reduce complexity. Determining which quotes to protect also requires consideration. Most traders thought there needed to be an exemption for block trades, given the importance of block trading in Europe.

A less prescriptive approach, focussed on enhancing accountability for and monitoring of best execution, could potentially achieve the same goals, without radically redesigning the European markets and risking unintended consequences. The key to this approach is better disclosure and data, and more effective monitoring and surveillance based on this information.

A consolidated tape is an important tool to achieve more accountability. It that can facilitate more informed decision making, and provide buy-side firms, of all sizes, with knowledge and insights about market quality of each venue. A consolidated tape will necessarily have higher latency than proprietary data feeds and is therefore not suitable for making order routing decisions for latency sensitive orders. However, it could be very useful for overall performance evaluation and assessing whether a broker is acting in a manner consistent with their best execution policy. For example, if a broker consistently routes orders to a market not at the EBBO, is this justified by greater volumes being available at a slightly worse price? In this scenario, the customer should be satisfied. In an alternative scenario, a broker may be missing the EBBO because they are not connected to the market offering the EBBO, and if this market is consistently at the EBBO the customer should be reconsidering the use of this broker or pushing the broker to connect to the venue offering this valuable liquidity.

Additional routing disclosures along the lines of recent amendments to US institutional routing disclosures could also be valuable. A consolidated tape and additional disclosures potentially enable buy-side firms to have more informed discussions with their brokers and equip regulators with tools to review best execution compliance. Brokers should also be required to disclose the venues to which they are connected in a more easily digestible and comparable form. Brokers connected to only one venue, or those not connected to venues which offer meaningful liquidity should be required to empirically demonstrate that they are fulfilling their best execution obligations without being connected to these venues.

Background and objectives of study

European primary markets experienced multiple market outages in 2020. During these outages trading essentially stopped across all venues. This raised concerns about the resilience of European markets.¹ More than fourteen years after the introduction of competition, the market appears to remain dependent on primary markets. This is not the case in the US equities market where trading continues relatively uninterrupted in the event of a primary market outage.² This has led some commentators to suggest that Europe should consider adopting a US-style rules framework.

This debate is occurring at a time when European policy makers and regulators are reviewing market structure. The European Securities Markets Authority (ESMA) is in the midst of a consultation on MiFID II/MiFIR, and the HM Treasury has recently launched a Wholesale Market Review consultation.³ Europe is also moving toward the introduction of a consolidated tape for both equity and bond markets. The introduction of a tape is a positive development for European markets. A recent paper by Market Structure Partners comprehensively discusses the issues associated with the creation of a tape – so this paper does not seek to duplicate that work.⁴

The regulatory frameworks in the UK and EU appear to be diverging. The UK has suspended Share Trading Obligations (STO)⁵ and the Double Volume Caps (DVC)⁶ and substantially lowered the threshold for the Large-in-Scale waiver.⁷ Its Wholesale Market Review is consulting on the definition of Systematic Internalisers (SI), providing more flexibility for SI trading, and the development of a consolidated tape.⁸ In contrast, the ESMA consultation aims to encourage more trading on venues to ensure better reporting and transparency. This review is consulting on the removal of the reference price and negotiated trade waiver, constraining SIs by increasing minimum quote size obligations and extending the regime to illiquid stocks and requiring Frequent Batch Auctions to disclose all orders. The Swiss market also operates under a different set of rules. This divergence creates the risk of regulatory fragmentation, which could also contribute to further market fragmentation, leading to more trading complexity and cost for the sell-side, buy-side and potentially end investors.

In this context, the objective of this study is to consider the strengths and weaknesses of an alternative regulatory framework: Regulation National Market System (Reg NMS) and to explore its suitability for the European markets. It also questions whether the US equities market

¹ An earlier Plato Partnership sponsored study by Comerton-Forde and Zhuo (2021) provides a detailed empirical analysis of an outage, identifies challenges experienced by traders and recommends potential solutions to make markets more resilient.

² See Jones (2014) for an empirical analysis of outages in the US market.

³ See ESMA (2020) and HM Treasury (2021).

⁴ See “The Study on the Creation of an EU Consolidated Tape,” Market Structure Partners, September 2020.

⁵ The Share Trading Obligation requires investment firms to ensure that the trades they undertake in shares that are admitted to trading on an EU regulated market or trading venue, take place on an EU regulated market (or Multilateral Trading Facility); an EU Systematic Internaliser; or a third country trading venue assessed as equivalent under the MiFID II Directive.

⁶ The Double Volume Caps take effect when dark trading exceeds 4% of market share on any particular venue and 8% market-wide. Where dark trading in a stock, measured over a 12-month rolling period, exceeds this level, it is banned for the following six months.

⁷ The Large-in-Scale waiver is a pre-trade transparency waiver for large trades. The size threshold varies with stock liquidity.

⁸ A Systematic Internaliser is an investment firm which, on an organised, frequent systematic and substantial basis deals on own account when executing client orders outside a regulated market, an MTF or an OTF without operating a multilateral system.

resilience is the result of Reg NMS, or whether there are other factors at play that should also be considered in Europe.

Study approach and structure

The paper begins with an overview of the current Reg NMS framework, focussing on the four new rules introduced when it was implemented. With this context, the paper then describes the current US equities trading landscape identifying the number and types of trading venues and their respective market shares. Time-series market quality statistics are presented. The paper assumes that the reader is broadly familiar with the European regulatory framework and trading landscape, but where relevant the paper provides comparisons to the European market regulatory framework and trading landscape. For ease of comparison, European market statistics are provided in Appendix A.

The paper then takes a deep dive into the academic literature on the impact of market structure on US market quality. It considers studies that evaluate the overall impact of the package of reforms introduced in Reg NMS, but also drills down into some of its specific features, such as the Trade-through rule and Access rule, and some of the resultant market structure changes, such as a proliferation of venues and order types and complexity in exchange fee models. Next, the paper offers a range of practical perspectives offered by members of the sell- and buy-side communities on both sides of the Atlantic. It concludes with lessons learned from the literature and traders and offers alternative approaches to enhancing the resilience and liquidity of European markets.

Reg NMS framework

The adoption of Regulation National Market System (Reg NMS) in 2005 aimed to strengthen and modernise the National Market System. It aimed to promote competition between markets whilst ensuring the markets were linked together in a unified system enabling interactions between buyers and sellers. Its goal was to achieve both competition between markets and competition between orders and to enhance the liquidity and efficiency of the equities market.

To understand its adoption and framing it is helpful to understand the prevailing market structure and its historical development. In the mid to late 1990s, trading in New York Stock Exchange (NYSE) listed stocks mostly took place on the exchange trading floor and was dominated by specialists. The NYSE accounted for more than 80% of trading in stocks listed on its own market. At the same time, the Nasdaq, a competitive electronic dealer market, was dealing with the fall-out of a scandal where dealers were found to have colluded to quote only on even eighth ticks.⁹ A series of regulatory changes served to promote competition in these markets:

- The Unlisted Trading Privileges Act of 1994 allowed any securities exchange to extend unlisted trading privileges to any company in the National Market System;
- The Order Handling Rules changed Nasdaq from a dealer-oriented over the counter (OTC) market to a more centralized order-driven market structure by requiring market makers to publicly display their best prices and to display customer limit orders if they were priced better than the market maker's quote;¹⁰

⁹ Christie and Schultz (2014) provided empirical evidence of Nasdaq market makers implicitly colluding to avoid odd-eighth artificially increasing the spreads. This led to a Department of Justice investigation, over \$1 billion in penalties and the introduction of the Order Handling Rules.

¹⁰ The Order Handling Rules were roll-out progressively over the period January to October 1997.

- Tick sizes were reduced from one-eighth of a dollar to one-sixteen of a dollar in 1997 and reduced to one cent in 2001.
- Regulation Alternative Trading Systems (Reg ATS), introduced in 1998 permitted trading venues that otherwise would fall within the definition of an exchange to be regulated as alternative trading systems (ATS) rather than as registered exchanges and self-regulatory organizations (SROs). ATSs have a lower regulatory burden. This formalized the broker-dealer automated Electronic Communication Systems that had emerged in the late 1990s to compete with exchanges. Reg ATS allows venues to avoid “fair access” requirements to publicly display its best bid or offer and to provide equal access to those orders, provided its market share remains below 5%; and
- Rule 390, which had restricted NYSE members from executing trades in NYSE stocks at off-exchange trading venues was rescinded.

Reg NMS pushed the notion of competition further. It comprised twelve rules, eight of which predated the implementation of Reg NMS. The rules that predated Reg NMS are requirements for public dissemination of trade reports (Rule 601) and quotations (Rule 602); public display of customer limit orders (Rule 604); public disclosure of order execution and routing information (Rules 605 and 606); customer account statements (Rule 607); national market system plans (Rule 608); and registration of securities information processors (Rule 609). This paper focuses on the four new rules: Rules 603, 610, 611, and 612. Table 1 summarises these rules.

Table 1. Regulation NMS

Rule	Description
Order Protection Rule/ Trade-through rule (Rule 611)	Establishes intermarket protection against trade-throughs for all NMS stocks by requiring venues to establish, maintain and enforce written policies and procedures. For a quote to be protected it must be immediately and automatically accessible and be at the top of the book. The rule provides exceptions for intermarket sweep orders (ISO), which allows market participants to access multiple price levels simultaneously at different trading venues; for the quotes of venues experiencing material delays in providing a response to incoming orders; and for flickering quotations with prices that have been displayed for less than one second.
Access rule (Rule 610)	Outlines standards governing access to quotes. Prohibits trading venues from unfairly discriminating against non-members or non-subscribers that access quotes through other subscribers or venues and enables access through private linkages. Limits the costs of accessing quotes to no more than \$0.003 per share. Requires venues to establish rules that prevent displayed quotes locking or crossing the quotes on other venues.
Market data rules (Rule 603)	Addresses the distribution, consolidation, and display of market data. Establishes uniform standards for distribution of quotes and trades. Requires distribution by an exclusive processor, and that data be made available to the processor on fair and reasonable terms. Allocates market data revenues among venues to encourage and reward the dissemination of trading and quotation data. An amendment to Rule 601 rescinded the prohibition on venues disseminating trade reports independently.
Sub-penny rule (Rule 612)	Prohibits market participants from accepting, ranking or displaying orders, quotes or indications of interest in pricing increments smaller than the prevailing tick (1 cent for stocks priced less than \$1). Note that that it does not prevent sub-tick trading which is possible on non-displayed venues and OTC.

The centrepiece of Reg NMS is Rule 611, which promotes intermarket competition and price protection by prohibiting “trade-throughs” – the execution of trades at prices inferior to those publicly displayed on another venue. The rule offers price protection, but only to orders at the ‘top of the book’ not to all orders across the depth of the book. To ensure that this requirement, which forces orders to be routed to the market displaying the best price, does not lead to anti-competitive pricing by the venue, Rule 610, the Access rule, imposes a restriction on the price that a venue can charge for accessing the market. In the absence of a trade-through rule, the access fee rule is arguably unnecessary. If access fees are too high, traders can choose not to route to that venue.

Rule 603, and the amended Rule 601, market data rules ensure that information is available to make informed and timely routing decisions. Rule 612, the sub-penny rule was intended to ensure that the minimum price variation remained economically meaningful, to reduce stepping ahead risk, to maintain sufficient depth at the best prices avoid quote flickering.

Reg NMS was controversial when introduced. Two of the five Securities and Exchange Commission (SEC) Commissioners at the time voted against its implementation and offered an extensive dissent.¹¹ Many practitioners also opposed its introduction. A 2005 Tabb Group study based on conversations with 53 head traders of long-only institutional investors found that only 19% of them supported the implementation of the trade-through rule.¹² Academic commentary suggested “it complicates the trading of large orders, can be gamed, hinders competitions, and undoubtedly will have unintended consequences.”¹³

Reg NMS is highly prescriptive, mandating the protection of orders, but only protects orders at the top of the book. Before the final rule-making, the SEC consulted on extending the trade-through rule to the full depth of book. This approach would have protected the best set of prices in the overall market for a given quantity of stock, instead of protecting only the best individual price on each respective market regardless of size. Such an approach would have been even more prescriptive, and would have created more technological complexity, and was ultimately abandoned.¹⁴ It is useful to consider this decision and the framing of Reg NMS in the context of best execution.

Brokers have, and always have had, an obligation to deliver best execution to their clients. Part of the motivation for Reg NMS was concern about best execution and the incidence of trade-throughs.¹⁵ However, Rule 611 made best price the de facto best execution, emphasising price over other factors such as size and probability of execution. Reg NMS also transfers some of the responsibility for best execution from brokers to exchanges and other trading platforms through technology linkages (Spatt, 2018). The focus on best price, also encouraged fragmentation, because each distinct market is offered price protection (Spatt, 2014).

¹¹ See [Dissent of Commissioners Cynthia A. Glassman and Paul S. Atkins to the Adoption of Regulation NMS](#) for details. While they supported the goal of enhancing the efficiency of markets, they did not believe the rules would achieve its goal and may in fact be detrimental to competition and innovation. They thought the rule changes should focus on improving access to quotations, enhancing connectivity among markets and market participants, maker clearer the broker’s duty of best execution, and reducing barriers to competition. They strongly opposed the trade-through rule.

¹² See Tabb (2013) for details.

¹³ See for example Blume (2007).

¹⁴ See Spatt (2018) for a detailed discussion of these issues.

¹⁵ An SEC staff study prior to the introduction of Reg NMS found that 2.3% of trades in NASDAQ stocks were executed at prices outside the best displayed prices at the time of execution.

Current US equities landscape

The current US equities landscape is fundamentally different from the pre-Reg NMS landscape. Markets are now almost exclusively electronic, trading speed has increased dramatically,¹⁶ venues have proliferated, fee structures and order types become more complex. This section addresses each of these changes and provides some market-wide market quality statistics pre- and post-Reg NMS.

Trading activity by market centre

Figure 1 reports trading activity by venue for May 2021, highlighting the venue proliferation and extreme fragmentation characterising the US market.¹⁷ There are 16 registered exchanges which account for approximately 57.6% of trading activity. Three exchange groups: the NYSE, Nasdaq and Cboe Global Markets operate five, three and four of these venues respectively. The remaining venues operate independently, with three of them being launched in 2020. The largest single venue, Nasdaq, accounts for 15.8% market share. Nine of the venues capture less than 2% market share each. Thirty-two dark pools capture approximately 13.2% market share, and the remaining 29.2% labelled TRF, for Trade Report Facilities is made up by an estimated 223 wholesale market making firms. Wholesale market makers are responsible for executing the majority of retail order flow in the US market, which accounts for around 24% of trading activity.¹⁸

Off-exchange retail order execution and payment for order flow (PFOF) have been a feature of US equities markets for decades, but it has received increased attention as the level of retail activity has surged in the last 18 months. PFOF was first introduced by Bernie Madoff, when his broker-dealer firm, began to selectively purchase and execute orders in NYSE-listed securities away from the NYSE by offering cash payments of one cent per share for market orders of less than 5000 shares, provided they did not come from professional investors. He guaranteed executions at a price no worse than the National Best Bid and Offer (NBBO). This practice was subsequently widely adopted well before the introduction of Reg NMS.

Figure 1 underrepresents the extent of fragmentation because the dark pool and TRF segments represent multiple distinct liquidity pools. The dark pool segment captures 27 broker-dealer ATSs, only two of which account for more than 1% market share, and five Single Dealer Platforms (SDPs), again with only two accounting for more than 1% market share. The activity executed in the dark pool and TRF segments occurs without any pre-trade transparency, and typically uses the NBBO as its reference price. It is also noteworthy that 7.7% of the exchange volume represents hidden liquidity with orders executing without being transparent to the market. The share of exchange volume that is hidden varies considerably across exchanges, with 61.9% of Investors Exchange's (IEX) 2.4% market share being hidden compared to only 7.8% of NYSE's 10.4% of market share being hidden.¹⁹

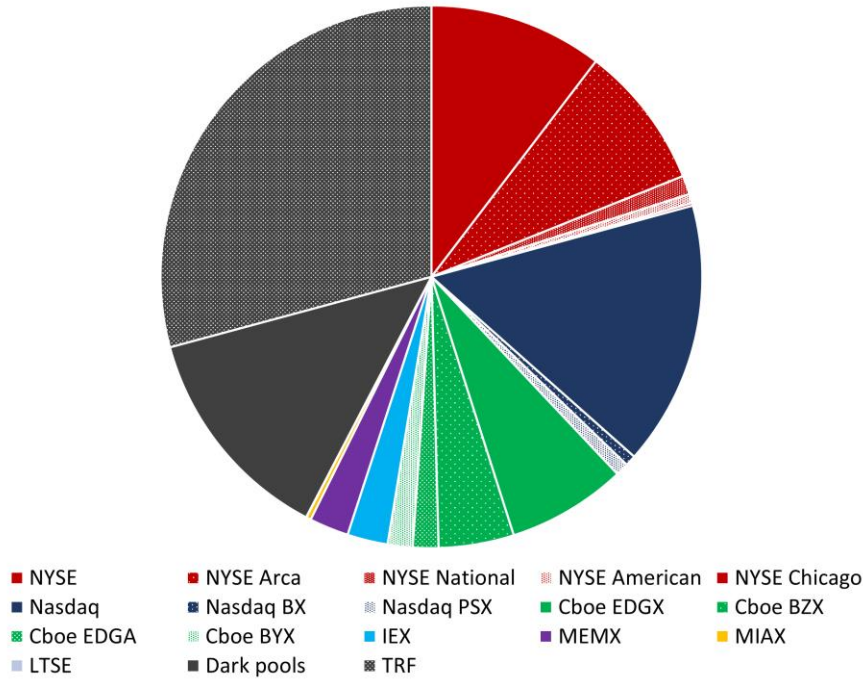
¹⁶ Market order execution speeds prior to Reg NMS from around 10 to 15 seconds in 2005 (Angel, Harris, Spatt, 2015) to times reported in microseconds today (Budish, Lee and Shim, 2021).

¹⁷ Appendix A provides details of the current European equities landscape for the purpose of comparison.

¹⁸ See Tabb (2021) for further details.

¹⁹ The detailed break-down of activity by venue is taken from Rosenblatt Securities: Let there be light, June 2021.

Figure 1. US trading activity by venue



Source: Rosenblatt Securities: Let there be light, US, June 2021

These statistics raise an obvious question: with so many venues, especially those run by the same operator, what are the differences in their offerings?

Exchange features

Table 2 summarises four important features of the 16 exchanges. This shows that the primary dimension on which exchanges differ is the fee model, with other dimensions such as order precedence, speed bumps and the provision of co-location services showing little variation. Exchange groups are incentivised to establish “cloned” markets differentiated primarily by their fee structures.²⁰ The relatively homogenous trading structure is attributed to Reg NMS and its focus on price and time priority (Harris, 2011).²¹ The trade-through rule’s focus on the top of the book means that price is the most important dimension of exchange competition.

²⁰ An SEC memo from the Division of Trading and Markets to the Equity Markets Advisory Committee titled Maker-Taker Fees on Equities Exchanges attributes this to Intercontinental Exchange, Chief Executive Officer (ICE owns the NYSE).

²¹ Harris also points to order handling rules, Reg ATS, and unlisted trading privileges as contributing factors and points out that the NYSE specialist and designated Nasdaq dealers were unable to meet their obligations when they had to compete with other traders that do not have similar obligations.

Table 2. Exchange features

	Fee model	Order precedence	Speed-bump	Offers co-lo
NYSE	Maker-taker	Price-parity-time	No	Yes
NYSE Arca	Maker-taker	Price-display-time	No	Yes
NYSE National	Inverted	Price-display-time	No	Yes
NYSE American	Maker-taker	Price-display-time	No	Yes
NYSE Chicago	Traditional	Price-display-time	No	Yes
Nasdaq	Maker-taker	Price-display-time	No	Yes
Nasdaq BX	Inverted	Price-display-time	No	Yes
Nasdaq PSX	Maker-taker	Price-display-time	No	Yes
Cboe EDGX	Maker-taker	Price-retail-display-time	No	Yes
Cboe BZX	Maker-taker	Price-display-time	No	Yes
Cboe EDGA	Inverted	Price-display-time	No	Yes
Cboe BYX	Inverted	Price-display-time	No	Yes
IEX	Traditional	Price-display-time	Yes	No
MEMX	Maker-taker	Price-display-time	No	Yes
MIAX	Maker-taker	Price-display-time	No	Yes
LTSE	Free	Price-display-time	No	No

Source: Exchange websites and academic literature

There is substantial variation in the magnitude of the fees/rebates charged/paid, but they tend to be anchored around the access fee limit. There is no limit on the magnitude of rebates, but the access rule limits the fee paid to \$0.003 per share (or 30 cents per 100 shares, referred to as 30 mils). The revenue side of the trade clusters around 30 mils. The largest rebate for providing liquidity is 45 mils (NYSE America) and demanding liquidity is 30 mils (NYSE National). The cheapest fees for providing liquidity are the Long Term Stock Exchange (LTSE) and IEX which are free, and for taking liquidity are LTSE which is free, and IEX which is 6 mils. What matters for exchange revenue is net fees (i.e. the difference between their fee and their rebate).²² Two of the newest exchanges, the Members Exchange (MEMX) and Miami International Securities Exchange (MIAX) are currently earning negative revenue on trading fees, paying more in rebates than they charge in fees.²³

Exchange fee structures are extremely complex and can change frequently. Fees can vary by stock, order type, lit vs. dark, continuous vs call auctions and user. Many exchanges also vary fees based on volumes traded, with higher volume tiers paying lower fees.²⁴ This complexity and alternative fee models allow the exchanges to attract different types of customers, depending on their liquidity needs. In addition, the trade-through rule encourages the fragmentation of liquidity across multiple venues, as each new venue offers an additional protected price and traders providing liquidity may seek out the shortest queue in terms of depth of orders already displayed at that price (Spatt, 2018).

²² Exchange fee schedules are publicly disclosed on their websites but are extremely complex. The figures referred to in this paper reflect the headline fees.

²³ This approach makes sense given their ownership structure. Both are owned by their users, asset managers, investment banks, proprietary trading firms and large retail brokers.

²⁴ RBC Capital Markets (2018) demonstrates the complexity of the exchange fee structures. They identified no fewer than 1,023 pricing “paths” across these exchanges, with a path representing the different decisions that could be made by a broker when routing an order to an exchange. This number increased by 22% compared to an earlier study in February 2016. They identified at least 3,762 separate pricing variables across the exchanges that could influence the fees/rebates charged/paid.

It is worth pointing out, that exchange fees/rebates are not typically passed on to the end investor.²⁵ Therefore, broker routing decisions are influenced by these fee structures. Rebates can also encourage high frequency trading as these firms can pursue rebate capture strategies across make-take and inverted venues.

Order precedence and order types

With two exceptions, exchanges operate using price-display-time priority. The trade-through rule means that price priority is enforced across markets, but time priority is not. Display priority means that within a market, displayed orders will be executed before non-displayed orders. One exception to the price-display-time priority approach is price-retail-display-priority offered by Cboe EDGX.²⁶ This means that displayed retail orders will have priority ahead of all other available interest at a given price level. This is aimed at encouraging retail order flow onto exchanges.

The other exception is price-parity-time on the NYSE, which is a carry-over from the exchange's specialist-floor trading days. Parity allocates shares among the top of the book, the Designated Market Maker (DMM) and floor brokers. By sharing the allocation among those who post the best price, rather than based on speed, the NYSE aims to offer institutional investors better fill rates, execution costs, and the ability to share executions at the same price as faster participants.²⁷

The trade-through rule and the complexity of exchange fees has also contributed to a proliferation of exchange order types. In April 2020, Rosenblatt Securities reported that there were 266 order types, and 29 unique order types compared to 252 order types and 36 unique order types in June 2013.²⁸ Rosenblatt group these order types into four categories: those that automate human trader functions, those responding to sensitivity to venue latency and fee disparities, those catering to regulatory desire for a tight and orderly NBBO and those that attempt to segment order flow. In their 2013 order type guide, Rosenblatt argued that this "order flow proliferation is the natural outcome of an unevenly regulated, rapidly evolving and highly automated market structure." However, the proliferation clearly introduces new challenges and complexities, and places the most sophisticated traders at an advantage.

The last category, orders that enable segmentation of order flow, aim to enable exchanges to more effectively compete with ATS's who are able to segment order flow because fair access rules do not apply to them, provided their market share is less than 5%.

Other features

IEX is an outlier in Table 2 as it is the only exchange not to offer co-location services, and to use a speed bump to slow down trading. These features of their business model aim to discourage high frequency trading and make their venue more friendly to institutional investors. These innovations were in place when IEX began its life as an ATS and were retained after IEX transitioned to exchange status. The LTSE also does not offer co-location.

²⁵ See Angel, Harris and Spatt (2015) for a discussion of the issues that arise due to fees not being passed through to customers. While the fees are not passed on directly, they may influence the commission rate offered to customers.

²⁶ The SEC [approved](#) this change in October 2019.

²⁷ See the [NYSE website](#) for further details.

²⁸ See Rosenblatt Securities, Updating our guide to exchange order types, April 2020 for details.

Alternative Trading Systems

Three of the four new rules included in Reg NMS: the trade-through rule, the access rule and sub-penny rule encourage the use of ATSS. Although some ATSSs initially operated as Electronic Communication Networks, all ATSSs currently operate as dark pools, therefore giving up trade-through protection but simultaneously providing investors with an opportunity not to reveal their trading intentions (Mahoney, 2021). Investors have choices about where to take liquidity, without having to offer that liquidity to all venues displaying the best price. Taking liquidity is also potentially cheaper than exchanges using a traditional or maker-taker fee model, as numerous ATSSs either do not charge fees or offer negotiable fee structures.

In addition to the advantages offered to liquidity takers, ATSSs also offer benefits to liquidity providers – orders can be posted in sub-penny increments, with a substantial fraction of ATSS trading occurring at midpoint.

Unconstrained by the trade-through rule and the access rule, ATSSs have arguably offered substantially more innovation in their trading models. There is more diversity in the order precedence models used including consideration of capacity (i.e principal vs agency), broker, size, pro-rata and even high frequency auctions. The use of conditional order types is also permitted. Order flow can be explicitly or implicitly segmented, by restricting access to certain customer-types, or allowing customers to opt-out of interacting with specific types of flows, or by setting minimum execution quantities on orders (Rauterberg, 2021).

Consolidated Tape

Two Securities Information Processors (SIPs) produce consolidated data for the US markets by processing and consolidating all protected bid/ask quotes and trades from every trading venue into a single data feed. The Consolidated Tape Association (CTA) oversees two tapes: Tape A for NYSE-listed stocks, and Tape B for Bats-, NYSE Arca-, NYSE American- and other regional exchange-listed securities. The UTP Plan oversees the tape for Nasdaq-listed Securities (Tape C). Each tape is exclusive.

The SIPs disseminate and calculate critical regulatory information including the National Best Bid and Offer (NBBO) and Limit Up Limit Down (LULD) price bands among other important information such as short sale restriction and regulatory halts.²⁹ The SIP only provides basic data. It works out which exchange has the best bid and offer (NBBO) and then shares these data with the market place (Rule 603). It determines which prices are protected (Rule 611) and limits locked and crossed markets (Rule 610). It does not provide more comprehensive data such as the depth of book and odd lots, which need to be obtained from proprietary feeds. The SIPs generate approximately USD 400 million in revenue each year, which is shared with trading venues based on the trades and quotes they provide to the market. Trades and quotes are equally weighted, with the dollar value traded or quoted determining the share of SIP revenues allocated to each venue. The SIP model has been criticised for subsidising fragmentation, as new venues secure tape revenue simply without offering incremental liquidity.³⁰

In December 2020 the SEC adopted new rules for the SIPs introducing a decentralised consolidation model allowing for competing consolidators. The new rules require each venue to make data available to two types of entities: (i) competing consolidators, who will create consolidated products for the public; and (ii) self-aggregators, such as brokers, dealers and

²⁹ See the [CTA Plan](#) and [UTP Plan](#) websites for further details.

³⁰ See [SIP Accounting 101](#) by Nasdaq's Chief Economist, Phil MackIntosh for further details.

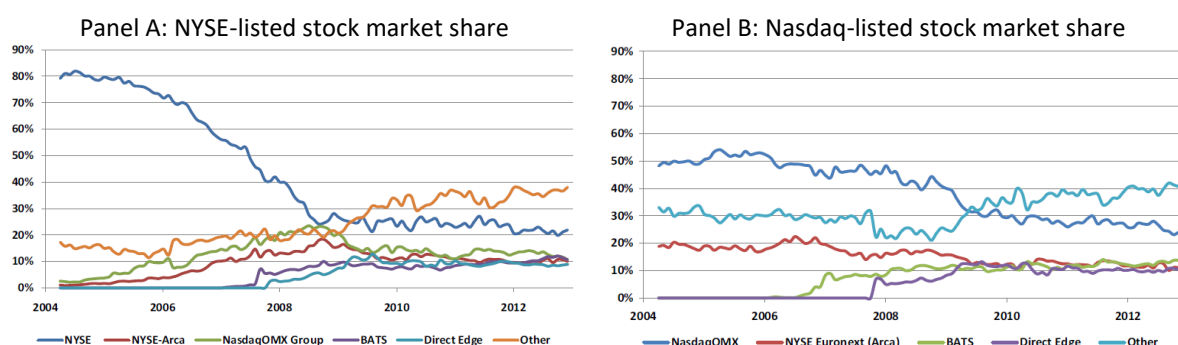
investment advisors who will consolidate data for their internal use. The new rules also add new content to the consolidated tape: odd lots; depth of book; and information about orders in opening and closing auctions.³¹ These changes were due to be implemented in July 2021 but have also been contested by the exchanges in the courts. The outcome is pending.

Evolution of fragmentation and market quality

Although Reg NMS was approved in August 2005, it was not implemented until July 2007.³² However, many of the effects of Reg NMS are not attributable to a single date because firms adapted their technology and strategies over the period leading up to the effective date. Therefore, a long time-series view is a useful way to understand the evolution of fragmentation and market quality. Angel, Harris and Spatt (2015) provide an excellent perspective and descriptive summary of these market changes.

Figure 2 clearly depicts the fragmentation of the market, which for both NYSE and Nasdaq, pre-dates Reg NMS. In both panels the “Other” category captures venues outside those listed and trades reported to the TRF. By the end of the sample period, “Other” accounted for around 40% of activity – and this has increased further since that time. Panel A shows that for NYSE-listed stocks, NYSE’s market share declined dramatically as other venues were faster and more automated. Panel B shows that the Nasdaq-listed stocks were already quite fragmented in the early 2000s but became even more fragmented post Reg NMS. Reg NMS also helped end the entrenched monopolistic specialist system on the NYSE (Spatt, 2021).

Figure 2. Evolution of market share in NYSE- and Nasdaq-listed securities



Source: Angel, Harris and Spatt (2015)

From a market quality perspective, Angel, Harris and Spatt (2015) also report substantial changes. Figure 3 shows that effective spreads declined markedly over the period. For the median stock quoted spreads declined from 4 cents to 2 cents. Quoted spreads declined across the board, with the smallest 5% of stocks falling from 8 to 5 cents, and the largest 5% of stocks falling from 2 to 1 cent – and today are extremely constrained by the 1 cent minimum tick size, on average. Although it is frequently reported that depths at the best prices have declined because of automation, Panel B of Figure 3 shows that depth for the median stock increased from around \$40,000 to \$120,000 – but some of that increase is attributable to rising prices over time.

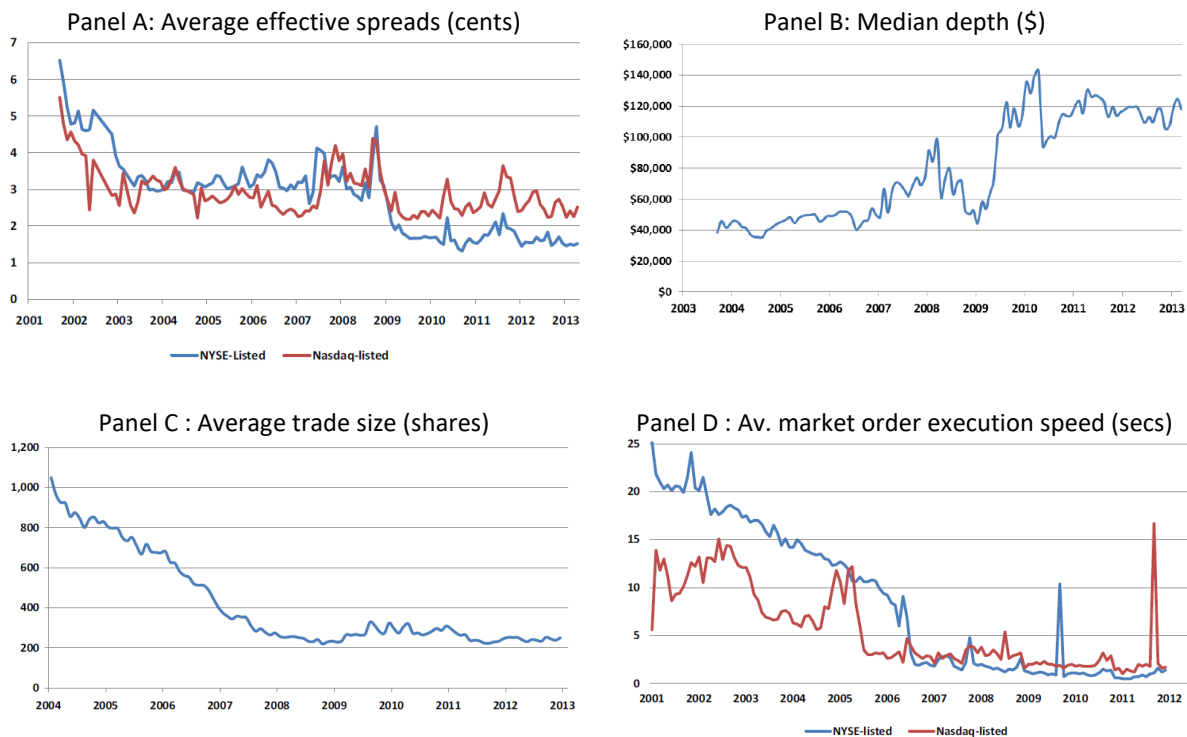
Automation and fragmentation encouraged the use of algorithms and order splitting. Panel C of Figure 3 shows that average trade sizes plummeted from over 1,000 shares per trade

³¹ See SEC [Market Data Infrastructure Final Rule](#) for details.

³² Reg NMS was implemented in two stages, a set of pilot firms in July, and remaining firms in August. However, many market centres and traders implemented changes across the board at the July date.

in 2004 to around 200 shares per trade in 2013. Today, Rosenblatt reports the average trade size is around 150 shares. Finally, Panel D of Figure 3 shows the speed of execution improved substantially, especially for NYSE-listed stocks, declining from an average of close to 25 seconds in 2001 to around one second at the end of the sample period. Today, execution speeds are reported in milli- and micro-seconds. Over the same period number of messages sent to the market skyrocketed, with quotes per minute per security peaking at close to 700 in 2012. Quote to trade ratios also spiked rising from around 4:1 in 2003 peaking at over 35:1 in 2012.

Figure 3. Market quality statistics



Source: Angel, Harris and Spatt (2015)

Academic insights on the impact of Reg NMS

While time-series trends in market quality statistics are informative – they offer no insights on cause and effect. There is a large body of academic research that has sought to establish the effect of Reg NMS on market quality broadly and the role of specific elements of the rules. This section summarises some of the key findings from this literature and the broader literature on competition between markets.

Theory on fragmentation and market quality

Starting with the theory - there are arguments both in favour of and against fragmentation – but most theoretical evidence points to fragmentation being harmful to markets. Network externalities point to consolidation being beneficial.³³ When more traders concentrate on a single market, it reduces search costs and makes finding counterparties easier. Improved liquidity

³³ See for example Chowdhry and Nanda (1991) and Madhavan (1995).

encourages information production and facilitates arbitrage, making prices more informative.³⁴ However, fragmentation increases competition between trading venues leading to lower trading costs.³⁵

A recent theory paper by Baldauf and Mollner (2019), to some extent reconciles these differences. They model two factors that impact outcomes: (i) the market power of exchanges and (ii) adverse selection arising from the race to react to information. As the number of exchanges increase, trading costs fall as each exchange will have less market power; but as the number of exchanges rises, order flow becomes more fragmented, liquidity providers are forced to deepen the aggregate book therefore becoming exposed to more adverse selection. Therefore, the overall effect of fragmentation will be context specific, and be influenced by the extent to which liquidity providers can protect themselves against adverse selection.

Empirical evidence on Reg NMS and fragmentation

Empirical evidence on the impact of fragmentation is mixed and supports the theoretical notion that the impact is context specific.³⁶ Two papers examine the overall impact of Reg NMS: Chung and Chuwonganant (2012) and Haslag and Ringgenberg (2020). Chung and Chuwonganant (2012) use a matched sample approach around the implementation of Regulation NMS and document increases in quoted and effective spreads, slower execution, lower fill rates, higher order cancellation rates and reduced depth. They also report an increase in the price impact and the dispersion of pricing error. Overall, they conclude Reg NMS was detrimental to the market. However, their analysis considers a period of less than 40 days, which may be insufficient to capture the real impact of Reg NMS.

Haslag and Ringgenberg (2020) provide a more nuanced analysis, focusing on a twelve-month period before and after the introduction of Reg NMS, but they also conduct analysis over a sample extending from 2003 to 2016. They use a difference-in-difference framework which allows them to draw causal conclusions. Overall market quality improved with the introduction of Reg NMS, but they find that the impact depends on stock size. The smallest quintile of stocks based on market capitalisation experience lower turnover, larger trade sizes, larger spreads, and worse pricing efficiency relative to the largest quintile of stocks based on market capitalisation. For the smaller stocks, a one standard deviation increase in fragmentation leads to 2% to 6% increase in effective spreads and a 7% to 9% decrease in pricing efficiency.

Haslag and Ringgenberg point to the trade-through rule, and specifically the top of book protection, as the explanation for this difference. For small-cap stocks, if there is insufficient depth available at the top of the book, traders need to get routed to multiple venues to secure the desired depth. This could increase the time to execution and adverse selection risk, potentially increasing execution risk. They find that the negative impact of fragmentation increases with stock level volatility, which they use as a proxy for adverse selection risk.

One potential solution to this adverse selection risk is the use of inter-market sweep orders (ISO). ISOs allow market participants to access multiple price levels simultaneously at different trading venues. The authors document that ISOs are used more frequently in small-cap

³⁴ See Yin (2005) for details about search costs, and Kyle (1984) and Chordia, Roll and Subramanyam (2008) for details about information producing and pricing efficiency.

³⁵ See Foucault and Menkveld (2008) and Colliard and Foucault (2012) for details.

³⁶ Many papers could be cited here, but a few providing evidence of fragmentation improving market quality are Foucault and Menkveld (2008), O'Hara and Ye (2011) and Menkveld (2013) and those suggesting it is harmful are Bessembinder and Kaufman (1997) and Bennet and Wei (2006).

stocks when fragmentation is high. A one standard deviation increase in fragmentation is associated with a 30% increase in ISOs. This finding suggests that Reg NMS increased adverse selection risk, especially for small-cap stocks.

Theoretical and empirical evidence on the trade-through rule

Pagnotta and Phillipon (2018) provides a formal analysis of the trade-through rule with the development of a theoretical model of exchange competition. Their model considers: (i) how and why investors value trading speed; (ii) how speed affects competition between venues; (iii) how regulation impacts (i) and (ii) and how these choices impact exchange investment in speed and fragmentation. The model considers two scenarios: an integrated scenario where there is a unique price that can be accessed via different venues (akin to Reg NMS) and a segmentation scenario where trades are executed at different prices in different venues (akin to MiFID II).

The authors find that price protection distorts competition between venues, benefiting venues with relatively low liquidity. Price protection enables investors in the relatively illiquid market to trade with investors who access the market via the fast venue. This reduces fee competition and investor participation for a given trading speed or venue. Price protection implicitly subsidises the slow/illiquid venue. The model also shows that this implicit subsidy encourages the entry of new venues – promoting fragmentation. The fact that price integration increases fragmentation helps to explain the large increase in fragmentation in the US to levels beyond what is observed in other markets.

The authors' model also shows that when price protection increases entry, welfare is improved, at about 15%-16% of total gains for trade. But this welfare gain gets smaller with each additional venue. If price protection does not lead to new entrants, the impact is negative (but small at 1%), reducing price competition and allocative efficiency. The authors argue that for a market that is already fragmented, such as in Europe, the introduction of price protection may not increase the number of venues and therefore is likely to reduce welfare.

Their model also examines the role of trading speed. They find that speed choices are inefficient because differentiation relaxes price competition. They show that speed increases the allocative efficiency of the market, but that it reduces the differentiation between venues, forcing them to focus on the fee dimension of competition, with faster venues charging higher fees to attract latency sensitive traders. These model insights again map well to the observed US experience. Exchanges aggressively compete on price, with many different fee models, and different pricing tiers aimed at attracting latency sensitive traders.

The trade-through rule potentially introduces frictions, particularly for large institutional traders. These traders may prefer to route to a venue with a slightly worse price if it offers more size – but the trade-through rule prevents this. These traders must first take the liquidity displayed at the best price on all venues – which may in turn move prices against them, before they can access the larger volume at a worse price. ISOs are designed to reduce this friction, allowing the order to simultaneously execute at all available best prices. In the ten months following the introduction of Reg NMS, ISOs accounted for 46% of trades and 41% of volume. These trades contribute more to price-discovery than non-ISOs, and post-trade return analysis shows that they are used by informed traders.³⁷

Curiously, a recent working paper by Li, Ye and Zheng (2021) finds that 57% of the NYSE trading volume comes from orders designed to refuse Reg NMS routing provided by exchanges and that the proliferation of order types is related to traders' desire to avoid Reg NMS.³⁸ The

³⁷ See Chakravarty, Jain, Upson and Wood (2012) for further details.

³⁸ The authors have access to order level data only for the NYSE, but it is likely that similar behaviour occurs on other venues.

authors highlight that 62% of Reg NMS exchange routing leads to worse net prices – which drives traders to avoid routing. This outcome is a combination of the trade-through rule and the access rule. While the trade-through rule always leads to better gross prices, it may not result in better net prices, because the access rule prohibits displayed quotes in one exchange from locking quotes on other exchanges and routing the order to another venue will incur a routing fee. Routing to unlock another market, may result in a worse net price for the trader.

As a consequence, 55% of NYSE limit orders choose “do-not-ship” (DNS) instructions, which cancel the order if it locks the market. The authors find that refusing Reg NMS routing is critical to being able to profit from displayed liquidity, with DNS limit orders earning a small profit of 0.99 bps after collecting the rebate but losing 1.80 bps if they paid the routing fee. Therefore, rather than encouraging displayed liquidity, Reg NMS creates incentives to cancel liquidity.

The authors also show that speed factors encourage liquidity taking orders to refuse Reg NMS routing, because traders can reduce latency by self-routing. Traders do this in one of two ways: using ISOs, which comply with Reg NMS by traders simultaneously sending orders to all venues offering the best price, without asking the exchange to check the best price on other venues; or using NMS Immediate or Cancel Orders (IOCs), which instruct the exchange to cancel the order if it needs to be routed out. The authors find that ISOs (NMS IOCs) pay an average transaction cost of 3.62 (3.72) bps upon execution but make a profit of 0.54 (0.84) bps one second after execution – suggesting that these orders successfully pick off stale quotes. These non-routable marketable orders win 94% of races in sniping stale quotes in NYSE.

While their data do not have any trader-type indicators, their evidence suggests that it is high frequency market making is the driver of refusing Reg NMS routing. DNS limit order win 72% of races to establish time priority in liquidity provision, and DNS limit orders successfully cancel stale quotes 43% of the time, while routable limit orders only do so 9% of the time. In addition, they find that order types that refuse Reg NMS routing are short-term informed, while the most uninformed and the most long-term informed order types accept Reg NMS routing. Taken together, these results suggest that the combination of the trade-through and access rules, and the new order types developed to respond to this market structure serve to benefit the short-term fast traders, rather than longer term investors.

Budish, Lee and Shim (2020) develop a new model of exchange competition, incorporating the features of Reg NMS. They examine the extent to which the trade-through rule and UTP allow exchanges to compete on trading fees and what they refer to as “speed technology” fees which comprises fees for co-location services and proprietary data feeds. They argue that the US market structure creates incentives for stock exchanges to innovate to address latency arbitrage and to create an arms race for speed. They document several stylized facts, including that (i) exchange trading fees are competitive, (ii) exchanges earn significant revenues from what they label as “speed technology,” which comprises co-location services and proprietary data feeds, and (iii) there has been significant growth in speed technology revenue during the Reg NMS era. They estimate that “speed technology” generated approximately USD 1 billion in revenue in 2018, which is about five times trading fee revenues.

The access rule and fee complexity

The access rule, and specifically the cap on fees of 30 cents per 100 shares, has contributed to the complexity in exchange fee structures. Although the use of rebates pre-dates Reg NMS, the access fee rule has undoubtedly influenced exchange rebates given the economic relationship between the allowed fees and rebates.³⁹ Access fees and rebates are not reflected in stock prices

³⁹ Note, that rebates are not capped, so rebates potentially exceed 30 cents per 100 shares. Exchanges paying large rebates typically charge high fees.

and are typically absorbed by brokers rather than passed on to customers. This potentially creates agency distortions where a broker is incentivised to route orders to maximise rebates/minimise fees rather than to get the best outcome for their customer.⁴⁰

Pagnotta and Phillipon's model showing that in the presence of the trade-through rule exchange compete aggressively on fees is supported by the observed fee structures for the exchanges. Spatt (2020) uses economic principles to identify ways in which the evolution of the fee and rebate structures, and specially the use of volume discounts (pricing tiers) is potentially anti-competitive. He argues that the fact that three corporate groups own twelve stock exchanges gives them considerable market power because only three, rather than 12 independent entities are making pricing decisions. He points to the fact that rebates sometimes exceed fees, as evidence of cross-subsidisation of trading. Rebate pricing tiers offered by individual exchanges and in aggregate are suggestive of attempts to price discriminate and segment the market. The fact that tiers are based on relative volume, rather than absolute volume suggests that these discounts are not related to costs. Further, because rebates are based on activity over the entire month, they are not known contemporaneously creating a lack of transparency. Finally, Spatt argues that exchanges cross-subsidise trading in order to increase the value of data and connectivity services.⁴¹

Fees, the trade-through rule and incentives for dark trading

Figure 2 shows that the fraction volume executed on dark venues has increased since the introduction on Reg NMS, suggesting that it has not achieved the objective of rewarding the display of limit orders by increasing their likelihood of execution. Dark venues do not directly benefit from Reg NMS or the trade-through rule. However, there may be some form of indirect causal connection between Reg NMS and the rise in dark trading.⁴² There are several possibilities:

- The trade-through rule does not require orders be routed to venues displaying the best price, rather it restricts trades at prices worse than the best price. Therefore, trading venues can execute at the best price, regardless of whether they are displaying orders at these prices. Therefore, orders resting at dark venues can potentially be executed without revealing the order information to the market.⁴³ This feature is attractive, particularly to institutional investors seeking to minimise information leakage.
- The access rule, and trading fees, provides additional incentives for the use of dark venues. Brokers can avoid exchange trading fees, by routing orders to affiliated dark venues, where they do not pay trading fees.⁴⁴

⁴⁰ Battalio, Corwin and Jennings (2016) provide evidence that retail brokers route limit orders exclusively to exchanges offering the highest rebates, and that these venues offer worse execution quality, including lower fill rates and lower execution speeds.

⁴¹ Spatt (2020) reports, based on discussions at the SEC Market Data Roundtable in October 2018 that Nasdaq's largest client and five of the largest Cboe clients receive net payments from the exchange, even after data and co-location charges which indicates another form of cross-subsidisation. This finding is also consistent with Budish, Lee and Shim's model.

⁴² Staff in the SEC Division of Trading and Markets make this suggestion in a memo to the SEC Market Structure Advisory Committee on Reg 611 of Reg NMS, however, there are no academic studies that directly examine the link between Reg NMS and the rise in dark trading.

⁴³ Although these dark executions are executed immediately, they provide less information to the market because the size of the order and the duration it has been resting is never revealed.

⁴⁴ Given that fees are not passed back to customers, this again creates the potential for conflicts on interests in routing decisions, as brokers are incentivised to route orders to affiliated ATSS. A recent study by Anand, Samadi, Sokobin and Venketaraman (2021) shows that not all brokers that own ATSS route more orders to affiliated venues, but for those that do, ATS routing is associated with lower execution quality.

- The sub-penny rule prohibits venues from displaying sub-penny prices but does not prevent sub-penny executions putting dark pools at a competitive advantage relative to exchanges. Dark pools are able to by-pass existing limit orders with minimal price improvement.⁴⁵ This benefit is particularly useful in stocks with deep order books (i.e. long queues) and spreads constrained by the minimum tick size.⁴⁶

Market data fees

Proprietary market data costs, and to a lesser extent the cost of connectivity and co-location has also received attention in the academic literature. Glosten (2020) analyses the economics of the exchange business to assess the competitiveness of pricing for proprietary market data. He concludes that while competition is effective at constraining trading fees, it is less effective at constraining costs of proprietary market data. This is because trading services are substitutes while proprietary data feeds are complements. Prices for market data do not affect the decision of where to place orders and buying data from one exchange does not replace the need to purchase data from others. As the number of trading venues rises, so too does the cost of market data for the sell-side.

Brannon and Jennings (2019) examine the correlation between exchange fees for market data, connectivity, and co-location services and exchange revenues, controlling for trading volume. They cite evidence of large increases in proprietary data costs since 2008. They argue that fixed costs for market data and connectivity can limit competition between brokers and put pressure on commissions. They find evidence that increases in fees led to statistically significant increases in revenues, indicating that there is a relatively inelastic demand curve for exchange market data, co-location and connectivity products and services. They also find evidence that the connection between trading volume and fee-based revenue is not strong and that reductions in the number of customers due to fee increases are compensated by the increased in revenue from larger fees paid by the remaining customers.⁴⁷

Practitioner perspectives on Reg NMS

Valuable insights on Reg NMS can also be obtained from members of the buy- and sell-side communities in both the US and Europe. A small number of these participants were interviewed: including both members of the Plato Partnership and other participants. The participants are all global players, and therefore skewed to the larger end of the market. However, they typically gave consideration to differences between their own experiences and those of smaller players in the interviews.

This section describes the common themes identified by these traders when considering the pros and cons of Reg NMS compared to the MiFID II framework. It also identifies the challenges that would arise in trying to apply a more prescriptive, Reg NMS-style regulatory model in the European context. The absence of a consolidated tape in Europe formed a core part of this discussion: with some participants indicating that such a model could not be considered without

⁴⁵ This problem can be avoided with the introduction of a minimum price improvement requirement such as those introduced in Australia, Canada and Europe. Comerton-Forde, Malinova and Park (2018) show that the introduction of this rule in Canada substantially reduced the level of dark trading and effectively eliminated intermediation in the dark.

⁴⁶ Buti, Consonni, Rindi, Wen and Werner (2015) develop a theoretical model to demonstrate this benefit and provide supporting empirical evidence from the NYSE and Nasdaq.

⁴⁷ The authors acknowledge that the way in which exchanges report segment and sub-segment revenue necessitates some judgement on their part.

a tape already being in place; and others thinking that the existence of a tape would reduce the need for more prescriptive best execution regulations.

Pros and cons of Reg NMS

There was almost universal agreement among the traders that Reg NMS improved the quality of the US market. For the NYSE, it forced a shift away from floor trading, and broke the specialist model, and more generally reduced the monopoly power of the primary markets. By mandating connectivity between the markets, it removed the barriers to entry and promoted competition. The prohibition on trade-throughs meant that orders had to be routed to the venue offering the best price, even if that was not the traders' preferred venue. Over time, as the market evolved to a point where there was no one, dominant venue, the primary market is no longer a single point of failure. In the event of a market outage, trading can continue with little disruption.

The requirement to route orders to the venue with the best price made it easier to demonstrate best execution, with some indicating that best price became the de facto best execution. This was seen as being beneficial for retail traders and smaller institutions that did not have resources to effectively monitor a less prescriptive form of best execution. However, this was intended as a guard-rail for best execution rather than a replacement for best execution.

The trade-through rule is effective at ensuring displayed orders are protected, and allows traders to choose where to post liquidity, but the prescriptive nature of the rule reduces the flexibility traders have for taking liquidity and introduces more complexity. Some traders expressed frustration at being forced to take small pieces of liquidity at many venues or being forced to take liquidity at venues they consider to be more 'toxic', potentially resulting in information leakage and signalling. Traders highlighted the extensive use of ISOs to enable them to try to minimise the impact of the trade-through constraints.⁴⁸ For non-marketable orders the main driver for using ISOs is cost and for marketable orders the most important factor is relative speed. Exchange routing relies on fibre connections, while some brokers utilise much faster microwave technology, providing further encouragement for the use of ISOs.⁴⁹

Having flexibility to consider other factors such as size, speed and probability of execution was seen as being very valuable in Europe. It is typically easier to do block trades in Europe than in the US and this was considered beneficial. However, most traders indicated that even in Europe, price is an important consideration, and that traders are generally reluctant not to take better priced liquidity – but will do so when their best execution policy and transaction cost analysis (TCA) supports it.

While recognising the value of the trade-through rule, all interviewees indicated it has also led to the unintended consequence of a proliferation of trading venues. One interviewee noted "too much competition just becomes fragmentation, and it is for no good reason if it is not bringing any innovation." There was agreement that 16 exchanges is too many – especially given that there is little variation in the market structure other than fees.⁵⁰ The proliferation of venues is thought to be driven by: (i) top of book protection, which guarantees order flow; (ii) exchanges operating multiple fee models to cater to different types of clientele, and allowing some

⁴⁸ This generated discussion about compliance issues associated with ensuring that their own routing processes did not generate trade-throughs, and the fact this necessitated the use of proprietary data feeds. This issue is discussed further later in the paper.

⁴⁹ As an example, Shkilko and Sokolov (2020) report that microwave technology is approximately 30% faster than the fastest fibre connection between New York and Chicago.

⁵⁰ A notable exception is IEX with its speed-bump and the absence of co-location.

segmentation of order flow akin to that offered by ATS; and (iii) consolidated tape revenue underwriting an exchange even if it has little trading activity. Excessive fragmentation was viewed as a failing of Reg NMS.

In contrast, in Europe traders are not obligated to connect to new venues immediately, but instead can be patient and wait to see if the market gains traction before incurring costs of connecting. Some interviewees indicated that periodic reviews of their best execution policy guide their decisions on connecting to new venues. Others noted that they thought that it was difficult to understand how any firm could justify being connected only to the primary market and be able to demonstrate they were fulfilling their best execution obligations.⁵¹

The combination of the access rule and the trade-through is thought to have encouraged complexity in fee structures. One interviewee noted “you need a PhD to understand fee structures in the US.” There were mixed views on the value of the complex fee structures, and rebate payments. Some viewed rebates as an effective way to encourage market makers to supply liquidity and others thought it created potential for conflicts, and that rebates had kept fees artificially high. European fee structures are generally considered to be less complex, but the introduction of a Reg NMS-approach in Europe could result in the same level of complexity developing. For example, exchange groups that operate multiple venues, such as Euronext and Nasdaq, could introduce alternative fee models in each venue to cater to different types of clienteles.

The proliferation of order types was also seen as a weakness of Reg NMS. Again, complexity was cited as an issue. As was the fact that order types are sometimes introduced to exploit/avoid specific fee models, to give advantages to certain types of traders or to work around frictions introduced by Reg NMS, like avoiding locked and crossed markets. However, multiple interviewees noted that some of these order types aim to level the playing field between exchanges and ATSs in respect of “fair access” and that some of the recent new order types offer genuine innovation, which is valuable.

A related issue is that the access fee rule and the ability for ATSs to segment order flow has encouraged off-exchange trading and the use of dark pools as this provides greater flexibility in achieving best execution. It was noted that in contrast to Europe, the consolidated tape ensured greater confidence to trade off-exchange knowing that the midpoint price is set by all venues, rather than just a single venue. Some noted the need for a higher level of attribution on the consolidated tape in the US so that traders can identify whether a trade has been executed in an ATS, a single dealer platform or by a wholesale market maker.

Some of interviewees noted that the trade-through rule incentivised investment in speed. One trader noted that it was much more difficult to capture liquidity using aggressive algos in the US than it was in Europe due to speed issues. Although there were mixed views on whether or not speed was more important in the US than Europe, there was agreement that speed was an important dimension in both jurisdictions, but for different reasons. In Europe, geographic dispersion is an important factor.

However, the introduction of a trade-through rule in Europe would undoubtedly force greater investment in speed. Currently, not all brokers are co-located at all venues – but a trade-through rule would necessitate more co-location to ensure best execution in a context where the top of book is protected. Co-location and technology costs are incurred by the sell-side. However,

⁵¹ It is important to note that although Reg NMS does not require every broker to be connected to every venue, and that except for ISOs, the obligation to avoid trade-throughs rests with the exchanges. So, a broker can rely on the exchange to route orders to other exchanges with better prices. Brokers can also choose to outsource their trading to other brokers, and retail brokers typically route their orders to wholesale market makers.

escalating costs will either compress broker margins or be passed through to the buy-side and end investors, or both.

Summary of evidence and perspectives on Reg NMS

Table 3 summarises the pros and cons of Reg NMS based on the evidence from the academic literature and the perspectives of buy-side and sell-side traders.

Table 3. Summary of pros and cons of Reg NMS

Rule	Pros	Cons
Trade-through	<ul style="list-style-type: none"> • No single dominant market – enhances resilience • Easier to demonstrate best ex - best price provides back-stop for execution quality 	<ul style="list-style-type: none"> • Excessive fragmentation – illiquid venues subsidised – undifferentiated venues • Reduces flexibility in best ex due to emphasis on price – harder to execute blocks • Encourages complexity in order types to avoid locked/crossed markets • Encourages order splitting, reducing trade sizes • Encourages investment in speed • Increases adverse selection risk in small stocks
Access rule	<ul style="list-style-type: none"> • Cap on fees • Use of rebates encourages liquidity provision 	<ul style="list-style-type: none"> • Cap now too high • Rebates keep fees higher than necessary • Encourages fee complexity • Enables anticompetitive exchange fee models • Encourages complexity in order type to avoid fees • Encourages shift to ATS to avoid fees • Creates potential routing conflicts of interest
Sub-penny rule	<ul style="list-style-type: none"> • Prevents exchanges competing on tick-size 	<ul style="list-style-type: none"> • Creates unlevel playing field between exchanges and ATS because ATS can trade in sub-pennies • Sub-optimal regime due to one-size fits all tick size
Market data	<ul style="list-style-type: none"> • Creates confidence in market quality • Provides certainty about NBBO and volumes 	<ul style="list-style-type: none"> • Tape revenue creates incentive for new venues • Creates two tiers of market data and increases data costs

Implementation challenges associated with a Reg NMS-style model in Europe

While Reg NMS has considerable merit, that does not mean that it is necessarily transferable to other contexts. It achieved its goal of enhancing competition in the US, at a time when the US market was dominated by two venues. It is less clear whether this approach would be adopted today. The SEC Equity Market Structure Advisory Committee (EMSAC) which operated in 2015 and 2016, considered a range of major changes to US equity market structure including the trade-through rule, the access rule and the market data rule. The committee proposed a pilot study on access fees, which was endorsed by the Commission but then challenged in the courts by the

NYSE, Nasdaq, and Cboe Global Markets.⁵² There have been numerous other proposals to change US market structure in recent years.⁵³

There were mixed views among the traders interviewed on whether a Reg NMS-style approach would offer value to the European markets at this point in its evolution. Even those who saw merit in a Reg NMS-style model in Europe identified significant practical challenges associated with its adoption. Further such a radical change would be costly, and likely create unintended consequences.

The first, and perhaps most obvious challenge is that Europe is not a single country. Applying such a prescriptive set of rules across many different countries, with different local markets and regulators, would create challenges. Specially, imposing uniformity across small, regional brokers would be very costly. More than 13 years since the introduction of MiFID I, many of these players continue to only be connected to the primary market. Second, while there are a relatively small number of large pan-European MTFs, the number of venues that would need to be connected across all ESMA regulated markets is large.

Given the large number of venues, should all displayed venues be protected? In the US, all exchanges are immediately entitled to quote protection. Interviewees indicated that this approach would be unmanageable in the European context. Some advocated a minimum market share requirement, like the approach taken in the Canadian market, would make this challenge more manageable.⁵⁴ But others thought this would negate the value of quote protection. The presence of periodic auctions in Europe raises an additional question: should periodic auctions be considered “immediately accessible”, or should they be excluded from quote protection? Their inclusion would create additional complexity.

Another significant factor to be considered in the European context is post-trade services. In addition to connecting to all venues for trading services, brokers would also need to create new connections for post-trade services. The absence of universal post-trade interoperability would make this extremely costly and burdensome. Without mandating universal post-trade interoperability trade-through protection is not practical – you can not force a party to trade at a venue where they can not settle the transaction. In the absence of universal post-trade interoperability, the only feasible approach is to only offer trade-through protection to those venues that are fully interoperable. While this may provide incentives for venues to become interoperable, it may also further fragment liquidity.

Assuming a set of eligible venues can be identified, the next question is who should ensure that orders are protected? Should this responsibility lie with the venues or with brokers? If it is the venues, all venues must be interconnected. If it lies with the brokers, all brokers must be connected to all venues, either directly or indirectly via arrangements with other brokers. Both approaches require substantial technology investment and cost for venues and/or brokers. In the US, primary responsibility for avoiding trade-throughs lies with the exchanges. However, where a broker chooses to manage their own routing using ISOs, they are responsible for ensuring that they do not trade-through. Brokers using ISOs need to make substantial investments in speed, paying for proprietary data feeds and co-location services. Similar investments would need to be made in Europe in the presence of a trade-through rule.

⁵² The exchanges won this case in the District of Columbia Circuit Court of Appeal. The court [decision](#) stated that the SEC had exceeded its statutory authority by trying to run an experiment rather than regulate.

⁵³ For example, in 2014 the Intercontinental Exchange proposed a grand bargain which included reducing access fees, introducing a trade at rule, eliminating maker taker pricing, and setting minimum market share requirement for protected quotes. In 2017, Nasdaq launched a blueprint to revitalise markets which included eliminating UTP for smaller and less liquid stocks and implementing a new intelligent tick regime.

⁵⁴ In October 2016, the Canadian Securities Administrators introduced a minimum market share threshold of 2.5% for venues to be eligible for quote protection.

Having established what venues will be protected, and who is responsible for ensuring protection, the next question to consider is which quotes should be protected? In the US, for a quote to be protected it must be immediately and automatically accessible by all participants in the market and be at the top of the book. Further, only round lot orders are protected.⁵⁵ The round lot requirement ensures that at least a minimum volume is offered before the quote is protected. European markets do not utilise round lots, so regulators would need to determine the appropriate minimum volume for quote protection. This could potentially be tied to the ESMA tick size regime – but introduces an additional layer of complexity into the market.

And should there be any exemptions that allow traders to bypass specific quotes? In the US, exemptions are limited to three scenarios. First, ISOs which allow participants to access multiple price levels simultaneously at different venues – but the broker sending this order is still responsible for ensuring that orders are not traded-through. Second, when a venue experiences a material delay in providing a response to an incoming order, other venues can declare “self-help” against this venue, and other venues are no longer obligated to route there. Third, it is possible to trade-through flickering quotes that have been delayed for less than one second. Equivalent exemptions would be sensible in the European context. The second exemption would help solve the market outage problems experienced in 2020.

Many interviewees thought the addition of a block exemption would be helpful or necessary in the European context, given the importance of Large-in-Scale venues.⁵⁶ Such an exemption could be aligned to the existing Large-in-Scale thresholds, or potentially set at lower levels, but above the average trade size for a stock.⁵⁷

Table 4 summarises the important questions that need to be debated and resolved before pursuing a Reg NMS-style model in Europe.

Table 4. Questions to address for implementation of Reg NMS in European context

Questions to address	Possible answers
What venues should be protected?	<ul style="list-style-type: none"> • All displayed and continuous venues • Displayed venues that meet a defined minimum market share requirement • Displayed venues that offer universal interoperability
Which quotes should be protected?	<ul style="list-style-type: none"> • Top of book vs full book • Minimum volume requirement (i.e. round lot equivalent)
Who should be responsible for compliance?	<ul style="list-style-type: none"> • Exchanges • Brokers • Both brokers and exchanges
Should there be any exemptions?	<ul style="list-style-type: none"> • Intermarket sweep equivalent • Self-help equivalent • Block trades (Large in scale or some other size threshold?)

⁵⁵ A round lot is currently defined to be 100 shares. However, the pending changes in the market data rules would vary the size of a round lot based on stock price.

⁵⁶ Rosenblatt Securities report that Large in Scale venues accounted for around 33% of dark volume in May 2021, and ESMA (2021) reports that the LIS waiver is the most frequently used waiver accounting for 32% of all waiver notifications submitted.

⁵⁷ A block exemption was extensively debated in the US prior to the introduction of Reg NMS, but ultimately it was excluded.

Consolidated tape and market data issues

The importance of a consolidated tape has been debated in Europe since the introduction of MiFID I. While Europe is moving closer to the implementation of a tape there is still debate about the precise form it should take. Should it be pre-trade, post-trade, real-time and what should it be used for? A detailed discussion of these issues is beyond the scope of this paper, but this section outlines some of the benefits a consolidated tape may offer, and highlights what a consolidated tape can not achieve.

A Reg NMS-style model unquestionably needs a real-time pre-trade tape. The US interviewees were at pains to point out that the development of a consolidated tape needed to be grounded in the realities of what is and is not possible with a consolidated tape. They noted that the consolidated tape is not a trading tool. To effectively offer best execution to their customers, they need to use proprietary data feeds.⁵⁸ They need prop feeds for two reasons: (i) they provide more data, such as depth of book and odd lot orders, which is essential for routing decisions; and (ii) the consolidated tape is too slow to reliably route orders. The latter point is particularly important from a compliance point of view for ISOs. Brokers need to be able to take a snapshot of the book based on their prop feed consolidation, before these orders are sent, providing evidence that they do not trade-through based on their view of the market.

It was universally agreed by all interviewees, that even with the development of a consolidated tape in Europe, large brokerage firms, managing institutional (latency sensitive) order flow would continue to create their own consolidation using proprietary data feeds. A trade-through rule would require them to purchase proprietary data feeds from all venues, which raises concerns about pricing of proprietary data, and the potential for escalating costs, as each venue has a monopoly on the supply of data from their venue. The argument in Glosten (2020) that proprietary market data from different venues are complements rather than substitutes suggests that competition may not be adequate to constrain increases in these costs. Despite these limitations, a public consolidated tape is viewed as a very useful resource for the buy-side, smaller brokers with less latency-sensitive needs, and for anyone viewing data with eyeballs. The introduction of a consolidated tape, without a trade-through rule, may reduce the importance of ultra-low latency feeds, and potentially reduce the need to purchase proprietary data feeds from every trading venue.

A consolidated tape is expected to provide a cost-effective way for these participants to have a more complete view of the market and offer basic tools to support greater accountability for best execution – especially for smaller investors. It offers a range of potential benefits. First, a post-trade consolidated tape would give traders more confidence about the overall volumes traded off-venues and allow them to identify venue market shares more reliably.⁵⁹ Giving traders the ability to easily identify addressable and non-addressable volume will improve trading decisions by providing more reliable estimates of average daily volumes. Investors could reliably compare their aggregate executions against, the aggregate flows in the market, and ask questions of their broker if their flow significantly deviated from the market aggregate.

Second, a real-time consolidated tape, providing all quotes or a snapshot of the available quotes at the time of each trade, would enable investors to more readily identify whether other venues systematically offer better prices. And if they do, they can again ask their brokers why

⁵⁸ The SEC Market Data Roundtable in October 2018 provided interesting insights on this issue. Exchanges claimed that buying proprietary data feeds was a commercial decision, not a mandate. However, a large buy-side firm indicated that they would not trade with any broker that did not consume proprietary data feeds.

⁵⁹ Oxera (2021) spells out the current challenges around the quality of reported data and the uncertainties this creates for the market.

they are not routing to the other markets. Investors can evaluate their executions against the European Best Bid and Offer (EBBO) rather than the Primary Best Bid and Offer (PBBO). While this would not be effective at an order-by-order level, due to latency issues, it would be informative in aggregate. A broker consistently and systematically executing outside the EBBO is unlikely to be achieving good execution outcomes. If a customer observes that they are consistently receiving executions outside the EBBO, and the EBBO is being set by a market which their broker is not connected to that demands an explanation. However, if a customer observes that their orders are consistently being executed outside the EBBO but for volumes that are greater than what is available at the EBBO they may be satisfied the broker is delivering best execution based on factors other than price. The absence of a consolidated tape makes it very difficult for a customer to assess the execution outcome and to know what questions to ask.

Fourth, data from a consolidated tape enables similar explorations of execution outcomes by regulators. Finally, a consolidated tape would enable systems to reference the EBBO rather than the PBBO, providing greater resilience during a primary market outage. With a regulatory change, the EBBO could also be used for the reference price waiver, providing investors certainty that their orders are executed at the midpoint of all available prices rather than just those offered by the primary market.

Careful consideration must be given to the governance of a consolidated tape to ensure that in addition to venues, buy- and sell-side firms also play a role in its creation and governance. Regulators and policy makers should also be cautious to avoid a situation where venues control both public feeds and the opportunity to profit by selling private ones.⁶⁰

Lessons learned and alternative approaches

The academic literature and the perspectives offered by practitioners demonstrate the complexity of market structure choices. The highly prescriptive nature of Reg NMS offers benefits, namely greater competition and a more resilient market but comes at the cost of greater complexity in technology, fee models, order types, and potential for excessive fragmentation. The benefits of this model accrue in large-cap stocks but not in small-cap stocks.

The principles-based approach to best execution taken in MiFID II offers much greater flexibility, especially around routing decisions, which is important for large institutional traders – but potentially entrenches the incumbent markets because some participants choose not to connect to competing venues. The success of a principles-based approach depends on rigorous commitment to achieving best execution across all players in the market – the buy-side, sell-side and regulators. It requires that these parties have the necessary tools to evaluate whether or not best execution is being achieved, and periodic reviews of whether improvements in the best execution policies are necessary.

Both Reg NMS and MiFID II aim to achieve the same goals – to provide frameworks for robust competition, to ensure liquid and resilient markets and to ensure investors receive the best possible execution. Introducing a more prescriptive model in Europe would fundamentally alter the market landscape – and would come at huge cost (both technology and compliance) to the players in the market. These costs are predominantly incurred by sell-side firms and will ultimately result in compression of their margins and/or the costs being passed onto the buy-side and the end investor. Prior regulatory reforms, both in Europe and elsewhere, demonstrate that

⁶⁰ In a January 2020 [speech](#) about reforming stock exchange governance, SEC Commissioner Robert J. Jackson Jr raised concerns about this issue in the US context, suggesting that the US law should change to address the incentives created by giving exchanges control over both public and proprietary data feeds.

fundamental reforms inevitably have unintended negative consequences. Less radical and more nuanced reforms carry less risk for the market.

Some market observers have concluded that the US market is more resilient during outages than European markets and have attributed this resilience to Reg NMS. This attribution overlooks some other important features of the US market, which are summarised in Table 5.

The first factor is that no single venue dominates trading – which means trading more easily switches venue in the event of an outage. Europe can build more resilient markets by promoting greater competition and ensuring trading is less concentrated on a single venue, and that trading is not dependent on pricing from a single venue. Second, the presence of a consolidated tape means that systems are set up to rely on the NBBO rather than the price on the primary market. This includes reference pricing for off-exchange trading. This again gives participants more confidence to continue trading in the event of an outage. Third, the “self-help” exemption to the trade-through rule is valuable, as it allows venues to disregard venues that do not respond, minimising disruptions. Fourth, the primary markets also have contingency plans in place for their closing auctions, and the reliability of these arrangements are periodically tested. Fifth, Regulation Systems Compliance and Integrity (SCI) which took effect in the US in February 2015, requires SCI entities to “design, implement, test and maintain IT policies and procedures for their systems capacity, integrity, resilience, availability and security.”⁶¹ This ensures that when an “SCI event” occurs the responsible entity must take corrective action and notify the SEC, ensuring better continuity of trading. Finally, the US market has a single entity, the Depository Trust & Clearing Corporation (DTCC) that provides clearing and settlement services for all equity transactions across all US venues. This ensures that post-trade services do not serve as a barrier to choosing a venue for execution.

Table 5. Factors contributing to US market resilience

Factor	Explanation
No single dominant market	Liquidity and price discovery distributed across multiple markets – single market failure does not disrupt trading
Consolidated tape	Systems rely on consolidated tape (or consolidated tapes created using prop data feeds) – not the primary market
Interconnectivity and self-help	If immediate response is not received – other exchanges can declare self-help
Contingency arrangements for closing auctions	Clearing defined contingency arrangements and market-wide testing for auction failures
Regulation SCI	Obligations for IT policies and procedures to ensure integrity and resilience of critical systems
Single clearing and settlement provider	The Depository Trust & Clearing Corporation is a user-owned utility that provides clearing and settlement services for all equity transactions

So, if Reg NMS is not the answer for Europe, what is? More targeted and nuanced reforms will likely achieve the goals of more resilience, greater liquidity and better execution outcomes, whilst reducing the risk of unintended consequences. Execution quality can be enhanced through more accountability on best execution. Greater resilience can be achieved by ensuring brokers are connected to more than one venue, and that their systems can adapt in the absence of one of these venues.

More accountability on best execution requires better data and disclosures. A consolidated tape would make data more accessible and reduce the cost of identifying where

⁶¹ See [Reg SCI](#) for details. SCI entities include exchanges, ATSS, registered clearing agencies and consolidated market data processors.

liquidity can be sourced and the markets consistently offering the best prices. While this would not aid real-time routing of orders, it would allow the buy-side to have a more informed view on the market quality on offer at different venues. Platometrics provides a useful example of the types of tools that could be offered based on consolidated data either in real time or at T+1.⁶² Using proprietary data feeds from multiple venues, Platometrics consolidates data and provides many standardised metrics that can be used to assess execution quality. For example, it reports the fraction of time each venue is at the EBBO and the depth at the EBBO at each venue for each stock. Other metrics such as the frequency of trade-throughs, and whether a trade-through occurs when another venue has greater volume, may also be a useful indicator when considered over a period of time or range of stocks.

Additional disclosures on routing and execution quality could also enable better monitoring of execution outcomes by the buy-side and regulators. Large institutions have the capacity to obtain the information required on request from their brokers, but this is more difficult for smaller institutions. Even if they can obtain this information, they may lack necessary resources and data analytics capacity to standardise these reports across their suite of brokers.⁶³ RTS 27 and 28 were intended to provide such data – however, it is widely agreed that they did not achieve their goal.⁶⁴ Order routing disclosures in the US, mandated in Rule 606(b)(3), are thought to be more informative – and recent changes to this rule provide a useful template that could be adopted in Europe. These reports provide a broad overview of how brokers are executing orders, the prices at which they are getting executed and the fill rates. Standardised reporting would enable generic tools to be built, reducing the cost of rigorous best execution monitoring for institutions.

Brokers are required to disclose all venues to which they are connected – but this information is not easily accessible nor effectively monitored. If a broker chooses to connect only to the primary market or is not connected to venues offering meaningful liquidity, they should be required to empirically demonstrate that they are delivering on their best execution mandate.⁶⁵ Regulators should validate this, particularly for brokers offering services to smaller investors. At a minimum, every broker should be required to connect to at least two venues for each jurisdiction they trade to ensure that they can continue trading in the event of a market outage.

Brokers should also consider the adaptability of their technology to an outage at one venue, to ensure that routing logic is not dependent on the primary market. This should include referencing the EBBO rather than the PBBO. This approach would be aided by a regulatory change replacing the “most relevant market” with the EBBO for the reference price waiver. Consideration should also be given to whether market wide testing of outage scenarios would be helpful.

⁶² [Platometrics](#) was built by the Plato Partnership in collaboration with BMLL Technologies.

⁶³ Some large buy-side firms indicated well-designed standardised reports would also be useful for them.

⁶⁴ The FCA and ESMA have suspended the obligation to provide RTS 27 reports.

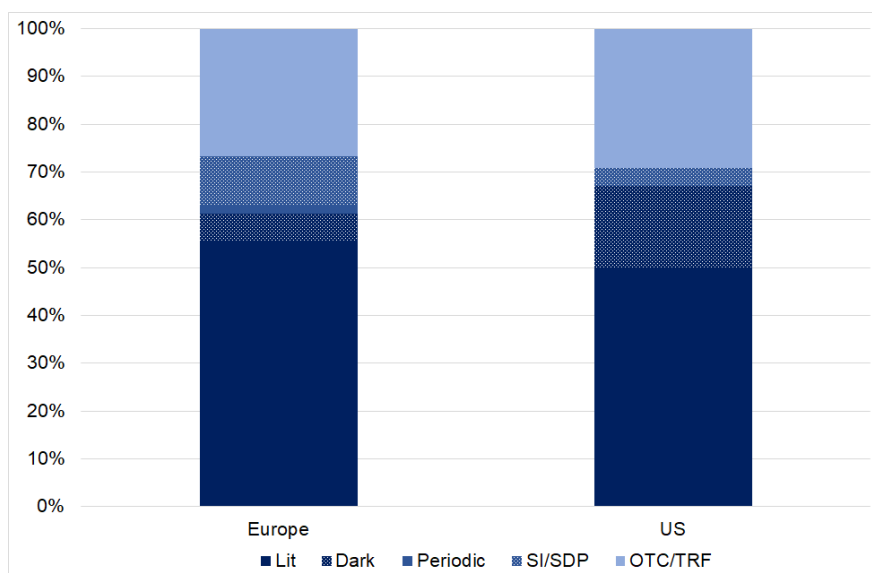
⁶⁵ Recital 108 of the MiFID II of Commission Delegated Regulation (EU) 2017/565 encourages this but validation should be required.

Appendix A: Current European equities landscape

A direct comparison between the US and Europe is complicated by at least two factors. First, the US is a single country with a small number of listing venues, while Europe includes many countries and many listing venues. Second, consolidated tape data is readily available for the US but not for the European market – giving rise to debate about what should and should not be included in aggregate volumes.⁶⁶

Overlooking the first complication, and considering all European markets together, Figure 4 reports the distribution of trading across different trading mechanisms. European lit markets capture a larger fraction of trading than US lit markets at approximately 55% vs 50%. Dark trading accounts for around 6% of trading in Europe compared to 17% in US, comprising 9.5% in dark pools and 7.7% hidden liquidity on exchanges. European Systematic Internaliser (SI) activity at 10.5% is much higher than the 3.7% executed in Single Dealer Platforms (SDP) in the US. Periodic auctions, which do not currently exist in the US, account for a little under 2% of European volumes. Over the counter (OTC) trading (labelled as TRF for the US) is roughly equal at 27% in Europe and 29% in the US.⁶⁷

Figure 4. Comparison of US and European market share by trading mechanism



Source: Rosenblatt Securities: Let there be light, US, June 2021 and Trading Talk, Europe June 2021

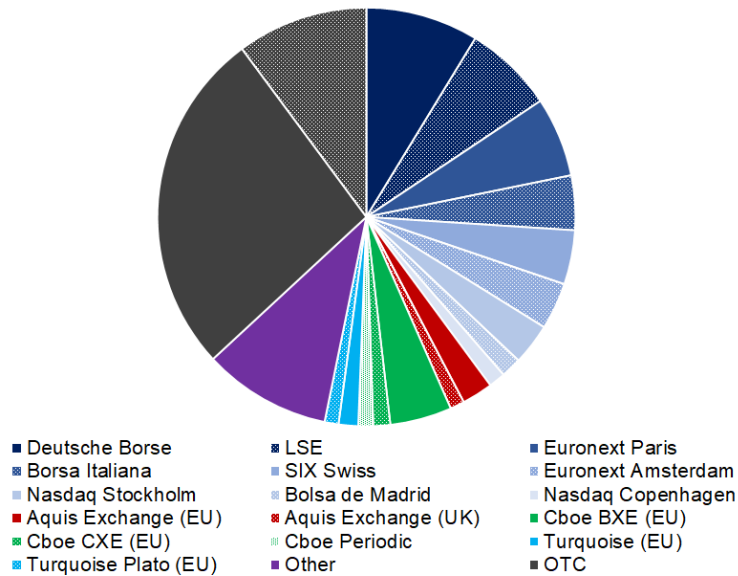
Figure 5 reports an equivalent of Figure 1 for the European markets. A large number of venues are aggregated in the “Other” category. The largest primary markets Deutsche Borse and London Stock Exchange account for 8.8% and 6.9% of activity, respectively. These relatively small numbers are due to the fact that the primary markets typically only trade securities in their home market. The largest pan-European Multilateral Trading Facility (MTF), Cboe BXE (EU) accounts for 4.8% of European volumes. SI and OTC volumes are consistent with those reported in Figure 4.

⁶⁶ See Oxera (2021) for a detailed discussion of these issues.

⁶⁷ Oxera’s estimates which exclude trades that do not contribute to price formation and trades executed out of hours, for Q1 2021 show that 42% of trading takes place on continuous lit markets, 17% in auctions, 7% on dark venues. 17% off-book on exchange, 11% on SIs and 6% OTC.

An analysis of trading on venues (i.e. excluding SI and OTC) within a particular market, rather than on Pan-European basis is helpful for understanding within country-level variation in trading activity.

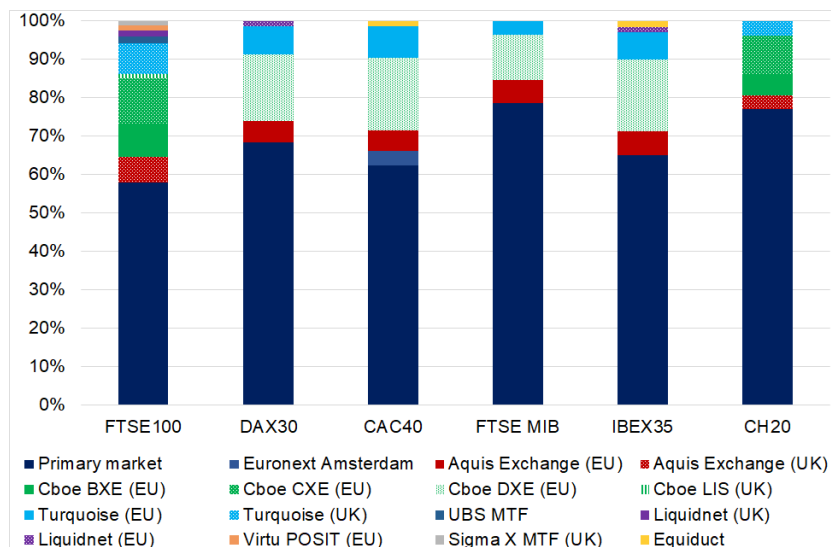
Figure 5. European trading activity by venue



Source: Rosenblatt Securities: Talk, Europe June 2021

Figure 6 reports market shares for the constituents of the major indices for six countries. This shows that the primary market accounts for a substantial fraction of trading activity for each country, ranging from a low of 57.6% for FTSE100 constituents to a high of 76% for the FTSE MIB. Cboe, Turquoise and Aquis are also important venues in these securities.

Figure 6. On venue market shares for constituents of major indices



Source: Rosenblatt Securities: Talk, Europe June 2021

Overall, these statistics indicate that the primary markets are more dominant in Europe compared to the US, and that European markets are less fragmented than the US. Dark trading is also higher in the US than Europe. OTC trading is substantial in both markets.



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