Comment Letter on Behalf of Virtu Financial, Inc.

Re: Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders,
Release No. 34-96494; File No. S7-30-22 (Dec. 14, 2022)

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March 30, 2023

VIA ELECTRONIC DELIVERY

Ms. Vanessa A. Countryman
Secretary
U.S. Securities and Exchange Commission
100 F Street, NE
Washington, DC 20549-1090

RE: Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders, Release No. 34-96494; File No. S7-30-22 (Dec. 14, 2022)

Dear Ms. Countryman:

Virtu Financial, Inc.[1] ("Virtu") respectfully submits this letter in response to the above-referenced rule proposed by the Securities and Exchange Commission (the "SEC" or "Commission") on December 14, 2022 (the "Proposed Rule").[2] Virtu strongly opposes the changes contemplated by the Proposed Rule because they present serious risks of diminishing liquidity in the marketplace, thereby threatening investor welfare and opportunities for capital formation; are based on a flawed economic analysis; and are the byproduct of a deficient rulemaking process.[3] The Commission should instead embrace the scientific method and adopt a

[1] Virtu is a leading financial firm that leverages cutting-edge technology to deliver liquidity to the global markets and innovative, transparent trading solutions to its clients. Virtu operates as a market maker across numerous exchanges in the U.S. and is a member of all U.S.-registered stock exchanges. Virtu's market structure expertise, broad diversification, and execution technology enable it to provide competitive bids and offers in over 25,000 securities, at over 235 venues, in 36 countries worldwide. Virtu broadly supports innovation and enhancements to transparency and fairness that increase liquidity and promote competition to the benefit of all marketplace participants.

[2] Proposed Rule: Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders, 87 Fed. Reg. 80266 (Dec. 29, 2022) (to be codified at 17 C.F.R. Part 242) (the "Proposed Rule"). Citations to the Proposed Rule are to SEC's Release No. 34-96494 (Dec. 14, 2022); File No. S7-30-22, *available at* https://www.sec.gov/rules/proposed/2022/34-96494.pdf. This letter incorporates by reference Virtu's responses to the other three rule proposals issued by the Commission on December 14, 2022. *See* Proposed Rule: Order Competition Rule, 88 Fed. Reg. 128 (Jan. 3, 2023) (to be codified at 17 C.F.R. Parts 240 and 242) (the "OCR Proposal"), *available at* https://www.sec.gov/rules/proposed/2022/34-96495.pdf; Proposed Rule: Regulation Best Execution, 88 Fed. Reg. 5440 (Jan. 27, 2023) (to be codified at 17 C.F.R. Parts 240 and 242) (the "Best Ex Rule Proposal"), *available at* https://www.sec.gov/rules/proposed/2022/34-96496.pdf; Proposed Rule: Disclosure of Order Execution Information, 88 Fed. Reg. 3786 (Jan. 20, 2023) (to be codified at 17 C.F.R. Part 242) ("605 Rule Proposal"), *available at* https://www.sec.gov/rules/proposed/2022/34-96493.pdf (collectively, the "Rule Proposals").

[3] Among other items, the Proposed Rule would: (i) amend the minimum quoting increments, also known as tick sizes, under Rule 612 of Regulation NMS to establish a variable minimum pricing increment that would apply to both the quoting and trading of NMS stocks; (ii) reduce the access fee caps under Rule 610 of Regulation NMS and require exchanges to make the amounts of all fees and rebates determinable at the time of execution; (iii) accelerate the implementation of the round lot and odd-lot information definitions adopted in 2020 under the

phased approach that begins with updating Rule 605 and then pausing to study and assess market quality based on the newly collected data before determining whether to move forward with the Proposed Rule and other proposals.

I. Executive Summary

In support of the new regime contemplated by the Proposed Rule, Chair Gensler has repeatedly asserted that harmonizing "tick sizes would help level the playing field between and amongst the dark and lit markets."[4] But this rationale is based on the false premise that there are rules in place today preventing exchanges from printing in sub-penny increments.[5] The playing field already is level. The notion that tick sizes need to be harmonized is a red herring aimed at masking the Commission's real objective – the elimination of off-exchange trading and the wholesaling business in order to drive more trading activity back to exchanges.[6] Rather than engaging in a risky experiment that arbitrarily dictates a new tick-size regime, the Commission should take a phased, methodical approach, starting with Rule 605 reform, which will enable the Commission to objectively measure outcomes and then consider any further rulemaking on an informed basis.

The purported benefits highlighted by the Commission in the Proposed Rule are decidedly theoretical and demonstrate a complete lack of understanding and appreciation of how the proposed changes will harm the marketplace and investors. Fragmenting liquidity across more price levels makes it harder for investors to find the liquidity they need, and will actually result in a wider NBBO, ***increasing the cost of liquidity***. Because of increased odd lot trades and message traffic that will result from smaller tick sizes, pennying will become more prevalent, which will ***reduce incentives for market makers and institutions to provide liquidity***. Similarly, the Proposed Rule's contemplated limitation on exchange rebates and fee tiers would ***reduce incentives to provide liquidity and harm competition*** between exchanges, especially new exchanges.

What is especially puzzling is the fact that the Commission seems to be ignoring the substantial research it conducted in its consideration of the Sub-Penny Rule in 2005, which

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Market Data Infrastructure ("MDI") rules; and (iv) amend the odd-lot information definition adopted under the MDI rules to require the identification of the best odd-lot order.

4 *See, e.g.*, SEC Chair Gary Gensler, Statement on Minimum Price Increments, Access Fee Caps, Round Lots, and Odd-Lots (Dec. 14, 2022), *available at* https://www.sec.gov/news/statement/gensler-tick-size-20221214.

5 Proposed Rule, *supra* note 2, at 24 ("Rule 612 prohibits national securities exchanges, national securities associations, ATSs, vendors and broker-dealers from displaying, ranking, or accepting quotations, orders, or indications of interest in any NMS stock priced in an increment smaller than $0.01 if the quotation, order, or indication of interest is priced equal to, or greater than, $1.00 per share."); *but see id*. at 25 ("the Commission granted exemptions from rule 612 to various national securities exchanges to establish 'retail liquidity programs' that allow them to accept and rank certain quotes and orders from certain participants in sub-penny increments as small as $0.001.").

6 The volume of NMS stocks traded on exchanges has remained at around 60% for the last 13 years, suggesting there is sufficient competition preventing any one trading venue from taking over a disproportionate share of the market. *Compare* OCR Proposal at 191-92 *with* Concept Release on Equity Market Structure at 15, Release No. 34-61358; File No. S7-02-10 (Jan. 14, 2010), *available at* https://www.sec.gov/rules/concept/2010/34-61358.pdf. The Proposed Rule would instead simply artificially increase exchange volumes.

ultimately concluded $0.01 to be the optimal tick size. In the Proposed Rule, the Commission has not provided adequate explanation for how its previous analysis of what was optimal then does not apply now. Equally puzzling is the Commission's reliance on the Tick Size Pilot ("TSP") as a basis for supporting the new regime contemplated by the Proposed Rule. The TSP studied the impact of a ***widened*** minimum quoting and trading increment for certain small capitalization stocks, and offered no analysis, data, or conclusions on the potential impact that a narrowed, sub-penny tick regime would have on the marketplace, the investor experience, or issuers.[7] It is an apples-to-oranges comparison and is irrelevant as a basis for support.

Moreover, the Commission has failed to consider the compound impact of the Proposed Rule on the three other market structure Rule Proposals released in conjunction with the Proposed Rule, and vice versa. Specifically, the changes to tick sizes set forth in the Proposed Rule will significantly impact the baseline conditions the Commission relies upon in calculating expected costs and benefits of the other Rule Proposals, thereby casting doubt on the Commission's projections in its economic analyses. The Proposed Rule also relies, in part, on data from Rule 605 reports – which use metrics that the Commission has acknowledged are deficient and in need of modification.[8] Reforms to Rule 605 reports will therefore necessarily impact the data underlying the Proposed Rule's economic analyses in ways for which the Commission has not adjusted.

Experts and market participants alike have raised serious concerns with the Commission's analysis. Attached to this letter, and incorporated by reference, is the Report of Professor Craig Lewis, the Madison S. Wigginton Professor of Finance and Professor of Law at Vanderbilt University. From June 2011 to May 2014, Professor Lewis was Chief Economist and Director of the Division of Economic and Risk Analysis at the U.S. Securities and Exchange Commission. Professor Lewis has identified significant deficiencies in the Commission's economic analysis and raises serious doubts as to crucial assumptions underlying the Proposed Rule and the other three rules proposed simultaneously by the Commission.

Virtu has separately submitted a joint statement with Cboe Global Markets, State Street Global Advisors, T. Rowe Price Group, and UBS Securities LLC, presenting a consensus position that urges the Commission to consider an iterative approach to enhancing retail investor execution quality.[9] Given the common objective in each of the proposed rules – to enhance execution quality for investors – we firmly believe this goal can best be achieved by updating and enhancing Rule 605 as it is arguably the most impactful and least disruptive of the proposed rules. Chair Gensler has repeatedly said that the NBBO yardstick is broken,[10] and the Commission already has a playbook for fixing the yardstick by adopting much-needed reforms to Rule 605 and implementing

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7 *See* Tick Size Pilot, Securities and Exchange Commission, *available at* https://www.sec.gov/ticksizepilot (last visited Mar. 26, 2023).

8 *See* Proposed Rule, *supra* note 2, at 205, n.557 (using realized spread statistics from Rule 605 reports to predict effect of decreased revenue for liquidity providers from smaller ticks).

9 Joint Letter of Cboe Global Markets, State Street Global Advisors, T. Rowe Price, UBS Securities LLC, and Virtu (Mar. 24, 2023), *available at* https://www.sec.gov/comments/s7-32-22/s73222-20161714-330556.pdf.

10 @GaryGensler, Twitter (Mar. 8, 2023, 11:30AM), *available at* https://twitter.com/GaryGensler/status/1633505358588284928.

enhancements to the NBBO required under the Market Data Infrastructure rules (i.e., publish odd lots and update round lot definitions). Only after fixing its yardstick would the Commission be equipped to accurately assess the market to determine where (if anywhere) the market could benefit from optimizations, such as price increment or fee changes. We encourage the Commission to return to its historical practice of taking a data-driven approach and engaging the industry to discuss potential enhancements or solutions to actual market failures.

Virtu is highly aligned with the joint letter submitted by the New York Stock Exchange ("NYSE"), Charles Schwab, and Citadel Securities, expressing similar concerns about the simultaneous implementation of four potentially far-reaching proposals.[11] They too have urged the Commission to consider a more targeted and phased approach, similar to the suggestions described above, that would reduce the risk of serious adverse consequences and allow the Commission to study the resultant impact on the market before proposing further changes. That these major institutions—all occupying distinct yet interrelated roles in our national securities market system—collectively reject the Commission's approach to the proposed rules in general, and the Proposed Rule in particular, strongly suggests that the Commission's process and analysis underlying the Proposed Rule is fundamentally flawed.

II. The Proposed Rule Risks Significant Harm to Retail Investors and the Marketplace

A. Smaller Tick Increments

The Proposed Rule's contemplated reduction of quoting tick increments carries significant risk of disrupting the marketplace and negatively impacting liquidity. Selecting optimal quoting increments is critically important because quoting increments impact many aspects of marketplace dynamics, including the cost of liquidity, incentives to provide liquidity, volatility, and messaging. Tiny tick sizes increase odd lots and message traffic while reducing depth as liquidity fragments across more price levels and narrower ticks reduce incentives to display liquidity, further weakening the NBBO. Studies show how tiny tick sizes can actually result in a wider NBBO, further increasing the cost of liquidity.[12] The pricing increment also affects incentives to provide liquidity. With smaller tick sizes, pennying will also become more prevalent, further discouraging liquidity provision by reducing the benefit to displaying a limit order to the market. In addition, finite trading tick increments would reduce opportunities for price and size improvement.

1. Definition of "Tick Constrained"

How "tick constrained" is defined is also a critically important feature of the Proposed Rule. In determining whether a symbol is "tick constrained," one must consider many factors, not just quoted spread. Getting this right is essential, and there appears to be a wide variance of views as to how many symbols are actually tick constrained.

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[11] Joint Letter of NYSE Group, Inc., Charles Schwab & Co., and Citadel Securities to the Securities and Exchange Commission (Mar. 6, 2023), *available at* https://www.ice.com/publicdocs/nyse/Joint_Consensus_Position_Letter_to_the_SEC.pdf.

[12] *See* Nasdaq, *Research on What Ticks Make Spreads Trade Best* (Mar. 2, 2023), *available at* https://www.nasdaq.com/articles/the-tick-spreads-that-help-stocks-trade-best.

In the Proposed Rule, the SEC estimates that well over half of NMS securities are tick constrained.[13] In a recent study, Cboe undertook a thoughtful analysis to test the validity of that estimate.[14] Specifically, Cboe examined the NBBO of all NMS securities during regular trading hours over an eight-month period. Cboe identified a subset of those securities trading over $1.00 and calculated the simple average quoted spread. The study found that "out of 10,125 securities, only 9% (877) should be considered preliminarily tick constrained —those with an average quoted spread of 1.1 cents or less[]."[15] Cboe then identified the securities in that subset that have a high quote size-to-trade size ratio (in the top 75 percentile) and a high average daily notional turnover (also in the top 75 percentile). Based on this analysis, Cboe concluded that ***only 67 symbols are in fact tick constrained and could potentially benefit from a reduction in the minimum quoting increments***.[16] The study concluded that applying a dynamic and objective framework to identifying tick-constrained names would enable "potential regulatory applications to be much more selective, and focused on actual market inefficiencies and needs, rather than a one-size-fits-all policy, which could potentially be harmful to market structure."[17]

Tick-Reduction Regime in Action

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13 *See* Proposed Rule, *supra* note 2, at 164.

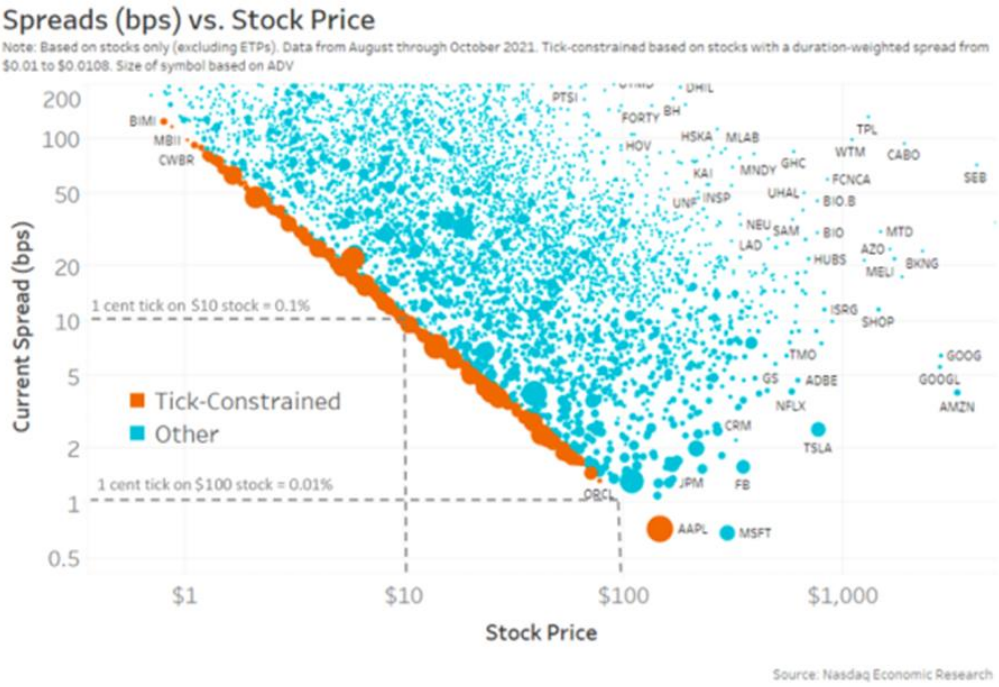
14 Cboe Global Markets, Comment Letter on Proposal on Regulation NMS: Minimum Pricing Increment, Access Fees, and Transparency of Better Priced Orders (No. S7-30-22) ("Cboe Comment Letter") (Feb. 28, 2023), https://www.sec.gov/comments/s7-30-22/s73022-20158236-326301.pdf; *see also* Cboe Global Markets, *Cboe Proposes Tick-Reduction Framework to Ensure Market Structure Benefits All Investors* ("Cboe Framework") (Sept. 22, 2022), *available at* https://www.cboe.com/insights/posts/cboe-proposes-tick-reduction-framework-to-ensure-market-structure-benefits-all-investors/.

15 Cboe Framework, *supra* note 14.

16 *Id*.

17 *Id*., Exhibit 5.

Based on its own analysis of stocks that trade with an average spread of less than 1.08 cents, Nasdaq also believes the number of tick-constrained stocks is significantly less than half of NMS stocks, as suggested by the Commission in the Proposed Rule.[18]



2. Tick Sizes That Are Too Small Lead to Negative Outcomes

Smaller tick sizes reduce incentives to provide liquidity. As Nasdaq concluded in a recent report, at smaller tick sizes, "the rate of pennying and excess message traffic could be a problem for mutual funds and market makers. Other research suggests having too many ticks actually widens spreads."[19] Nasdaq further observed that, for tick-constrained names, "[s]plitting ticks that much may cause spreads to drift wider or see less depth."[20] Consequently, this aspect of the Proposed Rule seems to have the potential to increase costs and harm market quality.

Smaller tick sizes will also lead to increased volatility and enable greater quote fading. In addition, message traffic will increase substantially. Messages are not free; they have a cost. This will increase the amount that market participants must spend to access and handle market data, adding to the exchanges' bottom lines. This increase in message traffic, when combined with dissemination of qualified auction information under the Proposed Order Competition Rule, will significantly add to the overall content of market data. The Commission has failed to analyze the

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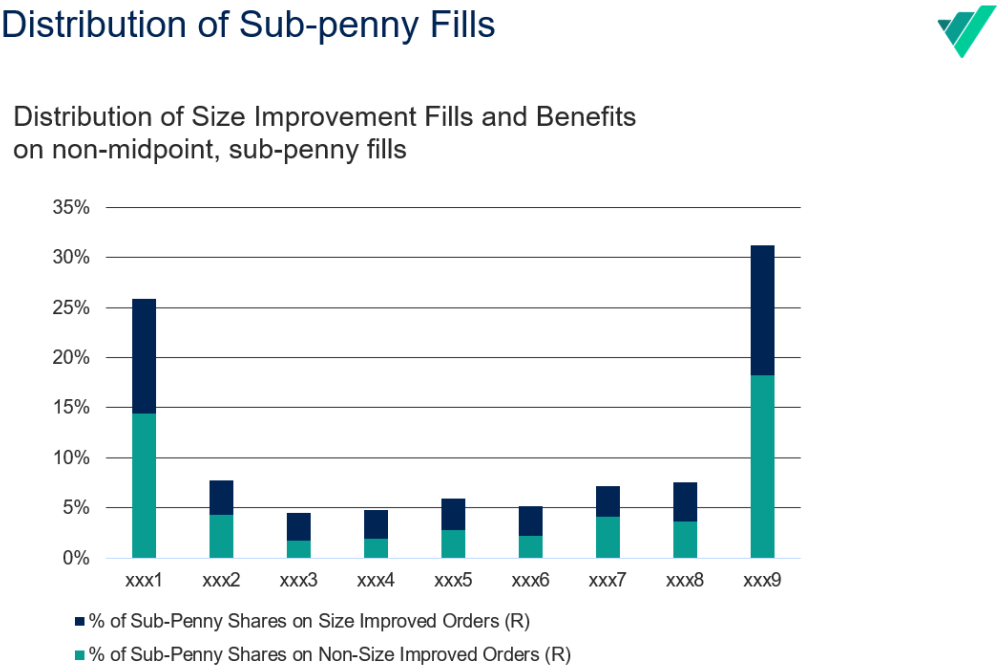
[18] Nasdaq, *The Tick Constrained Stock Problem* (Jan. 20, 2022), *available at* https://www.nasdaq.com/articles/the-tick-constrained-stock-problem.

[19] Nasdaq, *A Data-driven Summary of the SEC's New Proposals* (Feb. 13, 2023), *available at* https://www.nasdaq.com/articles/a-data-driven-summary-of-the-secs-new-proposals.

[20] *Id.*

impact of the significantly increased volume of market data on competing consolidators.

Further, forcing all trading to occur at wider price increments would only produce worse outcomes for investors via reduced price improvement and size improvement opportunities. In the Proposed Rule, the Commission neglects to quantify how much non-midpoint sub-penny trading is happening today and how much it benefits investors. Critics use the term "de minimis price improvement" when looking at trades filled at prices that are a few mils better than the NBBO. However, these critics are ignoring the size of the order filled relative to the size available at the NBBO. In the chart below, you can see that greater than 50% of retail volume filled at non-midpoint sub-penny prices were on size-improved orders, that is, orders that were for more shares than were available at the aggregate NBBO, yet were filled at prices better than the NBBO.



In a recent paper, Citadel noted that proponents claim eliminating the one-penny increment "is needed to 'level the playing field' between exchanges and off-exchanges venues so that exchanges can provide the same level of price improvement as wholesalers."[21] We agree with Citadel's conclusion that "public 605 data does not support this claim – even when unconstrained by the one-penny quoting rule, market participants on exchanges still do not quote or execute at prices that are as good as what can be achieved by wholesalers filling retail orders. As the debate about tick-size reform continues, we should bear in mind that any changes to the one-penny minimum quoting increment will not necessarily result in exchanges offering more competitive pricing."[22]

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[21] Citadel Securities, *Market Lens: Unlevel Playing Field? What 605s Can Tell Us About Tick Sizes* at 4 (Sept. 8, 2022), *available* at https://www.citadelsecurities.com/wp-content/uploads/sites/2/2022/09/Market-Lens-September-2022.pdf.

[22] *Id*.

3. Reducing Quoting Increments Fragments Liquidity Across Multiple Price Levels, Which Reduces the Quantity of Shares at the NBBO Price and Thereby Increases the Value of Exchanges' Direct Market Data Feeds

Reducing quote sizes may cause liquidity to fragment to finer tick increments, meaning market participants will need access to more price levels of market data to see the same quantity of shares as they were seeing prior to the Proposed Rule's reduction of quoting increments. For example, if there are 1,000 shares of a security available at $1.00 in the current market system, under the Proposed Rule there may be 100 shares available at each tenth of a penny increment at that same price ($1.001, $1.002, etc.). However, under the Proposed Rule, market participants would only see 100 shares available at the U.S. Securities Information Processor ("SIP"). To see all 1,000 shares that are available within $1.00, market participants would have to buy the direct data feeds from the exchanges because the SIP only publishes the top-of-book quote. Here, rather than leveling a playing field, the Proposed Rule would increase the value of exchanges' data by imposing a corresponding burden and costs on all other market participants.

4. The Proposed Rule Fails to Adequately Consider the Effect of Smaller Round Lots on the Robustness of the NBBO

Smaller round lots will also make the NBBO less robust, as a smaller amount of liquidity would now establish the NBBO benchmark. This reduced liquidity at the NBBO will be compounded by the proposed reduction in quoting tick sizes, which will disperse liquidity across more and finer price increments. Additionally, smaller round lot sizes will make it more difficult for institutions to discover how much liquidity is available and to trade in size, which increases their execution risk. To execute large orders, both institutions and retail orders alike will need to sweep across multiple market centers, exposing them to greater execution risk. Together, these changes would reduce the depth at the NBBO, leaving it subject to greater volatility and, in turn, reducing reliability and execution quality for retail investors.

B. Reduced Access Fees and Rebates Will Reduce Exchanges' Ability to Offer Incentives to Provide Liquidity and Will Harm Competition

In addition to reducing exchanges' ability to offer incentives to provide liquidity, limiting exchange rebates and fees would harm competition between exchanges by limiting their ability to offer differentiated pricing within the lower access fee cap. This restriction on competition would be especially felt by new exchanges and exchanges without significant listings, market data, and connectivity and data center revenue. Reducing exchanges' ability to incentivize posted liquidity hurts the NBBO in the form of wider spreads and less depth of liquidity. The reduced incentives for liquidity in thinly traded securities is especially concerning given how much liquidity improvements actually reduce an issuer's cost of capital and impact their ability to attract investors.[23]

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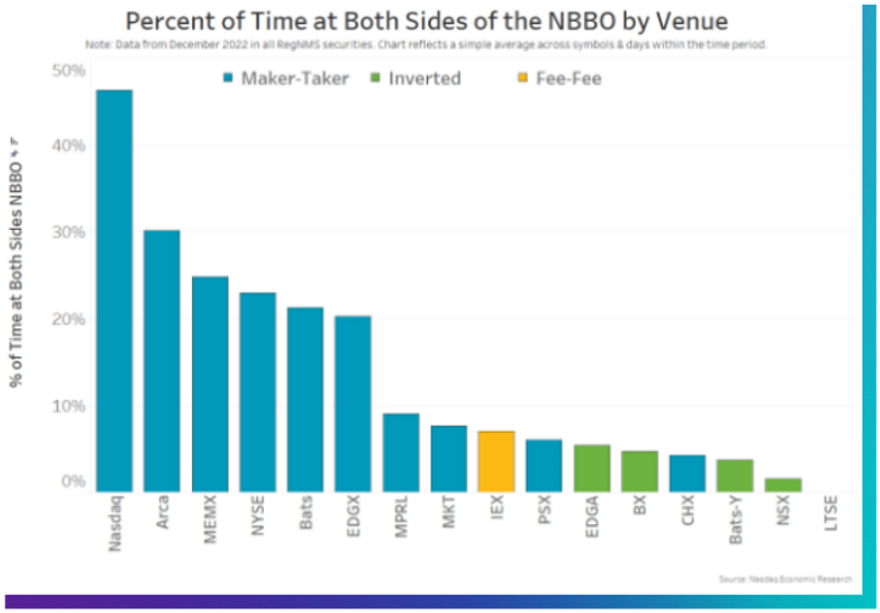
[23] *See, e.g.*, J. C. Lin, A. Singh, Wen Yu, Stock Splits, Trading Continuity, and the Cost of Equity Capital, 93 J. of Fin. Econ. 474, 475 (Jan. 1, 2009) ("On average, liquidity improvements reduce the cost of equity capital by 17.3%, or 2.42% points per annum, suggesting that the economic benefits of stock splits are nontrivial."), available at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1011.3751&rep=rep1&type=pdf.

In its recent paper, Nasdaq aptly summarized the risks posed by the reduction in incentives to provide liquidity that would result from lower access fees and rebates:

> [A]s we've said before, rebates are very different from other routing incentives. By being available to all and paid on lit quotes that lead to trades, they directly contribute to a tighter NBBO. That, in turn, creates "positive externalities" for the market – saving even those who trade off-exchange from crossing wider spreads, improving arbitrage and market efficiency, and reducing costs of capital for companies. The data clearly shows that markets offering liquidity providers a rebate have more competitive quotes, which we have found is especially important for thinly traded stocks.[24]

Chart 7: Time with a two-sided quote at the NBBO across all NMS Stocks



C. The Proposed Rule's Volume Fee Tier Rules Do Not Benefit Retail Investors or the Marketplace

The Proposed Rule's requirement that volume fee tiers are based on a prior period's activity is arbitrary and serves no purpose. We are perplexed as to why the Commission is choosing to wade into the business of telling private companies how to charge their customers. The Proposed Rule includes no data showing this change would cure any harm, nor does it claim any anticipated benefits that might flow from this change.

Moreover, requiring market participants to calculate their activity from the prior period in order to determine the volume fee and adjust their financial plans accordingly adds an unnecessary layer of complexity. The amount of effort required to understand the volume fee system, forecast

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[24] *See* Nasdaq, *supra* note 19.

volume fees for an upcoming period, and confirm that fees are indeed being calculated appropriately will especially disadvantage smaller brokers, who typically have less resources at their disposal for needless work such as this.

D. Revised Definitions of Round Lots Make the NBBO Less Robust and Reduce Transparency When Compounded with Tick Changes

Finally, the revised definitions for round lots would allow smaller order sizes to establish the NBBO benchmark, which, when combined with the Commission's proposed reduction in quoting tick sizes, as well as the changes contemplated in the Order Competition Rule Proposal, has the potential to significantly harm liquidity and make the NBBO less robust. In addition, taken together, the revised round lot definitions and quoting increments would significantly reduce transparency on the SIP and force more participants to purchase costly direct feeds to maintain the same level of transparency of liquidity.

III. The Commission Must Conduct Economic Analysis to Justify the Proposed Rule

The Securities Exchange Act of 1934, 15 U.S.C. § 78a et seq., (the "Exchange Act") expressly requires the Commission to consider, as part of the rulemaking process, "the impact any . . . rule or regulation would have on competition," and that the Commission may not adopt any "rule or regulation which would impose a burden on competition not necessary or appropriate in furtherance of the purposes of" the securities laws.[25] In addition, whenever the Commission is engaged in rulemaking generally "and is required to consider or determine whether an action is necessary or appropriate in the public interest, the Commission shall also consider, in addition to the protection of investors, whether the action will promote efficiency, competition, and capital formation."[26]

Circuit courts have repeatedly interpreted the above and similar statutory provisions, as well as general requirements under the Administrative Procedure Act, to require that the Commission conduct an economic analysis of any proposed rule.

> [T]he Commission has a unique obligation to consider the effect of a new rule upon "efficiency, competition and capital formation," 15 U.S.C. §§ 78c(f), 78w(a)(2), 80a-2(c), and its failure to "apprise itself—and hence the public and Congress—of the economic consequences of a proposed regulation" makes promulgation of the rule arbitrary and capricious and not in accordance with law. (citation omitted) . . . [T]he Commission acted arbitrarily and capriciously for having failed . . . adequately to assess the economic effects of a new rule. Here, the Commission inconsistently and opportunistically framed the costs and benefits of the rule; failed adequately to quantify the certain costs or to explain why those costs could not be

[25] 15 U.S.C. § 78(w)(a)(2).

[26] 15 U.S.C. § 78c(f); *see* 15 U.S.C. § 80a-2(c).

> quantified; neglected to support its predictive judgments; contradicted itself; and failed to respond to substantial problems raised by commenters.[27]

Further, courts have admonished that when agencies are charged with conducting an economic analysis, "it is a small matter to abide by the injunction of the arithmetic teacher: Show your work!"[28] As the Supreme Court has explained, an agency's most fundamental responsibility in issuing a rule is to "examine the relevant data and articulate a satisfactory explanation for its action including a 'rational connection between the facts found and the choice made.'"[29]

Executive Order 12866 sets forth the standards that federal agencies should follow when conducting a cost-benefit analysis required under the law:

> Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, ***such as material failures of private markets*** to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, ***including the alternative of not regulating***. . . Each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new agency action) as well as assess the significance of that problem.[30]

Consistent with these principles, the Commission's Division of Risk, Strategy, and

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[27] *Business Roundtable* v. *SEC*, 647 F.3d 1144, 1148–49 (D.C. Cir. 2011). For example, in *Am. Equity Inv. Life Ins. Co.* v. *SEC*, 613 F.3d 166, 178 (D.C. Cir. 2010), the court found that the SEC acted arbitrarily and capriciously when it failed to make a finding about the existing level of competition in the marketplace. Although the Commission urged that its rule would increase competition, the court found that, without first developing an understanding of the existing competition levels, the Commission "could not accurately assess any potential increase or decrease in competition." *Id.* In *Chamber of Commerce* v. *SEC*, 412 F.3d 133, 144–45 (D.C. Cir. 2005) the court found that the Commission violated the APA and failed to discharge its "statutory obligation to do what it can to apprise itself—and hence the public and the Congress—of the economic consequences of a proposed regulation" and to consider non-frivolous alternatives. It was not enough that the Commission disclosed difficulties determining certain costs or that it was without "a reliable basis" for determining those costs. *Id.*

Finally, in *Am. Petroleum Inst.* v. *SEC*, 953 F. Supp. 2d 5, 22–23 (D.D.C. 2013), the court found that the Commission failed to adequately consider alternatives when it simply dismissed proposed alternatives as too broad. It should have considered tailored versions of those alternatives and conducted a "fuller analysis" of alternatives "given the proportion of the burdens on competition" by the proposed rule. *Id.* at 23.

[28] *City of Holyoke Gas & Elec. Dep't* v. *FERC*, 954 F.2d 740, 743 (D.C. Cir. 1992).

[29] *Motor Vehicle Mfrs. Ass'n of U.S. Inc.* v. *State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (*quoting Burlington Truck Lines* v. *United States*, 371 U.S. 156, 168 (1962)).

[30] Executive Order 12866, Regulatory Planning and Review (Sept. 30, 1993), *available at* https://www.archives.gov/files/federal-register/executive-orders/pdf/12866.pdf (emphasis added). As an independent regulatory agency, the Commission is not legally bound by the requirements in Executive Order 12866. The Commission has acknowledged, however, that these principles represent accepted standards of good practice in conducting rulemaking proceedings. *See* Current Guidance on Economic Analysis in SEC Rulemakings at 3 (Mar. 16, 2012), *available at* http://www.sec.gov/divisions/riskfin/rsfi_guidance_econ_analy_secrulemaking.pdf.

Financial Innovation – now known as the Division of Economic and Risk Analysis ("DERA") – and the Commission's Office of the General Counsel ("OGC") issued guidance in 2012 on economic analysis in Commission rulemakings. The guidance provides that:

> Rule releases ***must include a discussion of the need for regulatory action and how the proposed rule will meet that need***. In some circumstances, there will be more than one justification for a particular rulemaking. Frequently, the proposed rule will be ***a response to a market failure that market participants cannot solve because of collective action problems***. Traditional market failures include market power, externalities, principal-agent problems (such as economic conflicts of interest), and asymmetric information.[31]

At the November 10, 2022, SIFMA Equity Market Conference,[32] the current Director of DERA underscored the importance of this guidance, explaining that identifying a market failure that needs to be addressed is Step 1 in DERA's process in conducting an economic analysis of a rulemaking.

We respectfully submit that, in issuing the Rule Proposal, the Commission has failed to satisfy its obligation under the Exchange Act, Executive Order 12866, the SEC's own administrative guidance, and relevant case law to identify a market failure that needs to be addressed, to articulate a satisfactory explanation for its action, or to consider the alternative of not regulating. The Commission has not provided reasons or supporting data that explains why existing finer trading increments are harmful to investors, or why its prior conclusion that $0.01 was the optimal tick size is no longer valid. Furthermore, the Commission has not quantified the costs of the rule, how they are outweighed by any potential benefit to retail investors, or why investors should be deprived of price improvement opportunities.

Indeed, the Commission admits that because it "does not have, and in certain cases does not believe it can reasonably obtain, data that may inform the Commission on certain economic effects, the Commission is unable to quantify certain economic effects," but that its "inability to quantify certain costs, benefits, and effects ***does not imply that such costs, benefits, or effects are less significant***."[33] In other words, the SEC acknowledges that there may be significant costs that it simply has not done the legwork to quantify, even though it has not even substantiated the need for the Proposed Rule to begin with.

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[31] Current Guidance on Economic Analysis in SEC Rulemakings, *supra* note 30, at 5 (emphases added).

[32] During the 2022 SIFMA Equity Market Conference, which consisted of a diverse industry audience, 93% of participants who were polled did not believe it was a good idea for the SEC to require auctions in equities markets for retail orders. *See* SIFMA Insights, *The 2022 Market Structure Week Debrief*, at 14 (Nov. 2022), *available at* https://www.sifma.org/wp-content/uploads/2022/11/SIFMA-Insights-Market-Structure-Debrief-2022-FINAL.pdf.

[33] Proposed Rule, *supra* note 2, at 146–47.

IV. The SEC's Economic Analysis is Fundamentally Flawed and Does Not Demonstrate That the Proposed Rule Would Improve Competition or Benefit Investors or the Marketplace

A. The Proposed Rule's Rationale for Harmonizing Tick Sizes is Based on a False Premise

The rationale offered by the Commission in support of the Proposed Rule is that there needs to be a "harmonization" of smaller tick increments so that all market centers are operating under the same rules. This rationale, however, is based on a false premise – in fact, existing quoting and trading increment rules ***are already uniform across market centers*** as there are uniform restrictions governing execution increments on any market center – exchange, ATS, or dealer.[34] An exchange's limitation on executing trades in sub-penny increments is a function of its own rules and offerings. In fact, many ATSs today provide sub-penny executions as a way of delivering significant price improvement to their participants; however, investors will lose these price improvement benefits if the Commission restricts trading to prescribed price increments.

The Commission has not performed an adequate economic analysis demonstrating the need for the Proposed Rule, the resultant costs and benefits, or that it considered alternatives – including not regulating. The release acknowledges that certain constraints faced by exchanges are partly due to the exchanges' own rules and not solely due to Commission regulations.[35] Accordingly, the Commission has not provided proper justification nor sufficient analysis regarding the purpose and impact of the Proposed Rule. In effect, the Commission is picking winners (exchanges) and losers (retail investors, issuers, wholesalers, ATSs and broker-dealers).

B. The Commission Has Failed to Demonstrate What Has Changed Since the Commission Last Considered – and Rejected – Moving to Sub-Penny Increments

As part of the Commission's consideration of the Sub-Penny Rule in 2005, the agency conducted a substantial amount of research related to tick size, and ultimately determined $0.01 to be the optimal tick size. The Commission provided a detailed explanation for why a penny tick size was optimal, listing concerns about penny-jumping, which would undermine execution priority, deprive the market of liquidity, and cause harm to investors. For example, the Commission observed:

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[34] Regulation NMS, Release No. 34-51808 at 231, File No. S7-10-04 at 230–31 (Aug. 29, 2005) ("Regulation NMS Adopting Release"), *available at* https://www.sec.gov/rules/final/34-51808.pdf ("After considering all views expressed on this issue, the Commission is adopting this aspect of Rule 612 as proposed and reproposed. Rule 612 will not prohibit a sub-penny execution resulting from a midpoint or volume-weighted algorithm or from price improvement, so long as the execution did not result from an impermissible sub-penny order or quotation. The Commission believes at this time that trading in sub-penny increments does not raise the same concerns as sub-penny quoting. Sub-penny executions do not cause quote flickering and do not decrease depth at the inside quotation. Nor do they require the same systems capacity as would sub-penny quoting. In addition, sub-penny executions due to price improvement are generally beneficial to retail investors.").

[35] *See* Proposed Rule, *supra* note 2, at 32 ("Accordingly exchange rules, and the requirement that such rules comply with rule 612, limit sub-penny trading on exchanges.").

> When market participants can gain execution priority for an infinitesimally small amount, important customer protection rules such as exchange priority rules and the NASD's Manning Interpretation as currently formulated could be rendered meaningless. Without those protections, professional traders would have more opportunities to take advantage of non-professionals, which could result in the non-professionals either losing executions or receiving executions at inferior prices. If investors' limit orders lose execution priority for a nominal amount, over time, investors may cease to use them, which would deprive the markets of a vital source of liquidity. Therefore, the use of sub-penny pricing could harm investors and the markets. [36]

While markets have become more automated since then, the same underlying market forces are still at play and today's technology would enable penny-jumping to be more prevalent. A review of the Regulation NMS Adopting Release shows that, at that time, some stocks were already constrained at a one-penny tick and the Commission reviewed and considered actual empirical evidence from commenters to that effect.[37] However, the Commission determined that stocks being tick constrained was not a sufficient reason to allow sub-penny quoting. In the Proposed Rule, the Commission does not explain why its previous analysis of what was optimal then does not apply now.[38] Notably, in passing the Sub-Penny Rule the Commission said that maintaining a $0.01 quoting increment would deter the practice of "stepping ahead of exposed trading interest by an economically insignificant amount,"[39] but the Proposed Rule would enable exactly this practice and thereby harm liquidity.

In addition, the Commission has simply specified the new tick-size levels,[40] and has not put forward any meaningful economic analysis to support the proposed tick-size schedule. Given the Commission's prior concerns about small tick sizes (less liquidity, pennying), the Commission should have provided more data-driven analysis about why these levels make sense. For example, the SEC could have conducted a new tick-size pilot to study the direct effects, or it could have evaluated appropriate tick size levels using effective spreads as a proxy for tick increments, given that high-priced stocks effectively quote in smaller effective increments than low-priced stocks.

Finally, the Commission presents ample evidence that, contrary to its assumption, the tick-

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[36] *See, e.g.*, Regulation NMS, Release No. 34-49325, File No. S7-10-04 (Feb. 26, 2004), *available at* https://www.sec.gov/rules/proposed/34-49325.htm. In the release, the Commission further noted that economic research "strongly suggests that much of the trading that currently takes place in sub-pennies is the result of market participants attempting to step ahead of penny-priced limit orders for the smallest economic increment possible. In the Commission's view, it is unlikely that the high rate of sub-penny clustering around $0.001 and $0.009 price points would have occurred in the absence of stepping ahead behavior. Furthermore, as OEA's research suggests, some sub-penny pricing as well as clustering around the 1 and 9 price points also occurred in increments finer than $0.001, which suggests that sub-penny pricing and the resulting stepping ahead activity could be taken to an absurd extreme." *Id.*

[37] Regulation NMS Adopting Release, *supra* note 34, at 353–354.

[38] *See* Ex. A, Craig Lewis, *The SEC's Proposed Rules for Equity Market Structure* at 32–33 (Section III.E.1) (Mar. 28, 2023).

[39] Regulation NMS Adopting Release, *supra* note 34, at 219.

[40] Proposed Rule, *supra* note 2, at 75-76.

size rule is not really a constraint because markets have developed various ways of allowing market participants to trade inside the spread. For example, Table 3 of the Proposed Rule shows tens of billions of dollar volume executed daily at midpoint both on- and off-exchange, as well as millions of dollars in daily price improvement at smaller increments inside the spread.[41]

C. The Proposed Tick Size Reduction Would Result in Less Liquidity and Transparency on Exchanges and Increase Costs to Market Participants

The Commission inappropriately uses the Tick Size Pilot ("TSP") to justify its proposed changes to the tick size by studying the effect of reducing the tick size from $0.05 to $0.01 at the end of the program. The TSP exclusively dealt with small cap stocks, yet the Commission extrapolates the observed effects to large cap stocks.[42] The Commission has not justified its assumption that these different classes of securities would have the same impact. The Commission even admits in its release that "[u]sing the TSP for analysis . . . has limitations because the TSP affected a subset of small cap stocks and primarily focused on changes in tick size."[43] In addition, there appears to be a number of technical flaws with the regression models relied upon by the Proposed Rule, such as not controlling for fixed effects and having an overly simplistic model that does not account for changes in volatility and individual stock returns, among other items.

For tick-constrained stocks, while a smaller tick size may result in tighter spreads, it would come at the cost of less liquidity, i.e., fewer shares, at the NBBO. This is because liquidity that is currently concentrated at the penny would likely disperse across the finer pricing increments, decreasing the liquidity at the top-of-the-book.[44] This change has specific consequences that could adversely increase costs to both investors and issuers alike.

When it passed the Sub-Penny Rule in Reg NMS, the Commission thought this was a problem: "The Commission believes that sub-penny quoting impedes transparency by reducing market depth at the NBBO and increasing quote flickering. In an environment where the NBBO can change very quickly, broker-dealers have more difficulty in carrying out their duties of best execution and complying with other regulatory requirements that require them to identify the best bid or offer available at a particular moment (such as the Commission's short sale rule and NASD's Manning rule)."[45]

More depth at the top-of-the-book simplifies order execution, as many executions can be completed in a single trade. If liquidity becomes more dispersed, the same trade may need to be executed across smaller lots, which could impose additional technology costs on investors and could also result in information leakage that indirectly increases investor costs. Some market

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41 Proposed Rule, *supra* note 2, at 161–63; Ex. A at 32–33 (Section III.E.1) ("Moreover, exchange mechanisms that allow for sub-penny prices already exist, and multiple exchanges have already established complementary retail programs, such as the NYSE's Retail Liquidity Program, Nasdaq's Retail Price Improvement Program, and IEX Exchange's Retail Program, which offer sub-penny executions.").

42 *See* Proposed Rule, *supra* note 2, at 198–99.

43 Proposed Rule, *supra* note 2, at 195.

44 *See* Ex. A at 34 (Section III.E.2) (discussing academic literature in which this effect is "well documented").

45 Regulation NMS Adopting Release, *supra* note 34, at 352.

participants make trading decisions using SIP data, which only shows top-of-book data. Because there will be less liquidity at the top-of-book, these investors will have less visibility into total market liquidity. Under the changes contemplated by the Proposed Rule, more participants will likely find it necessary to purchase more expensive depth-of-book data from exchanges in order to see the same amount of liquidity.

Moreover, there is an economic trade-off with a narrower bid-ask spread. A wider spread incentivizes an investor to provide liquidity: in providing liquidity, the investor foregoes certainty and immediacy in exchange for cost savings as the investor is compensated by earning the spread. On the other hand, an investor can pay the spread to guarantee a fill (by submitting a market order) — this is the "cost of immediacy." As the spread narrows, it decreases the incentive for investors to provide liquidity, and, at a certain point, liquidity providers switch to becoming liquidity demanders because they determine that the "cost of immediacy" is sufficiently low, or the incentive to provide liquidity is not large enough.[46] Accordingly, the narrower spreads that could result from a lower tick size for tick-constrained stocks will result in less liquidity, which would increase costs for investors.

D. The Proposed Rule Fails to Adequately Consider the Effect of Reducing Access Fees and Limiting Rebates and Tiers on Liquidity and Competition

Limiting rebates and tiers will reduce incentives to provide liquidity and will harm competition between exchanges. This effect will be especially strong with respect to new exchanges, as reducing revenue opportunities for exchanges that may not yet have significant listings or strong data center operations will limit their ability to differentiate pricing from established exchanges.[47]

However, the Commission fails to adequately assess the market impact of reduced liquidity and competition as a result of limiting rebates and tiers and reducing access fees. Rather than engage in an empirical analysis to quantify the impact to traders, the Commission generally opines that a resulting "reduction in liquidity provision may not be harmful to trading quality for [] stocks [with narrow spreads], under the reasoning that the reduction in rebates would alleviate currently existing distortions that lead to an oversupply of liquidity relative to the demand of liquidity."[48] Yet, the Commission does not explain what these purported "existing distortions" in liquidity supply are, nor does it attempt to quantify the current liquidity oversupply.

The Commission also opines that under the Proposed Rule, a "reduction in liquidity provision likely means that some proprietary trading desks and firms that currently specialize in

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[46] *See, e.g.*, Robert Bloomfield et al., *The 'Make or Take' Decision in an Electronic Market: Evidence on the Evolution of Liquidity*, 75 J. of Fin. Econ. 165, 174 (Feb. 2005) ("as spreads narrow, the benefits of the better price available to limit order traders decrease, causing more traders to prefer the certain execution of the market order."); Angelo Ranaldo, *Order Aggressiveness in Limit Order Book Markets*, 7 J. of Fin. Markets 53, 60 (2004) ("a wider spread encourages limit order placement and discourages market order submission.").

[47] *See supra* Section II.B.

[48] Proposed Rule, *supra* note 2, at 228.

providing liquidity and capturing rebates would cease operation."[49] The Commission fails to explain, though, how an environment with fewer liquidity providers would promote competition. It also provides no insight into the anticipated trading quality of thinly traded stocks and stocks with wider spreads if there are fewer liquidity providers operating in the market. Instead, the Commission focuses solely on the impact for "stocks with narrow spreads."[50]

Finally, the change in access fee cap would also reduce market liquidity. Reducing the access fee cap would also decrease the amount of rebates that exchanges are able to offer to attract liquidity. As fewer (more) market participants supply (demand) liquidity, liquidity would diminish, and investors' execution quality would worsen.

E. The Proposed Rule Fails to Account for Certain Key Metrics in Determining Tick-Size Constraints

The Commission's proposed methodology for determining tick-constrained stocks fails to include critical factors such as the Quote-Trade Ratio[51] and Notional Turnover Ratio[52] and will therefore lead to certain stocks being inaccurately labeled as tick constrained. The Proposed Rule provides no explanation for excluding these metrics from the Commission's methodology, despite the fact that both of these metrics are objective signals that show where there is ample liquidity and trading activity to support smaller quoting increments.[53] Incorporating these metrics, a Cboe analysis of tick-constrained stocks found that only 67 stocks should be considered tick constrained.[54] To accurately determine which stocks are truly tick-constrained, and actually achieve the Commission's stated goal of reducing effective spreads, the Commission must either incorporate the Quote-Trade Ratio and Notional Turnover Ratio into its methodology, or at the very least explain why it has chosen not to do so.

F. The Proposed Rule Fails to Adequately Consider the Effect of the New Access Fee Cap for All Market Participants

The Commission has arbitrarily selected new access fee caps without any quantitative basis or analysis for those selections. Crucially, the Commission has failed to consider the impact of the Proposed Rule on access fees as a percent of quotations. The only justification it provides for the new access fee levels is that trading centers will be able to maintain their "current net capture rate and [that the fees would] not impair the agency market business models," rather than assessing what the best access rates would be for the national market system itself.[55] The Commission's

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49 *Id*. at 230.

50 *Id*.

51 The "Quote-Trade Ratio calculates the daily average of each security's inside quote-size-to-trade-size ratio." Cboe Framework, *supra* note 14.

52 "The Notional Turnover Ratio calculates the daily average of each security's notional value traded divided by its daily market capitalization." *See id.*

53 *Id*.

54 *Id*.

55 Proposed Rule, *supra* note 2, at 100.

highly unusual consideration for preserving economic continuity in the exchanges' business models – a concern notably not demonstrated for broker-dealers, wholesalers, or ATSs – has no clear benefit for investors, further highlighting the extent to which the Proposed Rule disregards competition and instead picks winners (exchanges) and losers (retail investors, issuers, wholesalers, ATSs, and broker-dealers). Indeed, it is entirely appropriate for the Commission to assess the impact of the proposed access fee cap on market participants' varying business models. But any proposal should then account for the impact of the proposed access fee cap on *all* market participants and attempt to create the most competitive and effective environment on an overall basis, rather than doing so exclusively for exchanges.

G. The Proposed Rule Fails to Adequately Consider the Myriad Harms to the Marketplace That Could Result from Eliminating the Existing Minimum Quoting Increment

We agree with other market participants, including Citadel, that eliminating the one-penny minimum quoting increment could present significant risks to the marketplace. In its white paper, Citadel argued that "broadly eliminating the one-penny minimum quoting increment to which all market centers are currently subject can have many negative unintended consequences. As the Commission noted in its approval of the NYSE Retail Liquidity Program ("RLP"), widespread sub-penny quoting can lead to flickering quotes, reduced liquidity, higher transactions costs, and potentially increased dispersion in the securities markets."[56]

Furthermore, by way of example, the Commission has failed to address the impact of the Proposed Rule in other important contexts where reduced tick size would be consequential.

- The Commission has not considered what tick size a stock that undergoes a public offering should be assigned, and whether any variability between initial tick sizes across different exchanges may be exploited.

- It has not addressed how individual stocks in a stock split should be accounted for and whether they should retain the same tick size.

- The Commission does not account for cases in which a low-priced stock jumps to a higher price above $1.00. Under the current proposal, the stock would continue to have sub-penny pricing increments for the quarter despite its significantly increased price.

H. The Proposed Rule Fails to Address How This Rule Will Interact with the Other Market Structure Proposals and Other Existing Commission Rules

It appears that the Commission intends for the Proposed Rule to be adopted or implemented at the same time as three other interrelated rules, each of which represents a substantial and fundamental change to equity market structure (perhaps with the exception of the Rule 605 proposal). The Commission has also issued more than two dozen other proposed rules in the past

[56] Citadel Securities, *supra* note 21, at 4.

18 months, many of which also affect equity market structure.[57] The cumulative effects of multiple, major changes to the market structure compound, making the need for careful analysis of their intersections indispensable. But the Commission has provided almost no analysis as to how the proposals relate to, or would operate with, each other and the anticipated cumulative effects if more than one proposed rule is adopted. The purported costs, benefits, operational risks, and effects of any one proposed rule are certain to change depending on whether one or more of the other Rule Proposals are adopted. Yet the Commission erroneously considers each rule independently—as if it were the only rule being proposed—using the current market structure as the baseline for each one, and ignoring the possibility that the other rules may alter that baseline or otherwise address the same objectives of other Rule Proposals.[58] Commissioner Uyeda recognized this fundamental flaw in his dissent:

> [T]he Commission proposed—side-by-side—four complex rules with interrelated effects—and did not even attempt to consider the combined impact of those proposals. Far from being an incremental process, where the Commission and other interested persons could learn from experience before proceeding with reforms, the Commission has launched a shock-and-awe approach with the hope that everything falls into place and – more importantly – improves on the status quo. Whether that will occur is an open question.[59]

Industry participants have also expressed concern about the Commission's approach; a respected industry participant from T. Rowe Price recently observed: "We have to look at them in totality, but when we do that, there's so many layers to what the SEC proposed that it's difficult to understand and appreciate whether or not it would actually be beneficial to the marketplace."[60]

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[57] For example, the Commission's proposed amendments to the rules governing ATSs would change the definition of what is an "exchange" under SEC rules. Proposed Rule, *Amendments Regarding the Definition of "Exchange" and Alternative Trading Systems (ATSs) That Trade U.S. Treasury and Agency Securities, National Market System (NMS) Stocks, and Other Securities*, Release No. 34-94062; File No. S7-02-22 (Jan. 26, 2022), *available at* https://www.sec.gov/rules/proposed/2022/34-94062.pdf. The Proposed Rule fails to even reference that proposal, much less analyze how it would interact with the radical equity market structure changes contemplated in the Proposed Rule. Memorandum from Nicholas Padilla, Jr., Acting Inspector General, to Gary Gensler, Chair of the Securities and Exchange Commission at 3 (Oct. 13, 2022), *available at* https://www.sec.gov/files/inspector-generals-statement-sec-mgmt-and-perf-challenges-october-2022.pdf (noting SEC managers' concerns that the "more aggressive [regulatory] agenda—particularly as it relates to high-profile rules that significantly impact external stakeholders—potentially (1) limits the time available for staff research and analysis, and (2) increases litigation risk.").

[58] *See* Ex. A at 24–27 (Section III.C). *See* Securities and Exchange Commission, Open Meeting Part 01 at 1:08:25 – 1:09:00 (Dec. 14, 2022), https://www.youtube.com/watch?v=s9gdfxCoIq4 (Commission Division of Trading and Markets Director Zhu states that Commission believes each rule stands on its own and delivers its own benefit, in response to question whether staff has considered how best execution rule is likely to affect other rules being considered).

[59] Mark Uyeda, Commissioner, Securities and Exchange Commission, Statement on Final Rule on Shortening the Securities Transaction Settlement Cycle (Feb. 15, 2023), *available at* https://www.sec.gov/news/statement/uyeda-statement-settlement-cycle-021523.

[60] Janice Kirkel, *Industry fears burden of SEC's giant equity market makeover*, Risk.net, Feb. 24, 2023, *available at* https://www.risk.net/regulation/7956100/industry-fears-burden-of-secs-giant-equity-market-makeover (quoting Mehmet Kinak, T.Rowe Price Global Head of Systematic Trading and Market Structure).

In sum, understanding these intersections and the interoperability of the proposals is critical to ensuring that each of the four rules is actually necessary to enhance competition. Considering the significant overlap in the goals for the four Rule Proposals[61] (not to mention the other dozen rules proposed by the Commission) it would seem that if any of the other rules are successful at achieving their stated purpose, competition would be enhanced without the Proposed Rule (and its significant risks and costs) and the claimed benefits of the Proposed Rule are overstated.

With respect to the Proposed Rule, consider that the OCR Proposal is based on a baseline analysis of the existing market structure trading in full penny increments. The Commission does not take into account how adoption of reduced tick sizes under the Proposed Rule would alter its assessment of both the benefits and costs of the OCR Proposal. For example, the Proposed Rule assumes that reducing tick size would narrow spreads, yet the OCR Proposal is premised on the notion that wholesalers have higher realized spreads than orders executed elsewhere; but if tick sizes are reduced, spreads will theoretically narrow (if you accept the Commission's analysis and predictions) and the purported benefits of spread reduction by the OCR Proposal would be drastically overstated.

The Proposed Rule may also have detrimental impact on the effectiveness of other existing Commission rules, such as the Order Protection Rule (also referred to as the Trade-Through Rule). This rule is intended to protect investors from getting inferior execution when its order is displayed at the NBBO.[62] Less depth at the NBBO means there would be less volume receiving protection from the Trade-Through Rule.

Similarly, FINRA Rule 5320 prohibits a broker-dealer from trading ahead of a customer order unless an exception applies, such as where a broker-dealer provides price improvement to the order. Currently, the price improvement thresholds are measured at the level of a penny-per-share. The Commission has not explained how it or FINRA will recalibrate to account for the more granular tick sizes contemplated by the Rule Proposal.

More broadly, we are concerned that the economic analyses of each of the Proposals rely in part on execution quality reports under Rule 605 of Regulation NMS. However, the SEC acknowledges in the Rule 605 Proposal that the Rule 605 metrics are deficient and in need of enhancements.[63] It is unclear, therefore, the extent to which the Commission's analyses that use

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[61] *See, e.g.*, Proposed Rule, *supra* note 2, at 126 (proposing acceleration of implementation of round and odd-lot definitions so market participants can benefit from "increased transparency and enhanced execution quality"); 605 Rule Proposal, *supra* note 2, at 279 (stating that improving usability of Rule 605 reports "would lead to increased competition between reporting entities on the basis of execution quality, leading to improvements in the execution quality received by investors"); OCR Proposal, *supra* note 2, at 256 & n.499 (noting proposal will "increase competition" and "is predicted to improve execution quality"; also relying on measures of execution quality to justify rule throughout proposal); *see also* Best Ex Rule Proposal, *supra* note 2, at 15 (noting best execution obligations are premised on improving executions for customer orders).

[62] *See* Congressional Research Service, *The Trade-Through Rule* at 1 (June 6, 2005), *available at* https://crsreports.congress.gov/product/pdf/RS/RS21871.

[63] Rule 605 Proposal, *supra* note 2 at 174 ("[T]he utility of Rule 605 reports has been eroded, which has limited the Rule's ability to address the market failures identified in the Adopting Release [of Rule 605's predecessor in 2000], . . . [T]he metrics currently required to be reported by Rule 605 are no longer as useful for comparing execution quality across market centers as they were when Rule 605 was adopted, and other metrics that would

Rule 605 reports under the Proposed Rule, Best Ex Rule Proposal, and the OCR Proposal are reliable. For instance, the Commission acknowledges in the Rule 605 Proposal that Rule 605 reports would benefit from a size improvement metric. According to the Commission, a size improvement metric in Rule 605 reports would help address market participants' concerns of finding sources of liquidity for larger-sized orders.[64] At the same time, the Commission makes no attempt to evaluate size improvement as part of the OCR Proposal, nor does the Commission even acknowledge that the Rule 605 reports used to support the Commission's analysis in the OCR Proposal do not contain a size improvement metric and how that might impact its analysis.[65] The SEC needs to address these concerning inconsistencies between the proposals.

Presumably, the SEC envisions that the proposed amendments to Rule 605 will give retail investors more insight into the execution quality obtained by retail brokers, which will allow retail investors to switch to brokers who provide better execution. Assuming there is room for increased competition in the market, if realized, the Rule 605 amendments could increase competition across introducing brokers, and across wholesalers in a manner that improves execution quality without a need for the Proposed Rule (and its significant risks and costs). Indeed, a recent academic study indicates that proposed changes to Rule 605 may increase reported price improvement by up to 2.75 times currently reported figures.[66] Specifically, under the Rule 605 Proposal, covered orders would be expanded to include non-exempt short sales, odd lots, and (as noted) a size improvement metric. The study, by Notre Dame's Robert Battalio and Indiana University's Robert Jennings, found, based on a review of Rule 605 data and proprietary data provided by one or more wholesalers for the month of May 2022, that when short sales, odd lots, and size improvement are included – as would occur if the Rule 605 Proposal is adopted – price improvement as reported under Rule 605 increases from $81.2 million to $223.3 million.[67] If the Commission's proposed changes to Rule 605 are adopted and price improvement statistics of wholesalers significantly increase, this would matter significantly for the Commission's economic analyses in the Proposed Rule and other proposed rules.

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be useful for this purpose are not currently included in reporting requirements, which limits the current benefits of Rule 605 for promoting competition among market centers and improving execution quality for all types of investors.").

64 *Id*. at 130 ("The Commission believes that the use of size improvement statistics could help address these concerns by providing users of the statistics with information relating to which market centers and broker-dealers are more likely to be able to fill larger-sized orders at or better than the NBBO.").

65 While the Commission appears to have tried to mitigate some of the limitations of using Rule 605 data by supplementing its analyses with CAT data, the Commission does not appear to have tried to use CAT data to evaluate size improvement under the OCR. As noted, CAT data are also not available to the public and cannot therefore be evaluated by the public in its review and consideration of the Rule Proposals.

66 Robert H. Battalio, Robert Jennings, *Why Do Brokers Who Do not Charge Payment for Order Flow Route Marketable Orders to Wholesalers?* (Dec. 14, 2022), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4304124.

67 *Id*. at 19 ("Together, fully internalized and fully externalized orders adjusting for size improvement, odd lots, and short sells increases the Rule 605 defined price improvement from $81.2 million to $223.3 million, a 2.75-fold increase."). The Battalio and Jennings Study notes in footnote 25 that depending on how size improvement is calculated, the amount of price improvement is as high as $388 million for May 2022, which would be a five-fold increase. *Id.*

We recommend that the Commission amend Rule 605 to provide more comprehensive execution quality statistics on retail activity based on input from investors and market participants, and then pause to study and assess market quality based on the newly collected data before determining whether to move forward with the Proposed Rule.

V. The Commission Should Consider Other Alternatives That Do Not Risk Harm to Investors, Issuers, or the Marketplace

When an agency promulgates a rule, it must do more than provide a "detailed justification" for its decision (which the Commission failed to do here). It must also guard against regulatory instability by first considering reasonable "alternatives . . . within the ambit of the existing policy."[68] Here, the Commission did not consider a variety of viable alternatives that would be less burdensome and costly.[69]

For example, the Commission could have considered more avenues to facilitate midpoint execution for tick-constrained stocks. It could have proposed alternatives such as relaxing the Quote Rule to allow hidden quotes to be made available to retail order flow. This would be less invasive than requiring off-exchange market participants to comply with additional regulations.

As the NYSE has also offered in its comment letter on the four proposals, the Commission could also have pursued its goals by exploring innovations or enhancements to existing RLP programs.[70] As noted in the Proposed Rule, the Commission found that the first RLP, adopted on a pilot basis, was "reasonably designed to benefit retail investors by providing price improvement to retail order flow" and "could promote competition for retail order flow among execution venues."[71] The Commission has also observed that RLPs are "reasonably designed to minimize the concerns raised by sub-penny quoting."[72] Despite these benefits, RLPs have not attracted a significant volume of retail order flow. Rather than pursuing a radical overhaul of the tick size and access fee/rebate regime that has served the market well for nearly two decades, the Commission could have considered modest enhancements to the RLP programs to attract more order flow and study the resulting execution quality and related commercial dynamics. Yet this seemingly obvious and common-sense alternative is glaringly absent from the Proposed Rule.

The Commission also could have decided to maintain the status quo. There is evidence that the market does not perceive there is a substantive issue with the current structure, indicating that "no action" may be optimal:

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68 *DHS v. Regents of Univ. of Cal.*, 140 S. Ct. 1891, 1913 (2020) (brackets and internal quotation marks omitted).

69 *Wages & White Lion Invs., LLC v. FDA*, 16 F.4th 1130, 1139 (5th Cir. 2021) ("When an agency rescinds or alters a prior policy, its reasoned analysis must consider the alternatives that are within the ambit of the existing policy." (quoting *Regents*, 140 S. Ct. at 1913) (alteration incorporated; emphasis omitted)).

70 NYSE, Comment Letter at 6 (Mar. 13, 2023), *available at* https://www.sec.gov/comments/s7-31-22/s73122-20159564-327572.pdf.

71 Proposed Rule, *supra* note 2, at 26.

72 *Id*.

- If tick-constrained stocks were an economically important issue to investors, firms could address this by using stock splits or reverse stock splits, which would change the price level at which their stocks traded. This would have the effect of changing the relative value of a tick, and accordingly, the degree to which the tick constrained the stock. The fact that issuers do not discuss this indicates the issue is immaterial to them.

- Taking no action may also benefit slower traders. The Commission claims its proposal would benefit slower traders,[73] and while it is true that firms may have difficulty establishing time priority with a larger tick size, larger ticks do result in stickier prices which is not necessarily a bad outcome for slower traders. The frequency of "sniping" would be expected to *increase* as the tick size becomes smaller because smaller ticks generate faster and more frequent price changes.

Lastly, if the tick size were really a significant barrier to competition for exchanges, they could innovate solutions to solve for this. For example, exchanges could develop an order type that functions within the current structure (limit order pricing and priority-ranked based on even penny ticks) but where an order could provide sub-penny price improvement if matched to a marketable order from a counterparty that met certain objective conditions (such as being sourced from a retail customer). Or, alternatively, an exchange could introduce an order type that is executed at the penny but has a lower access fee (for maker taker exchanges) or a greater rebate (for inverted exchanges) for orders that meet certain objective conditions (such as coming from a retail investor) – in this structure, the routing broker could simultaneously offer price improvement back to its customer given the reduced fees it incurs.[74]

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[73] *Id*. at 257 ("A smaller tick could lead to greater competition on pricing, which more effectively balances liquidity supply and demand. This greater competition on pricing comes with reduced importance on time priority and discourages liquidity oversupply thereby allowing slower traders to better compete with faster traders to provide liquidity and earn the spread.").

[74] The exchanges would have to make SRO rule changes to implement such rules and the SEC would have to approve them.

* * *

The Commission has a long history of engaging in thoughtful, deliberate, and data-driven regulation – an approach well-suited to a topic as complex as tick size reform. Rather than engaging in a risky experiment that arbitrarily dictates a new tick-size regime, the Commission should embrace the scientific method, beginning with updating the NBBO yardstick through enhancements required under the Market Data Infrastructure rules and much needed reform to Rule 605. Only then should the Commission consider where (if anywhere) the market could benefit from quote increment or access fee reductions.

Respectfully Submitted,

Douglas A. Cifu
Chief Executive Officer

cc: The Honorable Gary Gensler, Chair
The Honorable Hester M. Peirce, Commissioner
The Honorable Caroline A. Crenshaw, Commissioner
The Honorable Mark T. Uyeda, Commissioner
The Honorable Jaime E. Lizarraga, Commissioner
Dr. Haoxiang Zhu, Director, Division of Trading and Markets

Exhibit A

The SEC's Proposed Rules for Equity Market Structure

Craig Lewis, Ph.D.*

March 28, 2023

* I am the Madison S. Wigginton Professor of Finance and Professor of Law at Vanderbilt University. From June 2011 to May 2014, I was Chief Economist and Director of the Division of Economic and Risk Analysis at the U.S. Securities and Exchange Commission. Virtu Financial, Inc. ("Virtu") provided financial support and access to its data in connection with this research.

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I. Introduction and Executive Summary

1. My name is Craig Lewis and I served as the Chief Economist and Director of the Division of Economic and Risk Analysis at the U.S. Securities and Exchange Commission ("SEC" or "the Commission") from June 2011 to May 2014. I received my Ph.D. in finance from the University of Wisconsin and have been a professor at Vanderbilt University since 1986, where I currently serve as the Madison S. Wigginton Professor of Finance. I have spent much of my career researching and analyzing U.S. financial markets and corporate financial policy. During my tenure at the SEC, my office co-authored a memo entitled "Current Guidance on Economic Analysis in SEC Rulemakings,"[1] which articulates the SEC's approach to conducting high-quality economic analysis in rulemakings and is still in effect today.

2. I submit this report which evaluates the package of equity market structure rules proposed by the Commission on December 14th, 2022 ("Proposed Rules"), with a particular focus on the economic analysis presented by the Commission. The rule package encompasses four interconnected proposed rules related to equity market structure: 1) the Order Competition Rule ("Order Competition Rule Proposal"),[2] which would require certain orders from individual investors to be subjected to a "qualified auction" before they can be internalized; 2) Regulation Best Execution ("Best Ex Rule Proposal"),[3] which would set forth a new best execution regime, in addition to the current regime administered by the Financial Industry Regulatory Authority ("FINRA") and Municipal Securities Rulemaking Board ("MSRB"); 3) Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders ("Tick Size Rule Proposal"),[4] which would establish variable minimum pricing increments and reduced access fee caps; and 4) Disclosure of Order Execution Information ("605 Rule Proposal"),[5]

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[1] Memorandum Re: "Current Guidance on Economic Analysis in SEC Rulemakings," Division of Risk, Strategy and Financial Innovation (RSFI) and the Office of the General Counsel (OGC), Securities and Exchange Commission, March 16, 2012, available at https://www.sec.gov/divisions/riskfin/rsfi_guidance_econ_analy_secrulemaking.pdf ("Guidance").
[2] See "Order Competition Rule," Release No. 34-96495; File No. S7-31-22, Securities and Exchange Commission, December 14, 2022 ("Order Competition Rule Release").
[3] See "Regulation Best Execution," Release No. 34-96496; File No. S7-32-22, Securities and Exchange Commission, December 14, 2022 ("Best Ex Rule Release"). Note, this rule proposal is applicable to fixed income and crypto asset securities as well. This report does not address these other asset classes.
[4] See "Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders," Release No. 34-96494; File No. S7-30-22, Securities and Exchange Commission, December 14, 2022 ("Tick Size Rule Release").
[5] See "Disclosure of Order Execution Information," Release No. 34-96493; File No. S7-29-22, Securities and Exchange Commission, December 14, 2022 ("605 Rule Release").

which would update the disclosure requirement for NMS stock order executions under Rule 605. All four proposed rules are based on the unsupported premise that the current system is insufficiently competitive and does not serve retail investors well. However, the Commission needs to provide a compelling economic justification for its rules individually and collectively, and therefore it needs to clarify how the package of rules will effectively promote efficiency and competition in the equity markets.

3. Historically, the Commission has taken a deliberate approach to additional rulemaking that considers the needs and concerns of both institutional and retail investors as it seeks to satisfy its mandate to protect investors and maintain fair, orderly, and efficient markets.[6] Noteworthy milestones include the deregulation of commissions and the development of consolidated dissemination of quotes and trades in the 1970s, the order handling rules in the 1990s, Regulation ATS in 1998, execution quality and order routing disclosures in the 2000s, decimalization in 2001, and Regulation NMS in 2005.[7] Since 2005, the regulatory framework has continued to evolve, enhancing market stability and improving investor experience.[8]

4. While the Commission should always seek and consider opportunities to enhance the markets, there is not a sound basis for a concern that retail investors are not well served in today's markets. The broad market consensus from retail brokers, wholesalers, buy-side, and exchanges, summarized by numerous market representatives at the SIFMA Equity Market Structure Roundtable held on September 13, 2022,[9] is that market quality for retail investors is very good and that drastic changes, such as those proposed, are not needed. There is also abundant academic research and empirical analysis that supports the view that the current system serves retail investors well.

5. The Commission presents new economic analyses in the proposing releases. For example, the so-called "Competitive Shortfall Analysis" purports to find evidence that the price improvement currently provided for retail orders could be much more significant. However, as

[6] The Commission's mandate also includes facilitating capital formation.
[7] See "The Commission Rate Issue," September 12, 1973; Release No. 14415, January 26, 1978; 43 FR 4342, February 1, 1978; Release No. 34-37619A, September 6, 1996; Release No. 34-40760, December 8, 1998; Release No. 34-43590, November 17, 2000; "Commission Notice: Decimals Implementation Plan for the Equities and Options Markets Exchange Committee on Decimals," July 24, 2000; Release No. 34-51808, June 9, 2005.
[8] See Release No. 34-61595, February 26, 2010; Release No. 34-67457, July 18, 2012; Release No. 34-73639, November 19, 2014; Release No. 34-80295, March 22, 2017; Release No. 34-83663, July 18, 2018.
[9] See "SIFMA Equity Market Structure Roundtable," *SIFMA*, September 13, 2022, available at https://events.sifma.org/equity-market-structure-roundtable.

explained in this report, this is an unsupported interpretation of an established and well-documented phenomenon, and the Commission has not demonstrated that the Proposed Rules would indeed provide such price improvement. Likewise, another one of the Commission's analyses purports to find large amounts of untapped liquidity at the midpoint when retail orders are being executed at less favorable prices, but for reasons explained below, this analysis has significant flaws and cannot be relied upon.

6. From a procedural standpoint, four simultaneous rules designed to address the same concern from different directions, and without a pilot, are unlikely to be an efficient or responsible policy-making approach. While economic analysis is always an essential part of the rulemaking process, it is even more crucial when simultaneous rule proposals interact using different approaches to address the same "problem."

7. The market has evolved in a way that works very well for retail and institutional investors alike. Under the current structure, wholesalers, a particular type of off-exchange market maker, play a central role in helping retail orders get high-quality executions. A clear understanding of the role wholesalers play is crucial to evaluating whether the Proposed Rules are more likely to help or hurt execution quality for retail investors. In particular, such an understanding is necessary to fully consider the economic effects of the Order Competition Rule Proposal, which would represent a radical change in how retail order flow is handled.

8. A summary of the findings in this report are as follows:

   a. Today's markets are highly efficient, particularly for retail investors, based on narrower quoted and effective spreads, significant price improvement, and faster execution speeds that are largely provided by wholesalers, who provide price improvement (including midpoint executions or better on over 44% of shares),[10] size improvement, and guaranteed executions of illiquid stocks. Wholesalers compete by providing high-quality executions, and retail brokers enforce competition by rewarding wholesalers who provide better execution quality with more order flow.

   b. The Commission proposes four separate rules designed to achieve the same overarching objectives, but contrary to its published guidance, the Commission does not justify why all four rules are necessary, neither individually nor in combination, and

[10] Order Competition Rule Release, Table 7.

instead evaluates each rule independently, ignoring the possibility that the other three rules in their individual capacity may already address the Commission's concerns. For this reason alone, the economic analysis in the Proposed Rules should be considered arbitrary and capricious.

c. The highly interconnected rules overlap in their intended benefits, but the costs tend to be orthogonal. Without a more robust analysis of the interaction effects of these complex rules, the Commission is unable to properly weigh the benefits of any given rule against its costs nor identify the least costly and least disruptive way to implement its rules.

d. The Commission presents an analysis of available non-displayed midpoint liquidity as support for its proposed Best Ex and Order Competition Rule Proposals. However, the Commission's analysis appears flawed as it ignores the economic reasons why this liquidity may not be accessible to retail investors and that some degree of "ignored" liquidity is not evidence of a failure of best execution. The Commission provides no guidance for how brokers should assess the various trade-offs in providing best execution in the new regime, such as how long an execution should reasonably be delayed in the search for higher levels of price improvement.

e. The Commission presents another analysis that compares realized spreads between exchanges and wholesalers to support its claim that qualified auctions would improve pricing for retail investors. However, its analysis needs to be reconsidered because it inappropriately compares realized spreads from a diverse set of liquidity providers with different motivations for providing liquidity, yielding an unreliable estimate of the proposed benefits under the Order Competition and Best Ex Rule Proposals. Also, without basis, the Commission uses realized spread to infer that institutional liquidity providers would participate in the auctions, ignoring that the retail liquidity programs offered by exchanges have attracted very little liquidity.

f. Additionally, numerous economic reasons suggest that implementing qualified auctions may not incentivize liquidity providers to participate, as some may have concerns about information leakage. Regardless, if liquidity is diverted from other

execution venues, market quality could worsen for retail and institutional investors by increasing adverse selection risk, resulting in wider spreads.

g. The Commission has not fully considered the Proposed Rules' possible unintended negative consequences that could undermine many of the benefits of the existing market structure, such as interfering with the competitive dynamics of wholesalers and retail brokers, which discipline prices and benefit retail investors. If adopted as proposed, the Proposed Rules could reduce or eliminate the significant benefits retail investors currently receive from wholesalers, including guaranteed executions for illiquid stocks, a substantial amount of price improvement including a high rate of midpoint executions, and size improvement. There is little reason to believe that wholesalers would continue to provide these benefits to the same degree they do today if the Order Competition Rule Proposal is adopted, resulting in increased trading costs to retail investors.

h. The 605 Rule Proposal is the least burdensome and costly of the proposed rules and may achieve all or most of the stated goals of the entire rule package. The 605 Rule Proposal also poses the least risk of creating unintended consequences associated with disrupting today's well-functioning market structure. Accordingly, the Commission should consider implementing the 605 Rule Proposal in isolation and then determine whether there is a need for further changes to the equity market structure, which could be implemented in pilot programs and in stages.

i. At its core, the approach taken by the Commission in its four rule proposals is an example of picking winners and losers without providing meaningful justification for its decisions.

II. Perspective on the U.S. Equity Market Structure and Past Regulations

9. A key question raised by the Proposed Rules is whether retail investors would receive better trade execution quality under a new market structure if the proposed rules were adopted. To address this and other questions, one must start with a clear understanding of the current state of equity trading, particularly from the perspective of retail investors. As discussed in this section, today's markets are highly competitive and reflect decades of regular, incremental

regulation by the Commission. Retail investors have benefited significantly from competitive equity markets, supported by a wealth of unambiguous empirical support showing that there has never been a better time to be a retail investor. Relative to prior decades, execution quality has improved while trading costs have decreased, both to a significant degree, and wholesalers have played a crucial role in helping retail investors achieve excellent execution quality and low trading costs.

A. Today's Markets Are Highly Efficient, Particularly for Retail Investors

10. These regulatory changes, coupled with technological advances, have greatly improved the experiences of all investors, and retail investors in particular. As an initial matter, direct trading costs, *i.e.*, trading commissions, have been virtually eliminated for retail investors trading through online platforms. Average commission rates as high as $35 per trade in 2003 fell to about $12 by 2012.[11] At the end of 2019, five major retail brokerages dropped their commission rates to zero in response to competitive pressures,[12] and most brokers currently do not charge commissions.

11. Based on a wide variety of well-documented metrics, it also is clear that execution quality has improved significantly for marketable orders of retail investors. Indicia of these improvements include narrower quoted and effective spreads, more significant price improvement, and faster execution speeds. For example, Angel, Harris, and Spatt (2015) show that the effective spreads of NYSE- and Nasdaq-listed stocks fell by more than 50% from 2002 to 2013.[13] According to a recent study by Modern Market Initiative, for "certain large cap stocks and ETFs," the bid-ask spreads had declined from "a range of 1-3 basis points by the 2010s [… to] about ½ a basis point [by 2020]."[14] The E/Q ratio, which measures the effective spread relative to the quoted spread and provides a normalized assessment of trade execution quality,

[11] James J. Angel, Lawrence E. Harris, and Chester S. Spatt (2015), "Equity Trading in the 21st Century: An Update," *Quarterly Journal of Finance*, Vol. 5, No. 1, Figure 11.
[12] "The Impact of Zero Commissions on Retail Trading and Execution," *Greenwich Associates*, February 25, 2020, available at https://www.greenwich.com/equities/impact-zero-commissions-retail-trading-and-execution.
[13] James J. Angel, Lawrence E. Harris, and Chester S. Spatt (2015), "Equity Trading in the 21st Century: An Update," *Quarterly Journal of Finance*, Vol. 5, No. 1, pp. 5−6. The authors observe effective spreads on NYSE and Nasdaq-listed stocks based on Rule 605 reports. Effective spread is "twice the difference between the actual trade price and the midpoint of the quoted National Best Bid or Offer ('NBBO') at the time of order receipt."
[14] "A Report on Market Automation and Dependable Liquidity in Times of Uncertainty: Investor Savings from Narrowed Bid Ask Spreads, Markets Functioning as Intended," *Modern Markets Initiative*, July 2022, p. 10.

has also improved over the years.[15] A recent white paper by Charles Schwab, which typically routes its marketable retail executions to wholesalers, shows that its average E/Q ratios declined by 67% in the last 15 years.[16] This substantial decrease translates into direct cost savings for retail investors.

12. "Price improvement" is an industry-standard metric that quantifies the quality of a trade execution by measuring the trade price relative to the best available prevailing public quote, as defined by Reg NMS, called the national best bid/offer ("NBBO"). In other words, price improvement quantifies the extent to which retail investors receive more favorable prices than the prevailing best quote on the exchanges. An industry report noted that "[n]early all retail broker-dealers send the overwhelming majority of their 'non-directed' orders—those not designated to go to a specific venue—to wholesale market makers" and estimated that between July 2018 and June 2019 "87% of retail market order shares received price improvement."[17] This report estimated that wholesalers provided $1.3 billion in savings to retail investors in 2018. The largest source of price improvement comes from wholesalers, and it has been increasing over time. Bartlett (2022) shows that the daily percentage of non-exchange trades in Dow stocks receiving price improvement has increased between 2014 and 2020 by as much as 50% for both round and odd lots.[18] Price improvement also can be achieved on exchanges through retail liquidity programs ("RLPs") or when hidden liquidity is available. Besides price improvement, retail investors also benefit from size improvement, which is sometimes referred to as "enhanced liquidity," and is the execution of more shares than the displayed amount at the NBBO quote.[19] Many retail orders exceed the amount of displayed liquidity at the NBBO and receive size improvement—an analysis by Virtu estimates that 45% of retail share volume (54% of retail

[15] The 605 Rule Proposal adds this metric as an update to the execution quality disclosure under Rule 605 of Reg NMS.
[16] "U.S. Equity Market Structure: Order Routing Practices, Considerations, and Opportunities," *Charles Schwab*, Q2 2022 ("Schwab White Paper"), Exhibit 3.
[17] "The Impact of Zero Commissions on Retail Trading and Execution," *Greenwich Associates*, February 25, 2020, available at https://www.greenwich.com/equities/impact-zero-commissions-retail-trading-and-execution.
[18] Robert P. Bartlett, III (2022), "Modernizing Odd Lot Trading," *Columbia Business Law Review*, Vol. 2021, No. 2, pp. 539, 545. See Figure 4.
[19] Schwab White Paper, Footnote 21.

notional volume) received size improvement in 2020.[20] Charles Schwab estimated that its customers received approximately $4.4 billion in size improvement in 2021.[21]

13. Moreover, execution speed has become significantly faster over the last few decades, with current execution times for most trades averaging just fractions of a second. Angel et al. (2015) show that the average execution time for trades of NYSE-listed stocks ranging in size from 100 to 9,999 shares decreased from approximately 25 seconds in 2001 to approximately two seconds in 2012.[22] This trend has continued. Several retail brokers report that their average execution time for orders of fewer than 1,999 shares in Q1 2022 was 0.05 seconds or less.[23]

B. The Role of Wholesalers and the Benefits They Provide to Retail Investors under the Current Market Structure

14. In today's markets, wholesalers play a crucial role in improving trading results for retail investors. Understanding this role provides helpful context to better understand and evaluate how potential regulations could upend and disrupt the balancing factors that have contributed to the structure of today's equity markets, and which currently benefits retail investors.

15. Trading in U.S. equity markets is highly competitive. There are 16 nationally registered stock exchanges, more than 30 alternative trading systems ("ATSs"),[24] and many dealers and off-exchange market makers who facilitate or provide liquidity for off-exchange executions. In 2020, trading on the national securities exchanges accounted for 62% of the dollar trading volume, while trading on ATSs accounted for about 11%, and trading on non-ATS venues accounted for 27%.[25]

16. The number and diversity of trading venues and liquidity providers indicate significant competition in U.S. equity markets. Numerous aspects of the current regulatory regime

[20] "Measuring Real Execution Quality," Presentation to the Investor Advisory Committee at the U.S. Securities and Exchange Commission, updated August 27, 2021, Virtu Financial. Available at: https://virtu-www.s3.amazonaws.com/uploads/documents/virtu-real-pi_20210827.pdf.
[21] Charles Schwab notes that "Size improvement, according to Virtu, was approximately 2x the amount of net price improvement on Rule 605 covered orders. Schwab's net price improvement was $2.2B in 2021." Schwab White Paper, p. 13.
[22] James J. Angel, Lawrence E. Harris, and Chester S. Spatt (2015), "Equity Trading in the 21st Century: An Update," *Quarterly Journal of Finance*, Vol. 5, No. 1, p. 12.
[23] See e.g., "Commitment to execution quality," *Fidelity*, available at https://www.fidelity.com/trading/execution-quality/overview; "Order Execution Quality," *TD Ameritrade*, available at https://www.tdameritrade.com/tools-and-platforms/order-execution.html.
[24] "SIFMA Insights: US Equity Market Structure Analysis," *SIFMA*, September 2021, available at https://www.sifma.org/wp-content/uploads/2021/09/SIFMA-Insights-Market-Structure-Matters-09-2021.pdf, p. 4.
[25] "2022 FINRA Industry Snapshot," *FINRA*, available at https://www.finra.org/sites/default/files/2022-03/2022-industry-snapshot.pdf, p. 37.

encourage and intensify competition among these venues. Moreover, as market structure has evolved, trading firms, to remain competitive, have sought to improve execution quality and lower trading costs for institutional and retail investors. One type of market innovation that has resulted in better execution quality is pooling investors into separate risk pools. For example, ATSs are venues where passive institutional investors, whose primary economic motive is to minimize the price impact of their order executions, trade anonymously. By executing trades in "dark pools," these investors avoid exposing their large trades while seeking potential buyers and sellers. Another example is how wholesalers serve as strategic outsourcing venues for retail brokers. Because retail trade flow is associated with lower adverse selection risk (meaning a lower chance that the market will move against the liquidity provider after a trade), wholesalers can provide better execution quality by segmenting order flow into separate markets based on their relative degree of informativeness, while on-exchange market makers handle trade flow associated with higher adverse selection and are unable to segment order flow.

17. Brokers still face challenges when trying to satisfy their best execution obligations. For example, there are many venues where liquidity providers do not display their quotes, such as ATSs and hidden orders on exchanges, making it harder for brokers to find the best price available for their customers.

18. Wholesalers perform two separate but interrelated functions concerning the execution of retail orders. First, wholesalers act as market makers who provide liquidity to retail orders by standing ready to buy or sell securities regularly and continuously on their own account. This requires a capital commitment so that they can provide liquidity in quantities sufficient to take the other side of the trade. In doing so, wholesalers take shares into their inventory, creating long or short positions that exposes them to market risk.

19. Second, they work with retail brokers to facilitate the "handling and execution" of the retail brokers' orders. Because they handle order flow and are not merely providing liquidity as a market maker, the wholesaler takes on the duty of best execution for these orders. Thus, a wholesaler cannot simply internalize all order flow but rather it must diligently find the best available price.[26] In practice, this means that wholesalers have direct connections to the

[26] Under FINRA rules, this means that the wholesaler "shall use reasonable diligence to ascertain the best market for the subject security and buy or sell in such market so that the resultant price to the customer is as favorable as possible under prevailing market conditions." See "Regulatory Notice 21-23, Best Execution and Payment for Order Flow," FINRA, available at https://www.finra.org/sites/default/files/2021-06/Regulatory-Notice-21-23.pdf.

exchanges, ATSs, and other dealers and can access liquidity in those other venues on behalf of the retail orders when necessary to ensure the customer order gets the best price available. Wholesalers typically accept order flow on a wide range of securities, including many that are highly illiquid. An analysis of proprietary data from Virtu shows that in December 2020, it accepted orders on nearly 8,000 distinct equity securities.[27]

20. Numerous studies use public and private data to document how trades routed to wholesalers receive superior execution relative to those routed to public exchanges. For example, Kothari, Johnson, and So (2021) show that the average price improvement for trades from Robinhood, which routes almost all of its trades to wholesalers, is 52% better than the price improvement for exchange trades of the same stocks on the same day.[28] Battalio and Jennings (2022) use proprietary data and exchange feeds to compare "seemingly identical" marketable orders routed to wholesalers and exchanges.[29] When factoring in exchange fees, they find wholesalers receive better prices over 90% of the time. Additionally, they find that wholesalers provide substantial supplemental price improvement to orders routed to external venues. In other words, using their own capital, wholesalers improve the execution prices given to customers. The net effect is that customers who would otherwise receive negative price improvement on these orders executed on an exchange receive positive price improvement from wholesalers.[30] Dyhrberg, Shkilko, and Werner (2023) use over three years of publicly available monthly data to compare trade quality between a set of aggregated wholesalers and a set of aggregated exchanges.[31] They report a higher portion of price-improved shares from wholesalers (66% vs. 10%) and a lower E/Q ratio for wholesalers (0.76 vs. 0.97) and conclude that "retail investors would generally be worse off on exchanges." The Commission's analysis of Rule 605 data (presented in "Table 6" in the Order Competition Rule Proposal) indicates an even sharper contrast between wholesaler and exchange execution quality. It reports higher fill rates of 69.1% vs. 27.3%, better E/Q ratios of 0.42 vs, 1.00, and a larger proportion of price-improved shares of

[27] See the Appendix for more details.
[28] S.P. Kothari, Travis L. Johnson, and Eric C. So, "Commission Savings and Execution Quality for Retail Trades," working paper, p. 2, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3976300.
[29] Robert H. Battalio and Robert H. Jennings, "Why do Brokers who do not Charge Payment for Order Flow Route Marketable Orders to Wholesalers?," working paper, cover page, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4304124.
[30] The analysis of Virtu data in the Appendix is consistent with this finding, showing that in December of 2020, Virtu provided $7.8 million in supplemental price improvement, of which $6.8 million was provided for orders routed fully or partially to exchanges.
[31] Anne Haubo Dyhrberg, Andriy Shkilko, and Ingrid M. Werner, "The Retail Execution Quality Landscape," working paper ("Dyhrberg et al."), p. 11, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4313095.

84.7% vs. 8.8% for wholesalers vs. exchanges.[32] For convenience, I show the Commission's analysis in Table 1.

Table 1: Excerpt from "Table 6: Rule 605 Wholesaler (WH) and Exchange (EX) Execution Quality Comparison for Marketable Orders under $200,000 for Q1 2022 by Security Type"

	All NMS Stocks	S&P 500	Non-S&P 500	ETF
Average Price	$33.99	$97.03	$13.52	$51.19
WH Share Volume (billion shares)	96.51	15.00	62.32	19.18
WH Dollar Volume (billion $)	$3,280.03	$1,455.40	$842.66	$981.98
EX Share Volume (billion shares)	172.08	39.89	86.67	45.52
EX Dollar Volume (billion $)	$9,025.52	$3,448.64	$1,899.61	$3,677.27
WH Fill Rate (%)	69.06%	73.17%	66.65%	65.03%
EX Fill Rate (%)	27.31%	32.53%	29.56%	17.63%
WH Effective Spread (bps)	2.05	0.72	5.70	0.89
EX Effective Spread (bps)	3.11	1.45	7.86	1.49
WH Realized Spread (bps)	0.72	0.30	1.55	0.64
EX Realized Spread (bps)	-0.67	-0.30	-1.97	-0.12
WH Realized Spread Adj PFOF (bps)	0.43	0.17	0.86	0.45
EX Realized Spread Adj Rebate (bps)	-0.001	-0.05	-0.24	0.28
WH Price Impact (bps)	1.33	0.42	4.15	0.25
EX Price Impact (bps)	3.78	1.74	9.83	1.61
WH E/Q Ratio	0.42	0.35	0.49	0.45
EX E/Q Ratio	1.00	0.98	1.00	1.01
WH % Pct of Shares Price Improved	84.7%	86.7%	82.5%	83.4%
EX % Pct of Shares Price Improved	8.8%	10.9%	9.5%	5.2%

21. There are several well-documented economic mechanisms that contribute to superior wholesaler execution, above and beyond the wholesaler's best execution obligations. One key mechanism is market segmentation. Compared to retail order flow, institutional order flow tends to involve sustained trading in a particular direction, making it more predictive of future price movements, primarily because, on average, institutional order flow is more informed. When a market maker quotes a price on an exchange, the quote needs to be wide enough to compensate the market maker for taking on greater adverse selection risk, which is the risk that the market will move against the liquidity provider due to trading against an investor who may have superior information about the stock. In contrast, when a wholesaler accepts orders from retail brokers, the wholesaler anticipates lower adverse selection risk and is therefore willing to offer liquidity at a better price (*i.e.*, pay a higher price to buy from a retail sell order or accept a lower price to sell to a retail buy order).

[32] See Order Competition Rule Release, Table 6.

22. Another mechanism promoting superior execution quality for retail orders is the intense competition between wholesalers, which retail brokers enforce. Brokers, who have a duty of best execution, use multiple wholesalers and rigorously evaluate the execution quality of each wholesaler, adjusting their order routing based on execution quality. For example, Schwab has described how it has "invested in its own order routing capabilities to ensure that seamless routing changes from one wholesaler to another can be made based on execution performance."[33] Anchoring the allocation of order flow on execution quality aligns the incentives of wholesalers and brokerage customers, who directly benefit, for example, by receiving better price improvement on their trades. Academic studies have validated this competitive dynamic. For example, Dyhrberg et al. find that wholesalers with lower realized spreads in a given month tend to attract more order flow in the following month.[34] Wholesalers also invest heavily in routing technology to source the best liquidity.[35]

23. In summary, wholesalers provide measurable value to retail investors relative to exchanges across several economic factors, such as market segmentation and robust competition. Currently, wholesalers are incentivized to find liquidity at the best prices available in the market, including hidden liquidity inside the NBBO, and to match or improve on the best price they find. Wholesalers' use of technology enables retail investors to obtain the price and size improvement levels they are currently getting. Any proposal that seeks to make drastic changes to the status quo should carefully consider the risk of undermining these aspects of the current market structure and the risk that execution quality may worsen. As discussed in Section III.D below, the Order Competition Rule Proposal, in particular, presents a serious risk of undermining execution quality and certainty for retail investors.

III. Economic Analysis of the Equity Market Structure Proposals

24. The Commission's economic analysis is severely flawed and falls short of the standard it sets in its guidelines for economic analysis. Adopting these rules as proposed would impose a significant risk to well-functioning markets that have benefited retail investors.

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[33] Schwab white paper, p. 14.
[34] Dyhrberg et al., pp. 5–6. The authors observe this effect for market orders in S&P 500 stocks.
[35] Schwab notes the comparative advantage of wholesalers, who focus on and invest in "sophisticated order routing / liquidity seeking capabilities, cutting-edge and resilient technology platforms, and highly specific risk management capabilities." See Schwab White Paper, p. 8.

25. This section is organized as follows: Section III.A describes the SEC's guidance for conducting an economic analysis as part of a proposed rule; Section III.B explains how the Commission has failed to provide an economic justification for its Proposed Rules; Section III.C explains why the Commission's economic analysis is inadequate and at odds with good policymaking; Section III.D describes how unintended consequences, particularly for the Order Competition Rule Proposal, may worsen market quality; and Section III.E describes specific flaws with the economic analysis in the Tick Size and Best Ex Rule Proposals. Finally, Section III.F recommends an alternative approach the Commission could take to improve equity market quality that is measured, analytical, and carries much less risk of dismantling the existing dynamics in the market that have resulted in extraordinary benefits to investors.

A. The SEC's Guidelines for Economic Analysis

26. The Commission's guidance on conducting an economic analysis includes four substantive components to be addressed:

i. the clear identification of a need for the rulemaking—a so-called "market failure" being one possibility—and an explanation of how the proposed rule will meet that need;
ii. the characterization of an appropriate economic baseline against which to measure the proposed rule's likely economic impact ("in terms of potential benefits and costs, including effects on efficiency, competition and capital formation in the market(s) the rule would affect");
iii. the identification and evaluation of reasonable alternatives to the proposed regulatory approach; and
iv. an assessment of the potential economic impact of the proposed rule and reasonable alternatives "by seeking and considering the best available evidence of the likely quantitative and qualitative costs and benefits of each."[36]

27. Based on a review of the economic analyses of the Proposed Rules, the Commission fails to meet the standards described above, and the resulting economic analyses contained in the four separate rule proposals are inadequate. The Commission fails to establish a clear justification for its Proposed Rules and does not address the problems it purports exist. These inadequacies are

[36] Guidance, pp. 1–2.

explained in more detail below. Additionally, the Commission has not sufficiently established a baseline against which to measure the impact of its Proposed Rules.

28. In sum, the Commission has failed to conduct a robust, high-quality, or informative economic analysis consistent with its own guidance. As a result, if the rules are adopted as proposed, there is a significant risk that the markets would become less efficient and retail investors would be harmed.

B. The Commission Has Not Provided an Adequate Justification for the Order Competition and Best Ex Rule Proposals and U.S. Equity Markets May Become *Less* Competitive under the Proposals

29. The Commission does not articulate market failures in the U.S. equity markets that would justify a need for new regulation. Instead, it relies on internal analyses, some of which are based on non-public data, and claims there is a lack of competition which results in suboptimal execution quality for retail orders.

30. These concerns animate the Commission's justification for the Order Competition and Best Ex Rule Proposals. Specifically, both proposals include the same two core analyses. The first analysis assesses available midpoint liquidity by examining how often the Consolidated Audit Trail ("CAT") data show hidden liquidity at the midpoint on at least one venue at the same time wholesalers internalize retail orders at prices worse than the midpoint.[37] From this, the Commission infers that brokers fail to find hidden liquidity when available. The second is the "Competitive Shortfall Analysis," which suggests that economic profits are higher for marketable retail orders executed off-exchange by wholesalers than for (presumably non-retail) orders executed on exchanges. From this, the Commission infers that price improvement for retail orders would be much more significant if those orders were sent to an auction where

[37] It should be noted that it is nearly impossible for anyone other than the Commission to perform this analysis, because it used CAT data and involved non-public, non-displayed orders. While the release contains a general description of what the analysis purports to do, it is difficult to understand what assumptions or decisions the staff had to make when implementing the analysis, or to verify that it was done correctly. I understand that SIFMA submitted a FOIA request for the CAT data, which was used by the Commission in its analysis, to be made publicly available. See "Request to Extend Comment Period on Four Rule Proposals," *SIFMA*, February 8, 2023, available at https://www.sifma.org/wp-content/uploads/2023/02/Request-to-Extend-Comment-Period-on-Four-Rule-Proposals.pdf. The release of this data would provide commenters with an opportunity to assess the accuracy and reliability of the Commission's analysis.

liquidity providers could bid competitively. Notably, there is considerable uncertainty with the Commission's analysis, which it acknowledges.[38]

31. As discussed below, these two analyses have fundamental flaws and, as such, do not support the Commission's justifications for the Order Competition or Best Ex Rule Proposals. Moreover, there are numerous reasons why the qualified auctions the Commission proposes are not likely to result in more competitive markets.

1. The Commission's Claim of Frequent Non-Displayed Midpoint Liquidity Is Severely Flawed

32. In both the Order Competition and Best Ex Rule Proposals, the Commission attempts to justify the rule with an analysis that suggests there was frequent non-displayed midpoint liquidity available at times when retail orders were executed at inferior prices,[39] implying that brokers may be failing to achieve best execution because they are not trading against available midpoint liquidity.[40] The Commission also cites this analysis as support for its assumption that there is significant unmet liquidity that would be willing to participate in the qualified auctions under the Order Competition Rule Proposal.

33. The Proposed Rules' description of midpoint liquidity is insufficiently granular to determine how the amount of midpoint liquidity is estimated. High-level descriptions are potentially problematic because it appears that the Commission's analysis did not consider order details that constrain how the midpoint liquidity order may be executed. Since the Commission's analysis matches retail orders to resting midpoint liquidity, a failure to control for order details,[41] such as a size constraint, will include orders that could not have been executed in the manner assumed by the Commission, resulting in an overstatement of the potential benefits. For example, many venues, especially ATSs, allow investors to set a minimum quantity for a

[38] For example, the Order Competition Rule Release states: "The Commission acknowledges considerable uncertainty in the costs and benefits of this rule because the Commission cannot predict how different market participants would adjust their practices in response to this rule." See Order Competition Rule Release, p. 254.

[39] See Order Competition Rule Release, Table 19; Best Ex Rule Release, Table 8.

[40] See Order Competition Rule Release, p. 182(The SEC states that "on average, 75% of [shares internalized by wholesaler at prices less favorable than the NBBO midpoint] could have hypothetically executed at a better price against the non-displayed liquidity resting at the NBBO midpoint on exchanges and NMS Stock ATSs.").

[41] Given the lack of a detailed description of how midpoint liquidity is identified, it is assumed that the Commission ignored minimum size constraints in its analysis of the availability of midpoint liquidity. This underscores the importance of providing a clear roadmap so that readers can understand how the analysis was conducted, especially in situations where the data used is non-public and replication is not possible.

trade,[42] and analysis shows that they use this feature frequently. For example, a major ATS firm, Intelligent Cross,[43] reports that "close to 60% of mid-point and near side pegged ordered shares had [a minimum quantity] specified."[44] If an institutional investor places hidden orders with a minimum quantity restriction deliberately, these orders would not trade against other smaller-sized (such as retail) orders even if they are at the same venue. Since institutional investors often trade in large blocks, while retail investors typically trade in smaller sizes, much of the hidden liquidity the Commission has identified is likely unavailable to most retail investors, which overstates the amount of accessible midpoint liquidity, mitigating a significant fraction of the Commission's estimated benefits associated with an auction mechanism.

34. One important economic reason an institutional investor would set a high minimum quantity for its hidden resting midpoint orders is to minimize information leakage. If an investor did not set a sufficiently large minimum quantity, a relatively small order could reveal its trading interest. Setting a large minimum quantity prevents the hidden resting midpoint order from being quickly revealed to the market and helps the institutional investor minimize price impact. Reducing price impact is a key objective of institutional investors that trade large quantities that take longer to complete.

35. If midpoint liquidity is deliberately provided in a way that prevents interaction with small orders, such as those of the average retail investor, the Commission's analysis of available midpoint liquidity cannot serve as (i) evidence of a failure of best execution under the current market structure or (ii) evidence that a qualified auction with retail-sized trades would incentivize liquidity providers that currently seek midpoint executions to participate in the auctions.

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[42] See e.g., Robert P. Bartlett, III and Justin McCrary (2015), "Dark Trading at the Midpoint: Pricing Rules, Order Flow and Price Discovery," working paper, footnote 9, available at https://www.stern.nyu.edu/sites/default/files/assets/documents/2%20Bartlett%20and%20McCrary%20Shall%20We%20Haggle.pdf ("For instance, Credit Suisse's Crossfinder, the largest ATS by trading volume, notes in its Form ATS that '[p]articipants have the option on Orders to specify…a minimum quantity.'"); "UBS ATS: UBS Binary Protocol (UBP) Specification," *UBS*, October 2019, p. 1, available at https://www.ubs.com/global/en/investment-bank/electronic-trading/equities/unique-liquidity/_jcr_content/mainpar/toplevelgrid_491929606/col1/innergrid_1876722392/xcol2/linklist/link_2093927680.1415558836.file/PS9jb250ZW50L2RhbS9hc3NldHMvaWIvZ2xvYmFsL2VsZWN0cm9uaWMtdHJhZGluZy9kb2MvdWJzLWF0cy1iaW5hcnktcHJvdG9jb2wtdWJwLXNwZWNpZmljYXRpb24tb2N0LTIwMTkucGRm/ubs-ats-binary-protocol-ubp-specification-oct-2019.pdf ("Minimum Quantity: Minimum quantity for each execution on the order.").

[43] According to FINRA, Intelligent Cross LLC had the third highest share volume among all ATSs, during the week of January 9, 2023. See "FINRA Transparency Data," *FINRA*, available at https://otctransparency.finra.org/otctransparency/AtsData, accessed February 3, 2023.

[44] "Minimum Quantity: Order Protection vs. Venue Optimization," *BAIRD*, April 28, 2021, available at https://www.rwbaird.com/newsroom/news/2021/04/order-protection-vs-venue-optimization/.

36. Other factors regarding trading access undermine the Commission's assumption of frequent midpoint liquidity. ATSs can be selective with whom they allow access to their liquidity. For example, an ATS run by a broker can decline to accept order flow from a competing broker. Other ATSs may restrict participation by certain types of traders. Therefore, even if the Commission sees non-displayed midpoint liquidity on the CAT tape at a particular venue, this liquidity is not necessarily available to all market participants.

37. Even if some midpoint liquidity identified by this analysis is accessible to retail order flow, it does not necessarily imply that retail investors could access that liquidity more often under the Proposed Rules. It does not necessarily follow that an investor making liquidity available at the midpoint on an ATS would be interested in participating in retail auctions under the Order Competition Rule Proposal, nor has the Commission demonstrated that such investors would likely participate in the auctions. The existence of untapped liquidity at the midpoint does not constitute evidence of a failure of a broker's best execution obligation. The Commission recognizes that brokers need to consider the trade-off between price improvement and execution delay in deciding how many markets to ping when executing an order.[45] However, the Commission's analysis of CAT data aggregates available midpoint liquidity across all liquidity providers, even relatively small venues. Thus, this highly theoretical analysis would "find" midpoint liquidity even if a broker would need to ping 30 or 40 different venues.

38. A broker handling a market order for an investor in a fast-moving market cares about execution speed and may determine it is optimal to check for liquidity in a few of the best venues before executing, even under the Best Ex Rule Proposal. The time delay associated with an exhaustive search for the availability of midpoint liquidity creates a significant risk that prices will move against retail investors, especially in fast-moving markets that are characterized by significant adverse selection risk. Yet, the Commission has not presented any analysis showing that an execution delay would not harm investors. Given the speed at which prices change in today's markets, which will only continue to increase, the Commission cannot simply ignore how an execution delay will impact retail investors.

[45] Best Ex Rule Release, p. 95 ("Proposed Rule 1101(a)(2)(iii) would require a broker-dealer's policies and procedures to address how it will reasonably balance the likelihood of obtaining better prices with the risk that delay could result in worse prices in determining the number and sequencing of markets to be assessed for its customers' orders.").

39. The Commission's failure to define best execution is a crucial omission of the Proposed Rules. A careful reading of the four separate rules leaves the reader with the impression that their overarching goal is to provide retail investors with greater access to midpoint pricing. In this context, midpoint pricing becomes the *de facto* standard for measuring best execution. In effect, the Commission is equating best execution with greater access to midpoint pricing and ignores other indicators of execution quality, like execution speed. A broker handling an institutional order may prioritize executing trades in larger blocks over executing smaller quantities at slightly better prices. Therefore, identifying "ignored" liquidity is not evidence of a failure of best execution. Nowhere in the Proposed Rules does the Commission discuss how brokers should assess the various tradeoffs involved in providing best execution. Since a broker cannot lock in quotes as it searches for midpoint liquidity, a requirement to ping an excessive number of trading venues to search for midpoint liquidity risks delays in execution speed and certainty due to quote fade in the intervening period. The Commission has ignored the tradeoff between midpoint liquidity and execution speed and that brokers balance these competing objectives.

2. The Commission's Interpretation of Realized Spreads, a Key Assumption in Its Competitive Shortfall Analysis, Is Severely Flawed

40. The Order Competition and Best Ex Rule Proposals contain numerous tables summarizing realized spreads observed from various subsamples of stocks from orders executed on exchanges and from orders of retail investors executed by wholesalers.[46] These tables purport to show that marketable orders executed on exchanges have lower realized spreads than those executed by wholesalers (indeed, it shows that orders executed on exchanges even have negative realized spreads). To interpret this information, the Commission assumes that (i) realized spreads approximate a liquidity provider's economic profit and (ii) on-exchange liquidity providers would be willing to provide additional liquidity at the same marginal profit to retail flow if only they had access to such flow.[47] Accordingly, if the order flow that wholesalers currently receive is instead routed to qualified auctions (*i.e.* order-by-order competition), the

[46] See Order Competition Rule Release, Tables 5–9.

[47] See Order Competition Rule Release, p. 212 ("Realized spreads are a proxy for the potential economic profit that liquidity suppliers may earn on a trade."); Best Ex Rule Release, pp. 270−271 ("[T]he realized spread serves as a proxy for wholesaler's economic profits before any fees are taken out.").

Commission assumes that these orders would receive more price improvement from liquidity providers, such that the realized spreads on these orders would be equivalent to the realized spreads observed on exchanges. The Commission calls the difference "forgone price improvement" and claims the benefit ranges from $1.12 to $2.35 billion annually.[48]

41. The conclusion that exchange order flow is subject to more adverse selection risk than retail order flow (*i.e.*, exchanges receive more "informed" orders) is not surprising or controversial. Importantly, this confirms one of the fundamental economic reasons why retail orders can benefit from being segregated and executed off-exchange.

42. Realized spreads measure transaction costs and market quality. Mechanically, the realized spread is similar to the effective spread (the difference between the execution price and the quote midpoint). However, it also factors in the short-term price impact of the trade, measured as the change in the quote midpoint after a short time interval, such as one minute.[49] Realized spreads are not a proxy for profitability because they ignore inputs that impact profitability, such as inventory holding costs, fixed costs, and transaction rebates and fees. Academics have noted that the "realized spread earned by wholesalers may represent either a substantial profit, or a combination of inventory and fixed costs that allows only for a zero profit, or anything in-between."[50]

43. From the perspective of a liquidity provider who seeks to earn the spread (*i.e.*, a market maker), the realized spread reflects the degree to which the incoming order flow predicts future price movements, making it a proxy for the adverse selection faced by the liquidity provider. The period used to calculate realized spreads approximates the market maker's assumed holding period, *i.e.*, the time it takes to flatten the position. If realized spreads are decreasing over time,

[48] Order Competition Rule Release, pp. 261−262.

[49] Strictly speaking, the difference between a trade's execution price and the future NBBO midpoint represents the realized half-spread. It is referred to as "realized spread" to be consistent with the proposing releases. See Order Competition Rule Release, p. 188. Liquidity providers have different holding periods, but this nuance is lost when relying on realized spreads. The SEC even acknowledges the trade-offs that must be made in setting the subjective parameters of the metric, and notes that "it is unclear whether the choice of any specific measurement horizon results in realized spreads more accurately measuring adverse selection risk, as the 'ideal' measurement horizon is not easily observable." See 605 Rule Release, pp. 249−251 ("Selecting an appropriate time horizon to calculate the realized spread must strike a balance between too short, which could distort the measures by transitory price impact, and too long, which could measure noise or the cumulative impact of subsequent market changes which are unrelated to the order's execution quality. An ideal measurement horizon would be one that aligns with the amount of time an average liquidity provider holds onto the inventory positions established from providing liquidity, which is not easily observable.").

[50] See e.g., Dyhrberg et al., p. 13.

this is a signal that the market maker is facing more adverse selection, and it should adjust its quotes to reflect the more "informed" nature of order flow.

44. Assuming the liquidity providers are market makers, an average negative realized spread would suggest that the market makers have not appropriately adjusted their quotes and have experienced (paper) losses in the one-minute (or five-minute) period immediately following their trades. This is an unrealistic and uneconomic assumption for a market maker, either on- or off-exchange, because a market maker seeks to earn the spread. Accordingly, there is no reason to believe that the price improvement expected by the Commission in the qualified auctions would be provided by market makers.

45. The negative realized spreads that the Commission observes on exchanges indicate that one- and five-minute windows are too long to accurately measure market maker profitability. By contrast, realized spreads are an effective way to measure the short-term price impact experienced by non-market maker liquidity providers who have longer-term trading horizons. Given their different investment objectives, there is no basis for assuming that non-market maker liquidity providers are motivated by realized spreads or that realized spreads play a role in the decisions these liquidity providers make regarding how and where they will provide liquidity.

46. Take, for example, an institutional investor who has decided to execute a trade based on a proprietary trading strategy. The investor may need to work the (potentially large) trade over hours or even days and may attempt to conceal its trading interest by trading on anonymous platforms like ATSs. This investor may also break its trade into smaller pieces that get routed to various trading venues, including exchanges. As discussed in Section III.B.1, such an investor may even forgo some opportunities to trade at "good" prices to minimize information leakage. This investor would not rely on realized spreads to measure its execution quality, partly because it will hold the position long-term, implying that a 60-second (or 5-minute) measure of market impact has no practical meaning. Instead, it will measure execution quality using metrics like implementation shortfall and a volume weighted average price ("VWAP") benchmark. Notably, this type of investor has a very different motivation in providing liquidity to the markets than a market maker. However, the Commission's economic analysis estimates the benefit of its rule based on the realized spreads of such investors.

47. Given the diversity of liquidity providers with different objectives for participating in the market, the SEC has no basis for comparing exchange-realized spreads and wholesaler-realized spreads. Dyhrberg et al. articulate this point and caution against making such a comparison:

> "[N]on-market makers['s] main goal is to manage positions rather than earn spread revenue. The realized spreads that non-market makers earn are therefore not reflective of market making costs and profits. Since non-market makers' share of exchange liquidity provision is significant, caution should be used when comparing exchange realized spreads to wholesaler realized spreads."[51]

Accordingly, the Commission's claimed benefit of forgone price improvement, which is based on a comparison of realized spreads between wholesalers and exchanges, is unreliable.

48. In addition to these limitations associated with using realized spreads as a measure of foregone price improvement, the Commission's Competitive Shortfall Analysis implicitly makes an apples-to-oranges comparison because it does not differentiate between the significantly different ratios of "market" to "marketable limit" orders executed on- and off-exchange, and the realized spreads associated with these different order types. Marketable limit orders, which are widely used on exchanges, show a higher degree of investor sophistication relative to market orders (which are nearly non-existent on exchanges), because they indicate that the investor is not willing to be filled beyond a certain price point. The Commission's analysis of 605 data finds that 79.2% of wholesaler order flow consists of market orders compared to only 0.3% on exchanges. But even more notable is that the average realized spreads for market orders are five times higher on exchanges than those of wholesalers (2.40 vs. 0.39),[52] suggesting that exchanges are much more "profitable" than wholesalers with market orders (applying the Commission's logic). Yet, the Commission bases its forgone price improvement estimate on a weighted average of realized spreads for all marketable orders (both market and marketable limit orders) despite the different nature of the order flow on- and off-exchange. The notion that price improvement for retail orders, which is predominantly made up of market orders, could be significantly improved solely based on observed differences in realized spreads for all marketable orders is fundamentally flawed and unsupported. In fact, the significantly higher

[51] Dyhrberg et al., p. 13.
[52] Order Competition Rule Release, Table 5.

realized spreads on exchanges for market orders calls into question the Commission's entire conclusion about foregone price improvement.[53]

49. The Commission also has no valid basis for assuming differences in realized spreads alone would incentivize liquidity providers to participate in qualified auctions, even if the auctions allowed them access to retail trade flow because realized spreads do not inform how and why non-market makers provide liquidity. In summary, realized spread is not a metric that predicts or informs non-market maker liquidity provision, and cannot be used to gauge how much liquidity would move to qualified auctions nor how much incremental price improvement liquidity providers might provide.

3. The Commission Has No Basis to Assume Adverse Selection Risk Will Induce Investors to Provide Liquidity to Qualified Auctions

50. In its competitive shortfall and midpoint liquidity analyses, the Commission assumes that liquidity providers would be willing to provide liquidity to the qualified auctions. The Commission claims "(t)he lower adverse selection risk of individual investor orders should incentivize other liquidity providers to participate in qualified auctions."[54]

51. As discussed in the prior section, non-market maker liquidity providers, primarily institutional investors, care more about position management than earning the spread.[55] For these liquidity providers, trading is motivated by an underlying investment thesis (*e.g.*, fundamental research), and they are in the market to minimize the price impact of executing these orders. Since auction messages and confirmations are publicly available to all market participants, their participation in the auctions likely increases the risk of revealing their trading interests. Such information leakage could more significantly impact their costs than the purported benefit of interacting with small-sized retail orders. As such, it is unclear how much institutional investors would be incentivized to participate in the auctions.

52. If institutional investors found it desirable to interact with retail order flow (*i.e.*, order flow associated with lower adverse selection), one would expect to see their active participation

[53] The Commission performs a similar analysis that uses CAT data. Because this analysis also is based on all marketable orders, it is subject to the same critique.
[54] Order Competition Rule Release, p. 315.
[55] See Dyhrberg et al., p. 4 ("Covering market making costs and earning liquidity provision profits is not as important to non-market making algorithms as to their market making counterparts, if at all.").

in the existing retail liquidity programs that many of the exchanges already offer and that have been viewed as a "close empirical analogue" to order-by-order auctions.[56] However, as the Commission notes in the Order Competition Rule Proposal, the volume executed through these retail liquidity programs is minimal,[57] undermining the Commission's assumption that institutional investors would interact with retail flow in the qualified auctions if given the opportunity.

53. Additionally, because institutional investors' trading is motivated by an underlying investment thesis such as fundamental research, they will likely have a pre-determined amount to trade. If, as the Commission predicts, these investors will participate in the qualified auctions,[58] they will divert liquidity from other venues where they are currently trading, such as ATSs or the exchanges' continuous order books, resulting in less liquidity at these other venues, potentially increasing trading costs to investors who continue to trade at those venues.

4. There Are Economic Reasons Suggesting Qualified Auctions Could Worsen Trade Execution Quality for Both Retail and Institutional Investors

54. There are economic reasons to believe that the qualified auctions under the Order Competition Rule Proposal would not achieve the type of benefits the Commission expects and may even worsen trade execution quality under the proposed rule.

55. The mandated structure of qualified auctions would create an informational disadvantage to retail investors. Specifically, qualified auctions require retail order flow to be announced publicly, and these auctions cannot be shorter than 100 milliseconds. By observing these announcements, liquidity providers could indeed have time to (given the forced delay) fade their quotes, particularly when they detect large imbalances in retail orders. Similarly, arbitrageurs observing these retail order auction signals would be able to trade ahead of retail order flow. For example, arbitrageurs that detect a significant buy interest from retail investors based on the

[56] See e.g., Thomas Ernst, Chester S. Spatt, and Jian Sun, "Would Order-By-Order Auctions Be Competitive?" working paper, pp. 4−5, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4300505.

[57] Order Competition Rule Release, p. 208 ("[I]t is the Commission's understanding that the share of individual investor trading volume executed through RLPs is small. For example, in 2021, less than 0.2% of consolidated volume executed in exchange RLP programs.").

[58] Order Competition Rule Release, p. 316 ("The availability of marketable individual investor order flow at qualified auctions would likely draw institutional trade execution algorithms to supply liquidity in qualified auctions, where they might trade at the quote midpoint or at least inside the NBBO.").

public auction messages may first buy all the available volume at the prevailing offer price and then profit by selling such volume to retail investors at a higher price.

56. Qualified auctions may negatively affect exchange limit order books and venues that do not host auctions. Under the current market structure, wholesalers route part of their retail order flow to exchanges and ATSs. Suppose that all retail flow under $200,000 is diverted to auctions as stated in the Order Competition Rule Proposal. In that case, fewer retail orders would interact with the limit order books of exchanges or at any venues where retail flow is currently sent. The remaining order flow on those venues would have a higher proportion of institutional orders with greater adverse selection risk. Exchange market makers now facing higher adverse selection would increase quoted spreads, leading to wider quoted spreads on exchanges. This effect will be amplified if the diverted trade flow decreases trading venue volume. Institutional investors that trade at these venues would incur higher trading costs. Retail investors also could be affected if the auction fails—in this case, retail orders might be routed to exchanges or ATSs to be executed at the quote, and, therefore, they would receive even worse execution because they would be exposed to wider quoted spreads.

57. Additionally, retail orders routed to qualified auctions are likely to be systematically harmed in episodes of correlated order flow or high volatility. For example, a study by Charles Schwab reported that in "times of extreme volatility and wider quoted spreads, our data show that off-exchange wholesalers perform even better than exchanges. … when volatility increased or trading shifted to wider-spread securities, the non-exchange market centers were able to smooth out the cost of crossing the spread by keeping effective spreads low, while the Schwab order-flow-adjusted exchange effective spread increased more than the quoted spread."[59] Since there would be fewer natural liquidity providers during periods of increased volatility, liquidity would likely be scarce, and auctions would be more likely to fail. This effect would be amplified for illiquid stocks, meaning stocks that have low average trading volume. A failed auction would further reduce liquidity because it would signal to the market that no one was willing to provide liquidity in the auction. Accordingly, wholesalers handling these orders would be less incentivized to internalize them. Instead, these orders may get routed to exchanges with greater adverse selection where the quoted spreads would be wider and may be executed without

[59] See Schwab White Paper, p. 16.

receiving any price improvement or size improvement, worsening the execution quality of retail investors.

C. The Commission Fails to Conduct a Minimally Acceptable Economic Analysis Because It Does Not Analyze How the Separate Rules Will Interact with Each Other

58. The four separate rules the Commission has proposed address the same overarching claimed concerns about competition, conflicts of interest, transparency, and the impact on overall execution quality. Given the overlap in regulatory objectives, the Commission could have proposed a single omnibus rule that included the primary features of the four separate rules and could have addressed the interactions associated with the main rule components and whether a legitimate economic basis exists for all of them.

59. An acceptable economic analysis would need to address the incremental interactions between rule components and discuss why each feature is included. A discussion of reasonable alternatives, a required component under the SEC Guidance on Economic Analysis, would consider why different combinations of rule components (*e.g.*, enhanced 605 reporting, smaller tick increments, and enhanced 605 reporting combined with smaller minimum tick increments) did not fully address the stated regulatory objectives.

60. The Commission's decision to propose four separate rules designed to achieve the same overarching objectives does not obviate the need to consider how they interact—it remains a required component of any rigorous economic analysis. For this reason alone, the economic analysis in the proposed rules should be considered arbitrary and capricious. As a result of this failure, two fundamental issues arise that relate to how the Commission should have performed its economic analysis.

61. First, the Commission does not justify why all four rules are necessary, neither individually nor in combination. This is particularly troubling given that the proposals are designed to accomplish the same overarching goals. Second, the Commission uses the status quo of the current market structure as the baseline to analyze each rule. While this is an appropriate way to define the baseline, the Commission then evaluates each rule independently and measures benefits as if each rule is the only one being proposed. In effect, each rule ignores the possibility that the other three rules may already address the Commission's concerns.

62. To further illustrate this point, consider how each rule purports to increase competition, perhaps the most critical objective of the Proposed Rules. The Commission claims the Order Competition Rule Proposal would "benefit individual investors by promoting competition and transparency to enhance the opportunity for their orders to receive more favorable prices than they receive in the current market structure."[60] It claims the 605 Rule Proposal would "increase transparency of order execution quality … and help promote competition among market centers and broker-dealers."[61] For the Tick Size Rule Proposal, the Commission claims, "harmonization of the minimum pricing increment for the quoting and trading across venues would promote competition and innovation, while preserving most meaningful price improvement opportunities."[62] For the Best Ex Rule Proposal, it claims the "regular review process would promote competition among executing brokers and help ensure that customer orders are executed consistently with the proposed best execution standard."[63] Clearly, the expected benefit the Commission believes its rules will achieve is overlapping.

63. Alternatively, the discussion about competition could be regulatory boilerplate that the Commission includes to satisfy its mandate to consider the effects on efficiency, competition, and capital formation ("ECCF"). The possibility that it represents regulatory boilerplate is a distinct possibility because the Commission fails to establish a compelling case for why there is a market failure that requires additional regulation.[64]

64. Important policymaking questions arise from these overlapping objectives, particularly given that the Commission has yet to justify why each rule needs to be adopted. For example, are the estimated benefits purely additive? Must all the rules be adopted to achieve the desired level of competition, or might it be achieved with fewer? Might the Commission have more transparency into the effects of each new rule if they were adopted in a phased manner? If the

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[60] "Fact Sheet: Proposed Rule to Enhance Order Competition," Securities and Exchange Commission, December 14, 2022, p. 2, available at https://www.sec.gov/files/34-96495-fact-sheet.pdf.
[61] "Fact Sheet: Disclosure of Order Execution Information," Securities and Exchange Commission, December 14, 2022, pp. 1–2, available at https://www.sec.gov/files/34-96493-fact-sheet.pdf.
[62] Tick Size Rule Release, p. 73.
[63] Best Ex Rule Release, pp. 154–155.
[64] According to the Current Guidance on Economic Analysis in SEC Rulemakings, "Statutory provisions added by the National Securities Market Improvement Act of 1996 and the Gramm-Leach-Bliley Act of 1999 to the 1933, 1934, and 1940. Acts—which require the Commission to consider efficiency, competition, and capital formation whenever it is 'engaged in rulemaking and is required to consider or determine whether an action is necessary or appropriate in the public interest'—expressly call for consideration of several broad economic issues in addition to the protection of investors." Guidance, pp. 2–3.

605 Rule Proposal were implemented, which arguably has the lowest chance of creating unintended negative consequences, would the Commission still believe other rules were needed?

65. As an example, if the 605 Rule Proposal were implemented and did increase the level of competition among market participants, what would be the impact to the competition shortfall which the Commission estimated, without the rule, to be $1.5 billion per year? Similarly, would $1.5 billion still be an accurate estimate under a new tick size regime where spreads would likely narrow? Presumably the competition shortfall estimate would decrease in size. At what point does the reduced benefit still justify the cost of the Order Competition Rule Proposal, which again, carries a significant risk of negative unintended consequences? The Commission presents no economic analysis to address these critical issues.

66. In summary, the Proposed Rules are highly interconnected; their intended benefits overlap significantly, but their costs tend to be orthogonal. The Commission's lack of analysis regarding the interaction of these rules overestimates their benefits because each rule refers to the same benefits. Further, without a more robust analysis of the interaction effects of these complex rules, the Commission cannot properly weigh the benefits of any given rule against its costs nor identify the least costly and least disruptive way to implement its rules.

D. The Rules Will Have Unintended Consequences That Could Undermine Many of the Benefits of the Existing Market Structure

67. The four separate rules proposed by the Commission amount to a significant overhaul of the existing equity market structure, on a scale not seen since Reg NMS. If the proposed rules are implemented, market participants will adjust how they operate, which will establish new equilibria and could shift the market in unintended ways. This section describes some of the negative outcomes that are likely to occur if the Proposed Rules were adopted.

1. Competitive Dynamics in Today's Markets That Effectively Discipline Prices Could Be Dismantled

68. The Commission has promoted two distinct yet complementary forms of competition: competition among orders and competition among market centers. The Reg NMS release describes this as follows:

> The NMS thereby incorporates two distinct types of competition – competition among individual markets and competition among individual orders – that together contribute to efficient markets. Vigorous competition among markets promotes more efficient and innovative trading services, while integrated competition among orders promotes more efficient pricing of individual stocks for all types of orders, large and small. Together, they produce markets that offer the greatest benefits for investors and listed companies.[65]

69. Historically, the Commission has tried to balance these two forms of competition in its rulemaking to create the highest quality and most efficient markets. However, in the Order Competition Rule Proposal, the Commission arbitrarily prioritizes "order-by-order competition" over competition between individual markets.[66] A significant change like this would dismantle the competitive dynamics that have evolved between market centers, dynamics that provide significant benefits to retail investors.

70. Wholesalers compete for retail market flow from retail brokers by providing timely and cost-efficient executions for retail brokerage customers. This includes offering high levels of price improvement (including a large portion of midpoint executions), offering size improvement, and guaranteeing execution for all retail trade flow, which includes the execution of many illiquid stocks. Since wholesalers have a duty of best execution (in addition to brokers), they use sophisticated order routing technology to find the best sources of liquidity. Wholesalers and retail brokers have aligned incentives to achieve superior trade executions; wholesalers use these metrics to win order flow, and retail brokers advertise them in their marketing efforts.

71. Retail brokers use multiple wholesalers and evaluate them in terms of the execution quality they provide. It is standard practice for a broker to use multiple wholesalers.[67] Routing to multiple wholesalers is instructive because it indicates that the market centers trading NMS stocks face significant competition. Retail brokers are well-positioned to hold wholesalers to account if they provide poor execution quality by increasing their allocation of order flow to those wholesalers who offer better execution quality. Notably, in the Best Ex Rule Proposal, the commission acknowledges this competitive dynamic, namely that the ability to monitor

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[65] Release No. 34-51808, June 9, 2005, p. 12.

[66] In the Order Competition Rule Proposal, the Commission acknowledges that brokers assess wholesaler allocations, but it does not address how this mechanism serves to discipline execution quality. See Order Competition Rule Release, p. 327 ("In fact, retail brokers regularly re-assess whether their current allocation of trading interest to liquidity providers, including wholesalers, exchanges, and ATSs, is optimal.").

[67] See Table A1 in the Appendix, based on Rule 606 reports.

performance and having low switching costs encourage competition and result in increased execution quality.[68] The Commission makes this observation in relation to institutional investors who use multiple broker-dealers—it is unclear why the Commission does not discuss this dynamic in its Order Competition Rule Proposal, as the same dynamic exists between retail brokers and wholesalers.[69]

72. A recent paper discusses this competitive dynamic and empirically shows that wholesalers receive higher allocations when realized spreads are comparatively lower than those of competitors.[70] The paper also shows that realized spreads did not decrease after a new wholesaler, Jane Street, entered the market or after Schwab and TD Ameritrade merged. If wholesalers had not been operating in a highly competitive market, one would expect that either of these events would have reduced the profitability of the wholesalers in the form of reduced realized spreads, yet this did not happen, indicating that wholesalers were already operating in a highly competitive environment.[71]

73. Wholesalers are incentivized to provide the best possible executions for a number of reasons. The inability to identify the best sources of liquidity will likely result in order flow being allocated to a different wholesaler who does. Also, the risk of a best execution violation motivates wholesalers to find the best executions. Wholesalers further improve execution quality by contributing their own capital to provide supplemental price improvement to orders routed externally (either fully or in part), even though this may result in a loss on those orders. The strategic allocation of order flow to market centers that provides the best executions incentivizes wholesalers to compete for order flow. It is an effective mechanism that disciplines

[68] Best Ex Rule Release, pp. 312–313, ("The Commission understands that institutional customers often utilize multiple broker-dealers in the handling of their orders, which lowers the costs of switching brokers if they exhibit poor execution quality. Furthermore, in general, the Commission believes that there is less conflict in institutional customer order handling because institutional customers have better access (compared to retail customers) to data, which they utilize to monitor and analyze the execution quality that various broker-dealers offer. The Commission believes that (compared to retail brokers) institutional monitoring and lower switching costs encourage broker-dealers to provide increased execution quality in order to compete to attract institutional orders.").

[69] As mentioned in Section II.B, the brokers evaluate wholesaler performance and adjust order flow based on execution quality. For example, as mentioned in Section II.C., Charles Schwab has "invested in its own order routing capabilities to ensure that seamless routing changes from one wholesaler to another can be made based on execution performance."

[70] Dyhrberg et al., p. 23. See also, Schwab White Paper.

[71] Note, this paper uses realized spreads as a proxy for profitability, in part because there is not a better alternative in the data. However, this use of realized spread as a proxy for profit does not have the same issues and limitations that are discussed in Section III.B.2 because the realized spreads being compared are all for wholesalers (all of which are off-exchange market makers), and the authors are not comparing realized spreads from different types of liquidity providers, such as institutional investors.

customer order execution quality.[72] This competitive dynamic between market centers ultimately benefits retail investors who receive better execution quality.

74. By mandating auctions as required under the Order Competition Rule Proposal, the Commission would displace market center competition in favor of order-by-order competition because wholesalers would no longer be able to internalize trade flow directly.

2. The Benefits Retail Investors Currently Receive from Wholesalers Could Decrease Significantly or Be Eliminated, Including Guaranteed Executions for Illiquid Stocks, High Rates of Price Improvement and Midpoint Executions, and Size Improvement

75. As noted in the previous section, wholesalers compete for order flow from retail brokers by offering high levels of price improvement (including midpoint executions), size improvement, and guaranteeing execution for all retail trade flow they receive, including for illiquid stocks. Offering these benefits as well as trade routing services represent the wholesaler's cost of doing business.

76. The Commission suggests that if there is a lack of interest from liquidity providers to participate in the auctions, most retail orders "could simply be internalized by wholesalers, similar to the current market, though perhaps at inferior prices compared to what they might have received under the current market structure."[73] Wholesalers provide price improvement on the majority of orders they receive and midpoint executions on nearly half of those orders. This behavior is the result of strong competition among wholesalers as they seek to attract order flow from retail brokers. This competition arises endogenously because retail brokers' best execution obligations require them to route order flow to the wholesaler that provides the best pricing. However, under the Order Competition Rule Proposal, most orders can only be internalized after an auction fails, meaning that wholesalers will no longer be incentivized to compete at the same levels for order flow from retail brokers, and consequently may not offer retail brokers the same level of benefits. By disrupting this competitive dynamic, there is no economic basis to assume that, under the Order Competition Rule, wholesalers would internalize the same level of order flow, or would provide the same levels of price improvement as they do in the current market

[72] For example, Dyhrberg et al. find that wholesalers with lower realized spreads in a given month tend to attract more order flow in the following month. See Section II.B above.
[73] Order Competition Rule Release, p. 285.

structure, particularly for less liquid stocks. As a result, retail customers would likely receive less price improvement and fewer midpoint executions.

77. It is likely that execution quality for illiquid stocks would deteriorate if the Proposed Rules are implemented. In its Best Ex Rule Proposal, the Commission cautions that "execution prices may be less favorable for retail investors under the proposal if liquidity providers that previously paid for order flow and fulfilled these difficult to execute orders under such arrangements dedicate less capital to making markets in these securities."[74] This concern is warranted. In 2019, the Commission released a statement noting concerns regarding liquidity and high transaction costs for thinly traded stocks,[75] and expressly solicited proposals to improve the market quality of these stocks. It referenced an internal study showing that "approximately one-half of all NMS stocks have an average daily trading volume ('ADV') of less than 100,000 shares."[76]

78. Wholesalers currently provide a non-trivial amount of price improvement for illiquid stocks. By my calculations, in December 2020, Virtu provided price improvement of $0.037 per share on average to fully internalized orders of securities with an average daily volume of 100,000 shares or less, and $0.051 to fully internalized orders with an average daily volume of 50,000 shares or less. The Order Competition Rule Proposal would disincentivize wholesalers from providing the same levels of support for these securities (either through guaranteed execution or price improvement), which could lead to worse execution quality and higher costs for retail investors.

79. Lastly, there is no reason to believe that wholesalers will continue to provide size improvement to the same degree they do today. Under the current market structure, wholesalers have incentives to provide high-quality executions, which includes size improvement. Size

[74] Best Ex Rule Release, pp. 347–348.
[75] Release No. 34-87327, October 17, 2019, pp. 2–3. ("The secondary market for thinly traded securities faces liquidity challenges that can have a negative effect on both investors and issuers. In particular, thinly traded securities, which are often also smaller-capitalization securities, tend to have wider spreads and less displayed size relative to securities that trade in greater volume, often resulting in higher transaction costs for investors. Potential investors in such securities also may be concerned that they could encounter difficulties finding the necessary liquidity to establish or unwind positions in the stocks. A lack of readily available liquidity also may discourage potential market makers from electing to make markets in those securities. For these reasons, a thinly traded security could affect a potential investor's willingness to invest in that issuer's securities, possibly resulting in even fewer trades. Having a less liquid security also could negatively affect an issuer's financing (e.g., the cost of capital)." [Citations omitted]).
[76] "Division of Trading and Markets: Background Paper on the Market Structure for Thinly Traded Securities," *Securities and Exchange Commission*, p. 1, available at https://www.sec.gov/rules/policy/2019/thinly-traded-securities-tm-background-paper.pdf.

improvement occurs when a wholesaler executes more shares than the displayed quantity available at the quote. The Commission acknowledges the value of size improvement in the 605 Rule Proposal and even includes a new field to measure it.[77] Notably, the Commission fails to consider size improvement in the Order Competition Rule Proposal. It is noteworthy that the Order Competition Rule Proposal does not address how auctions eliminate the possibility for wholesalers to offer retail investors size improvement nor how auctions avoid the "walking-the-book" scenario mentioned in the 605 Rule Proposal.[78] From an economic perspective, providing size improvement is another way for wholesalers to build relations and reputations, allowing them to attract more order flow. By failing to account for size improvement and the fact that, in the new regime, wholesalers will not be incentivized to provide it to the same degree, the Order Competition Rule Proposal understates the costs of its rule.

E. Other Issues with the Commission's Economic Analysis

1. For the Tick Size Rule Proposal, the Commission Does Not Adequately Justify Why the Economic Arguments It Relied Upon When Establishing the Current Tick Sizes Are No Longer Applicable and Why a New Tick Size Regime Is Needed

80. As part of the Commission's prior rulemakings, such as the Sub-Penny Rule in 2005, the Commission conducted a substantial amount of research related to tick size and ultimately determined $0.01 to be optimal, reasoning that sub-penny-jumping would undermine execution

[77] The 605 Rule Proposal suggests a size improvement metric that is "the cumulative number of shares of the full displayed size of the protected bid [(offer)] at the time of execution, in the case of a market or limit order to sell [(buy), … which will be] capped at the order size." See 605 Rule Release, p. 131. However, this metric will not clearly differentiate the level of size improvement provided. Specifically, there are a number of orders in which the broker does not have the opportunity to provide size improvement because the order size is equal to or less than the available shares at the NBBO. The Commission's proposal to include all orders in the calculation, even when there is no opportunity to provide size improvement, obfuscates the amount of size improvement provided when the opportunity actually exists. Capping the shares at the order size does not eliminate this problem. As such, this metric is not a reliable measure of the actual size improvement offered and is not as informative as it could be.

[78] The 605 Rule Proposal notes that "[i]nformation about price improvement is different from information about whether orders received an execution of more than the displayed size at the quote, *i.e.*, 'size improvement.' The price improvement metrics currently required by Rule 605 do not necessarily capture a market center's ability to fill orders beyond the liquidity available at the NBBO. For example, consider a situation in which the market is $10.05 x $10.10 with 100 consolidated shares available at the NBO of $10.10 and 100 consolidated shares available at the next best ask price of $10.15. Say that a trader submits a marketable buy order for 200 shares to a market center, which fills the entire order at the best ask price of $10.10. The market center's Rule 605 statistics would reveal a price improvement metric of $0 for this order, despite the fact that the trader saved money by avoiding having to walk the book, which would have resulted in a total price of (100 * $10.10) + (100 * $10.15) = $2,025. As a result of the market center's ability to offer this 'size improvement,' the trader saved an average of $10.125 - $10.10 = $0.025 per share." See 605 Rule Release, pp. 256–257.

priority, deprive the market of liquidity, and cause harm to investors.[79] Additionally, a vast body of academic literature addresses the economics of tick size,[80] going back to the studies of the change in tick sizes from eighths to sixteenths in the late 1990s and then to decimalization in the early 2000s. The Commission considered much of this literature when it adopted the Sub-Penny Rule. While markets have changed and have gotten considerably faster, many of the same underlying economics relevant to tick size remain important considerations. For instance, finer tick sizes could undermine execution priority by tick jumping. In addition, smaller spreads due to finer tick sizes reduce market transparency at the top-of-the-book.

81. When it adopted the Sub-Penny Rule, the Commission reviewed and considered empirical evidence from commenters about the impact of stocks that were tick-constrained at a penny,[81] and ultimately determined that tick-constrained stocks were insufficient to allow sub-penny quoting. In its Tick Size Rule Proposal, the Commission does not explain why its previous analysis is no longer valid. Notably, in passing the Sub-Penny Rule, the Commission said that the rule would deter the practice of "stepping ahead of exposed trading interest by an economically insignificant amount."[82] However, its latest Tick Size Rule Proposal would enable and encourage this practice.

82. Finally, under the current market structure, investors have access to numerous venues, both on- and off-exchange, to execute orders at sub-penny prices. According to the Tick Size

[79] See e.g., Release No. 34-49325, February 26, 2004 ("The Commission believes that OEA's research discussed above strongly suggests that much of the trading that currently takes place in sub-pennies is the result of market participants attempting to step ahead of penny-priced limit orders for the smallest economic increment possible. In the Commission's view, it is unlikely that the high rate of sub-penny clustering around $0.001 and $0.009 price points would have occurred in the absence of stepping ahead behavior. Furthermore, as OEA's research suggests, some sub-penny pricing as well as clustering around the 1 and 9 price points also occurred in increments finer than $0.001, which suggests that sub-penny pricing and the resulting stepping ahead activity could be taken to an absurd extreme. When market participants can gain execution priority for an infinitesimally small amount, important customer protection rules such as exchange priority rules and the NASD's Manning Interpretation as currently formulated could be rendered meaningless. Without those protections, professional traders would have more opportunities to take advantage of non-professionals, which could result in the non-professionals either losing executions or receiving executions at inferior prices. If investors' limit orders lose execution priority for a nominal amount, over time, investors may cease to use them, which would deprive the markets of a vital source of liquidity. Therefore, the use of sub-penny pricing could harm investors and the markets.").

[80] For example, Angel, Harris, and Spatt (2011) mention that "small tick sizes facilitate parasitic quote-matching trading strategies designed to extract option values from standing orders." See James J. Angel, Lawrence E. Harris, and Chester S. Spatt (2011), "Equity Trading in the 21st Century," *Quarterly Journal of Finance*, Vol. 1, No. 1, p. 49.

[81] Release No. 34-51808, June 9, 2005, pp. 353–354 ("A few commenters argued that investors would incur costs from artificially widened spreads as a result of Rule 612. One commenter analyzed trading in six high-volume securities and concluded that Rule 612 would have costs of over $400 million in these securities alone due to wider spreads. Another commenter stated that, if all markets traded QQQQ solely in sub-pennies, the savings would be approximately $150 million per year. A third commenter argued that allowing sub-penny quoting in '23 of the most appropriate securities' would generate annual savings of anywhere between $342 million and $1.9 billion.").

[82] Release No. 34-51808, June 9, 2005, p. 219.

Rule Proposal, tens of billions of dollar volume is executed daily at the midpoint both on- and off-exchange, as well as millions in daily price improvement at smaller increments inside the spread.[83] Moreover, exchange mechanisms that allow for sub-penny prices already exist, and multiple exchanges have already established complementary retail programs, such as the NYSE's Retail Liquidity Program, Nasdaq's Retail Price Improvement Program, and IEX Exchange's Retail Program, which offer sub-penny executions.

2. The Tick Size Rule Proposal Would Result in Less Liquidity at the Top of the Book for Tick Constrained Stocks

83. To justify its proposed changes to the tick size, the Commission uses the Tick Size Pilot ("TSP") by citing the effect of reducing the tick size from $0.05 to $0.01 at the end of the program. The TSP exclusively dealt with small-cap stocks, yet in the Tick Size Rule Proposal the Commission inappropriately extrapolates the observed effects to large-cap stocks.[84] The Commission has not justified its assumption that these different types of securities would have the same impact. In its Tick Size Rule Proposal, it admits that "[u]sing the TSP for analysis also has limitations because the TSP affected a subset of small-cap stocks and primarily focused on changes in tick size."[85] A carefully designed analysis is required to evaluate the impact of the Tick Size Rule Proposal. Trying to extract relevant comparisons from large changes in tick sizes for relatively illiquid stocks is not apples-to-apples, and risks designing changes that could harm liquidity and create other unintended consequences.

84. For tick-constrained stocks, a small tick size would likely result in a tighter spread but would also result in less liquidity at the NBBO because liquidity that is currently concentrated at the penny would be dispersed across the finer pricing increments. This dispersion mechanically reduces liquidity at the top of the book, all else equal. This effect is well documented in the academic literature. For example, Bessembinder (2003) finds that "[after decimalization,] quoted bid-ask spreads declined substantially on [NYSE and Nasdaq]" and that "quotation sizes decreased dramatically after decimalization."[86] Additionally, this effect could be exacerbated by

[83] See Tick Size Rule Release, Table 3.
[84] See Tick Size Rule Release, Table 9.
[85] Tick Size Rule Release, p. 195.
[86] Hendrik Bessembinder (2003), "Trade Execution Costs and Market Quality after Decimalization," *Journal of Financial and Quantitative Analysis*, Vol. 38, No. 4, pp. 747–769.

sub-penny-jumping behavior: Buti, Consonni, Rindi, Yuanji, and Werner (2015) discuss the adverse effects of sub-penny-jumping, including its effects on inside depth: "The SEC realized that if traders could undercut limit orders sitting on the book by an economically insignificant amount, it would potentially reduce the incentive for traders to post limit orders at the top of the [public limit order book], and therefore could have a detrimental effect on inside depth."[87]

85. More depth at the top of the book simplifies order execution, as many executions can be executed as a single trade. If liquidity becomes more dispersed across ticks, the same order may need to be executed with smaller lots, resulting in slower executions and possibly causing information leakage that increases investor costs. Moreover, some market participants make trading decisions using SIP data, which only shows top-of-book data. Because there will be less liquidity at the top of the book, these investors will have less visibility into total market liquidity. Under the Tick Size Rule Proposal, they may need to acquire more expensive depth-of-book data, primarily from exchanges, to see more liquidity.

3. The Best Ex Rule Proposal Would Increase Costs to Market Participants Without Adding a Clear Benefit to Execution Quality

86. The Best Ex Rule Proposal requires broker-dealers to have policies and procedures to identify and incorporate "material potential liquidity sources."[88] Due to the lack of details,[89] brokers could interpret this as a requirement to access additional liquidity sources, even if these new sources provide limited incremental value. At scale, this represents a much larger and unnecessary burden compared to the existing best execution regime and would likely not result in better overall execution quality.

87. An overly strict interpretation of this rule is not necessarily consistent with the well-accepted principles of best execution, which require that brokers use "reasonable diligence."[90] A broker-dealer can determine that it has access to reasonable liquidity sources, such that adding

[87] Sabrina Buti, Francesco Consonni, Barbara Rindi, Yuanji Wen, and Ingrid M. Werner, "Sub-Penny and Queue-Jumping," *Fisher College of Business Working Paper*, p. 4.
[88] See Best Ex Rule Release, pp. 65–66.
[89] See e.g., Best Ex Rule Release, p. 181 ("Although the Commission has not established a set of specific minimum data elements that a broker-dealer would need to acquire to achieve best execution and has acknowledged that it cannot specify the data elements that may be relevant to every specific situation, it has identified the various types of data needed by broker-dealers to fulfill their duty of best execution.").
[90] See "5310. Best Execution and Interposition," FINRA, available at https://www.finra.org/rules-guidance/rulebooks/finra-rules/5310.

access to supplementary liquidity sources might not be worth the cost (*e.g.*, exchanges membership fees, ATS subscriber fees, and other connectivity fees for access).

88. Under the Best Ex Rule Proposal, to comply with the rule requirements, broker-dealers might need to subscribe to data feeds from small trading venues with low liquidity, even though the broker-dealers would not route any meaningful volume to such venues. Subscription costs could become crippling for smaller broker-dealers if they are required to make connections to many or all venues that may offer midpoint liquidity. High costs may cause smaller broker-dealer firms to exit or merge with larger firms, thereby reducing competition. By contrast, smaller trading venues would receive a windfall from simply selling their market data. Ultimately, retail investors would bear these additional costs in the form of poorer execution quality, higher trading costs, and fewer services from their brokers.

89. The Best Ex Rule Proposal also imposes additional requirements on market participants involved in "conflicted transactions," requiring them to evaluate an even broader range of markets beyond those identified as "material." In other words, the rule requires these brokers to assess opportunities at venues they deem not reasonably likely to provide the best prices for customer orders. From an economic perspective, the Commission has decided to effectively levy a penalty on brokers who accept payment for order flow, which would then discourage them from doing so.[91] This could result in higher costs for retail investors, particularly if retail brokers no longer receive payment for order flow and can therefore no longer support commission-free trading. At its core, this is another example of the Commission picking winners and losers without providing meaningful justification for its decisions.

F. The 605 Rule Proposal is the Least Burdensome and Costly of the Proposed Rules and May Achieve All or Most the Stated Goals of the Entire Rule Package

90. As discussed above, the Commission does not provide an adequate justification for the package of rules it proposes (or even for any rule individually). Nevertheless, there is always room at the margin to enhance markets for investors. Among these four proposed rules, there are

[91] See Order Competition Rule Release, p. 300, ("Currently, wholesalers do not charge retail brokers for routing and execution services, and pay some retail brokers PFOF for the right to provide these services. If the implementation of qualified auctions results in a significant loss of wholesaler profits, wholesalers might have to begin charging for routing and execution services. If wholesalers begin charging a fee for routing services, retail brokers would have to absorb this cost and earn lower profits and/or pass on a share of this cost to their customers.").

economic reasons to believe that the 605 Rule Proposal could cost-effectively improve market quality.

91. Currently, it is difficult for investors to compare execution quality across brokers based on Rule 605 and Rule 606 data. The 605 Rule Proposal would require larger brokers to report on order execution quality. This feature would enable investors to better compare execution quality across brokers. The associated increase in transparency would further encourage and motivate brokers to make good routing decisions by allowing them to review wholesaler performance rigorously.

92. As a caveat, it is not apparent that this feature would improve retail execution quality, as the retail broker market is highly competitive, and outcomes could be asymmetric.[92] However, to the extent that there are unexploited opportunities to improve execution quality for retail investors, as the Commission has claimed in its release, empowering investors to compare execution quality across retail brokers (and consequently to switch brokers based on this information) could be the most efficient and effective way to address concerns about execution quality.

93. Compared to the other proposed rules, the 605 Rule Proposal poses the least risk of creating unintended consequences associated with dismantling beneficial elements of the current market structure. For example, one benefit of the 605 Rule Proposal relative to the other rule proposals is that it would not require market participants to reprogram their routing decision logic or their bidding strategies. It also would impose the lowest initial compliance costs, according to the Commission's estimates, as shown in Table 2. Given these reasons, the Commission should consider implementing the 605 Rule Proposal in isolation, measuring the resulting impact (which would establish a new baseline), and then should determine whether there is a need for further changes to the equity market structure relative to the new baseline which could be implemented in pilot programs and in stages.

[92] The proposed rule may change the equilibrium mix of the brokers used by their customers, in ways that can result in positive or negative externalities for other investors. The new rule is designed to allow investors to better compare execution quality across brokers. Based on this information, investors may migrate toward brokers that have better execution quality statistics. As discussed in the other releases, order execution quality tends to be inversely related to how much of a broker's order flow represents "informed" trading (because liquidity providers are willing to provide more price improvement to orders from "uninformed" traders). If the rule induces informed traders to move to brokers that previously had uninformed traders, it could cause execution quality to worsen at that broker.

Table 2: Initial and Annual Compliance Costs of the Proposed Rules[93]

	Initial Compliance Costs	Annual Compliance Costs
605 Rule	$8.9 million	$6.8 million
Order Competition Rule	$48.29 million	$1.99 million
Tick Size Rule	$58.4 million	$0.498 million
Best Ex Rule	$165.4 million	$128.9 million

94. According to its analysis, the Commission believes the 605 Rule Proposal will improve the equity markets, much like it claims its other proposed rules will. For example, the 605 Rule Proposal claims the rule would "better promote competition among market centers and broker-dealers on the basis of execution quality and ultimately improve the efficiency of securities transactions."[94] It also claims that broker-dealers "fac[ing] conflicts of interest that would otherwise misalign their interests with their customers' interest in receiving the best possible execution quality would be better incentivized to manage these conflicts as a result of an increase in their need to compete on the basis of execution quality."[95] If the Commission is correct in its assessment, the problems it claims to have identified regarding competition and conflicts of interest may be fully addressed by its 605 Rule Proposal alone.

[93] See 605 Rule Release, Table 9; Tick Size Rule Release, Table 13; Order Competition Rule Release, Table 21; Best Ex Rule Release, Table 23. Note that Table 23 of the Best Ex Rule Release estimates the initial compliance costs could go as high as $165.4 million if all broker-dealers need to update their policies and procedures to comply with the proposed rule.
[94] 605 Rule Release, p. 5.
[95] 605 Rule Release, p. 319.

Appendix – Supplemental Data Analysis

A. Competitive Dynamics for Wholesalers under the Current Market Structure

1. This section of the appendix includes supplemental analyses highlighting certain competitive factors wholesalers face in today's markets, including an analysis of the types of execution venues retail brokers typically use, which includes multiple wholesalers, exchanges, and ATSs. This section also includes an example of how the market share for the order flow of one particular retail broker has changed over time for various wholesalers.

2. Publicly available Rule 606 data indicate that it is common practice for retail brokers to send their order flow to multiple execution venues, including wholesalers, exchanges, and ATSs. Table A1 contains a list of brokers with a substantial retail customer base and shows the various execution venues they used to execute their customer orders using January 2022 data.

Table A1: Recipients of Order Flow from Select Retail Brokers

		Wholesaler								Exchange						
Retail Broker	Number of Trading Venues	Citadel	G1	IMC	Jane Street	Two Sigma	UBS	Virtu	HRT	Cboe	IEX	MEMX	MIAX Pearl	Nasdaq	NYSE	ATS
Ally Invest	3	✔	✔					✔								
Charles Schwab	9	✔	✔		✔	✔	✔	✔		✔		✔		✔		
E*Trade	8	✔	✔		✔	✔	✔	✔		✔				✔		
Fidelity Investments	10	✔	✔		✔	✔	✔	✔		✔				✔	✔	✔
Interactive Brokers	9	✔							✔	✔	✔	✔	✔	✔	✔	✔
Robinhood	6	✔	✔		✔	✔		✔						✔		
TD Ameritrade	3	✔				✔		✔								
Vanguard	4	✔	✔				✔	✔								
Webull	6	✔		✔	✔	✔		✔		✔						

Source: Rule 606 Reports
Note: The table is based on Rule 606 reports filed by a selection of brokers and shows the trading venues used to route non-directed orders of S&P 500 and non-S&P 500 stocks in January 2022. Some trading venues may be omitted because brokers are not required to list all the venues in their Rule 606 reports. Trading venues operated by the same exchange family (e.g., NYSE and NYSE Arca) are grouped into a single exchange; all ATSs are classified as "ATS."

3. As shown in the table, it is common for a retail broker to route orders to five or more wholesalers in addition to the exchanges and ATSs they use. The data show that some of the largest retail brokers, Charles Schwab, E*Trade, Fidelity, Robinhood, and Webull, used at least five wholesalers, and Ally Invest, TD Ameritrade,[96] and Vanguard used at least three. In addition, retail brokers commonly route to exchanges and ATSs.

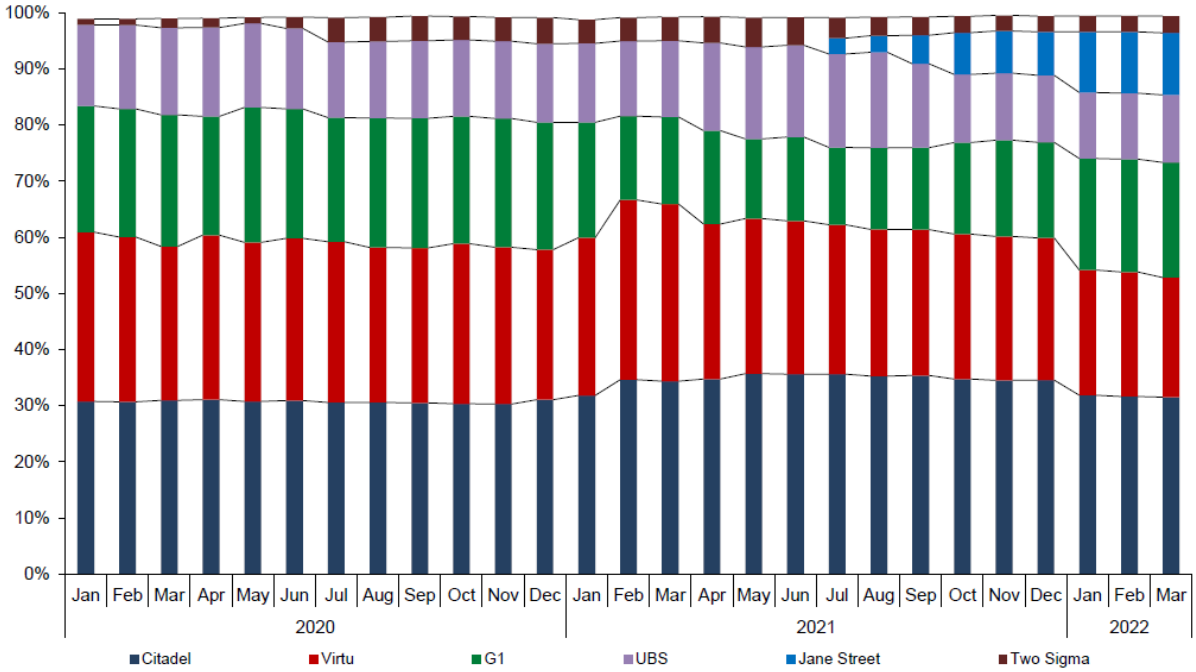
[96] TD Ameritrade was acquired by Schwab, but in January of 2022 (the date for the data used), these firms operated independently.

4. The mix of multiple execution venues that retail brokers use creates a highly competitive environment where wholesalers try to differentiate themselves by providing high-quality order executions. This competition is consistent with how retail brokers describe their relations with wholesalers, and research empirically observes that retail brokers reward wholesalers for providing better execution quality.[97] Rule 606 data can show how retail brokers vary the amount of order flow they send to different wholesalers. Based on my review of these reports, I am not aware of any contract between retail brokers and wholesalers that would guarantee any amount of order flow, suggesting that brokers can add or remove a wholesaler at any time.

5. Figure A1 analyzes the trade flow allocations of Charles Schwab to its wholesalers over approximately two years. In this example, the wholesaler Jane Street first received order flow from Charles Schwab starting in July 2021 and continued to earn larger market share each month through March 2022 (the end of the data sample). The share wholesalers earn in a given month can change considerably over time, even on a monthly basis. For example, in February 2021, G1 appears to have lost a sizable amount of business relative to the prior month, while Citadel and Virtu received higher shares. The opposite occurred in January 2022, when Schwab increased its allocation to G1 and decreased its allocations to Citadel and Virtu. This type of variation in wholesaler market share is expected as retail brokers seek to identify the best execution each month and reallocate order flow accordingly.

[97] See Section III.D.2 in my report.

Figure A1: Charles Schwab's Allocation of Order Flow to Wholesalers
January 2020 – March 2022



Source: Rule 606 Reports
Note: The figure is based on Rule 606 reports filed by Charles Schwab and includes non-directed orders on S&P 500 stocks routed to wholesalers in each month. Market share does not sum to 100% because non-wholesaler venues are not displayed.

6. Table A2 shows the minimum and maximum ranges of market share from Charles Schwab that wholesalers earned from January 2020 through March 2022. In addition, the table shows each wholesaler's largest monthly increase and decrease in terms of market share. For example, G1's share of Schwab's order flow fluctuated from between 13.8% to 24.1%, spanning a factor of nearly 2x. In G1's worst month, it lost 27.4% of its order flow share; in its best month, it gained 16.6%. These factors are more exaggerated with Schwab's smaller wholesalers, such as Two Sigma, who, in its best month, doubled its market share from the prior month, but whose total was at most 5.2%. For Schwab's largest wholesalers, month-to-month variation is less volatile. For example, the best and worst months for Schwab's largest wholesaler, Citadel, translate into a gain of 8.7% or a loss of 7.8% of its order flow share. As discussed in Section III.D.1, these changes are associated with the execution quality the wholesalers provide.

Table A2: Minimum and Maximum Wholesaler Market Share of Charles Schwab's Order Flow, January 2020 – March 2022

	Minimum Share of Broker Order Flow	Maximum Share of Broker Order Flow	Largest Month-Over-Month Positive Change in Share	Largest Month-Over-Month Negative Change in Share
Citadel	30.3%	35.7%	8.7%	7.8%
Virtu	21.3%	32.0%	14.1%	12.5%
G1	13.8%	24.1%	16.6%	27.4%
UBS	11.7%	17.0%	15.5%	18.9%
Jane Street	2.8%	11.0%	72.2%	---
Two Sigma	1.1%	5.2%	119.1%	36.1%

Source: Rule 606 Reports
Note: The table is based on the Rule 606 reports filed by Charles Schwab. It displays summary statistics of the share of non-directed orders on S&P 500 stocks routed to wholesalers. Jane Street is only listed in the retail broker's Rule 606 reports starting in the third quarter of 2021. Data for this wholesaler ranges from July 2021 through March 2022. During this period, its market share of Charles Schwab's order flow consistently increased.

B. Analysis of Virtu's Order and Trade Data

1. Introduction

7. This study analyzes a proprietary dataset from Virtu, which operates one of the largest wholesaler businesses. The dataset consists of fully filled market orders and marketable limit orders routed to Virtu in December 2020 and includes 7,817 different tickers.[98] Analyzing this dataset allows for insights not available when using public data. For example, the dataset contains more granular information than Rule 605 reports, which aggregate monthly data and exclude odd lots. Additionally, the dataset contains more information than the consolidated SIP data, such as the actual trade direction, which allows for a more accurate analysis of price improvement.[99]

8. The focus of this study is to analyze the execution quality of wholesaler orders. A summary of the analysis shows that in December of 2020:

a. Over 54 million orders were routed to Virtu, representing 20.6 billion shares. Virtu fully internalized 85.5% of the orders, equating to 59.6% of the shares. Virtu also sourced liquidity ("externalized") from exchanges, ATSs, and other venues. It fully externalized 12.9% of the orders (or 16.7% of the shares), and partially internalized the remaining 1.6% (or 23.7% of the shares).

b. Virtu provided approximately $95 million in price improvement to its fully internalized orders. Virtu supplemented its price improvement for non-internalized orders by contributing over $7.8 million of its capital for the month.[100] Most of the supplemental price improvement ($6.8 million) was provided to orders routed to the exchanges either fully or in part.

c. Fully internalized orders received higher rates of price improvement and midpoint executions relative to fully or partially externalized orders. Specifically, 78.7% of fully internalized orders received price improvement, and 49.1% were executed at

[98] December 2020 is intended to represent a typical month of market activity. Unfilled and partially filled orders were excluded from the data. To exclude items such as tradable rights, warrants, preferred stocks, and other non-standard securities, only tickers that are reported by CRSP (which excludes many of these) were included. This filtering step does not meaningfully alter the results of the analysis.

[99] Studies relying on public sources typically use the Lee-Ready method to infer trade direction, designating a buy (sell) trade if its price is higher (lower) than the midpoint. This method, by design, will mis-categorize any trades executed at a price better than the prevailing midpoint price.

[100] The analysis does not include the fees that Virtu paid to exchanges and ATSs to obtain liquidity.

the midpoint. Of the fully externalized orders, 39.4% received price improvement, and 9.4% were executed at the midpoint. However, after factoring in supplemental price improvement, 75.3% of fully externalized orders received price improvement, and 9.6% were executed at the midpoint.

d. The partially internalized orders are the largest by average share size and average dollar volume. In terms of average share size, these orders are approximately 20 times larger than fully internalized orders and 10 times larger than fully externalized orders. When executing a large order, particularly one that exceeds the shares available at the quote, the market may move before the order fully executes, resulting in "negative" price improvement, even when the order is executed optimally. Large orders may include institutional activity, implying that measures of conventional price improvement may not be informative for these orders.

e. There is a direct relation between the order size, the time taken to execute the order, and the price improvement the order receives. Across all order categories, larger orders are on average associated with longer execution time and less price improvement. The largest orders are most likely to exceed the displayed quantity at the NBBO.

2. Detailed Analysis of Virtu's Wholesaler Data

9. Virtu received 54.3 million orders in December 2020, which equated to 20.6 billion shares and $604.4 billion in dollar volume. Virtu internalized 85.5% of these orders and found external liquidity sourced from exchanges, ATSs, and other off-exchange venues, for 12.9% of its orders.[101] Virtu partially internalized 1.6% of the orders, meaning liquidity was sourced for some of the shares externally while other shares were internalized. Even though these orders only make up 1.6% of all orders, they represent 23.7% of all shares, indicating they are disproportionately large relative to fully internalized and fully externalized orders. Partially internalized orders were by far the largest—over 10 times the size of fully externalized orders

[101] Off-exchange orders include those executed on ATSs, single dealer platforms, and any other bilateral trading. The limited number of trades that are missing an execution venue are classified as externalized trades.

and over 20 times the size of fully internalized orders. Virtu's order type data and the number of shares are reported in Table A3.

Table A3: Summary of Virtu's December 2020 Orders

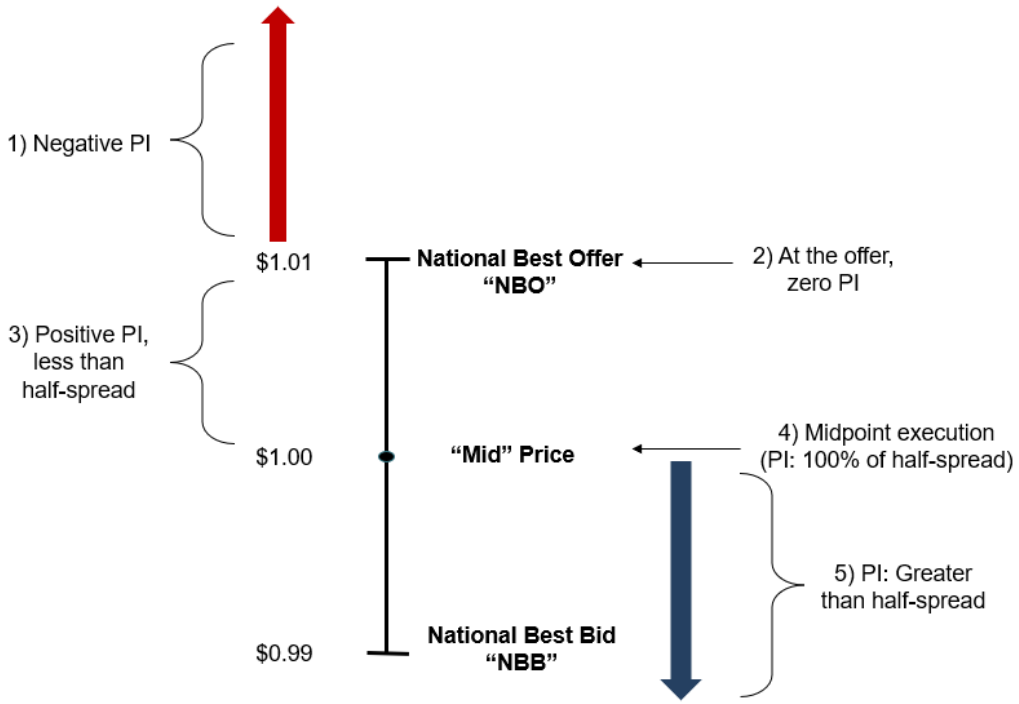
Orders	Number of Orders	% of Total	Number of Shares	% of Total	Average Shares per Order	Dollar Volume ($ Millions)	% of Total
Internalized	46,428,949	85.5%	12,258,712,264	59.6%	264	$442,659	73.2%
Partially Internalized	843,791	1.6%	4,869,810,174	23.7%	5,771	$90,177	14.9%
Externalized	6,999,509	12.9%	3,433,684,046	16.7%	491	$71,603	11.8%
Total	**54,272,249**	**100.0%**	**20,562,206,484**	**100.0%**	**379**	**$604,440**	**100.0%**

Source: Virtu Data
Note: The table summarizes the fully executed marketable orders of Virtu in December 2020, excluding tickers that cannot be found in CRSP data as of December 2020.

10. The following analysis measures Virtu's order execution quality in terms of price improvement, based on a percentage of the half spread (i.e., the distance from the market best quote to the midpoint) and time elapsed for the order to fully execute. Figure A2 visually illustrates the various price improvement zones for a buy order, all relative to the NBBO at order arrival time. All zones represent the total price improvement after the order has been fully executed, even when multiple trades are needed to complete the order.[102] The figure shows five zones: (1) when a buy order executes at a price higher than the NBO at order arrival time, price improvement is negative; (2) when a buy order executes at the NBO, price improvement is zero; (3) when a buy order executes below the NBO but above the midpoint, price improvement is positive but less than the half spread; (4) when a buy order executes at the midpoint, price improvement is 100% of the half spread; and (5) when a buy order executes below the midpoint, price improvement is more than the half spread.

[102] Similar logic would apply to a sell order.

Figure A2: Illustrative Diagram of Price Improvement Zones for a Buy Order



11. Table A4 summarizes the distribution of Virtu's December 2020 orders across these five zones, broken out by fully internalized, partially internalized, and fully externalized orders.

Table A4: Distribution of Price Improvement for Virtu's December 2020 Orders

						Percent of Orders Falling Within				
	Number of Orders	Average Order Size	Median Order Size	Average Seconds Elapsed from Order to Execution	Median Seconds Elapsed from Order to Execution	Greater than Half-Spread	Midpoint Execution	Less than Half-Spread	Zero	Negative
Internalized	46,428,949	264	21	0.18	0.01	2.6%	49.1%	27.0%	20.5%	0.8%
Partially Internalized	843,791	5,771	1,400	22.26	0.03	3.5%	2.6%	56.5%	9.7%	27.7%
Externalized	6,999,509	491	65	8.04	0.02	2.6%	9.6%	63.1%	20.9%	3.8%
All	**54,272,249**	**379**	**25**	**1.53**	**0.01**	**2.6%**	**43.3%**	**32.1%**	**20.4%**	**1.6%**

Source: Virtu Data
Note: An order's time elapsed measures the duration between its receipt and its last trade execution.

12. Notably, 43.3% of all Virtu's orders were executed at the midpoint, constituting 49.1% of fully internalized orders, 2.6% of partially internalized orders, and 9.6% of fully externalized orders. Additionally, 78.0% of all orders received at least some degree of price improvement (i.e., transacting above the NBB for a sell order or below the NBO for a buy order).[103]

[103] This figure is calculated by summing the following: orders receiving price improvement greater than the half-spread (2.6%), midpoint execution (43.3%), and orders receiving positive price improvement lower than the half-spread (32.1%).

Approximately 1.6% of Virtu's orders had negative price improvement, the lion's share of which is attributable to the largest orders that require more liquidity—*i.e.*, from the partially internalized orders.

13. Table A4 also shows the average and median order execution times (elapsed time from order receipt to full execution). The fully internalized orders are executed the fastest, with a median execution time of 0.01 seconds, followed by the fully externalized orders, with a median execution time of 0.02 seconds, and finally, by the partially internalized orders, with a median execution time of 0.03 seconds. Notably, the median order execution time across order types is significantly shorter than the 100 to 300 milliseconds proposed time duration for the qualified auctions in the Order Competition Rule Proposal. Average order execution times are substantially longer than median execution times, particularly for the non-internalized orders, indicating the presence of outliers in the data that took a long time to execute.

14. Academics have acknowledged how conventional measures of execution quality for large orders that may exhaust the available liquidity at the top of the book may be misleading and show "disimprovement" even when such a large order is executed against standing orders in the limit order book.[104] Therefore, this analysis includes both gross price improvement statistics, which excludes any negative price improvement from an order and which may be more appropriate for large orders, and net price improvement statistics, which include all orders regardless of whether the price improvement is positive or negative. Table A5 reports aggregated statistics of price improvement measured in average and median dollars per order, the percentage of the half spread captured, and in basis points relative to the dollar value of the order.

[104] See e.g., Jeffrey M. Bacidore, Robert H. Battalio, and Robert H. Jennings (2002), "Depth improvement and adjusted price improvement on the New York stock exchange," *Journal of Financial Markets*, Vol. 5, No. 2.

Table A5: Price Improvement on Virtu's December 2020 Orders

	Gross Price Improvement					Net Price Improvement				
	Total ($)	Average per Order	Median per Order	% Half-Spread	Basis Point of $ Value	Total ($)	Average per Order	Median per Order	% Half-Spread	Basis Point of $ Value
Internalized	$100,384,384	$2.16	$0.04	48.0%	2.27	$95,020,794	$2.05	$0.04	45.5%	2.15
Partially Internalized	$8,981,723	$10.64	$0.25	21.7%	1.00	-$39,602,985	-$46.93	$0.25	-95.8%	-4.39
Externalized	$14,807,658	$2.12	$0.03	43.5%	2.07	-$543,103	-$0.08	$0.03	-1.6%	-0.08
All	**$124,173,766**	**$2.29**	**$0.04**	**43.7%**	**2.05**	**$54,874,706**	**$1.01**	**$0.04**	**19.3%**	**0.91**

Source: Virtu Data
Note: The gross price improvement statistics account for orders executed at better prices than the NBBO, i.e., with non-negative price improvements, and assume those executed at or outside the NBBO receive zero price improvement. The net price improvement statistics assume negative price improvement for orders executed outside the NBBO.

15. There is little difference between gross and net price improvement for the fully internalized orders because most have positive price improvement. Additionally, order size tends to be smaller than externalized (either fully or partially). Based on net price improvement, internalized orders capture 45% of the half-spread and average $2.05 per order or 2.15 basis points. On net, internalized orders included $95 million in price improvement.

16. For the fully externalized orders, the total dollar amount of net price improvement is negative $0.5 million. Notably, this figure reflects supplemental price improvement, meaning Virtu used its capital to improve realized execution prices. Without this supplemental price improvement, net price improvement would have been negative $5.9 million. The average price improvement per order was negative $0.08; however, the median price improvement per order was positive $0.03.

17. For partially internalized orders, net price improvement was significantly negative ($40 million). However, given the large size of these orders (10x larger than fully externalized orders and 20x larger than fully internalized orders), gross price improvement may be more informative. For example, many of these orders may have been submitted by institutions which trade in large quantities. To the extent this was the case, conventional price improvement metrics are less relevant for institutions that evaluate execution quality based on implementation

shortfall, VWAP averages relative to another benchmark, or slippage.[105] The gross price improvement for partially internalized orders totaled approximately $9 million.

18. When order size exceeds the amount of liquidity available at the NBBO, wholesalers, in some cases, may be willing to offer more shares at or better than the quote that is publicly displayed. In other cases, wholesalers may seek to execute some or all of the order on the exchanges. Because there is insufficient liquidity available to fill the entire order at the NBBO, a portion of the order may be executed at the next best price(s). Additionally, larger orders may need to be broken up into smaller pieces and routed to multiple venues to obtain the best execution, and therefore may take longer to execute. For these reasons, there is an inverse relation between order size and the price improvement the order receives.

19. Table A6 shows the distribution of price improvement by order size measured in shares for internalized and non-internalized orders.[106] Generally, as the order size increases, the average execution time and the rate of "disimproved" orders (i.e., orders with negative price improvement) increases. Internalized orders showed the lowest rates of negative price improvement, totaling 0.6% for the smallest orders, to 1.9% for the largest orders of 5,000 or more shares. Midpoint executions similarly decreased from 52.2% to 13.8%, and orders executed at the quote increased from 21.0% to 36.5%. For fully externalized orders, the smallest orders had a negative price improvement rate of 2.7%. The rate of negative price improvement generally increased for each order size, with a rate of 20.3% for the largest order bucket.

[105] Schwab white paper, p. 7 ("[I]nstitutional trades are more likely to 'move the market' – which is why their execution quality is often measured based on slippage from the NBBO, as opposed to price improvement within it").

[106] The buckets of share sizes are the same as those reported in Rule 605 reports, but also include odd lots, and orders at or larger than 10,000 shares.

Table A6: Distribution of Price Improvement for Virtu's December 2020 Orders

Internalized							Average Seconds	Median Seconds	Percent of Orders Falling Within				
Order Size (Shares)	Number of Orders	% of Total Orders	Number of Trades	% of Total Trades	Number of Shares	% of Total Shares	Elapsed from Order to Execution	Elapsed from Order to Execution	Greater than Half-Spread	Midpoint Execution	Less than Half-Spread	Zero	Negative
1 - 99	31,858,742	68.6%	32,252,971	66.8%	540,922,315	4.4%	0.15	0.01	2.2%	52.2%	24.0%	21.0%	0.6%
100 - 499	9,244,290	19.9%	9,808,188	20.3%	1,712,501,151	14.0%	0.19	0.01	3.6%	45.5%	30.9%	18.9%	1.1%
500 - 1,999	3,928,109	8.5%	4,415,245	9.1%	3,342,543,518	27.3%	0.21	0.01	3.9%	43.4%	33.1%	18.4%	1.2%
2,000 - 4,999	929,860	2.0%	1,127,672	2.3%	2,482,550,989	20.3%	0.32	0.01	1.6%	23.3%	53.6%	20.1%	1.3%
5,000 or greater	467,948	1.0%	654,870	1.4%	4,180,194,291	34.1%	1.30	0.01	2.1%	13.8%	45.7%	36.5%	1.9%

Partially Internalized							Average Seconds	Median Seconds	Percent of Orders Falling Within				
Order Size (Shares)	Number of Orders	% of Total Orders	Number of Trades	% of Total Trades	Number of Shares	% of Total Shares	Elapsed from Order to Execution	Elapsed from Order to Execution	Greater than Half-Spread	Midpoint Execution	Less than Half-Spread	Zero	Negative
1 - 99	59,525	7.1%	144,281	1.8%	2,147,066	0.0%	9.79	0.01	4.7%	2.2%	68.5%	13.0%	11.6%
100 - 499	138,607	16.4%	461,461	5.6%	35,084,108	0.7%	8.48	0.02	4.6%	4.5%	63.4%	11.7%	15.8%
500 - 1,999	264,005	31.3%	1,460,145	17.7%	252,892,184	5.2%	13.75	0.02	3.5%	3.9%	64.0%	7.8%	20.7%
2,000 - 4,999	156,364	18.5%	1,486,720	18.1%	442,613,981	9.1%	25.32	0.03	2.4%	1.8%	55.6%	7.0%	33.2%
5,000 or greater	225,290	26.7%	4,681,713	56.9%	4,137,072,835	85.0%	41.83	0.04	3.2%	0.4%	41.0%	11.8%	43.6%

Externalized							Average Seconds	Median Seconds	Percent of Orders Falling Within				
Order Size (Shares)	Number of Orders	% of Total Orders	Number of Trades	% of Total Trades	Number of Shares	% of Total Shares	Elapsed from Order to Execution	Elapsed from Order to Execution	Greater than Half-Spread	Midpoint Execution	Less than Half-Spread	Zero	Negative
1 - 99	3,763,859	53.8%	4,112,030	26.7%	86,288,754	2.5%	10.01	0.01	2.6%	7.4%	65.0%	22.3%	2.7%
100 - 499	2,039,925	29.1%	3,715,360	24.1%	375,370,572	10.9%	4.12	0.02	2.9%	14.9%	59.3%	20.2%	2.7%
500 - 1,999	843,823	12.1%	3,934,473	25.5%	719,123,646	20.9%	5.20	0.02	2.4%	8.4%	67.2%	15.9%	6.0%
2,000 - 4,999	203,316	2.9%	1,740,860	11.3%	543,939,490	15.8%	13.24	0.02	2.4%	5.8%	60.9%	18.2%	12.7%
5,000 or greater	148,586	2.1%	1,917,873	12.4%	1,708,961,584	49.8%	21.08	0.02	2.7%	5.1%	45.7%	26.3%	20.3%

Source: Virtu Data
Note: An order's time elapsed measures the duration between its receipt and its last trade execution.

20. Because larger orders take more time to execute fully, the market price often moves away from the quote established when the order initially arrived. Additionally, the number of shares demanded often exceeds the available shares reported at the NBBO, meaning the order is more likely to move prices because it can have a greater market impact if it depletes the available liquidity. When this happens, price improvement appears negative, even though the order was executed at the best available prices.

21. Table A7 illustrates an example of a buy order for 5,400 shares of the ticker AMLP on December 15, 2020, that was fully externalized and the accompanying trades that completed the order. This example shows how the trade price worsened as liquidity was removed from the market. The first two trades, each for 100 shares, were executed at the midpoint price of $27.575. These trades were followed by 20 trades totaling 4,023 shares executed at the NBO of $27.580. Finally, five trades totaling 1,177 shares were executed at the next best price of $27.585. Together, these trades completed the order of 5,400 shares. However, the order's volume-weighted price is worse than the quote at the time of the order receipt, meaning the order is associated with negative price improvement, even though the average execution price of $27.581 is better than the VWAP of the displayed shares, which is $27.587.

Table A7: Example of a Large Order with Price Impact

Order Details

Date	Timestamp	Ticker	Buy/Sell	Volume (in shares)	Average Execution Price	NBB	NBO	Shares at NBB	Shares at NBO	VWAP of Displayed Shares	Total 605 PI
12/15/2020	11:28:15.590	AMLP	B	5,400	$27.581	$27.57	$27.58	3,499	1,723	$27.587	-$4.89

Trade Details

Number	Date	Timestamp	Ticker	Quantity	Execution Price	Execution Venue
1	12/15/2020	11:28:15.599	AMLP	100	$27.575	Off-Exchange Venue
2	12/15/2020	11:28:15.600	AMLP	100	$27.575	Off-Exchange Venue
3	12/15/2020	11:28:15.608	AMLP	300	$27.580	Off-Exchange Venue
4	12/15/2020	11:28:15.609	AMLP	300	$27.580	Off-Exchange Venue
5	12/15/2020	11:28:15.609	AMLP	300	$27.580	Off-Exchange Venue
6	12/15/2020	11:28:15.610	AMLP	300	$27.580	Off-Exchange Venue
7	12/15/2020	11:28:15.610	AMLP	300	$27.580	Off-Exchange Venue
8	12/15/2020	11:28:15.610	AMLP	200	$27.580	Off-Exchange Venue
9	12/15/2020	11:28:15.610	AMLP	200	$27.580	Off-Exchange Venue
10	12/15/2020	11:28:15.611	AMLP	100	$27.580	Off-Exchange Venue
11	12/15/2020	11:28:15.611	AMLP	300	$27.580	Off-Exchange Venue
12	12/15/2020	11:28:15.611	AMLP	300	$27.580	Off-Exchange Venue
13	12/15/2020	11:28:15.611	AMLP	100	$27.580	Off-Exchange Venue
14	12/15/2020	11:28:15.612	AMLP	100	$27.580	Exchange
15	12/15/2020	11:28:15.612	AMLP	300	$27.580	Exchange
16	12/15/2020	11:28:15.612	AMLP	100	$27.580	Exchange
17	12/15/2020	11:28:15.612	AMLP	100	$27.580	Exchange
18	12/15/2020	11:28:15.613	AMLP	3	$27.580	Exchange
19	12/15/2020	11:28:15.613	AMLP	100	$27.580	Exchange
20	12/15/2020	11:28:15.613	AMLP	20	$27.580	Exchange
21	12/15/2020	11:28:15.613	AMLP	500	$27.580	Exchange
22	12/15/2020	11:28:15.614	AMLP	100	$27.580	Exchange
23	12/15/2020	11:28:15.623	AMLP	100	$27.585	Off-Exchange Venue
24	12/15/2020	11:28:15.623	AMLP	300	$27.585	Off-Exchange Venue
25	12/15/2020	11:28:15.624	AMLP	200	$27.585	Exchange
26	12/15/2020	11:28:15.624	AMLP	300	$27.585	Exchange
27	12/15/2020	11:28:15.625	AMLP	277	$27.585	Exchange

Source: Virtu Data

22. For orders filled with liquidity sourced from exchanges and other off-exchange venues, Virtu supplements the price improvement using its capital. Table A8 shows that in December 2020, Virtu paid $7.8 million to improve the execution quality of its non-internalized orders. The majority was provided to fully externalized orders and nearly eliminated the net negative price improvement for this type of order. Less supplemental price improvement was provided to partially internalized orders which represent a much smaller percentage of Virtu's orders. Out of the $7.8 supplemental price improvement, $6.8 million was provided to orders—either fully or partially—routed to exchanges. When all orders are viewed in aggregate, Virtu provided approximately $55 million in price improvement to customer orders in December 2020.

Table A8: Supplemental Price Improvement by Virtu for Its December 2020 Orders

	Internalized			Externalized			Partially Internalized			Overall	
	PI ($ million)	Average Size Per Order (in Shares)	PI Per Share	PI ($ million)	Average Size Per Order (in Shares)	PI Per Share	PI ($ million)	Average Size Per Order (in Shares)	PI Per Share	PI ($ million)	PI Per Share
PI Before Supplement	$95.0	264	$0.0078	-$5.9	491	-$0.0017	-$42.0	5,771	-$0.0086	$47.1	$0.0023
Supplemental PI	--	--	--	$5.3	491	$0.0016	$2.4	5,771	$0.0005	$7.8	$0.0009
Total	**$95.0**	**264**	**$0.0078**	**-$0.5**	**491**	**-$0.0002**	**-$39.6**	**5,771**	**-$0.0081**	**$54.9**	**$0.0027**

Source: Virtu Data