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

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

Dear Ms. Countryman:

Pragma appreciates the opportunity to comment on the Commission's proposed rule, Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders (the "Proposal").

Pragma is a quantitative trading technology vendor and a broker-dealer registered with the SEC specializing in algorithmic trading. We primarily serve banks, large institutional brokers, and quantitative hedge funds. We do no proprietary trading, provide no prime brokerage services, and have no customer accounts or retail services. We have a history of publishing quantitative research notes based on empirical data showing how market structure affects trading costs from a practitioner's perspective.

We strongly support the basic elements of the proposed Tick Sizes and Access Fees rules:

- Allowing smaller tick sizes for tick-constrained stocks.
- Reducing access fees appropriately.
- Requiring off-exchange executions to occur at valid NMS ticks, leveling the playing field.
- Reducing the lot size for higher-priced stocks to a value better aligned with market needs and practice.

Indeed, Pragma published a market structure note in 2015 illustrating how constrained tick sizes degrade execution quality and suggesting a package of changes to improve market structure broadly overlapping the Proposal.[1]

However, we believe several details of the Proposal can be improved. In the remainder of this comment letter we:

- Suggest using notional spread width as a framework for evaluating tick size changes.
- Offer cross-sectional evidence suggesting that 4-8 ticks are too many.
- Offer data from stock splits suggesting that (a) 4-8 ticks are too many, and (b) tick sizes smaller than $0.005 will indeed be required to un-constrain some stocks.
- Recommend 1.5-4 ticks as a better range than 4-8.
- Recommend a monthly rather than quarterly tick size adjustment.
- Request that the Commission explicitly adopt a framework for evaluating whether these changes are beneficial and commit to monitoring and periodically publishing the results.
- Recommend that the Commission consider extending the proposal to tick sizes of larger than $0.01 to avoid the negative effects of economically insignificant ticks for higher-priced stocks.
- Recommend a version of the proposed transparency rule around exchange fees that would provide more practical benefits to investors and their agents.
- Recommend a modification of the proposed lot sizes that may better suit higher-priced stocks.

[1] https://www.pragmatrading.com/resource/market-structure-march-2015/

SPREAD WIDTH

Spread width, defined as the average bid-ask spread in basis points of the stock price, is a well-established key metric for market quality because it is one of the primary determinants of trading costs. A small order can usually execute at the cost of ½ the spread. Large orders are often broken up into small pieces and spread out in time through the use of execution algorithms, so spread width is also a key determinant of institutional trading costs. And the width of the spread can be thought of as the precision of price discovery, to the extent the bid-offer spread (plus or minus fees) represents the envelope for the market's view of fair value. For this reason, it is important to look at evidence bearing on how the proposed changes to market structure are likely to affect spread widths.

The Proposal discusses two main goals with respect to tick sizes:

1. Allow smaller ticks for stocks that are currently constrained, i.e., have an average spread of around $0.01 and are unable to narrow it further because of the $0.01 tick size; but
2. Avoid tick sizes so small that they are "economically insignificant" and undermine the price-time priority system, thus discouraging liquidity providers.

There is a "Goldilocks" assumption implied by these goals: too large a tick size makes spreads wider, and too-small a tick size *also* makes spreads wider, but in some optimal range the tick size is *just right* – spreads will be narrowest, and trading costs lowest. Market rules should encourage (and certainly not prevent) trading in that optimal range, and an important question is *whether the Proposal will do this*.

CROSS-SECTIONAL EVIDENCE

We start by directly looking at spread width as a function of stock price in the market today. Since ticks are a constant $0.01, price in a sense sets the number of "available" ticks for the stock. Of course, many factors affect spread width besides price; most obviously volume and volatility.

The figure on the next page shows average spread width as a function of stock price, controlled for volume and volatility, for 2,642 of the most liquid stocks, which collectively represent about 96% of the common stock value traded in the market.

FIGURE 1 Median Spread for $10k with Fees Normalized by Volatility

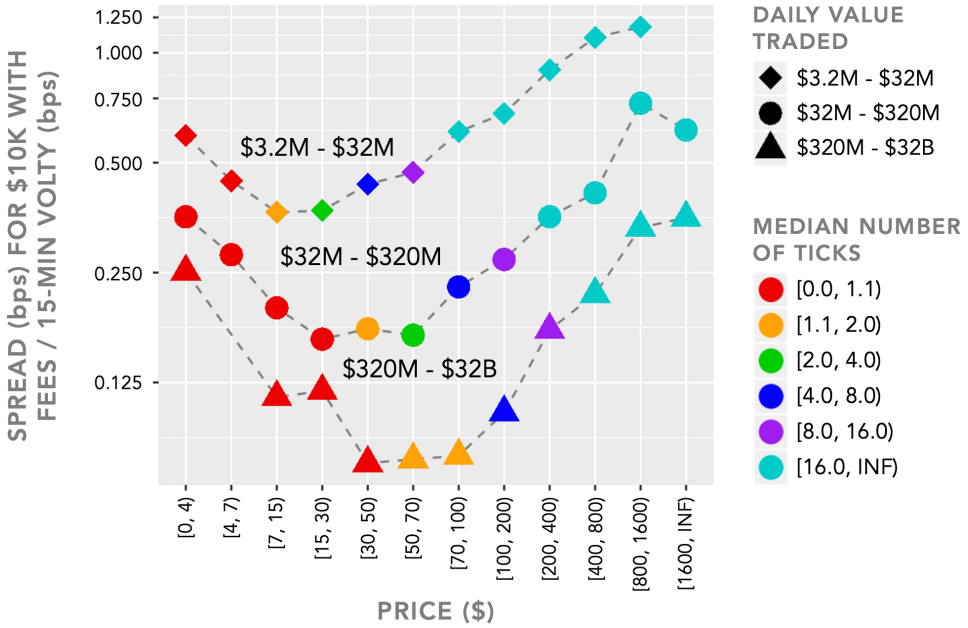


Figure 1 buckets stocks by daily value traded and price. The top line represents 1,489 stocks that trade in the range of about $3.2mm - $32mm/day; the middle line represents 964 stocks that trade in the range from $32mm - $320mm, and the bottom line 189 stocks that trade $320mm and up. The X axis defines the stock price buckets.

Each point thus represents a set of stocks with comparable price and average daily value traded. The Y position shows the average spread width of those stocks in basis points, normalized by volatility (see the appendix for more details on normalization).

A few patterns are evident. Naturally, stocks that trade a higher dollar value per day enjoy narrower spread widths, as seen by their lower position on the Y axis. And, supporting the goldilocks assumption, each curve is U-shaped: too-low-priced stocks have wider spreads because they are tick constrained; when prices are a little higher than that (and presumably stocks are no longer tick-constrained) spreads are narrowest; and beyond that as price and number of ticks get higher, spreads widen.

The ***color*** of each point reflects the median spread in ticks for stocks in that bucket, allowing us to look more directly at the relationship between the number of ticks and spread width in basis points. Moving from left to right along each "smile" curve, red points show buckets where stock price is on average too low and many stocks are tick-constrained, with the median stock's spread less than 1.1 ticks. At somewhat higher prices, where spreads are narrowest, the median stock's spread is from 1.1 to 4 ticks; picked out in orange and green. At still higher prices, to the right side of each curve, spreads start to widen again. Blue points show buckets where the median stock's spread in the range required by the Proposal: 4 to 8 ticks.

The key observation with respect to the Proposal is that **buckets with spreads in that range of 4 to 8 ticks (blue) are worse, i.e., on average have wider spreads in basis point terms, than buckets with fewer ticks** (so long as they are not tick-constrained), identified in orange and green.

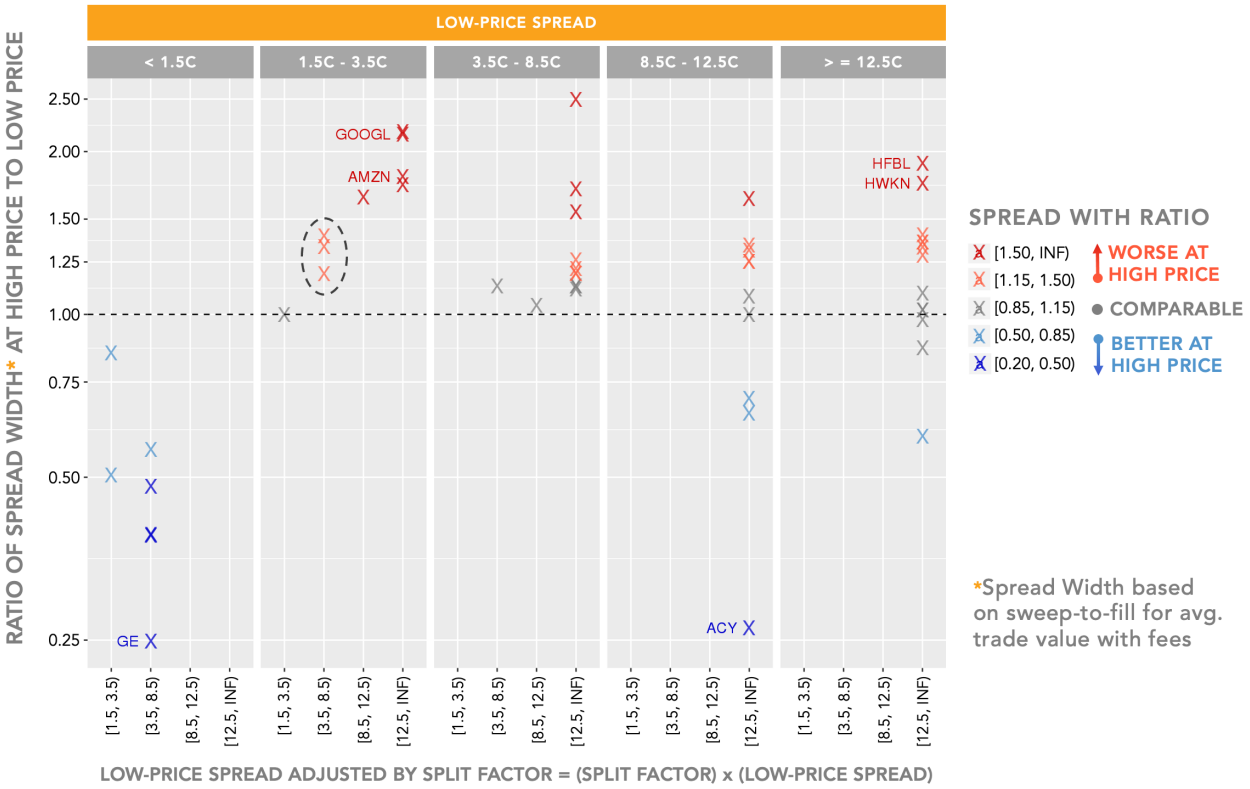
It's worthwhile to note that this pattern of more ticks *increasing* spread width (outside of tick-constrained stocks) is not an artifact of lot size or fees. The spread widths reported above are based on the sweep-to-fill price to buy or sell $10,000 using Level-2 market data (i.e. including odd-lot orders), with approximate fees included. This approach is likely favorable to stocks with more ticks: it assumes quotes across price levels and exchanges up to the desired value can be seen and accessed successfully. The reality is likely to be worse: market participants don't all have access to level 2 data, and report difficulty in sweeping displayed liquidity across exchanges and price levels.

EVIDENCE FROM STOCK SPLITS

Another way of looking at the question of how many ticks are optimal is using the "natural experiment" provided by stock splits and reverse splits. When a stock splits, the price changes, but the $0.01 tick size stays constant, as does the fundamental value of the company. So, in some sense the before/after comparison can be considered more concrete and apples-to-apples than the cross-sectional data shown above.

The figure below shows how the spread width compares across 51 splits and reverse splits over a two-year period from February 2021 through February 2023.

FIGURE 2



Each point represents a single stock that had a split or reverse split, normalized to make it easy to see across both types of events whether the higher stock price (thus more available ticks) was associated with a narrower or wider spread in basis point terms. Position on the Y-axis shows the actual ratio of spread width in basis points between the lower price and the higher price: a value of 1 means the spread width

was unchanged by the split; values below 1 (colored blue) mean spreads were narrower at the higher price (when there were more ticks available); and values above 1 (colored red) mean the spreads were wider at the higher price.

The stocks are sorted into buckets (shown as panels) based on the average spread in cents at the lower price (after a split, or before a reverse split). Since a stock split or reverse split does not change the fundamental value of the company, when the price scales with the split factor, so theoretically should the spread. The X-axis within each panel shows how the spread should theoretically have adjusted by the split ratio.

For example, GOOGL (seen labeled at the top of the second panel) had a 20:1 stock split on July 18, 2022. The higher price, before the split, was over $2,330, and the bid-ask spread was about $1.14, or 4.9 bps. The lower price, after the split, was about $112, and the bid-ask spread narrowed to $0.026, or 2.27 bps. The spread width at the higher price was 2.15 times the spread width at the lower price, so the GOOGL point is placed with Y value of 2.15 and is colored red to emphasize that the higher price was worse. GOOGL falls in the second panel because its spread at the lower price fell in the $0.015 – $0.035 bucket. Within that panel, it falls in the [12.5, Inf] X-axis bucket because the projected high-price spread (low-price spread multiplied by the split factor) is $0.026 x 20 or $0.52.

The first panel starting from the left shows stocks with average spread of less than $0.015 at the lower price (price pre-reverse split or price post-split), and therefore all were likely tick constrained. Perhaps unsurprisingly, all but one of the events for these tick-constrained stocks were reverse splits, increasing price, and effectively allowing more ticks. All such events resulted in narrower spreads in basis point terms, as expected. **Several stocks settled to spreads less than half the low-price spread, indicating that for some stocks, a half-penny tick size would still be too constraining, and smaller tick sizes are needed.**

The second and third panels show stocks that had spreads of between 1.5 and 8.5 ticks at the lower price and were therefore empirically not tick-constrained. For these events, the notional spread width at the higher price (before the split, as these events were all regular splits) was almost always worse than at the lower price. **Again, for non-tick-constrained stocks, higher prices and thereby more ticks are associated with wider spreads in basis point terms.** The stock splits circled in the second panel provide empirical evidence that a tick range of 3.5-8.5, roughly the range proposed by the Commission, leads to wider notional spread than a range of 1.5-3.5 ticks, as illustrated by all three points being notably above the dashed line. Even though this evidence is just a handful of examples, it supports that the proposed range of 4-8 ticks may be too granular, and an alternative of 1.5-4 ticks would serve better.

The fourth and fifth panels show stocks that had spreads of more than 8.5 ticks at the lower price (these events were also all regular splits). While higher prices and still more ticks are still mostly worse, the picture is slightly less clear – perhaps because the stocks were far above the optimal range even at the lower price.

PROPOSAL ANALYSIS OF TICK SIZE PILOT END (TSP)

The Commission presented an analysis supporting the view that a smaller tick size is generally better for tick-constrained or near-tick-constrained stocks based mainly on the end of the small-cap-large-tick pilot ("Minimum Pricing Increments"; p. 201). The Commission also recognizes that having too small a tick

size is detrimental to the spread width and uses the TSP analysis for non-tick-constrained names (bins 3 and 4 as defined on p. 198) to demonstrate that degradation. While the TSP analysis provides strong supporting evidence that a smaller tick size is indeed better for tick-constrained stocks or near-tick-constrained stocks, it does not provide evidence that 4-8 ticks is a reasonably optimal compared to alternatives like 1.5-4 ticks (refer to the Appendix for more details).

TICK SIZE RECOMMENDATIONS

The evidence above strongly supports the core component of the Proposal: that tick-constrained stocks will benefit from smaller tick sizes with narrower spreads.

While perhaps not conclusive, the lines of evidence from our analysis also suggest that the Proposal's range of 4 to 8 ticks is too many and will force wider spreads and higher trading costs on the market than necessary.

This leads to our primary recommendation: stocks should be moved to a smaller tick size only when their average spread is less than 1.5 in the preceding month; and moved to a larger tick size only when their spread is greater than 4 ticks in the preceding month.

Finally, we note our recommendation aligns with the Proposal's general approach of using actual market conditions to drive changes. We see this as a sound approach because so many potentially conflicting factors and conditions can affect a given stock's spread. The tick size should only be made smaller when it proves empirically to be too large – i.e., it approaches constraint as seen by the average spread going below 1.5 ticks. And the tick size should only be made larger when it exceeds the few ticks that appear to be optimal.

MONTHLY ADJUSTMENTS

The Proposal suggests quarterly adjustments to tick size to "balance the need to update minimum pricing increment at regular intervals such that the interval can reflect market conditions without updating too frequently as to introduce undue complexity to the market system" (p.59-60). Because many stocks will be affected, we believe all affected market participants will have to automate the process of consuming the tick size updates and updating their systems accordingly. Given that, the incremental complexity of monthly updates over quarterly is negligible. We would expect more frequent smaller updates to reduce how often and for how long a stock's tick size stays outside the optimal range.

EVALUATION FRAMEWORK

The data presented above suggests to us that apparently reasonable changes to market structure may have undesirable, yet predictable consequences. We therefore respectfully request that the SEC adopt an explicit framework for evaluating whether the actual effects of the Proposal are harmful or beneficial – for example using notional spread width as we've done in this letter, or any other metric or metrics the Commission feels are more suitable. We also request the Commission monitor and regularly share their findings with market participants.

LARGER TICKS FOR HIGH PRICED STOCKS

Although the primary driver for the present Proposal is tick-constrained stocks, the Commission clearly believes that economically insignificant tick sizes are a serious concern. If it were not so, the commission would presumably take the much simpler step of using a $0.001 tick size for the entire class of stocks.

The evidence presented in this letter strongly supports this concern: outside of tick-constrained stocks, more, smaller ticks generally seem to be harmful, leading to wider spreads and higher transaction costs, in addition to more difficult trading conditions resulting from thinner liquidity at the market's inside price, and practical challenges in successfully sweeping liquidity across exchanges and price levels.

The evidence presented above bears most directly on high-priced stocks with average spreads above $0.03 or $0.04 in the market today. Generally speaking, the higher the stock price and the more ticks in the spread, the wider the spread in basis point terms. The Commission's analysis of the Tick Size Pilot for non-tick-constrained finds evidence consistent with our observations ("Minimum Pricing Increments"; p. 201).

We therefore recommend that the SEC consider extending to higher-priced stocks the same benefits of keeping ticks adjusted to an economically significant size. This would mean defining tick sizes of $0.02, $0.05, $0.10, etc., and the same regular re-calibration for all stocks – for example, making the tick size smaller when the stock approaches being tick-constrained (less than 1.5 ticks) and making the tick larger when the average spread exceeds 4 ticks.

ACCESS FEES

The Proposal caps access fees to:

- $0.0005 for stocks with a tick of $0.001, and
- $0.001 for stocks with a tick of $0.002 or higher

The $0.001 fee cap for most stocks should be fine, but **we recommend keeping fees strictly less than ½ of the tick size**. If fees reach ½ the tick size, it means that the same effective price point can be achieved multiple ways on an all-in basis with different nominal prices (e.g., an offer at 10.000 with a $0.0005 rebate, or a bid of 10.001 with a $0.0005 rebate). The consequences of this complexity are hard to predict but may include price instability and quote flickering. We would therefore recommend capping access fees to:

- $0.0003 for stocks with a tick of $0.001
- $0.0006 for stocks with a tick of $0.002
- $0.001 for stocks with a tick of $0.005 or higher

ACCESS FEE TRANSPARENCY

Regarding the proposal that "all exchange fees and rebates be determinable at the time of execution," while we agree with the objective of practical fee transparency, we don't believe the Proposal will materially reduce "uncertainty regarding the fee amount at the time of execution […] for market

participants conducting best execution analyses and […] order routing decisions" (referred to below as "Market Participants"; p. 107).

Few brokers route directly to the exchanges (at least on a volume-weighted basis). Rather, most brokers pay to route their orders through larger "DMA" brokers to gain the benefit of the large brokers' exchange fee tiers. While the Proposal would simplify life for those few large DMA brokers and proprietary trading firms who closely track where they fall on exchange fee schedules, it wouldn't directly help the referenced Market Participants.

Even if fees are determinable, it will provide little practical transparency for most Market Participants. Each trade report from an exchange comes back tagged with idiosyncratic fee codes and even where brokers pass those codes through to their clients, the brokers would additionally have to provide their tier information to their clients in advance. The format of this information, judging by common practice today, would be complex, idiosyncratic to each broker, and not machine-readable. This would still leave accounting for fees an onerous and error-prone process, and realistically still beyond the reach of most Market Participants.

A change that would provide real, practical help to Market Participants who make their own routing decisions and use DMA brokers for market access would be to require exchanges and brokers to pass back the actual fee or rebate to be charged on each execution report, expressed in dollars. Note these fees that are passed back to the client wouldn't have to reflect the underlying venue's fees to the broker, only the actual fee the broker agreed to charge (or rebate remit) their client.

Finally, in order to help Market Participants who don't receive pass-back fees and rebates understand what their broker is making or spending to execute their trades, exchange fee transparency – even if it were practically available – is not enough. A significant fraction of volume is executed against non-exchange venues that are not required to charge standard fees, and where fees are often held as competitively sensitive secrets. However, such Market Participants don't need real-time information. For them, a monthly report disclosing the total fees and rebates associated with their order flow would be sufficient for the purposes the Proposal identifies.

LOT SIZE

The Proposal to define the lot size based on the stock's price is a valuable step "to increase transparency about the best priced quotations available in the market" ("Minimum Pricing Increments"; pp 113).

In order to evaluate the proposed lot sizes, we study how much the spread for a given lot size degrades compared to the best available spread, i.e., the spread for 1 share. The spread for a given lot size being much wider than the spread for 1 share indicates the lot size hides a lot of potential price improvement, and is too large. We set the threshold at 25% increase in spread, a balance between being a material-enough increase in trading cost while avoiding an economically insignificant lot size.

FIGURE 3

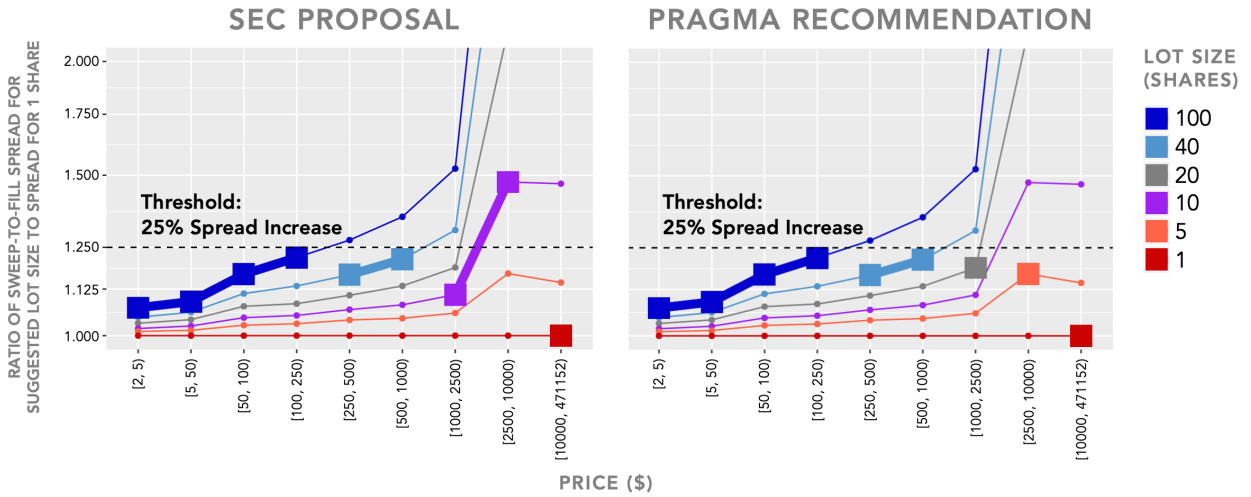


Figure 3 shows the ratio of the spread for a given lot size to the spread for 1 share in buckets of price (refer to Appendix for details on data and definitions). Note, the lines in the left and right panels are identical; only the use of bolding to represent the SEC Proposal (left) and Pragma's recommendation (right) are different. Each colored line corresponds with a specific lot size choice from 100 shares (blue) to 1 share (red). For low-priced stocks, the lot size of 100 results in a small increase in spread over the 1-share spread, as one would expect. For higher priced stocks, the spread for 100 shares starts to be materially worse than the 1-share spread, exceeding the 25% threshold at prices over $250. For still higher priced stocks, the spread for 100 shares is dramatically worse, providing strong evidence that smaller lot sizes are needed to make the basic elements of the NMS market structure, i.e. quote transparency and protection, effective for high-priced stocks.

In the figure on the left, the bold lines and large point markers highlight the SEC proposal. Going to a lot size of 40 shares for prices $250-$1k is a good choice, putting the spread increase just under the 25% threshold. A lot size of 10 shares for prices $1k to $10k, however, seems suboptimal, as stocks in the upper part of that range, from $2.5k - $10k, have spreads above the 25% threshold. We recommend a slight modification to the Proposal by breaking up the $1k to $10k range into two buckets, $1k-$2.5k with lot size of 20 shares and $2.5k-$10k with a lot size of 5 shares. This brings the effective spread reasonably close to the 25% threshold without exceeding it. In the figure on the right, the bold lines and large point markers highlight this slight modification to the SEC proposal. Both the SEC proposal and Pragma's recommendation are shown in Table 1 below.

TABLE 1 Lot-Size Proposal and Pragma's Recommendation

PRICE RANGE	SEC PROPOSAL	PRAGMA RECOMMENDATION
Under $250	100 shares	100 shares
$250 to $1,000	40 shares	40 shares
$1,000 to $2,500	10 shares	**20 shares**
$2,500 to $10,000	10 shares	**5 shares**
Over $10,000	1 share	1 share

MINIMUM PRICING INCREMENT FOR TRADING

We strongly support the Commission's proposal to align the minimum pricing increment to the quoting increment for all trading alongside the other changes in the Proposal.

Allowing private off-exchange transactions on terms that are prohibited on-exchange manifestly creates an uneven playing field, harms investors in mutual funds and ETFs by denying them access to retail liquidity, and creates the conditions for wholesalers to extract rents in excess of the value they provide to market participants by exploiting conflicts of interest between retail brokers and retail investors.

Previously there was a reasonable justification for this otherwise undesirable situation: for tick-constrained stocks in particular, such inside-the-spread trading allowed retail investors to trade at more favorable prices than they could on-exchange. However, the present Proposal mitigates those problems in the market structure and neutralizes that rationale.

With appropriately smaller tick sizes for highly liquid, low-priced stocks, the SIP will much better reflect the true market. Constraining off-exchange trading to occur at valid pricing increments will properly re-establish a level playing field. This will provide a practical benefit to ordinary investors in mutual funds and ETFs by making it more likely they will be able to interact with retail liquidity and may ultimately benefit retail investors as well by creating more robust, transparent and open competition for their order flow.

CONCLUSION

Pragma supports the key elements of the Commission's Proposal, believes they will reduce trading costs for investors, and improve transparency and fairness in the US equity markets. We have suggested several adjustments to the proposal that we believe will further improve outcomes for investors. We appreciate the opportunity to provide this feedback and would be happy to further discuss any of the points raised in this letter at your convenience.

Respectfully submitted,

David Mechner
Chief Executive Officer
PRAGMA LLC

Appendix

SPREAD WIDTH BASED ON SWEEP-TO-FILL PRICES WITH FEES

In figures 1 and 2, in order to have a fair comparison of spread width between stocks with vastly different prices, we calculated the spread not for 100 shares (i.e. to the best SIP spread), but instead based on the sweep-to-fill prices for the same value, for example, $10k. The sweep-to-fill price is calculated by simulating sweeping through a consolidated Level-2 order book across exchange and taking the resulting average price. The sweep-to-fill spread is then the difference between average price to buy $10k and the average price to sell $10k, in basis points. In order for the spread width to fairly capture the potential narrowing of effective spread via liquidity being available in inverted exchanges (taker-maker) rather than regular exchanges (maker-taker), we include the fee in the sweep-to-fill price, and where relevant prioritize taking inverted liquidity.

FIGURE 1

A value of $10k is used to calculate the sweep-to-fill prices for the spread width.

The y-axis of Figure 1 shows the average spread for each stock in basis points normalized by the 15-minute volatility for that name. This normalization effectively controls for differences in volatility for a give bucket of volume and price.

Since the average daily value of stocks in the analysis spans several orders of magnitude, a log scale is used.

While the data is not provided here, the U-pattern and the observation that 4-8 ticks is suboptimal compared to 1.5-4 ticks are consistent for other definitions for the spread-value, including for 100 shares (the current SIP spread), 1 share (best Level-2 spread), and when excluding fees and rebates.

FIGURE 2

In the spread width calculation, since we are comparing the same stock before and after the corporate action rather than comparing different stocks, we use the stock's the average trade value rather than a standard $10k to calculate the sweep-to-fill prices. Note, the same trade value is used to calculate the sweep-to-fill price before and after the corporate action.

While the y-axis uses the sweep-to-fill based spread with fee accounting, the spread buckets in the panels and x-axis use the basic spread based on the best Level-2 quotes to reflect the granularity of the tick size relative to the best observed spread.

The observations described in figure 2 are consistent for other definitions of spread width, including for twice the average trade size, for 100 shares (SIP spread), for 1 share (best Level-2 spread), and excluding fees and rebates.

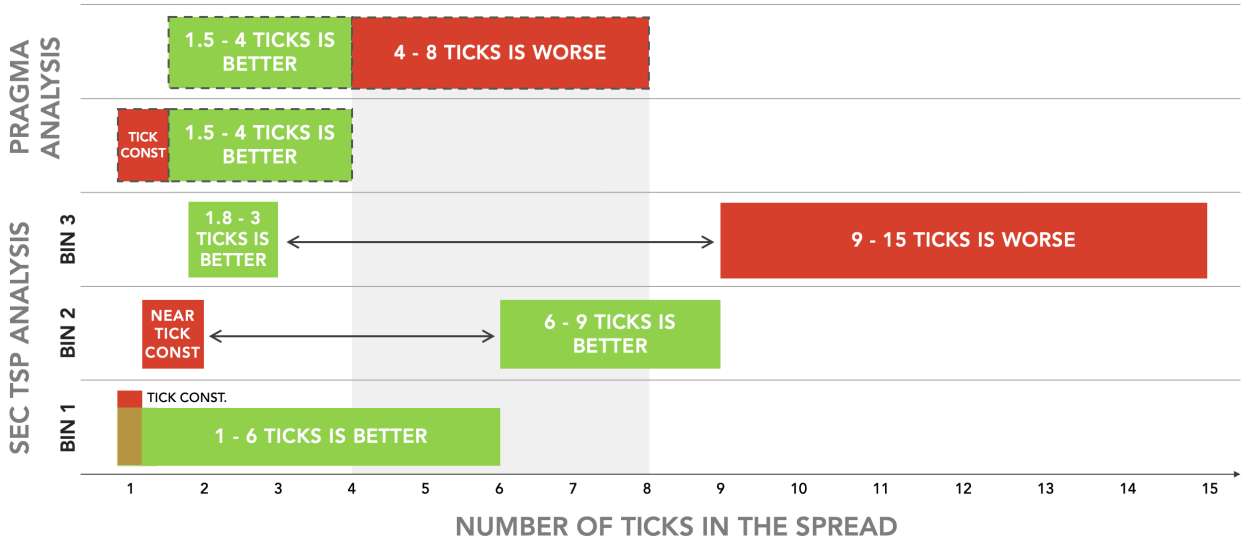
FIGURE 3

Data in the figure is based on a week of trading data from February 2023 for 4,445 stocks. The spread width is calculated based on the sweep-to-fill prices for each potential lot size and does not include fees and rebates.

PROPOSAL ANALYSIS OF TICK SIZE PILOT END (TSP)

The take aways from the TSP analysis ("Minimum Pricing Increments"; pp. 198-202) related to spread width can be summarized as follows. Note, Bin 4 is excluded from the figure below as it applies to a tick range well beyond that covered by the Proposal.

FIGURE 4



- **Bin 1** examines stocks with an avg. spread of 0 to $0.06 in the 5c tick regime, which is equivalent to a spread range of 1 to 1.2 ticks. Analysis shows that spread reduces after the tick size is reduced to 1c, equivalent to a tick spread range of 1 to 6 ticks. This demonstrates that having a spread of 1 tick means the stock is likely constrained and would benefit from a smaller tick size to allow it to collapse to a more natural, smaller spread.
- **Bin 2** examines near-tick-constrained stocks with spreads of $0.06 to $0.09 in the 5c regime, equivalent to a spread range of 1.2 to 1.8 ticks. Spread improves after the tick size is reduced to 1c, equivalent to a spread range of 6 to 9 ticks. This suggests that **having 6-9 ticks is better than having 1.2-1.8 ticks.**
- **Bin 3** examines stocks with a spread of $0.09 to $0.15 in the 5c tick regime, which is equivalent to a spread range of 1.8 to 3 ticks (close to Pragma's recommendation). Spread degrades after the tick size is reduced to 1c, equivalent to a spread range of 9 to 15 ticks. This suggests that **having 1.8-3 ticks is better than having 9-15 ticks.**
- **Bin 4** examines stocks with a spread of $0.15 or greater in the 5c tick regime, equivalent to a spread range of 3 ticks or more. The spread degrades after the tick size is reduced to 1c, equivalent to a spread range of 15 more ticks. This demonstrates having too many ticks degrades spread but does not suggest a range.