

December 18, 2023

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

Re: Request for Comment on the Proposed Changes to Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders (File Number S7-30-22)

Dear Ms. Countryman:

I appreciate the opportunity to comment on the proposed changes to Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders ("The Proposal").

Please note that I write today in my name only. My comments represent only my opinions and not necessarily those of Interactive Brokers, for whom I serve as the lead independent director, any mutual fund for which I am a director or trustee, or my employer, USC. Moreover, none of these entities reviewed or limited my comments.

Market structure in the United States has evolved substantially since the Commission adopted Reg NMS. Accordingly, the Commission's reconsideration of elements of Regulation NMS is appropriate.

Exchange Fees

The most important of the proposed amendments to Regulation NMS concerns the fees that exchanges charge traders for arranging trades. Exchanges match buyers to sellers. Thus, they are similar to brokers who perform the same services.

Like brokers, exchanges historically collected fees for their services by charging the seller or buyer (or both) transaction fees. These fees were essentially commissions for arranging trades. Under this traditional fee collection standard, the cost traders pay for arranged trades is simply the sum of whatever fees the exchanges charge buyers and sellers.

Standards for collecting exchange fees started to change when some Electronic Communication Networks ("ECNs") started charging fees based on the trader's role in the transaction. For every transaction arranged at an order-based exchange, one side of the trade (the "maker") created ("made") the opportunity to trade, typically by posting a standing limit order, and the other side (the "taker") took it by submitting a marketable order. The ECNs then charged a high



fee (the “access fee” or “make fee”) to the taker and rebated much of it to the maker (the “rebate” or “take fee”). This standard for setting exchange fees is called the maker-taker model. The total revenue to the exchange is the difference between the make fee and the take fee.

ECNs adopted maker/taker prices to encourage brokers to route their customers’ limit orders to them. If these orders executed, the brokers received the exchange fee rebates, which they typically did not pass on to their clients. However, this practice hurt the brokers’ limit-order submitting clients. Because taking traders (or their brokers) had to pay high access fees at the ECNs, when traders at a maker-taker venue and a traditional fee venue were making market at the same price, takers would take first at the traditional venue to avoid the high taker fee at the maker-taker venue. The limit orders at the maker-taker venues thus tended to execute after those at the traditional venues and often would not execute when prices moved away from them. These routing decisions thus allowed brokers to profit from their customers at the customers’ cost—a clear violation of their agency responsibilities to their customers.

Regulation NMS limited access fees to 30 cents/hundred shares in large part because some ECNs had substantially increased access fees and rebates to much higher levels. The resulting significant variation in fees was problematic because order routing standards (trade through rules) were (and continue to be) based only on quoted prices and not prices net of exchange fees and rebates, which are the only prices relevant to traders.

In the debate leading up to the adoption of Regulation NMS, I argued that the Commission should eliminate the maker-taker pricing standard and require exchanges to revert to the traditional fee collection standard. I was concerned that the maker-taker model was hurting limit order traders and creating unintended problems with the trade-through rule because quoted prices were no longer comparable when access fees varied across venues.

Voices opposing a mandate that all exchanges revert to the traditional trading model claimed that the Commission had no authority to regulate prices. However, the Commission would not have regulated prices as exchanges can freely compete on price under either standard. Instead, the SEC would have been simply making markets more orderly—well within its mandate—by specifying a standard under which all participants would compete. It would have made the markets fairer—again within its mandate—by eliminating the agency problem discussed above. Finally, it would have made the markets more transparent by making quoted prices more informative of actual trading costs and eliminating the hidden pipeline that transferred revenue from limit order traders to their brokers.

Voices opposing a mandate that all exchanges revert to the traditional trading model also argued that the maker-taker model encouraged trades to offer liquidity by subsidizing market-making. But strong economic theory (the equilibrium spreads model postulated by Cohen,

Maier, Schwartz, and Whitcomb¹) shows when liquidity suppliers are subsidized at the cost of liquidity takers, spreads decline. If they did not, everyone would want to be a liquidity supplier, and no trade would occur. So, maker-taker pricing created narrower quoted spreads on average, but it does not affect the net cost of providing liquidity.²

After the adoption of Regulation NMS, almost all exchange venues eventually adopted maker-taker pricing (ISE was the notable exception) with (until the introduction of inverted exchanges) similar sets of access fees and rebates. Although quotes no longer represented the actual costs of trading, the agency problem discussed above disappeared because almost all venues had similar pricing, and the one major one that did (ISE) focused on institutional traders concerned about high-speed traders. Brokers still received revenues from executing customer limit orders, but the access fees they paid on behalf of their customers who submitted marketable orders offset the revenues associated with this hidden pipeline. A few brokers—notably Interactive Brokers—allowed their customers to elect to pay exchange fees and receive exchange rebates, but most did not.

When the Commission adopted Regulation NMS, nobody imagined that exchange holding companies would create inverted exchanges that they operate alongside their maker-taker exchanges. Inverted exchanges employ the maker-taker model, but their make fees are positive and their take fees are negative—the opposite of regular maker-taker exchanges. In all other respects, these inverted exchanges have the same trading rules as their counterparts that use the original maker-taker pricing.

With the introduction of the inverted exchanges, the agency problem discussed above returned. Retail brokers typically send their customer limit orders to the maker-taker exchanges, receiving rebates if the orders execute.³ When a maker-taker exchange and an inverted exchange both quote the same prices, everyone will send their marketable orders to the inverted exchange, where the exchange pays them to trade, instead of to the maker-taker exchange, where they must pay to trade.

The traders who make markets at inverted exchanges are primarily proprietary traders who want to trade ahead of orders making market at maker-taker exchanges. For example, suppose that a large quantity is bid at 20 at a maker-taker exchange. A trader seeking to trade ahead could bid 20 at an inverted exchange and would typically trade ahead. The cost of doing so

¹ Cohen, K., Maier, S., Schwartz, R. and Whitcomb, D. (1981) Transactions Costs, Order Placement Strategy, and Existence of the Bid-Ask Spread. *Journal of Political Economy*, 89, 287-305, available at <https://doi.org/10.1086/260966>.

² This argument assumes that the tick is not creating an effective lower bound on spreads. When the tick determines the minimum spread, maker-taker pricing exacerbates the problem. With or without maker-taker pricing, when the tick is binding, traders will queue to provide liquidity.

³ Now retail brokers also send their standing limit orders to wholesalers who forward them to exchanges. The wholesalers benefit from seeing the order flow and they pass the rebates (and sometimes more) back to the brokers as payments for order flow.

would be approximately ½ cent/share—0.25 cents of lost rebate had they traded at the maker-taker exchange plus the 0.25 cent/share make fee at the inverted exchange.

The simultaneous operation of maker-taker and inverted exchanges thus effectively creates a convoluted exchange system in which the minimum price variation is ½ cent for those traders who can access the inverted exchanges. But, as noted above, most brokers will not regularly send their customers standing limit orders to inverted exchanges because the brokers typically pay the make fees. So we have an unlevel playing field where sophisticated professional proprietary traders can trade on ½ cent ticks, and everyone else trades on 1 cent ticks.

This problem became even more significant following ISE's recent adoption of maker-taker pricing, where the maker pays nothing to make markets. (It formally used traditional pricing.) This innovation created a 0.25-cent tick between the maker-taker and the inverted exchanges.

My attached working paper, "The Quarter-Penny Tick," provides a more thorough discussion of the problem with maker-taker fees and provides evidence of how traders exploit the convoluted market structure that these fees enable.

The Commission should level the playing field so that everyone plays on an equal basis. It should do so to promote fairness because the public cannot fix the problem itself. The public is largely unaware of the problem, most brokers have no incentive to fix the problem, and the stickiness of client accounts (due to unrelated issues) ensures that many sophisticated retail and institutional clients will not switch brokers to trade through brokers such as Interactive that are willing to pass through fees and rebates.

The best way to fix this problem would be to require exchanges to revert to traditional fees imposed on buyers or sellers (or both) without regard to their maker-taker status. This system worked well before the introduction of maker-taker pricing and continues to work well in comparable U.S. futures markets and foreign stock exchanges. Accordingly, no risk of unintended consequences exists.

A second-best way to fix the problem would be to permit maker-taker pricing while setting the maker fee or the taker fee to some constant by regulation, which could be zero. This alternative would eliminate the distinction between maker-taker and inverted exchanges, ending the agency problem discussed above. It would also likely result in the closure of the inverted exchanges, which would reduce market fragmentation and thereby improve the competition among traders for best price. It would focus all price competition among exchanges on the unconstrained fee, enhancing the competition among exchanges.

These changes thus would improve the competitions among traders for best price and among exchanges to host the first competition. The Commission rarely gets the opportunity to improve both competitions—usually, it chooses among policies that improve one at the cost of the other. It should not miss this opportunity.

One additional benefit also makes these changes beneficial to the markets and economy. The present system discourages investors from offering liquidity when trading because they are subject to the above agency problem. Eliminating this agency problem will increase the number of traders willing to offer liquidity, lowering the overall liquidity cost. The cost will drop because buy-side traders will increasingly be able to trade directly with other buy-side traders without the intervention of dealers. Dealers will suffer because they will lose the benefit of the agency problem. But, the markets will be better off overall because investors will lose less to intermediaries.

Whether the Commission fixes the maker fee or the taker fee does not matter much. I suggest that the Commission set the take fee to zero because the primary service that exchanges provide is the representation of standing limit orders. Exchanges should charge for this service. When they charge takers fees, exchanges effectively say that you must pay me if you want to trade with my client. Elsewhere in the economy, common and statutory law identify such fees as kickbacks and subject them to severe restrictions.

Which fee the Commission pegs, and at what level it pegs the fee, will affect quoted bid/ask spreads. If the Commission pegs the maker fee at a negative value, quoted bid/ask spreads will be smaller, and if the tick size is binding, quoted sizes will be larger. If the Commission pegs the take fee at zero, as I suggest, quoted spreads will wider. Note, however, that these decisions would not affect equilibrium conditions in the market for providing liquidity because only net spreads (quoted spreads adjusted for exchange fee) matter in the absence of the agency problem and if the tick size is not binding.

Implementing these changes may require regulators to adjust tick sizes. Tick-size decisions should be secondary to solving the exchange fee problem. Tick sizes should be set to work well with the proper exchange fee structure and not the converse. Exchange fees should not be set to improve the wrong fee structure.

The Commission's proposals to cap rebates at 0.1 cents and to reduce quote tick sizes for some stocks will not eliminate the agency problem associated with inverse exchanges, though it will mitigate the problem somewhat by producing smaller quote ticks, which will result in smaller effective ticks for those trader who can access the inverted exchanges.

The Commission should be careful about reducing tick sizes since smaller ticks facilitate parasitic trading designed to exploit the option values of standing limit orders. Smaller ticks thus lead to smaller exposed quotes and more hidden liquidity, which generally is not in the public interest.

Volume discounts and premia

The Commission also proposes prohibiting volume discounts for fees and premia for rebates. I wholeheartedly agree with this Proposal. Conditioning payments on volume is anticompetitive. Brokers should route based only on best execution considerations for each order they hold. These volume schemes distort routing decisions, and the Commission should prohibit them.

The only possible competitive argument for volume discounts is that they amortize fixed costs (such as line fees or port fees) over variable order flow. But exchanges can charge brokers such fixed fees if they want, and they should if competition forces them to do so.

Minimum Price Increments

The minimum price increment (“tick size”) is an essential determinant of market quality as it regulates the cost of stepping in front of standing orders at an exchange. Small tick sizes allow fast traders (“quote matchers”) to cheaply extract the option values of exposed standing limit orders at the best bid or offer. This trading strategy discourages slower traders from offering liquidity (posting limit orders), which makes it harder for natural buyers to find natural sellers without the intermediation of dealers. Here is how the quote-matching strategy works:

Suppose a slow trader posts a buy limit order that makes the best bid at \$20.00. A quote-matcher then may post an order priced one tick higher—currently 1 cent—at \$20.01, effectively leaning on that order. The quote-matcher will trade at \$20.01 if a marketable sell order arrives. If prices subsequently rise, the quote-matcher will profit to the extent of the rise as long as they remain invested. But suppose the quote-matcher thinks that prices will fall (perhaps because the quote-matcher sees other the prices or values of correlated securities and indices fall). In that case, the quote-matcher will quickly sell to the original buyer (if still present) at \$20.00 for a loss of 1 cent (ignoring exchange fees).

The quote-matching strategy will be profitable on average if quote matchers are faster traders than the traders upon whose limit orders they lean and other traders who might try to trade with those limit orders based on the same information. Profitability also depends on the tick size since it is the cost that quote matchers incur to set up their positions.

The money that the quote matchers take out of the markets hurts the traders upon whose orders they lean. They would have traded if the quote-matchers had not stepped in front of them. Instead, they risk having to chase the market when prices move away from them. When high-speed traders use the quote-matching strategy, slower liquidity-supplying traders tend not to trade when they wish they had and trade when they wish they had not. A typical response to this problem is to take liquidity instead of offering it.

The improved prices that quote-matchers offer to liquidity demanders benefit the liquidity demanders, but the benefit comes at the expense of the traders upon whose orders the quote-matchers leaned. The markets obtain no net benefit from this strategy. Instead, the strategy hurts the markets as natural traders switch from offering liquidity to taking liquidity so that intermediating dealers extract more money from the markets.

Tick sizes that are too large are also problematic. Large tick sizes increase the quantities traders bid and offer at exchanges as traders post liquidity to take advantage of prices that may be

substantially below or above values. The queue sizes vary depending on whether values are values closer to the best bid or best offer. When closer to the best bid, the queue at the best offer will be large as traders hope to sell at a price substantially above value. In this case, queues at the best bid will be small, and most trade will occur at the best bid.

The dynamics associated with large tick sizes decrease market quality as trading jumps from one tick to another. And, when values are between the bid and ask, trade slows down because traders are unwilling to trade at prices that do not reflect values. Large tick sizes also tend to fragment markets as traders seeking to trade ahead of others at a given price post their orders at other markets in the hope of trading earlier.

The above comments demonstrate the public interest in setting appropriate tick sizes. Who should set tick sizes, and what sizes should be chosen?

Regulators must set the tick sizes. Without universal minimum price increment regulations, some exchanges will set tiny tick sizes to attract traders who want to exercise the quote-matching strategy or improve price by just a little to trade earlier. Exchanges that might want to provide a more appropriate tick size to protect their liquidity-supplying customers will not be able to provide such protection because traders seeking to trade ahead can trade elsewhere at exchanges with smaller tick sizes.

The Commission proposes that primary exchanges set tick sizes based on average bid/ask spreads and that the exchanges review the sizes and potentially adjust them quarterly. The Proposal seeks to ensure that bid/ask spreads are not “tick-constrained,” which occurs when tick sizes are so large that bid/ask spreads are regularly just one tick wide.

I agree with the approach. Theoretical considerations based on the option values of standing orders suggest that tick sizes should increase with volatility and decrease with expected standing time, which varies inversely with trading volumes. Since spreads also depend on the same variables in the same ways (because standing limit orders set the spreads), average spreads provide the information necessary to set spreads.

However, I believe that the proposed tick sizes are too small. The Proposal formulas set the tick sizes to ensure that average spreads will be about 4-8 ticks wide. It would be better to target spreads of about two ticks. When too many ticks are available between the bid and offer, traders engage in substantial leapfrogging as they jump in front of standing orders to get precedence. Fast traders equipped to cancel and resubmit orders quickly will be advantaged over slower traders. Allowing those fast traders to profit from their greater speed would be justified if they added liquidity to the markets, but I suspect that they primarily use this facility to extract order option values.

Note that substantial variation now exists across stocks in the average number of ticks between bid and ask prices. Accordingly, the Commission can and should determine how market quality varies by the average number of ticks in the spread. With such results, the Commission can

better set the tick sizes to explicitly target the market quality variables it is most interested in. The most important such variable is institutional transaction cost as institutions represent most stock holdings, and because the preponderance of institutional stakeholders are U.S. citizens who benefit directly or indirectly from pension plans, mutual funds, endowments, foundations, and insurance contracts (whose costs depend in part on portfolio transaction costs).

I am concerned about the additional complexity the Proposal adds to the market. If adopted, tick sizes will vary across securities and across time. Some mechanisms should ensure traders can quickly determine the tick size currently used for each stock.

The current system of a single tick size for all stocks above one dollar is flawed. It worked reasonably well when small companies had low prices, and large companies had higher, but not extremely high prices. The smaller stocks, which were more volatile and less actively traded, had large tick sizes as a fraction of price. In contrast, the larger, more actively traded stocks had proportionately smaller relative tick sizes. But in the last 30 years, the correlation between stock size and price level has decreased as exchanges have had less influence on when companies split and reverse split their stocks to keep stock prices at sensible levels. The Commission could push the exchanges to address stock price levels through their listing standards, but the fight does not seem worthwhile.⁴

Some people may suggest that the issuers set the tick sizes for their stocks. I sympathize with this approach because we expect company directors to act in their shareholders' best interests. However, I have no faith that directors understand the issues well enough to make good decisions, and I fear that the companies' senior financial managers would be too influenced by their investment bankers to make these decisions well. Accordingly, I would oppose any such proposals, which, fortunately, the Commission is not presently considering.

Transparency of Better Priced Orders

I concur with the Commission's efforts to improve order transparency. The asymmetries among those with access to important information about standing orders are unfair.

Presently odd-lot orders that provide better prices than the NBBO are not included in the NBBO. The problem is most serious for high-priced stocks for which economically significant orders may be odd-lot orders and for lower-priced stocks for which many odd-lot orders may aggregate up to economically significant quantities at a given price.

⁴ Stock price levels are arbitrary—economic theory and common sense suggest that aggregate company values do not depend on their stock price levels so that stock price levels depend only on the number of shares outstanding. However, many companies seem to believe that high stock prices convey a message of quality, perhaps by reminding investors that the companies have grown substantially. If true, aggregate company values may depend on price levels.

Information about these odd-lot orders is available to exchange data subscribers but generally not to other traders who cannot afford to buy these data feeds. Retail brokers who can afford these data have little incentive to provide them to their clients due to their expense and because the wholesale dealers to whom they route orders in exchange for payments benefit from seeing these data when others cannot. These information asymmetries benefit those traders who have better data access. Fairness demands that these data be more widely available.

Furthermore, the importance of the NBBO to the Commission's efforts to promote transparent markets and best execution suggests that it should define the NBBO to reflect market conditions accurately in all stocks regardless of their price levels.

Please do not hesitate to contact me if I can further assist the Commission with these issues.

Sincerely,



Larry Harris
Fred V. Keenan Chair in Finance
USC Marshall School of Business

cc:

The Honorable Gary Gensler, Chairman
Mr. Haoxiang Zhu, Director, Division of Trading and Markets
Ms. Jessica Wachter, Chief Economist and Director, Division of Economic and Risk
Analysis

The Quarter-Penny Tick

Larry Harris*

May 25, 2022

Abstract

Stock exchange fee pricing schemes—maker-taker, inverted taker-maker, and flat pricing—have created convoluted markets in which an effective quarter-penny tick is primarily available only to sophisticated traders who switch between maker-taker, inverted, and flat markets as market conditions change. The system creates an agency problem between brokers and their clients, resulting in poor routing decisions as brokers try to maximize exchange fee rebates. The quarter-penny tick also reduces the cost of certain parasitic trading strategies to the detriment of investors. This study identifies how sophisticated traders exploit the system and provides an empirical characterization of the problem.

Keywords: Maker-taker, taker-maker, inverted exchanges, trading tick, minimum price variation, exchange transaction fees

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1 Introduction

Securities and Exchange Commission Regulation NMS requires quoted prices in the National Market System to be a multiple of one penny in the United States.¹ Similar regulations also set the minimum price variation in other countries. The Commission adopted these regulations primarily to ensure that traders who want to trade ahead of other traders offering to trade at a given exchange must improve prices by a penny at that exchange.

Without this restriction, a trader who wants to trade ahead of all other traders could bid or offer prices that are only a tiny fraction of a penny better than the prevailing national best bid or offer. Because exchange trading systems enforce price priority, and because traders naturally seek the best available price, this tactic allows traders with insignificantly better prices to trade first when a marketable order arrives, regardless of how long other traders at slightly inferior prices have been waiting to trade.

The SEC set the minimum price variation at a penny following vociferous complaints by institutional buy-side traders about a parasitic trading strategy that practitioners call pennyng and academics call quote-matching.² The buy-side traders were upset by electronic traders who would step in front of their standing limit orders by improving prices by a small fraction of a penny at alternative electronic trading systems (then mostly ECNs) that permitted subpenny pricing.³ Since market order traders always seek the best price, these mostly proprietary traders would trade before the institutional traders. The institutional traders lost if prices subsequently moved away before their limit orders filled, as often happens.

The quote-matching strategy allows quick traders to extract option values from standing limit orders.⁴ Standing limit buy and sell orders respectively provide put and call options to the first traders willing to sell or buy at the offered limit prices. For example, suppose that an institutional trader places a standing limit order to buy at \$20.00. If a fast trader can buy first, perhaps at \$20.000001, the fast trader will profit if prices subsequently rise. But if the fast trader subsequently suspects that prices will fall—perhaps because the trader is watching prices, volumes, and orders in correlated securities—the fast trader will sell to the institutional trader at \$20.00 if the order is still standing. The institutional trader will fail to trade when she wished that she had, or she will trade when she wished that she had not. The fast trader using the quote-matcher strategy faces a potentially unbounded gain on the upside, and, if the institutional order remains on the book, a downside loss of only \$0.000001 per share plus exchange fees and clearing costs. The quote-matching strategy is best executed by fast traders who can reverse

¹ The national market system (“NMS”) is the set of exchanges and order display systems that facilitate trade in exchange-listed stocks. All but the smallest stocks trade in the NMS. Regulation NMS only limits price quotations and thus the operation of exchange order precedence rules that depend on prices. Traders are permitted to negotiate sub-penny prices if they so desire.

² See Amihud and Mendelsohn (1990) for the first academic reference (of which I am aware) to the quote-matching strategy.

³ ECNs (Electronic Communications Networks) are electronic trading systems that provide exchange matching services but which are not regulated as exchanges. The most important of these systems—Island, Archipelago, BATS, and DirectEdge—now operate as exchanges.

⁴ See Harris (2002) *Trading and Exchanges* Chapter 11 (Order Anticipators) for a fuller description of the quote-matching strategy and how investors can defend against it.

their trades before any factors that break their confidence also cause the traders upon whose orders they are leaning on to cancel those orders. The quote-matchers also must trade before any other traders who also might want to trade with these standing orders.

The potential losses to the fast trader of exercising the quote-matching strategy decrease with the tick size because the tick size regulates the cost of using price priority to trade ahead. Accordingly, the SEC adopted the penny tick so that traders must improve prices by at least a penny to obtain order precedence. As a result, the penny tick discourages quote-matching, especially for low-priced stocks.

1.1 The quarter-penny tick

Recent developments in U.S. securities markets now ensure that the effective tick size is often one-quarter penny for sophisticated proprietary traders. Although Reg NMS regulates tick sizes at one penny, it only partly regulates the fees and rebates that exchanges charge and return to the traders and brokers who send orders to exchanges. Diversity in these fees and rebates has effectively created quarter-penny ticks for sophisticated traders.

Exchanges traditionally priced their services by charging a small fee to sellers, and depending on the exchange, sometimes also to buyers. These traditional exchange fees were like commissions that brokers charge for arranging trades. If exchanges still collected traditional exchange fees, they now would be about 0.05¢ per share.⁵

With the introduction of new electronic trading systems, collectively called ECNs, a new exchange fee system called maker-taker pricing emerged.⁶ Exchanges that use maker-taker pricing charge a high fee—called the taker fee or access fee—to the traders who initiate trades by taking standing bids or offers using a marketable order. They rebate a significant fraction of the taker fee to the makers whose standing orders made the market. The rebate is called the maker rebate or liquidity rebate. Although fees vary somewhat across maker-taker exchanges and substantially across clients based on their monthly trading volumes, the typical taker fee is 0.30¢ per share (the maximum permitted by Reg NMS⁷), and the typical maker rebate is 0.25¢ per share. The exchange thus earns the difference of 0.05¢ per traded share.

Almost all retail and many institutional brokers pay the taker fee and keep the maker rebate when trading on behalf of their clients. A few retail brokers, such as Interactive Brokers, pass these transaction fees and rebates through to their clients if they request unbundled pricing. Some institutional traders also obtain unbundled pricing from their brokers. High-frequency proprietary

⁵ Some smaller exchanges such as NSYE Chicago (the former Chicago Stock Exchange) still use the traditional pricing model. NSYE Chicago charges a flat fee of 0.10¢ per share to buyer and seller, with some exceptions. See https://www.nyse.com/publicdocs/nyse/NYSE_Chicago_Fee_Schedule.pdf. These high fees ensure that traders primarily use NYSE Chicago to report matched trades (crossed trades) for which it charges no fees, but for which it receives market data revenues from the trade reporting networks (Networks A and B and Nasdaq).

⁶ Island ECN adopted the first maker-taker pricing scheme in 1997.

⁷ See Reg NMS Rule 610, the “Access Rule” in <https://www.sec.gov/rules/final/34-51808.pdf>.

traders (“HFTs”) pay and receive transaction fees whether they are registered dealers or trade through brokers.

ECNs introduced maker-taker pricing to create a financial incentive for brokers to route their customers’ standing limit orders to them.⁸ These limit orders provide liquidity (the ability to trade when you want to trade) to other traders and thus attract marketable orders that produce trades that generate ECN revenues.

The competition among ECNs to attract standing limit orders led to increasingly higher maker rebates and thus higher taker fees. It also caused all traditional exchanges to eventually adopt maker-taker pricing. When the taker fees charged by at least one ECN became greater than one cent per share, the SEC acted to limit taker fees to 0.3¢ per share.⁹

An effective half-penny tick is due to a second innovation in exchange pricing. Starting in 2009, some exchange holding companies created exchanges that differ from their original exchanges only in how they charge exchange fees.¹⁰ These new exchanges, often called inverted exchanges, invert maker-taker pricing: They charge makers a fee for trading and provide rebates to the takers. The maker fee is typically about 0.25¢ per share, and the taker rebate is about 0.20¢ per share.¹¹ Like the maker-taker fees, the taker-maker fees vary somewhat by exchange and substantially across clients depending on their trading volumes.

The combination of maker-taker pricing and taker-maker pricing effectively creates a half-penny tick. For example, suppose that a proprietary trader places a limit order to buy at \$20.00 at a maker-taker exchange and another at the same price at an inverted exchange. If the order at the maker-taker exchange executes, the trader will pay \$20.00 per share but will receive the maker rebate of 0.25¢, yielding a net price of \$19.9975. If the order at the inverted exchange executes, the trader will pay

⁸ ECNs originally called the taker fee and the maker rebate the “access fee” and the “liquidity rebate.” Many exchanges now call them the liquidity-removing fee and the liquidity-providing fee.

⁹ Attain ECN, among a few others, had been charging extremely high access fees. The high rebates associated with these access fees caused some dealers to quote very aggressive markets. Brokers who then routed to those ECNs because they were quoting the best prices were forced to pay extremely high fees. Some brokers refused to pay these fees, which led to some legal actions. The aggressive markets often locked or crossed other quotes, which caused some brokers’ order handling systems to stop routing orders electronically. To avoid these problems, the SEC ultimately limited access fees to 0.30 cents per share in its Reg NMS Rule 610. See the Reg NMS Proposing Release No. 34-49325 Section IV.B.3.i, “How Access Fees Cause Distortion in the Markets”, at <https://www.sec.gov/rules/proposed/34-49325.htm>.

¹⁰ In 2009, Nasdaq Inc. converted the former Boston Stock Exchange, which it bought in 2007, into the first inverted exchange. Renamed Nasdaq BX, Nasdaq operates this inverted exchange in parallel with its maker-taker exchange, Nasdaq Stock Market.

¹¹ The Nasdaq fee schedule for the inverted exchange Nasdaq OMX BX appears at http://www.nasdaqtrader.com/trader.aspx?id=bx_pricing. Schedules for CBOE’s two inverted exchanges, Bats EDGA and Bats BZX, appear at https://markets.cboe.com/us/equities/membership/fee_schedule/edga/ and https://markets.cboe.com/us/equities/membership/fee_schedule/byx/.

\$20.00 plus the maker fee of 0.25¢, yielding a net price of \$20.0025. The difference between the two prices is 0.0050, or half a penny per share.

Note that orders at inverted exchanges often trade before orders at the same price at maker-taker exchanges because takers prefer to receive rebates rather than pay taker fees. In the above example, the taking seller at the inverted exchange will receive a net price of $\$20.0020 = \$20.00 + 0.20\text{¢}$ when taking at the inverted exchange, and a lower net price of $19.9970 = \$20.00 - 0.30\text{¢}$ when taking at the maker-taker exchange. The difference in prices is \$0.0050, or half a penny.¹²

The higher cost to makers at inverted exchanges ensures that makers always prefer to trade at maker-taker exchanges at any given price. But, if a maker-taker exchange already has substantial order volume waiting to trade at a price, a maker wanting to trade at that price must stand in line waiting until all previously submitted exposed orders at that price trade.¹³ While waiting, the market might move away from the price so that the maker would fail to trade. At the cost of a half-penny, the maker can jump ahead of this line by placing the order at an inverted exchange, thereby increasing the probability of trading quickly.

A quarter-penny tick is now available to sophisticated traders due to an innovation in pricing that the Investor's Exchange ("IEX") adopted in March 2021. The IEX now uses a modified maker-taker pricing model—hereafter called "flat pricing"—that charges 0.06 cents per share for orders that remove liquidity (taking orders) and no fee for orders that provide liquidity (making orders).¹⁴ It formerly used the traditional pricing model and charged equal amounts to buyers and sellers, with some exceptions.

With flat pricing, traders who want to trade ahead of orders at a maker-taker exchange can post at IEX. Then, if their orders execute, their net cost of jumping ahead is only 0.25 cents per share.

The availability of maker-taker, flat, and inverted exchanges provides three net price points surrounding every penny. Measured relative to a whole cent p , the price points are $p\text{¢} - 0.25\text{¢}$, $p\text{¢}$, and $p\text{¢} + 0.25\text{¢}$. The effective price grid thus has a resolution of one-quarter cent, except that net prices at $p\text{¢} + 0.50\text{¢}$ are not available.

Widespread use of these different price points leads to net spreads that can be as small as 0.50 cents. For example, the net spread between a \$20.00 bid at an inverted exchange (\$20.0025 net price) and a 20.01 offer at a maker-taker exchange (\$20.0075 net price) is \$0.005, or 0.50 cents. In general, net spreads can be on any quarter of a cent above 0.50 cents. Reg NMS generally prohibits exchanges from quoting markets that would lock or cross another exchange quote. A lock occurs when one exchange's bid is equal to another exchange's ask. A cross occurs when a bid is above an ask. Accordingly, although net spreads of 0.25 cents are in principle possible (for example, when a maker-taker exchange has a bid at \$20.00 and a flat exchange has an offer at the same price), they could occur only if one exchange

¹² Variation in the fee schedules across exchanges and among traders due to volume discounts ensures that not all traders will see an exact half-penny tick, but the variation around one-half cent is significant for most traders, and the variation has almost no effect on order routing decisions (except those made to qualify for volume discounts).

¹³ At a given price, makers who expose their orders trade ahead of all traders who hide their orders.

¹⁴ See <https://www.sec.gov/rules/sro/iex/2021/34-91443.pdf>.

locks the market with another exchange, which Reg NMS prohibits. Table 1 presents scenarios that give rise to different net spreads.

Sophisticated traders benefit from effective quarter-penny tick pricing by selectively routing their orders to maker-taker, flat, and inverted exchanges. For example, if the quoted best bid or offer is at a maker-taker exchange and they want to be first in line, i.e., improve the net price, they can route (or reroute) their order to a flat exchange where they quote the same price. If the quoted best bid or offer is at a flat exchange, they can route their order to an inverted exchange at the same price. And if the quoted best bid or offer is at an inverted exchange, they can route their order to a maker-taker exchange where they bid or offer a penny higher or lower to effectively be first in line at the cost of a half-penny.

The effective quarter-penny tick is available only to liquidity suppliers who can control their order routing and who pay and receive exchange transaction fees and rebates. Because most retail and institutional investors trade through brokers who absorb these fees, their brokers usually do not allow them to offer liquidity at inverted exchanges because the brokers would have to pay the maker fees. Instead, their brokers route their standing limit orders to maker-taker exchanges where the orders will trade only after orders at the same price and side trade at the inverted and flat exchanges.

The diversity in exchange fee pricing schemes thus creates an agency problem between brokers and their clients.¹⁵ The brokers route to maker-taker exchanges to obtain transaction fee rebates even though their clients might prefer better representation of their standing orders. Investors who want better representation for their liquidity-supplying orders and are willing to pay for it must trade through brokers who pass through exchange transaction fees and rebates. Those brokers also must have routing systems and algorithmic trading systems that route orders based on net prices instead of quoted prices.

Finally, note that the agency problem does not affect the routing of marketable client orders. Brokers gladly route their customer's marketable orders to inverted exchanges where they receive taker rebates.¹⁶ But the clients do not benefit because almost all brokers keep the inverted exchange maker rebates.

The quarter-penny tick cheapens the cost to proprietary traders of using the quote-matching strategy to extract option values from standing limit orders. If all exchanges used the same pricing model, the cost of stepping in front of an order would be a penny. Under the current market exchange fee system, the cost is a quarter-penny or a half-penny, depending on the exchange representing the standing order. Since brokers route most customer orders to maker-taker exchanges, the cost is a quarter-penny for stepping in front of most customer buy orders (by placing a same-priced buy order at a flat exchange) ,

¹⁵ This agency problem also existed when ECNs first used maker-taker pricing, but the traditional stock exchanges did not. It went away when all exchanges converted to maker-taker pricing with similar fee and rebate schedules. With the introduction of inverted exchanges, the agency problem returned.

¹⁶ A regulatory problem would exist if, to avoid paying take fees, brokers refused to route marketable orders to maker-taker exchanges when those exchanges have the best price. But such behavior is not likely because the trade through prohibition in Reg NMS prevents orders routed to exchanges with inferior prices from trading at those prices, and because, unless explicitly permitted by a market-not-held instruction, brokers cannot retard the execution of a marketable order while waiting for an inverted exchange to offer the best price.

and a half-penny for stepping in front of most customer sell orders (by placing a sell order one-cent lower at an inverted exchange).

Being able to step in front of other traders also allows dealers and other proprietary traders to sell liquidity services more effectively, albeit at a lower spread, than can investors who cannot access inverted exchanges, or who do not know why and how they should do so. Traders who offer liquidity only at maker-taker exchanges will trade less often than those who will pay a half-penny or quarter-penny to get in front of them. Trading at inverted and flat exchanges by these sophisticated liquidity suppliers thus makes using standing limit orders less productive for investors who might want to lower the costs of their trades by using standing limit orders. Investors forced to compete on this unlevel playing field are more likely to use marketable orders than limit orders, which increases the revenues of the more capable traders.

The SEC has not publicly expressed much concern about this agency problem until recently. Its efforts to promote best execution historically have focused mainly on the execution of marketable orders and not on the best representation for standing limit orders.

In response to rising concerns about transaction fees, in December 2018, the SEC proposed a transaction fee pilot study of exchange fees.¹⁷ However, a June 2020 District of Columbia Circuit Court ruling that the pilot study plan violated the Administrative Procedure Act stopped its implementation. As a result, the SEC has not yet mandated the study.

2 Evidence

To identify the use of net fractional pricing, using TAQ exchange quotations data, I computed the National Best Bid or Offer for each stock on several days based on net transaction-fee adjusted prices. I subtracted 0.25¢ from all bid prices for maker-taker exchanges and added 0.25¢ to all ask prices. I did the opposite for inverted exchange quotes. I left the flat exchange quoted prices unadjusted.

I analyzed three days: Friday, October 15, 2021; Friday, March 4, 2022; and Thursday, March 7, 2022. The first date was a typical trading day in October on which the open-to-close S&P 500 return was 0.5%, with an intraday range of 0.6%. Market volatility on March 4 was greater: The open-to-close S&P 500 return was -0.3%, with an intraday range of 1.3%. Finally, March 7 was still more volatile: The open-to-close S&P 500 return was -2.9%, with an intraday range of 2.9%.

Time-weighted frequency distributions showing which market type provided the transaction-fee adjusted National Best Bid or Offer appear in Figure 1. For each day, the maker-taker exchanges are most often at the best bid or offer, while the flat exchange (IEX) least often provides the best price.

If the fractional penny portion of actual security values were uniformly distributed between 0 and 1 penny, all traders were sophisticated, and traders rounded their orders to the nearest available net sub-penny price, then the expected frequencies would be 37.5% for maker-taker and inverted exchanges,

¹⁷ See “Transaction Fee Pilot for NMS Stocks,” SEC Release No. 34-82873 at <https://www.sec.gov/rules/proposed/2018/34-82873.pdf>.

and 25% for flat exchanges. Flat exchanges have a lower share because their pricing is a quarter-penny from either of its neighbors, whereas the other two exchange types are a quarter-penny away on one side and a half-penny on the other.

At an average rate of approximately 18%, the flat exchange (IEX) market share of best prices is below the predicted 25% rate.¹⁸ The difference may be due to IEX's 38 mile (61 kilometer) long fiber-optic coil ("the IEX speed bump") that slows quotes and trades by 0.350 milliseconds one-way and thus delays roundtrip order/response communications by 0.7 milliseconds. As a result, high-frequency traders may shun the exchange because they cannot cancel standing orders there as quickly as they can at other exchanges.

Comparisons of the distributions for bids and offers on each day show that the distributions appear nearly identical for bids and offers and also across days. The market shares of the three exchange types appear stable in both dimensions.

I separately tabulated absolute intraday quote changes in the transaction-fee adjusted National Best Bid and the National Best Offer for stocks in various price level bins for each day. The results (Figure 2) show that quote changes of less than one penny are much more common than changes of one penny or more for all price levels. Comparisons of Panels A with B (October 15, 2021), Panels C with D (March 3, 2022), and Panels E with F (March 4, 2022) show slight variation in these distributions between bids and offers. Comparisons of Panels A, C, and E (Offers) and of Panels B, D, and F (Bids) show that these distributions are quite similar across the three dates. Most notably, little variation appears between the distributions for March 4 and March 7, even though volatility on March 7 was much greater than on March 4.

Figure 3 presents the distribution of time-weighted bid/ask spreads based on the transaction-fee adjusted National Best Bid and the National Best Offer. For each day, net spreads of less than one cent are common, especially for the lower-priced stocks. A comparison of Panels B (March 4, 2022) and C (March 7, 2022) shows slightly wider spreads in the more volatile March 7 trading session, as is commonly observed in all markets. The effect is small and most pronounced for the lower-priced stocks.

3 Summary

Exchange pricing schemes have created a convoluted system that produces a near-complete quarter-penny tick grid that sophisticated traders can use, but which most investors cannot access and do not even recognize. Agency problems arise when brokers do not pass transaction fees and rebates through to their customers. Instead, brokers route standing limit orders only to maker-taker exchanges, and proprietary traders often trade ahead, disadvantaging other traders.

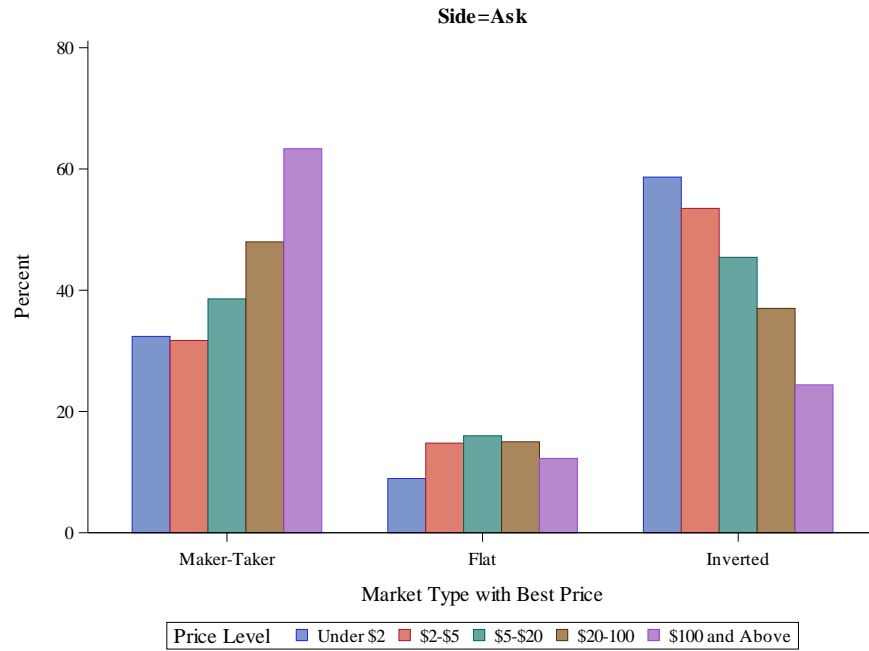
Brokers, HFTs, and exchanges all benefit from the current exchange transaction fee schedules. The Brokers get fee rebates from their customers' trades. The HFTs obtain trading profits. And the

¹⁸ The IEX speed bump is described at <https://exchange.iex.io/about/speed-bump/>.

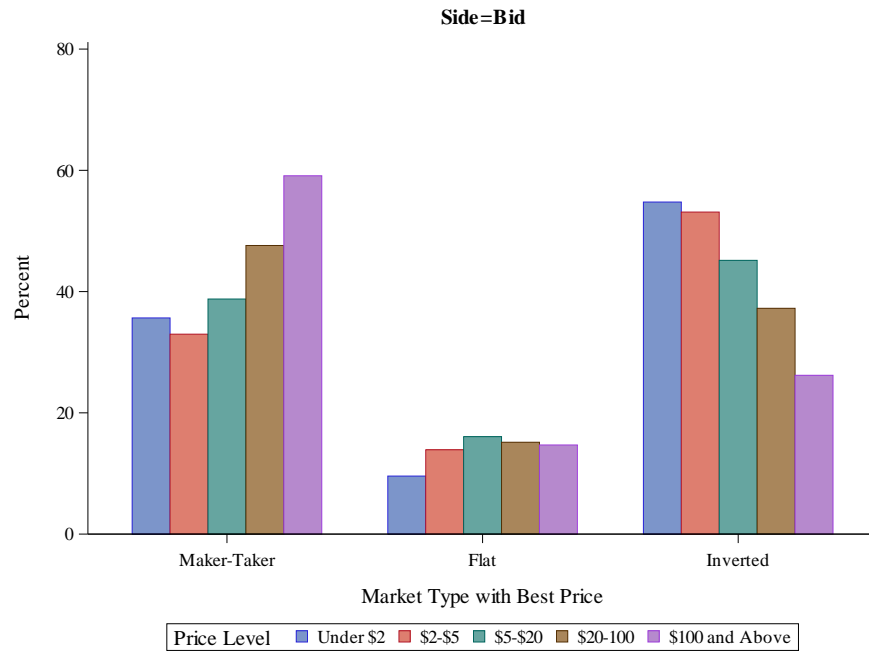
Exchanges collect market data revenues from selling low-latency data to HFTs who require these data to exploit the quarter-cent tick created by the exchanges' transaction fee schedules.

The problem can be best corrected by eliminating exchange pricing based on who is the maker or the taker in a transaction. Instead, exchanges would collect their exchange fees as they traditionally did—by charging fees to the buyer or seller.

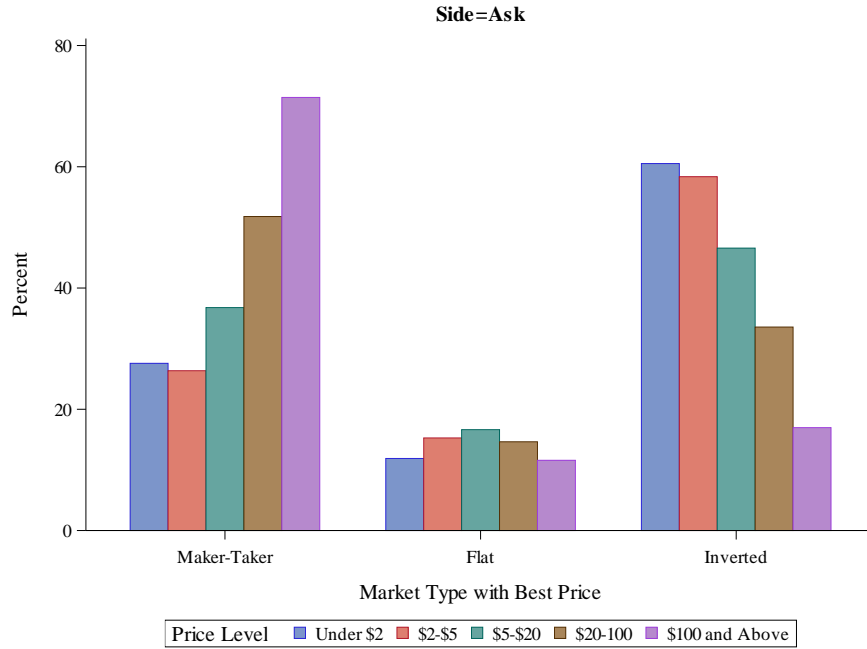
Figure 1: Time-weighted frequencies of the market type with the price setting the transaction-fee adjusted National Best Bid or Offer. The sample includes all stocks above \$1 with 100 or more quotes during the day during normal trading hours.



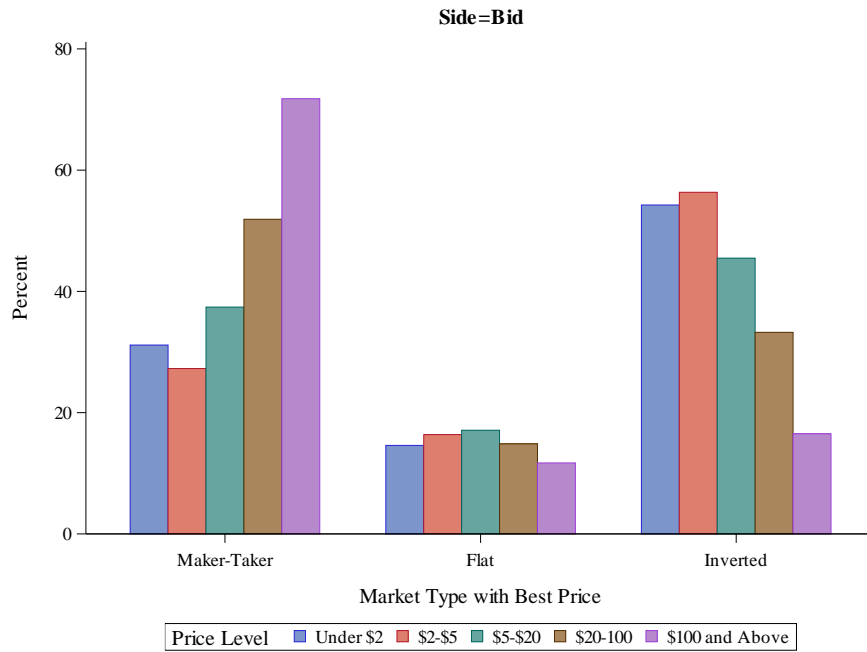
Panel A: Market Type at the Transaction-Fee Adjusted National Best Offer on October 15, 2021



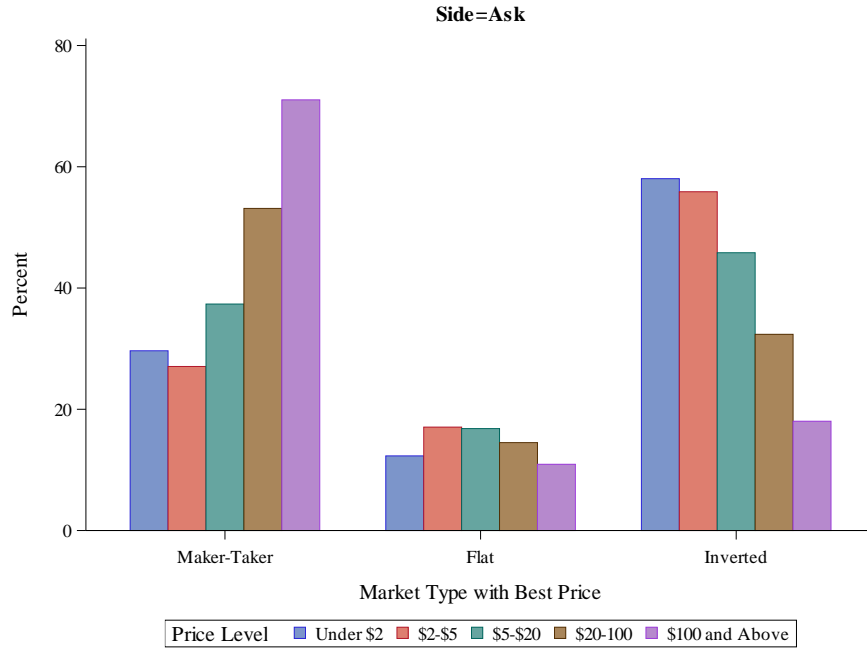
Panel B: Market Type at the Transaction-Fee Adjusted National Best Bid on October 15, 2021



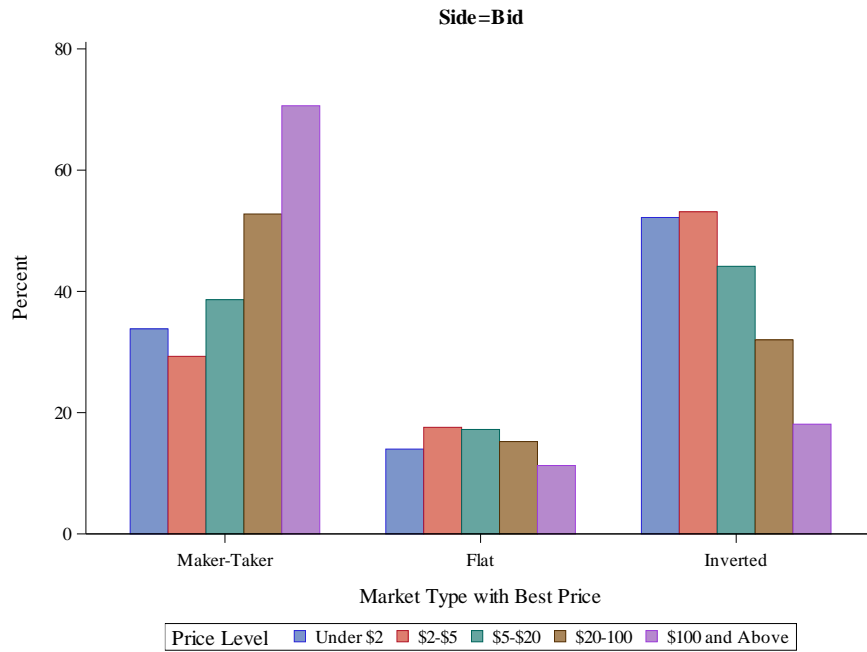
Panel C: Market Type at the Transaction-Fee Adjusted National Best Offer on March 4, 2021



Panel D: Market Type at the Transaction-Fee Adjusted National Best Bid on March 4, 2021

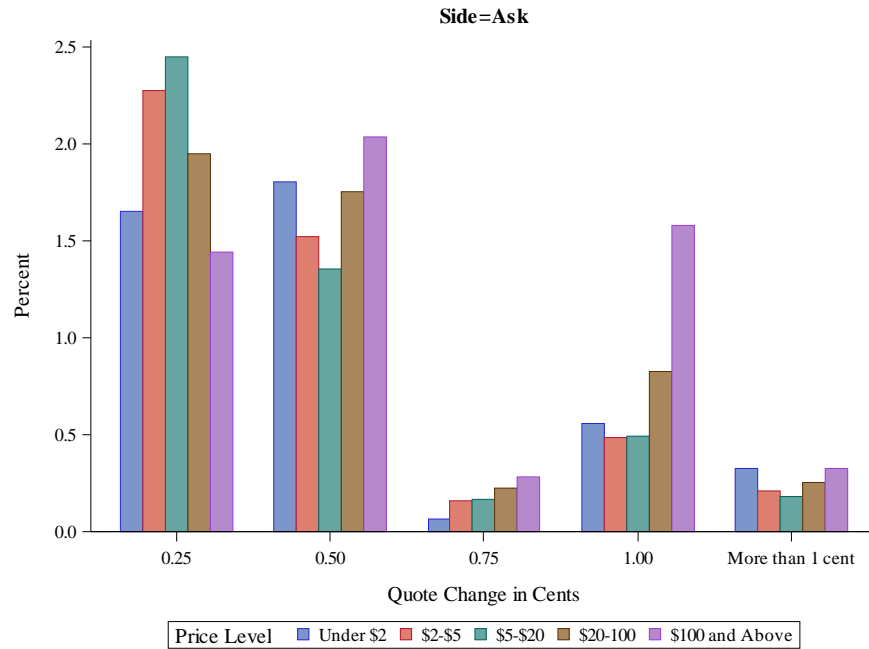


Panel E: Market Type at the Transaction-Fee Adjusted National Best Offer on March 7, 2021

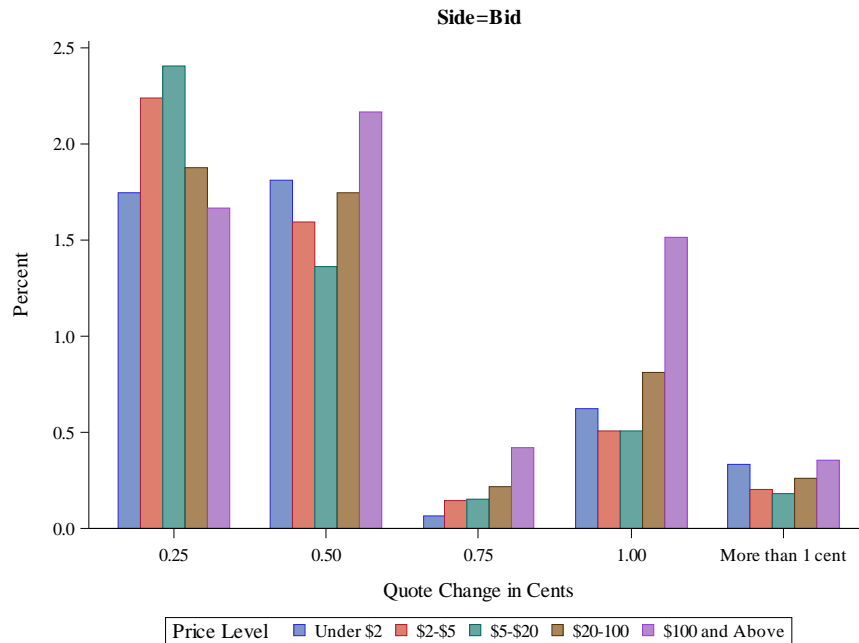


Panel F: Market Type at the Transaction-Fee Adjusted National Best Bid on March 7, 2021

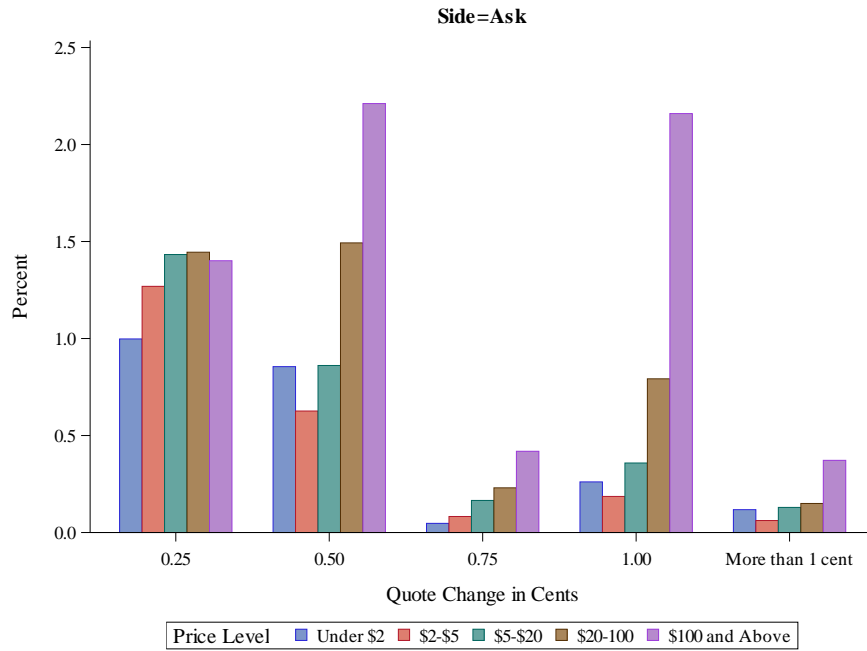
Figure 2: All non-zero absolute transaction-fee adjusted net changes in the National Best Bid or Offer. The sample includes all stocks above \$1 with 100 or more quotes during the day during normal trading hours. The low percentages reflect high frequencies of zero-change records when sizes changed but prices did not, or when one side of the market changed, but the other side did not.



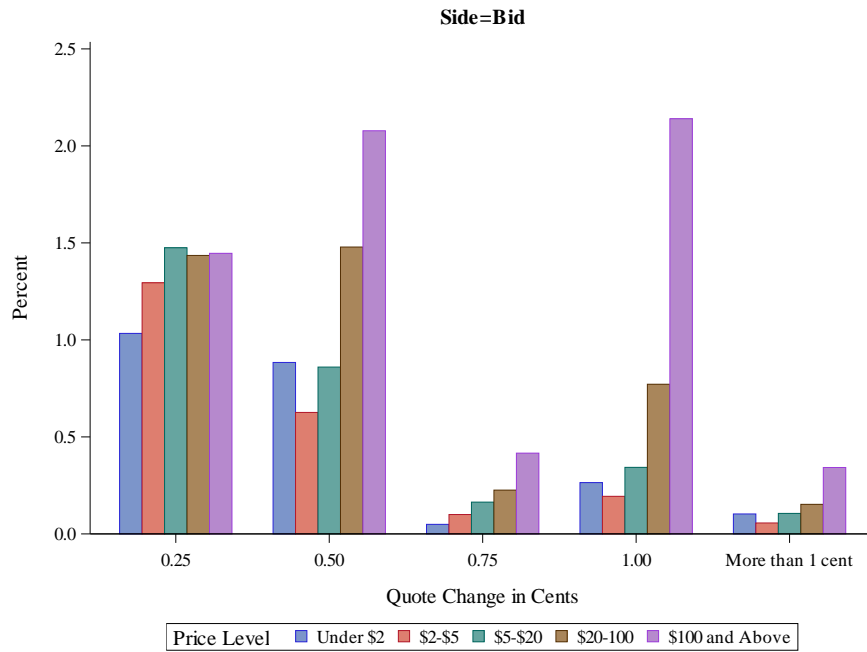
Panel A: Absolute Changes in the Transaction-Fee Adjusted National Best Offer on October 15, 2021



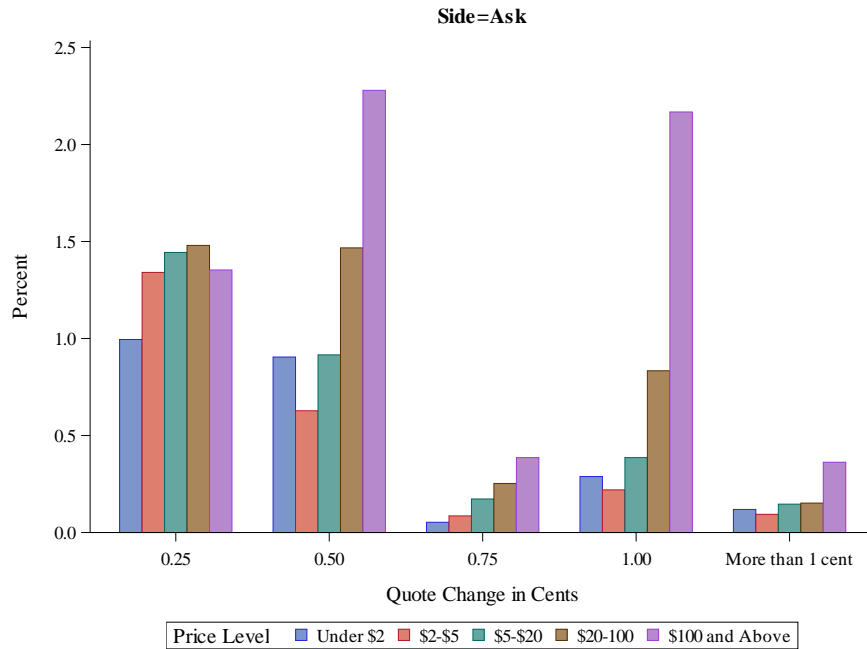
Panel B: Absolute Changes in the Transaction-Fee Adjusted National Best Bid on October 15, 2021



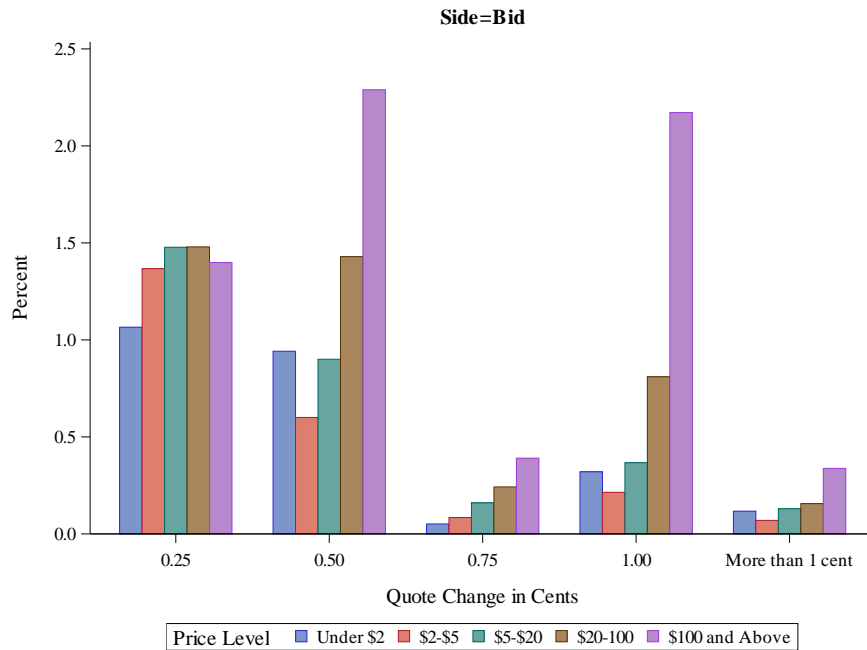
Panel C: Absolute Changes in the Transaction-Fee Adjusted National Best Offer on March 4, 2021



Panel D: Absolute Changes in the Transaction-Fee Adjusted National Best Bid on March 4, 2021

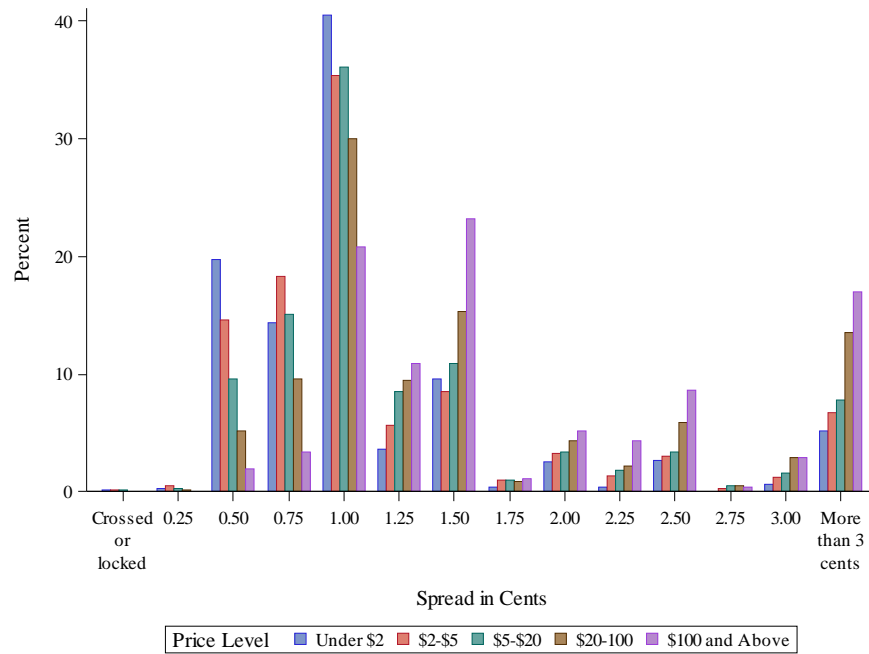


Panel E: Absolute Changes in the Transaction-Fee Adjusted National Best Offer on March 4, 2021

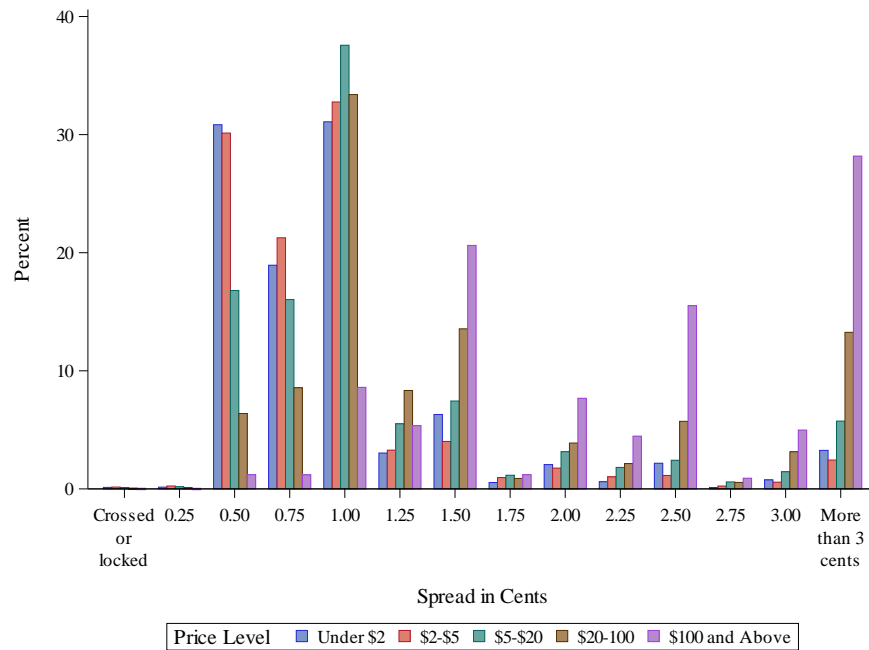


Panel F: Absolute Changes in the Transaction-Fee Adjusted National Best Bid on March 4, 2021

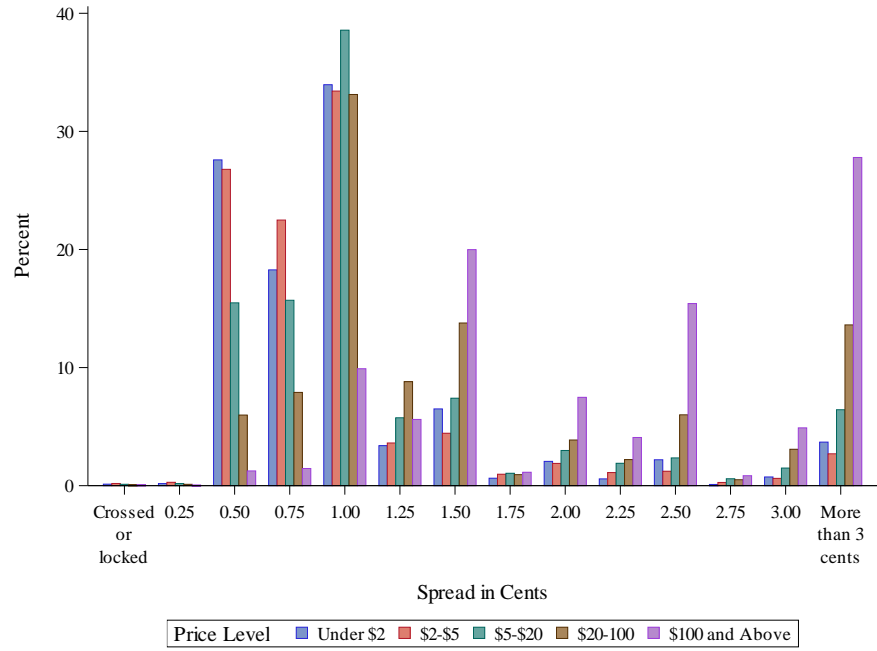
Figure 3: Time-weighted transaction-fee adjusted National Best Bid or Offer spreads. The sample includes all stocks above \$1 with 100 or more quotes during the day during normal trading hours.



Panel A: Transaction-fee adjusted NBBO spreads for October 15, 2021



Panel B: Transaction-fee adjusted NBBO spreads for March 4, 2022



Panel C: Transaction-fee adjusted NBBO spreads for March 7, 2022

Table 1: Scenarios that give rise to some different net spreads. The maker fee is -0.25 cents/share at maker-taker exchanges, 0 cents at flat exchanges, and 0.25 cents at inverted exchanges.

Net Spreads (cents)		Ask Prices (cent part only)						
		20 at flat exchange	20 at maker-taker exchange	21 at inverted exchange	21 at flat exchange	21 at maker-taker exchange	22 at inverted exchange	
	Net price	20.00	20.25	20.75	21.00	21.25	21.75	
Bid Prices (cent part only)	20 at maker-taker exchange	19.75	Locked	Locked	1.00	1.25	1.50	2.00
	20 at flat exchange	20.00	Locked	Locked	0.75	1.00	1.25	1.75
	20 at inverted exchange	20.25	Crossed	Locked	0.50	0.75	1.00	1.50
	21 at maker-taker exchange	20.75	Crossed	Crossed	Locked	Locked	Locked	1.00
	21 at flat exchange	21.00	Crossed	Crossed	Crossed	Locked	Locked	0.75
	21 at inverted exchange	21.25	Crossed	Crossed	Crossed	Crossed	Locked	0.50

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