

How Exchanges Compete:

An Economic Analysis of Platform Competition

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Contents

1. Executive Summary.....	1
2. Economic Definition of a Platform.....	4
3. Exchanges as Platforms.....	5
3.1 Exchanges Are Multi-Sided Markets.....	5
3.2 Exchanges Have Joint Products.....	6
3.2.1 The Challenges of Joint Products.....	7
3.3 Nasdaq Is a Platform.....	7
4. Exchanges Compete Across Their Platforms.....	8
4.1 Proof That Platform-Wide (All-In) Costs to Users Matter to the Market.....	8
4.1.1 All-In Explicit Costs Vary Across Platforms–But Are Kept in Line at a Platform Level.....	9
4.1.2 Implicit Costs and Explicit Costs Matter at the Platform Level.....	10
4.2 All-In Costs Need Not Equalize for Across Participant Categories.....	13
4.3 Platform Competition Constrains Total Costs and Product Costs.....	13
4.4 Comparing Different Exchange Platforms.....	14
4.4.1 Different U.S. Exchange Business Models.....	14
4.4.1.1 Market Quality Models.....	15
4.4.1.2 Participant-Owned Models.....	17
4.4.1.3 Queue Priority Models.....	18
4.4.1.4 Speed Bump Platforms Add to Provider Spread Capture by Avoiding Trades.....	19
4.4.1.5 Listing v. Non-Listing Platforms.....	21
4.5 Exchanges Compete Against Non-Exchange Platforms.....	23
4.6 Unbundled Prices and Economic Costs.....	23
4.7 Competition and the Consolidated Tape Plans.....	23
4.8 Platform Competition Has In Fact Constrained Market Data Fees.....	24
5. Customers’ Business Models and Customer Choice.....	26

- 6. Not All Participants on the Platform Have Equal Consumption 27
 - 6.1 US Equities Markets Are Formed By An Ecosystem Of Market Participants 27
 - 6.2 Issuers Benefit From Capital Formation and Provide Returns to Investors 28
 - 6.3 Those Who Trade the Least Provide Price Discovery. 28
 - 6.4 Those Who Trade the Most Make Markets More Efficient. 29
 - 6.5 Not All Market Participants Trade, and Many Who Do Trade Slowly 29
 - 6.6 Fixed Fees Inefficiently Allocate Utility Across the Market’s Varied Participants 29
 - 6.7 Fees That Vary By User and Usage Are Both Efficient and Fair 30
- 7. Public Markets Create Public Benefits Not Reflected in Exchange Fees 31
- 8. Conclusion 32

1. Executive Summary

Exchanges compete as platforms against each other and off-exchange venues. Platforms are markets that facilitate interactions among multiple parties. The value of a platform is derived from inter-side externalities, or network effects, with the presence of participants on one side attracting participation on the other.¹ They often feature joint products, which are multiple products or services that are generated by the same production technology and therefore share the same costs.

Exchanges are quintessential platforms.

Exchanges exhibit the network effects characteristic of platforms: trade executions increase the value of market data; market data functions as advertisement for on-exchange trading; listings increase the value of trade executions and market data; and greater liquidity on the exchange enhances the value of ports and colocation services.

Why does this matter?

Competitive markets improve product quality, broaden consumer options, foster innovation and maintain lower prices. These benefits are available to equity market participants because the data shows that the market for exchange services is competitive. Because the market is competitive, the best regulatory framework for the delivery of exchange services—which collectively channel investors into productive opportunities that fuel capital formation and economic growth—is one that fosters competition.

As such, this paper is not just about the Exchange Act, or even economic theory. It is about creating a market structure that is best at supporting capital formation and economic growth through lower cost, higher quality, and more innovative on-exchange trading.

Platforms deliver exchange services efficiently and effectively—and thereby fuel capital formation and economic growth—because, when it comes to platforms, 1+1 is greater than 2.

Platforms in general, and exchange platforms in particular, exhibit positive network effects. Larger trading platforms offer lower trading costs. As trading platforms attract more liquidity, bid-ask spreads tighten, search costs fall (by limiting the number of venues that a customer needs to check to assess the market), and connection costs decrease, as customers have no need to connect to all venues.² The whole is therefore greater (in the sense that it is more efficient) than the sum of the parts.

This is not to say that smaller trading platforms do not have a role to play. They provide specialized services that cater to individual customer needs. These specialized services help the smaller exchanges grow by driving liquidity to their platforms, and, if they are successful, achieve the economies of scale that benefit the larger enterprises. Because the total costs of interacting with an exchange are roughly equal, smaller exchanges offset higher trading costs with lower connectivity, market data, or other fees. While the mix of fees will change as exchanges grow, the all-in cost of interacting with the exchange remain roughly the same.

The network benefits of exchange platforms go beyond what is expected from platform theory alone. Exchanges have a unique role to play in market transparency because they publish an array of pre- and post-trade data that non-exchange venues, for the most part, do not. Non-exchange venues benefit from transparency by using published market data to set their own prices and assess their own trading strategies.

As the SEC recently noted in its market infrastructure proposal,³ the number of transactions completed in non-exchange venues has been growing. Allowing exchanges to compete as platforms means that they will be better able to compete against non-exchange venues, and, to the degree order flow is shifted from non-exchange to exchange venues, overall market transparency is

1 See Joost Rietveld and Melissa A. Schilling, "Platform Competition: A Systematic and Interdisciplinary Review of the Literature," (November 27, 2020), available at <https://journals.sagepub.com/doi/full/10.1177/0149206320969791>.

2 Nasdaq's experience shows that fewer customers connect with smaller trading venues than with larger venues.

3 See Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Price Orders, Securities Exchange Act Release No. 96494 (File No. S7-30-22), available at <https://www.sec.gov/rules/proposed/2022/34-96494.pdf>

improved.⁴ Moving liquidity onto lit venues helps non-exchange venues by enabling them to provide more accurate pricing to their customers, and play their own role in capital formation more efficiently and effectively.

Competition works as an effective system of fee regulation because, as we show in this paper, significant competitive forces constrain combined fees across all exchange products and services, and no exchange is able to provide services that cost more to use than any other in the aggregate.⁵ *Although different exchanges have very different fee models for their products and services—and fees for specific services may differ markedly across venues—the “all-in” cost of interacting with an exchange is largely equalized across trading venues.*

This is because not all customers need to purchase all exchange services. In the case of market data, for example, while broker-dealers engaging in on-exchange trading have more of a need of multiple data feeds than other users, they still have the opportunity to route order flow to non-exchange venues that offer price improvement. More importantly, many market data customers are not broker-dealers and therefore are not governed by the same regulatory obligations. For example, non-exchange venues purchase market data to set internal bids and offers; investors purchase data to understand the state of the market generally; media companies purchase data to report financial news. Not all of these customers need to purchase market data from all venues; purchasing products from one venue or a subset of venues is enough. As many proprietary market data products are substitutes, such products compete directly, adding to platform competition and therefore enhancing the overall competitive environment among exchange venues.⁶ As long as a sufficient number of customers can choose a different venue, exchanges are constrained from charging excessive fees.⁷

Tailoring fees to the customer’s use case, needs and willingness to pay is fairer than cost-based fees or those based on some other criteria. In general, exchanges offer specialized fees in the form of discounts from a standard fee. Examples of such discounts include non-professional fees, media enterprise licenses, and broker-dealer enterprise licenses. Offering discounts to specific classes of customers allow for broader dissemination of information, and provide customer discounts commensurate with the customer’s ability to pay.

Reliance on competitive solutions is fundamental to the Exchange Act. Where significant competitive forces constrain fees, fee levels meet the Exchange Act standard for the “equitable allocation of reasonable dues, fees, and other charges among members and issuers and other persons using its facilities,”⁸ unless there is a substantial countervailing basis to find that a fee does not meet some other requirement of the Act.⁹ As we demonstrate herein, competition exists at a platform level. Evidence of platform competition demonstrates a competitive environment for each product sold as part of the array of trading platform services, provided that nothing about the product or its fee structure impairs competition.¹⁰

4 Non-exchange venues rely on market data distributed by exchanges to set prices. Greater transparency allows both exchange and non-exchange venues to operate more effectively and efficiently.

5 The Exchange Act mandates the “equitable allocation of reasonable dues, fees, and other charges among members and issuers and other persons using its facilities.” See 15 U.S.C. § 78f(b)(4). The language of this provision requires examination of the fee schedule as a whole, referring generally to “reasonable dues, fees, and other charges.” Nothing in the Act requires the individual examination of specific product fees in isolation. Provided that a proposed rule change does not in and of itself undermine competition, evidence of platform competition is sufficient to show that the product operates in a competitive environment. A determination of whether a proposal permits unfair discrimination between customers, issuers, brokers or dealers would remain a separate product-specific inquiry.

6 To be clear, the existence of platform competition does not preclude competition at the product level. Top of book data from various exchanges (i.e., bids and offers and last sale information) are close substitutes, and, as such, compete directly at the product level. The existence of this type of product-level competition does not preclude the existence of platform competition, but rather enhances the overall competitive environment.

7 To use an analogy from FTC merger guidelines: “The loss of competition may not matter if a sufficient number of customers are likely to switch to products or services sold by other companies if the merged company tried to increase its prices.” Federal Trade Commission, Mergers, available at <https://www.ftc.gov/advice-guidance/competition-guidance/guide-antitrust-laws/mergers/markets>.

8 See 15 U.S.C. § 78f(b)(4).

9 See SEC, Staff Guidance on SRO Rule Filings Related to Fees (May 21, 2019) at n. 34, available at <https://www.sec.gov/tm/staff-guidance-sro-rule-filings-fees> (“If significant competitive forces constrain the fee at issue, fee levels will be presumed to be fair and reasonable, and the inquiry is whether there is a substantial countervailing basis to find that the fee terms nevertheless fail to meet an applicable requirement of the Exchange Act (e.g., that fees are equitably allocated, not unfairly discriminatory, and not an undue burden on competition).”)

10 Nothing in the Exchange Act requires proof of product-by-product competition.

Moreover, the “cost-based” fee analysis suggested in the SEC Staff Guidelines as a possible alternative to a competitive analysis may not be feasible. As discussed below, exchange platforms produce joint products. Economic theory suggests, however, that there are no objective criteria to allocate costs across joint products, and any cost allocation would therefore be arbitrary.¹¹

Further, fee caps eliminate incentives to invest and innovate, inevitably harming consumers, even when those fee caps are aimed at only a single product or subset of products. Moreover, regulating fees for a single product (or subset of products) would most likely not change the “all-in” cost of interacting with an exchange, and therefore any benefit to the customer is unclear.

For all of these reasons, competitive forces create a better and more efficient market structure that incentivizes innovation and efficiency better than any cost-based system of regulation.

What is the evidence that platform competition works?

The combination of explicit all-in costs to trade and other implicit costs has largely equalized the cost to trade across venues.¹² This is a function of the fact that, if the **all-in** cost to the user of interacting with an exchange—taking into account the amount of liquidity of the exchange—exceeds market price, customers cease to buy the services of that exchange, and therefore the exchange must adjust one or more of its fees to attract customers. As such, platform competition has resulted in a competitive equilibrium in the market for exchange services, in which trading platforms are essentially price takers, taking into account the all-in cost of interacting with the platform. This competitive equilibrium is a natural consequence of competition, and demonstrates that no exchange platform can charge excessive fees and expect to remain competitive, thereby constraining fees on all products sold as part of the platform. The existence of platform-level competition also explains why some consumers route orders to the exchange with the highest explicit trading costs even though other exchanges offer free or a net-rebate for trading.¹³

The economic concept of platform competition has been recognized by both the SEC and the courts. SEC Staff Guidance published in 2019 acknowledged that platform competition can constrain aggregate returns, regardless of the pricing of individual products, and that platforms often have joint products.¹⁴ The Supreme Court in *Ohio v. American Express Co.*¹⁵ recognized that, as platforms facilitate transactions between two or more sides of a market, their value is dependent on attracting users to both sides of the platform (i.e., network effects). Fees cannot be analyzed from only one side, but rather must be considered within the larger context of the platform to test for anti-competitive behavior.

The application of well-established economic theory shows that exchanges are platforms. Exchanges facilitate interactions between multiple sides of the market—buyers and sellers, companies and investors, and traders and market watchers—and their value relies upon their ability to draw customers to multiple sides of the platform, with the presence of participants on one side attracting participation on the other. The competition among exchanges as trading platforms, as well as the competition between exchanges and alternative trading venues, constrain exchanges from charging excessive fees for any exchange products, including trading, listings, ports and market data. Indeed, the fees that arise from the competition among trading platforms may be too low

11 Current fees for connectivity, transactions, data and other joint products are based on the value of the service, and are not cost-based.

12 Competition across platforms constrains platform fees, and results in “all-in” costs becoming equal across platforms. The Staff Guidance on SRO Rule Filings Relating to Fees, however, states that platform theory requires that the “overall *return* of the platform, rather than the *return* of any particular fees charged to a type of customer, . . . be used to assess the competitiveness of the platform’s market” (emphasis added), and states that “[a]n SRO that wishes to rely on total platform theory must provide evidence demonstrating that competitive forces are sufficient to constrain the SRO’s aggregate return across the platform.” See “Staff Guidance on SRO Rule Filings Relating to Fees.” SEC, 21 May 2019, <https://www.sec.gov/tm/staff-guidance-sro-rule-filings-fees>. (“Staff Guidance on SRO Fees”). We do not know, and cannot determine, whether returns are equalized across platforms, because we do not have detailed cost information from other exchanges. An analysis of returns, however, is unnecessary to show that competition constrains fees given that, as we demonstrate below, platform competition can be demonstrated solely by examining costs to users.

13 Empirical evidence also shows that market data is more valuable from exchanges with more liquidity. Many customers decide not to take data from smaller markets, even though they are free or much lower cost than larger markets.

14 Staff Guidance on SRO Fees. As noted above, we cannot demonstrate that returns are equalized across platforms, as we do not know the costs of other exchanges. *Supra*, n.2. Having said that, the equalization of costs to the user demonstrates that platform competition constrains the fees charged by exchange platforms without requiring a separate analysis of whether returns are equalized across platforms.

15 *Ohio v. American Express Co.* 138 S. Ct. 2274, 585 U.S. ___ (2018).

because they fail to reflect the benefits to the market as a whole of exchange products and services, allowing other venues to free-ride on these investments by the exchange platforms, increasing fragmentation and search costs.

Given that the exchange market is competitive and that exchanges compete as platforms, platform competition is the most accurate model of the exchange landscape and should therefore be central to the Commission's economic analysis of exchange fee filings.

2. Economic Definition of a Platform

In economics, the widely-accepted definition of platforms is that they are “[t]wo-sided (or more generally multi-sided) markets [which] enable interactions between end-users, and try to get the two (or multiple) sides ‘on board’ by appropriately charging each side.”¹⁶

A key aspect of platforms is the existence of “[i]nter-side ‘externalities[,]’ [meaning] demand for platform services by customers on one side of the platform depends positively on the demand for platform services by customers on the other side of the platform.”¹⁷

In other words, the value of the platform relies on network effects, in which the firm must attract users to each “side” of the platform. Platforms face pricing incentives that would be unusual for other types of businesses. For platforms, the owner “may choose to charge a ‘negative price’ ... to one side of the transaction and a ‘positive price’ to the other side”¹⁸ to incentivize participation and enhance the value of the platform overall.

These unique features of platforms mean that measures of competition that focus only on one side of the platform—or, even more narrowly, measures that focus on only one dimension of competition (such as price) on one side of the platform—are ill-suited for multi-sided platforms, and competition must be measured at the platform level.

Another aspect of platforms is that they often produce “‘joint products’ with ‘joint costs.’”¹⁹ Joint products are “multiple products or services that are generated by the same production technology,” and their production results in joint costs, or “costs that are incurred on behalf of more than one product or service and thus, potentially, are linked to more than one revenue source.”²⁰ For example, in the dairy industry, cow’s milk generates cream, cheese, yogurt, khoa, ice cream, butter and saturated oil (ghee).

The challenge of joint products, particularly in a regulated market, is that joint costs make standard economic cost-based pricing impossible to employ accurately since “there is no economically sound methodology for allocating or attributing any portion of the joint costs to any given product, service, or customer... [and] no economically appropriate way to evaluate whether the price of an individual jointly produced product or service is above or below the cost of providing that product.”²¹

Consider the fact that growing wheat results in wheat and straw, refining flour creates flour and bran, and raising cattle results in beef and leather. It is not possible to assign a unique cost to each of the joint products. For example, 50 percent of the cost of raising cattle could be assigned to the production of leather, but the implicit cost of producing leather could also be estimated at 10 percent, or 90 percent. There is no objective way to distinguish one cost allocation from another.

16 Rochet, Jean-Charles and Tirole, Jean. (2004). Two-Sided Markets: An Overview.

17 Ordovery, Janusz and Bamberger, Gustavo. “Statement of Janusz A. Ordovery and Gustavo Bamberger.” 2019.

18 *Id.*

19 Staff Guidance on SRO Fees.

20 Ordovery, Janusz and Bamberger, Gustavo. “Statement of Janusz A. Ordovery and Gustavo Bamberger.” 2019.

21 *Id.* We note that the 2019 Staff Guidance assumes that a unique cost can be assigned to each exchange product. For joint products, assigning a single, unique cost to joint products is arbitrary. The difficulties of allocating costs for joint products are magnified where a substantial portion of the platform’s costs are fixed, as is the case for stock exchanges. Markets characterized by high fixed costs and low marginal costs present the additional problem of accounting for disproportionately high fixed costs in assessing an appropriate measure of prices vs. costs than, for example, markets for wheat or beef.

Legal precedent is consistent with economic theory. In *Ohio v. American Express Co.*, the Supreme Court held that credit card networks operate two-sided platforms that “cannot make a sale to one side of the platform without simultaneously making a sale to the other,” and that platforms exhibit “‘indirect network effects,’ ... where the value ... to one group depends on how many members of another group participate.”²² Therefore, “[t]wo-sided platforms must take these effects into account before making a change in price on either side.”²³ The Court concluded that American Express’s “antisteering” provision, which prevented merchants from encouraging patrons at the point of sale to use other credit cards with lower transaction fees, was not anti-competitive. This is because the higher fees were part of American Express’s larger platform, and were used to cross-subsidize its rewards program, enhancing the value of the platform to cardholders, which encouraged spending valued by merchants.

SEC Staff’s 2019 Guidance broadly aligns with this definition, and its viability to prove competition among exchanges, noting that “platform theory generally asserts that when a business ... bring[s] together two or more distinct types of customers, it is the overall return of the platform, rather than the return of any particular fees charged to a type of customer, that should be used to assess the competitiveness of the platform’s market.”²⁴ The SEC has also acknowledged the role of cross-subsidization in platforms, which is often the result of them producing “‘joint products’ with ‘joint costs.’”²⁵

3. Exchanges as Platforms

In this section, we demonstrate that, by the economic definition, exchanges are platforms. They are multi-sided markets whose value is reliant on network effects that feature joint products.

3.1 Exchanges Are Multi-Sided Markets

Exchanges are a “quintessential example of multi-sided ‘platforms’” because, in the purest sense, platforms “facilitate interactions among two or more ‘sides,’” or distinct groups of customers,²⁶ and this is precisely what occurs on exchanges.

In attracting customers, exchanges demonstrate characteristics consistent with multi-sided platforms, relying on inter-side externalities, or network effects, to increase the value of the platform, and using the exchange’s price structure to promote those network effects.

Market data acts as a form of advertising for an exchange, where better performance in market quality attracts additional liquidity. Exchanges without the best quotes attract fewer trades. Market data begets trading and vice versa (see Figure 6 in Section 4.4.1.1), as exchanges with better quotes tend to trade more, creating positive externalities of public prices and greater liquidity. The trades and quotes in turn create more liquidity through many professional and non-professional displays. There is even evidence that greater adoption of market data results in more trading among non-subscribers to market data due to the benefit of increased liquidity on the exchange.²⁷

Listings also facilitate trading and market data, attracting more users to the platform. If an exchange demonstrates superior liquidity and market quality, as confirmed by the data, it will attract more companies to list on the exchange. As more companies list on an exchange, it attracts more order flow, again resulting in a virtuous cycle that boosts network effects.

22 *Ohio v. American Express Co.* 138 S. Ct. 2274, 585 U.S. ____ (2018)

23 *Id.*

24 Staff Guidance on SRO Fees. As noted above, an analysis of returns is not necessary to demonstrate the effects of platform competition *Supra*, n.2.

25 *Id.*

26 Ordovery, Janusz and Bamberger, Gustavo. “Statement of Janusz A. Ordovery and Gustavo Bamberger.” 2019.

27 Hendershott, Terrence & Rysman, Marc & Schwabe, Rainer. (2024). Stock Exchanges as Platforms for Data and Trading. <https://sites.bu.edu/mrysmann/files/2024/02/2024.02.16-DRAFT-NYSE-IF-paper.pdf>

The same is true for colocation. Market participants use the colocation services of exchanges with better trading, boosting the participants' confidence in trading, improving liquidity and spreads, attracting more traders, and making data more valuable to other customers.

Exchanges use a different pricing structure to attract investors and bolster these network effects, depending on their business model (see Section 4.4).

3.2 Exchanges Have Joint Products

Exchanges also feature another prototypical characteristic of platforms: joint products.

Joint products are “multiple products or services that are generated by the same production technology.”²⁸ Just as the processing of milk results in a variety of joint products, a common exchange process—the trading engine—creates joint products. The trading engine advertises quotes, which attract orders and result in trades, which, at the same time create market data. The process also provides liquidity for issuers, which promotes listing services and encourages users to purchase colocation services to ensure better connections.²⁹

The fact that these are joint products is demonstrated by a simple thought experiment. One cannot imagine a quote without trading, or a trade without a quote,³⁰ or traders connecting to a venue that is not trading.

Consider markets “without an exchange,” like bond markets today. There are fewer infrastructure costs associated with creating those markets, but also “no demand for connections to the exchange... [and] no market data is created.”³¹

Substantial evidence that exchanges are platforms is provided by an examination of what exchanges actually sell.

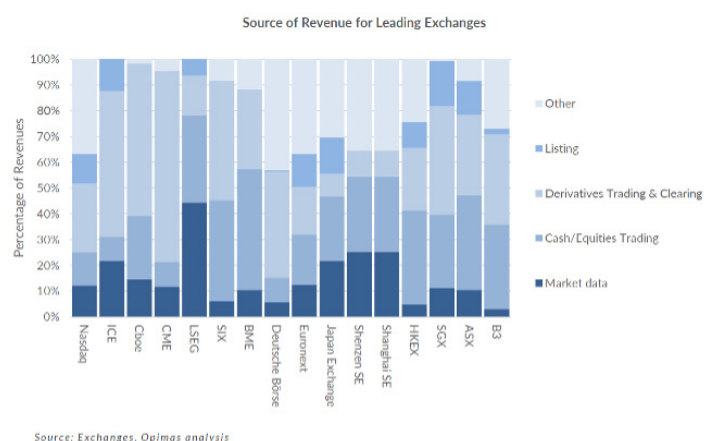
Data shows that exchanges around the world earn revenues from a combination of their joint products, regardless of the regulatory environment that prevails in a particular country or region (Figure 1).

As platforms, all exchanges produce joint products, which different customers value differently. These products are another source of competition among exchanges, with innovation and pricing structures creating different avenues for platforms to differentiate.

In the U.S., an exchange that prices its joint products optimally to one customer group provides opportunities for other exchanges to price their joint products in different ways to appeal to other customer groups, which enhances competition and improves customer welfare as the various exchanges respond to customers and competition in determining the various components of their competitive offerings.

Clearly listing, trading, data, and colocation services are joint products.

Figure 1: Exchanges Worldwide Earn Revenues from Joint Products



28 *Id.*

29 Schwabe, Rainer. “Platform Competition and the Regulation of Stock Exchange Fees.” *National Law Review*, 9 Jun. 2022, <https://www.natlawreview.com/article/platform-competition-and-regulation-stock-exchange-fees>

30 To be sure, dark pools do not publish public quotes, but they base their trades on the quotes provided by lit markets.

31 Ordovery, Janusz and Bamberger, Gustavo. “Statement of Janusz A. Ordovery and Gustavo Bamberger.” 2019.

3.2.1 The Challenges of Joint Products

It is a misconception that consumers use joint products jointly; joint products are jointly produced, but are not necessarily jointly purchased. “These trading, data, and co-location services are used by overlapping sets of firms (some use all three, some only a subset) and the value of these services is interconnected. Data from a stock exchange, for example, are more valuable when the exchange carries more trading activity.”³²

In other words, not all customers use all exchange services. To be sure, traders use market data, but not to the same extent, and not all users of market data actually trade. Index providers use market data to create indexes, but do not necessarily trade the underlying securities on an exchange. Similarly, ATs may use market data to benchmark prices without trading on an exchange.

The specific offerings of each exchange, as well as its pricing structure, determine the utility to each customer. And, critically, different customers utilize the exchanges’ various products in different quantities, which leads to variations in the extent to which customers are attracted to the different exchanges’ pricing structures. In assessing the utility of a platform, each customer must consider the total costs incurred for the product mix they will use at each exchange.

Importantly, the utility of the market is also maximized when each joint product is optimally priced—as that reduces the amount of forgone consumer and producer surpluses (economic deadweight losses) due to inefficient pricing and production, where some underpay while others do not consume. Economic theory shows more optimal pricing could more readily reflect the value of products to users, allowing exchanges to create new products for additional customers, increasing access to the market and promoting innovation.

In the case of exchange fees, platform competition and the fee’s impact on all sides of the platform must be considered. The determination of whether a proposed fee is subject to such competition requires a determination of whether the product is part of the exchange platform, i.e., whether the product is subject to inter-side externalities, where the presence of participants on one side attracts participation on the other. If the proposal does not restrict overall competition, and it is part of the platform and subject to inter-side externalities, then it is subject to competitive constraint.

Critically, in assessing whether fees are subject to competition, the pricing choices of one exchange should not be deemed unreasonable simply because they differ from the choices made by other exchanges (e.g., pricing higher in one joint product and lower in others). Differentiation and variation in product offerings are hallmarks of competition and beneficial to customers and consumer welfare. A fee proposal should not be rejected, for example, simply because a proposed price for one platform product is higher than a competitors’ prices for a similar product because one can expect the first platform’s other joint products to be priced lower to maintain platform competitiveness.

Determining a cost basis for exchanges’ joint products is not objectively possible, as economic theory has developed no objective criteria to assign a specific cost to one product out of a set of joint products, and therefore any assignment of cost would be highly subjective. Is the cost of a server related to listings, data, or trading? Is that allocation the same for liquid and illiquid securities? How should subsidies to market quality be included? There is no objective way to distinguish one allocation from another.

3.3 Nasdaq Is a Platform

By these well-established economic standards, Nasdaq and other exchanges are platforms. Stock exchanges operate trading engines that bring together buyers and sellers of securities. Nasdaq pays liquidity providers (a “side”) a rebate to attract them to the exchange, and our success in doing so has resulted in superior market quality (see Table 1 in Section 4.4.1), incentivizing liquidity providers and removers to trade on Nasdaq (network effects).

32 Schwabe, Rainer. “Platform Competition and the Regulation of Stock Exchange Fees.” *National Law Review*, 9 Jun. 2022, <https://www.natlawreview.com/article/platform-competition-and-regulation-stock-exchange-fees>

The bids, asks, spreads, and transaction clearing prices—which form the building blocks of market data—are all inherent in the operation of the trading engine. Market data and trade executions are generated by operation of the trading engine (joint products). The presence of joint products is further evidence that exchanges are platforms.

The volume of trades on Nasdaq results in valuable market data, which in turn makes traders more confident in Nasdaq, and makes it worthwhile for many to invest in colocation services.

The excellent market quality on Nasdaq attracts listings to the exchange, and has even resulted in companies switching to Nasdaq after listing on an exchange with poorer market quality (see Box 3 in Section 4.4.1.5). Increased listings add to trading and quoting breadth, which adds to data and secondary market revenues. But that is not the only way to price and offer products that exist in today's U.S. Equities markets, as we show in the following section.

4. Exchanges Compete Across Their Platforms

By now, it is clear that exchanges operate as multi-sided platforms that feature joint products.

In this section, we demonstrate that platform competition constrains pricing among exchanges as measured by all-in costs for users to trade.

Customers consider the all-in cost for them to trade at each venue, including the explicit costs of trading, connectivity, membership, and data. Regardless of different pricing structures for each service, exchanges compete at the level of aggregate cost to the customer, as a mix of multiple services is the relevant metric for many customers.

We also see that implicit costs to trade cannot be overlooked in assessing competition. Implicit costs, including markouts, opportunity costs and fulfillment rates, are part of the cost of interacting on an exchange, and are a basis for competition among exchanges.

When explicit and implicit costs are considered in tandem, costs to the user are largely equalized across exchanges. This suggests, as explained in greater detail below, that a competitive equilibrium exists and exchange fees are therefore constrained by competition.

Although all-in costs to users are constrained, we cannot gauge the aggregate returns of each exchange platform. Still, as we will discuss, the competitive nature of the exchange business sees some exchanges operating at a loss, a result that is inconsistent with the assertion that exchanges enjoy market power (Section 4.4.1.2).

In the context of the competition among platforms, different exchanges operate a variety of different business models. Each exchange's platform uses different pricing structures, each appropriate for its target customers in order to enhance its multi-sided platform via network effects.

As noted above, a subset of competition among trading platforms is the competition between listing and non-listing exchanges. This is because UTP rules allow venues to unbundle listing and trading operations, and profit from lower costs of just executing orders (see Section 4.4.1.5).

4.1 Proof That Platform-Wide (All-In) Costs to Users Matter to the Market

Demonstrating that exchanges compete at the platform level, and that all-in costs to the user are already constrained by that competition, requires a two-step analysis.

First, we analyze the all-in explicit costs for the user to trade across exchanges, which vary significantly.

Second, we consider the implicit costs for the investor to trade on each venue, which broadly equalizes costs to the user across venues. These implicit costs come primarily in the form of realized spreads.

Considered together, it is clear not only that all-in costs to users are roughly equal across exchanges, but also that implicit costs explain how venues with far higher explicit costs manage to compete with seemingly much cheaper venues (and conversely, how exchanges with higher implicit costs use lower fees to compete). This is strong evidence that all exchange fees are constrained by competitive forces. To the degree that any exchange sets a particular fee at a level that causes all-in costs to the user to be too high relative to the market, that exchange must lower other fees to remain competitive. The fact that all-in costs to users have equalized means that competition has constrained exchanges to a competitive equilibrium of prices at a platform level. Fees for particular products may vary as different exchanges attempt to appeal to different segments of the market, but fees overall are constrained by operation of market forces.

As an additional constraint on the ability of an exchange to set fees at a level that is too high relative to the market, we also demonstrate that exchanges face competition from non-exchange venues.

4.1.1 All-In Explicit Costs Vary Across Platforms—But Are Kept in Line at a Platform Level

The first step in demonstrating that exchanges compete at the platform level, and therefore face constraints on exchange fees, is to analyze the explicit cost to trade on each exchange.

As platforms, exchanges can utilize a variety of pricing structures, since joint products preclude pricing based on the cost to the exchange.

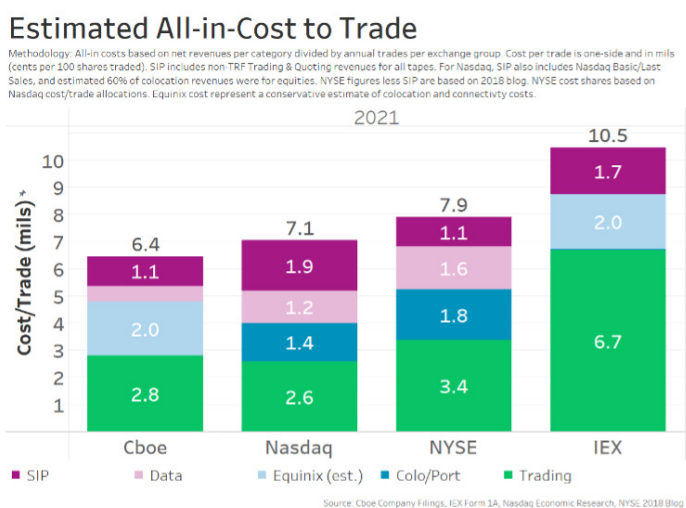
Exchanges may choose to charge more for trading and little or nothing for data—though that may partly reflect the economic value of a particular exchange’s data (exchanges with more liquidity also have more valuable data, and those with less liquidity have less valuable data). These choices are consistent with the SEC staff’s understanding that “an exchange pricing its trade execution fees higher and its market data fees lower (or vice versa), would—because of ‘platform’ competition—nonetheless receive the same overall aggregate return from the two joint products.”³³

This aligns with the customer experience as well. Although traders pay a fee per trade, joint products like data and colocation are also part of the cost to trade. This includes all explicit costs incurred, whether charged directly by the exchange or indirectly through a vendor of exchange data. For example, Cboe and IEX do not charge for colocation, but those wishing to trade on those venues still incur an explicit cost paid to a third party for the ability to route orders to those venues, which we have estimated (Figure 2, Equinix portion of bars). Nasdaq and NYSE charge participants directly for colocation and fees are reflected in the chart accordingly.

Taking all explicit costs to trade into account, however, reveals significant differences across exchanges. In fact, it is over 60% more expensive to trade on the costliest exchange than on the cheapest (Figure 2).

Such a sizeable disparity suggests that there is another factor that keeps these exchanges in competition. Specifically, when implicit costs are considered, the difference in cost to trade is minimized.

Figure 2: 2021 All-In Cost to Trade by Exchange



33 Staff Guidance on SRO Fees.

4.1.2 Implicit Costs and Explicit Costs Matter at the Platform Level

Examining implicit costs to trade is the second step in demonstrating that exchanges compete at the platform level, which constrains pricing power.³⁴

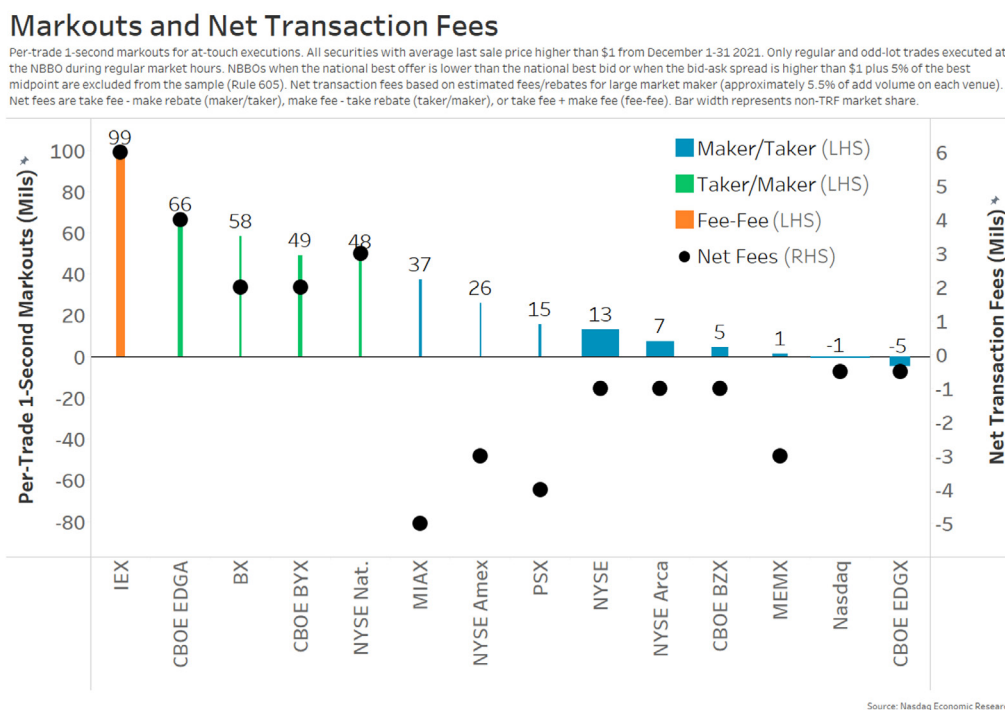
The realized spread, or markouts,³⁵ capture losses or profits liquidity providers earn atop of explicit fees (see Box 1 for additional context on how to understand markouts, and their impact).

The fact that implicit costs are not revenues that accrue to exchanges is immaterial because they are costs borne by customers and therefore impact customer decisions.

Data shows the venues with the highest explicit costs (Figure 3, black dots) – typically inverted and fee-free venues – have the lowest implicit costs from markouts (positive values imply profits for market participant) and vice versa (bars). Higher markouts mean more spread capture, but since these venues also tend to have the least volume (bar width represents non-TRF market share), those markouts are less consistently available.

Maker-taker venues instead subsidize NBBO quotes via net negative fees, which helps offset worse spread capture. These differences highlight why all-in economics matter for customers. Absent a subsidy to offset adverse selection, a market maker would be unlikely to quote on maker-taker venues, for example.

Figure 3: Per-Trade Markouts and Net Transaction Fees by Exchange



34 Trading costs are not always borne by a single party. Broker-dealers, when not trading on their own behalf, are agents of third-party investors. This does not change our analysis, however, as broker-dealers are expected to act in good faith on behalf of their customers.

35 Per-trade markout is a measure of theoretical profitability from the perspective of a **liquidity provider**. We only consider regular and odd-lot trades executed at the NBBO during continuous trading session. Instances when the market is crossed, or the bid-ask spread is higher than \$1 plus 5% of the NBBO midpoint price (Rule 605 criteria), have been excluded from the sample. For each security-day combination, the markout is calculated as:

$$Markout = 10,000 * \frac{1}{E} \sum_{e=1}^E Side_{e,t} * (Midpoint_{e,t+1s} - Execution Price_{e,t})$$

where $Side_{e,t}$ is a variable that takes the value -1 (1) for trades executed at the prevailing best offer (bid); and $Midpoint_{e,t+1s}$ is the prevailing NBBO midpoint one second after execution time t .

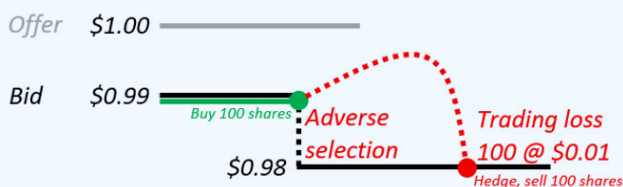
The overall per-trade markout is calculated as the trade-weighted markout.

Note on Data:

In general, the data in this report is from 2021 or 2022. This is the deliberate result of trying to make sure cross-comparisons between figures in this paper are fair. Importantly, we believe that more recent data are consistent with the findings of this paper. For example, see a 2022 version of Figure 2's All-In Cost to Trade – the latest data available at the time of publishing – in the "All-in Economics to Trade Are What Matter Most" post on Nasdaq.com.³⁶

Box 1: Understanding Markouts: Why market participants select adverse selection

The concept of markouts was created by market makers, who are trying to capture the spread, while providing a two-sided (bid and offer) market. For those traders, being filled on the bid or the offer will cause a loss if the fill results in the market prices changing.

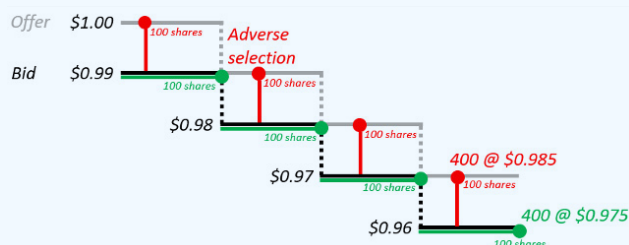


For example, a fill on a market maker's bid, just as the stock gets cheaper to buy, results in a "virtual loss", as they have a long position and the new bid is lower than their fill. Hedging their exposures out would require selling at the new, lower, bid, locking in a realized loss on the trade.

However, markouts aren't always bad. In fact, for an institutional investor, working a large order, a fill with a negative markout can be close to optimal for a few of reasons:³⁷

1. It is a fill, at the "near touch" (bid for a buyer) which is cheaper than the original order paying the spread
2. It eliminates additional wait time to finish the order, allowing another order to be entered sooner, reducing opportunity costs.
3. It often allows the next order to be placed at an even better limit price, reducing the overall cost of the position.

We show that in the example below:



- A relatively urgent buyer (but not so urgent as to push prices higher) might pay the offer each time they enter the market. Over the time window in the chart below, their trading leads to 400 shares executed at \$0.985, which is superior to the mid price at the time of the first order's arrival.
- A relatively passive buyer, in contrast, will join the bid. However, as the stock price is falling, each time the buyer gets a fill, they experience "adverse selection." Over the time window in the chart below, their trading leads to a lower cost for 400 shares executed at \$0.975, even though adverse selection adds to \$4 (400 shares at \$0.01). Again, the realized price beats the arrival mid price.

In this sense, adverse selection can be "good," especially if an investor is working a large order that requires many more executions to complete.

³⁶ Mackintosh, Phil. "All-in Economics to Trade Are What Matters Most." *Nasdaq*, 28 Sep. 2023, <https://www.nasdaq.com/articles/all-in-economics-to-trade-are-what-matters-most>

³⁷ Institutional investors typically work large orders over time, sometimes days, adding to, on average, an impact cost from trading: <https://www.nasdaq.com/articles/how-much-does-trading-cost-the-buy-side>

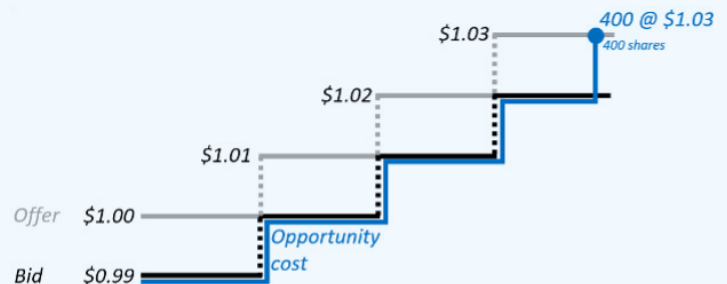
Avoiding adverse selection (for a buyer) requires avoiding fills at the bid side of the spread. That creates opportunity costs, as the diagram below shows. This can also happen if the posted order, instead of being adversely selected, signals the buyer to the market.

Over time, if the price instead drifted up, the buyer could have no executions at the end of the period. Completing their 400 shares trade, by crossing the spread at the end of the period, may instead cost \$1.03. That results in the worst execution price, a shortfall vs arrival mid of \$0.035, which is \$0.015 worse than the order with adverse selection.

Analysis shows waiting for executions significantly adds to the variance in shortfall, or execution risk,³⁸ on average. It can also result in much faster trading toward the end of the trading window, in order to complete the total order, which can also add to execution costs, according to research.³⁹

Our research also shows a trade-off between liquidity and execution quality that exists on a continuum: The more liquidity you need, the more price impact you should expect.⁴⁰ Consequently, broker algorithms and market makers are constantly weighing the cost of immediate liquidity, and lower opportunity costs, against better spread capture (lower markouts^{41,42}) with more opportunity or explicit trading costs.

However, brokers and investment managers also deploy sophisticated analytic tools⁴³ to assess how to better manage that tradeoff.



Other research from multiple sources finds that competition has largely equalized all-in costs to users across venues, when accounting for explicit and implicit costs.

Research by Bernstein confirms that participants route trades in a way that not only accounts for explicit and implicit costs – but also very efficiently values opportunity costs, like lower odds of getting a fill on inverted venues.⁴⁴

Figure 4 is sorted by liquidity (bar size and rank is by market share). The fact that all-in trading costs⁴⁵ (grey dots) marginally decline for the less liquid venues is interesting (dashed line). This may reflect the fact that there are other costs of waiting in less liquid venues that are not included here, such as the cost of trading in a venue that has a lower fill probability. Having said that, what is striking here is that all-in trading costs are equalized, with minor variation. These lower costs for less liquid venues reflect the lower quality of such exchanges, and the greater difficulty of such exchanges in providing fills.

38 Mackintosh, Phil. "How Fast Should You Trade?" *Nasdaq*, 7 Nov. 2019, <https://www.nasdaq.com/articles/how-fast-should-you-trade-2019-11-07>

39 Mackintosh, Phil & Ewen, Graham. "Portfolio Strategy: Estimating Execution Costs." Exhibit 8, *Credit Suisse*, 12 Nov. 2008.

40 Mackintosh, Phil. "What Markouts Are and Why They Don't Always Matter." *Nasdaq*, 23 Jul. 2020, <https://www.nasdaq.com/articles/what-markouts-are-and-why-they-dont-always-matter-2020-07-23>

41 Mackintosh, Phil. "Routing 201: Some of the Choices and Algo Makes in the Life of an Order." *Nasdaq*, 14 Nov. 2019, <https://www.nasdaq.com/articles/routing-201%3A-some-of-the-choices-an-algo-makes-in-the-life-of-an-order-2019-11-14>

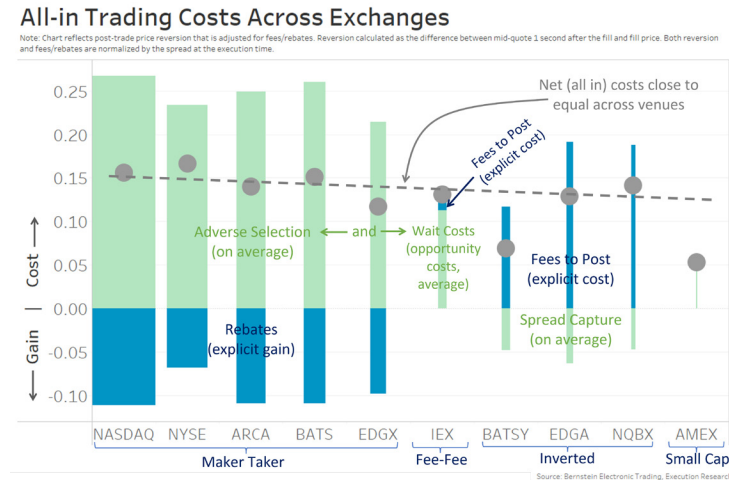
42 Mackintosh, Phil. "Routing 101: Identifying the Cost of Routing Decisions." *Nasdaq*, 14 Dec. 2018, <https://www.nasdaq.com/articles/routing-101-identifying-cost-routing-decisions-2018-12-14>

43 Tools include Virtu's TCA product, Babelfish TCA, Pragma and internal proprietary TCA and routing reports.

44 Bershova, Nataliya & Jaquet, Paul. (2019). Execution Quality and Fee Structure: Passive Lit Executions. Bernstein Electronic Trading, Execution Research. The data in Figure 4 is from this research, and therefore excludes the newer trading venues added after this paper was published.

45 The Bernstein research measures costs via price reversion (mid-quote 1 second after the fill – fill price) adjusted for fees/rebates, with reversion and fees/rebates normalized by spread at time of execution.

Figure 4: All-In Trading Costs by Venue



Notwithstanding these minor variations, research by DiMaggio has found that, after accounting for more than just the cost of take fees, the “all-in” (or net) trading costs of routing to inverted venues and maker-taker venues was the same.⁴⁶ This shows that not only are the explicit costs of trading an important part of the competitiveness of platforms, so are the implicit costs.⁴⁷ That competitiveness has resulted in the sum of explicit and implicit costs to trade largely equalizing across exchanges, which is a durable result across different methodologies.

4.2 All-In Costs Need Not Equalize Across Participant Categories

We have shown that all-in costs to trade are largely equalized across exchanges, demonstrating the competitive equilibrium of the exchange market. To extend this, are all-in costs equalized across types of market participants, like market makers?

In short, no. And they need not be.

That’s because not all exchanges are trying to attract market makers. Therefore, costs will differ for venues whose business model rely on attracting market makers – like maker taker venues – and for those that do not – like inverted venues.

In fact, in the exchange business, with so many different business models and so many different participants – including those who do no trading – it’s infeasible for prices to equalize at the participant level.

4.3 Platform Competition Constrains Total Costs and Product Costs

A key point to understand is the manner in which platform competition constrains the pricing of individual products.

If an exchange charges a supra-competitive price for a particular product, meaning a price that would boost the total cost to the investor to interact with the exchange above competitive levels, market forces will discipline that pricing approach.⁴⁸ If an exchange boosts the price of one joint product, but drops the prices of other joint products (or offers negative pricing for other joint products), that is not a point of concern, but rather reflects competitive differentiation that should be expected to enhance consumer welfare. Conversely, if the overall package of products and prices is not attractive to a sufficient volume of customers, enough consumers will have another option so as to constrain the price that an exchange may charge.

46 Di Maggio, Marco & Liu, Jerry & Rizova, Savina & Wiley, Ryan. (2020). Exchange Fees and Overall Trading Costs. SSRN Electronic Journal. 10.2139/ssrn.3625801.

47 The Di Maggio research measures costs via gross effective spread + rebate or fee + market impact (change in quoted NBBO midpoint over a five-minute window).

48 Market forces also work at a product level, separately from platform competition. For example, many market data products, such as top of book data (bids and offers as well as last sale information) are substitutable across exchanges. As a result, as discussed in Section 4.8 below, direct competition has constrained market data fees.

As long as all-in costs to the user are restrained by competitive forces, as we have shown they are, there is no regulatory basis to be concerned with pricing in isolation for one among the joint products of a platform.

4.4 Comparing Different Exchange Platforms

U.S. exchanges operate a number of different platform business models today, and each is able to attract customers and compete. In this subsection we detail:

- How exchanges work and where economic cross subsidies exist to attract customers.
- How exchanges contribute to (or detract from) fair and efficient markets and capital formation.
- How different types of exchange platforms address different customer needs, many (but not all) of whom multi-home, meaning they are customers on multiple exchanges. That way, they can trade on whichever exchange best meets their needs for the current trade.

4.4.1 Different U.S. Exchange Business Models

Table 1 shows all exchanges ranked by market share, with explicit trading costs (columns 10-12), and contribution to market quality in the columns between. We have color coded this heatmap to show apparent strengths (green) and weaknesses (red) of each model.

Explicit costs to trade are very different.

How do all these different business models compete unless all-in costs to users are constrained?

Table 1: Heatmap of Different Exchange Models and Their Characteristics

1	2	3	4	5	6	7	8	9	10	11	12
Venue	Business Model	Pricing Model	Lit Market Share ¹	Listing Exchange	Time at NBBO ²	Quote Breadth ²	S&P 500 Spreads (bps) ³	Provider Markouts (mils) ⁴	Provider Exchange Fees (mils) ⁵	Taker Exchange Fees (mils) ⁵	Net Fees (mils)
Nasdaq	Market Quality	Maker Taker	28.5%	Yes	47%	83%	12	-1	-30.5	30.0	-0.5
NYSE	Market Quality	Maker Taker	17.8%	Yes	29%	65%	16	13	-29.0	28.0	-1.0
Arca	Market Quality	Maker Taker	13.3%	Yes	26%	76%	27	7	-31.0	30.0	-1.0
Cboe - EDGX	Market Quality	Maker Taker	9.9%	No	17%	66%	34	-5	-28.0	27.5	-0.5
Cboe - BATS	Market Quality	Maker Taker	8.0%	Yes	18%	90%	22	5	-31.0	30.0	-1.0
MEMX	Industry Owned	Maker Taker	7.2%	No	26%	55%	435	1	-32.0	29.0	-3.0
IEX	Speed Bump	Fee-Fee	4.1%	No	24%	40%	553	99	0.0	6.0	6.0
Cboe - EDGA	Queue Priority	Inverted	2.5%	No	5%	48%	34	66	26.0	-22.0	4.0
Cboe - BATY	Queue Priority	Inverted	2.2%	No	3%	48%	47	49	17.0	-15.0	2.0
National	Queue Priority	Inverted	1.5%	No	3%	33%	285	48	26.0	-23.0	3.0
MIAX	Industry Owned	Maker Taker	1.4%	No	9%	22%	673	37	-32.0	27.0	-5.0
PHLX	Market Quality	Maker Taker	1.3%	No	7%	51%	168	15	-34.0	30.0	-4.0
BX	Queue Priority	Inverted	0.9%	No	5%	46%	205	58	17.0	-15.0	2.0
American	Small Cap	Small Cap	0.9%	Yes	16%	46%	550	26	-29.0	26.0	-3.0
Chicago	Other	Fee-Fee	0.5%	No	8%	31%	783	572	10.0	10.0	20.0
LTSE	ESG	Other	0.0%	Yes	0%	0%	1000	2202	0.0	0.0	0.0

¹ December 2021 share excluding TRF.

² December 2021 data in all RegNMS Securities. Quotes measured over 1-minute snapshots on day-by-day basis for each symbol and exchange. Numbers reflect simple average across symbols and days.

³ December 2021 data. Quoted spread equals Limit-Up/Limit-Down bands spread when no quote is available on an exchange at a specific moment.

⁴ December 2021 data for securities with average last sale price > \$1. Only regular and odd lot trades executed at the NBBO during regular market hours.

⁵ Estimated fees/rebates for large market maker (approximately 5.5% of add volume on each venue) as of September 2022.

Source: Exchange fee schedules, Nasdaq Economic Research

4.4.1.1 Market Quality Models

The six largest exchanges by market share all operate maker-taker platforms.

Rebates—a negative price—are paid to liquidity providers, while other trading customers are charged more to trade. This attracts liquidity providers, or market makers, since they face adverse selection in the role of providing liquidity and require an incentive to offset that risk.

This business model is similar in many ways to the platform business model analyzed by the *Supreme Court in Ohio v. American Express Co.* That case recognized that, since platforms facilitate transactions between two or more sides and their value is dependent on network effects, fees cannot be analyzed from only one side, and must be considered within the larger context of the platform to test for anti-competitive behavior.

As we see from Table 1, these markets overwhelmingly contribute more to market quality (green shades for NBBO, breadth and spreads).⁴⁹ This fact is highlighted by the data in Figure 5, which shows the leading maker-taker exchanges have the most liquidity (bar width), set NBBO the most (bar height),⁵⁰ and they also have the tightest spreads.

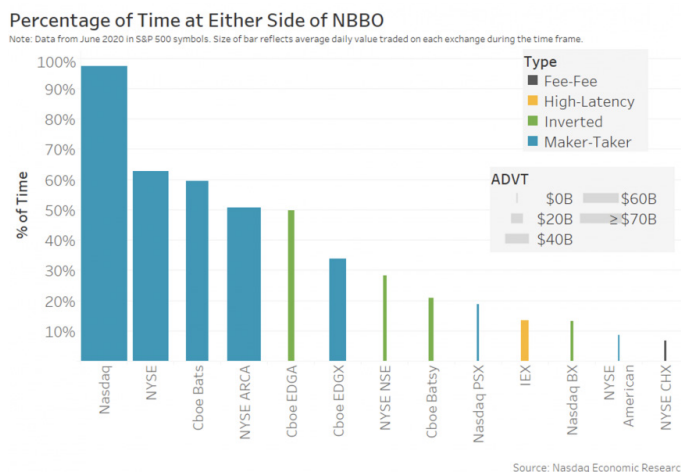
A benefit of rebates is that they can be used to encourage public quoting to create two-sided markets⁵¹ for *all* stocks,⁵² not just the largest by market capitalization. That is particularly important to small-cap issuers, allowing investors to trade efficiently in their less liquid stocks.

The “market quality” of a platform creates additional network effects:

- Many are also listing exchanges, with their liquidity and tighter spreads benefiting the issuer via lower trading costs and higher market capitalization.
- Because they consistently have the best prices,⁵³ even after explicit costs, they attract more urgent traders (takers) to the platform for liquidity.
- They also maintain actionable quotes that all can trade with. That in turn increases trading and market share. It also means many more sophisticated traders, with high-turnover strategies, prefer to be connected to these venues directly, often with co-located hardware for themselves or their customers.

Because of reliably good prices and high liquidity, price discovery tends to occur on these venues more, making their quote and trade information (data) an important input to more customers (including ATs and wholesalers).⁵⁴ That in turn makes their data more valuable and easier to sell (Figure 6); “[d]ata from a stock exchange... are more valuable when the exchange carries more

Figure 5: Maker-Taker Venues Have Most Time at NBBO and Highest Liquidity



49 Mackintosh, Phil. “The Third Annual Intern’s Guide to the Market Structure Galaxy.” *Nasdaq*, 16 Jun. 2022, <https://www.nasdaq.com/articles/the-third-annual-interns-guide-to-the-market-structure-galaxy>

50 Mackintosh, Phil. “Three Charts That Show the Importance of a Competitive Bid/Offer NBBO.” *Nasdaq*, 4 Dec. 2018, <https://www.nasdaq.com/articles/three-charts-that-show-the-importance-of-a-competitive-bid-offer-nbbo-2018-12-04>

51 Mackintosh, Phil. “Who Pays for Price Discovery?” *Nasdaq*, 21 Nov. 2019, <https://www.nasdaq.com/articles/who-pays-for-price-discovery-2019-11-21>

52 Mackintosh, Phil. “Incentivizing a Competitive NBBO for All.” *Nasdaq*, 23 Sep. 2021, <https://www.nasdaq.com/articles/incentivizing-a-competitive-nbbo-for-all-2021-09-23>

53 Mackintosh, Phil. “The 2022 Intern’s Guide to Trading.” *Nasdaq*, 23 Jun. 2022, <https://www.nasdaq.com/articles/the-2022-interns-guide-to-trading>

54 Mackintosh, Phil. “An Intern’s Guide to the Market Structure Galaxy.” *Nasdaq*, 16 Jul. 2020, <https://www.nasdaq.com/articles/an-interns-guide-to-the-market-structure-galaxy-2020-07-16>

trading activity.”⁵⁵ Our research has also shown a relationship between proprietary data fees and market share, particularly at the exchange group level (large circles).⁵⁶ The relationship is weaker at individual venues (small circles) with lower market share. In some cases, like IEX, this is by design because their platform model does not charge for use of depth data by professionals – possibly because its lower volumes make its data less valuable – but may charge more for other aspects of the platform, like trading.⁵⁷

The highly liquid venues also contribute more positively to fair and efficient markets, as well as price discovery, in line with the SEC’s mandated objectives. However, those positive externalities are not currently considered in the SEC’s processes for reviewing fees.

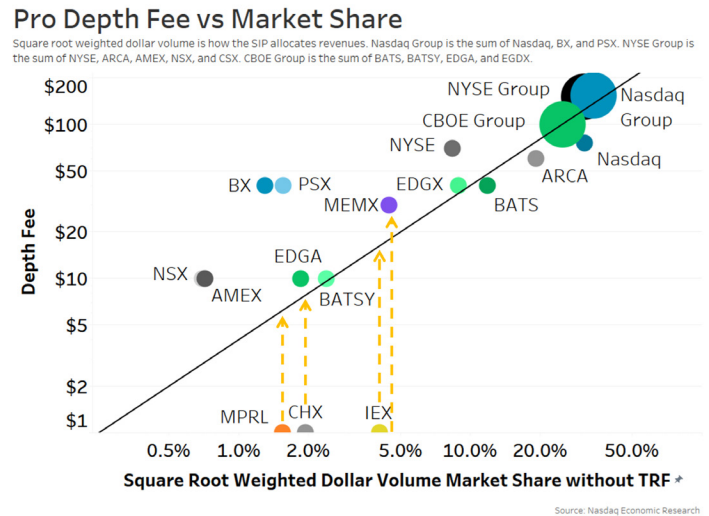
The negative price charged to liquidity providers is part of the larger maker-taker platform because it is in service of creating features attractive to the other side of the platform—oftentimes tight spreads, and actionable and lit quotes along with more valuable market data.

The linear relationship between market volume and depth of books fees shown in Figure 6 is direct evidence of the network effects inherent in all platforms: liquidity makes data more valuable. As discussed below, exchanges employ various techniques to attract liquidity, including rebates.

Negative trading costs may also be necessary to try to compete with wholesaler platforms, which bundle price improvement, PFOF, and fill guarantees, combined with the enhanced spread capture made possible by customer segmentation.⁵⁸ As such, negative trading costs are essential to bring liquidity to lit markets, which provide external benefits of transparency not available on dark platforms. Of course, negative trading costs would be impossible to offer without the support from other “sides” of the platform—market data, connectivity and other services—which allow exchanges to offer negative prices while also providing essential information not just for broker-dealers trading on the platform, but also for ATSS, index providers and other market participants. The only way to take these other factors into account when assessing proposals related to market data, connectivity, and other fixed costs is to examine the “all in” cost of trading on an exchange.

Maker-taker platforms also have another benefit for the platform owner. By making the largest contribution to the NBBO, their data is, by definition, more useful to participants. This result is consistent with the incentive structure established by the SEC in the SIP plans to pay a greater share of SIP⁵⁹ data revenues to markets based on time at the inside (Figure 7).

Figure 6: Maker-Taker Venues Have Most Time at NBBO and Highest value data



55 Schwabe, Rainer. “Platform Competition and the Regulation of Stock Exchange Fees.” *National Law Review*, 9 Jun. 2022, <https://www.natlawreview.com/article/platform-competition-and-regulation-stock-exchange-fees>

56 Mackintosh, Phil. “Accounting for Prices of NMS-II Depth.” *Nasdaq*, 9 Dec. 2021, <https://www.nasdaq.com/articles/accounting-for-prices-of-nms-ii-depth>

57 The chart reflects professional depth of book fees; we note that IEX and MIAX have both added certain market data fees, but have not added professional depth of book fees.

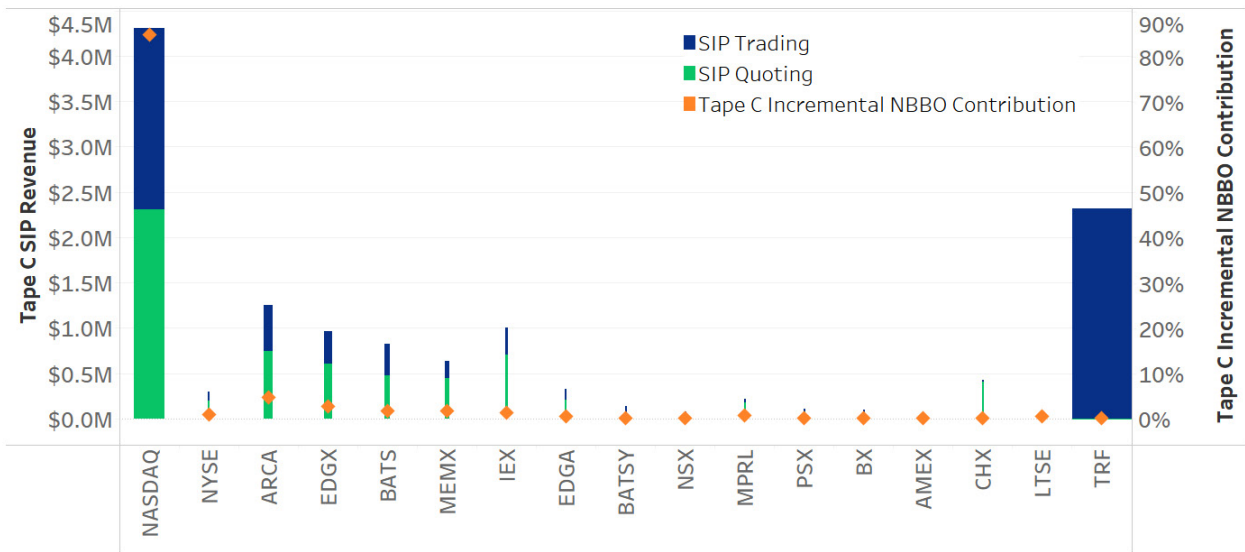
58 Mackintosh, Phil. “What Is Segmentation?” *Nasdaq*, 4 Nov. 2021, <https://www.nasdaq.com/articles/what-is-segmentation-2021-11-04>

59 Mackintosh, Phil. “SIP Accounting 101.” *Nasdaq*, 25 Mar. 2021, <https://www.nasdaq.com/articles/sip-accounting-101-2021-03-25>

Figure 7: The SIP incentive structure rewards venues that contribute most to the NBBO

Tape C SIP Revenue vs. Incremental NBBO Contribution

All data is for December 2021. Bar width represents Tape C market share.



Source: Nasdaq Economic Research

4.4.1.2 Participant-Owned Models

A variation of the maker-taker model is a participant-owned exchange like MEMX and MIAX.

Industry ownership creates an even broader platform where participants can capture profits from an exchange's activities, or offset exchange losses with trading profits. That allows select participants to cross-subsidize market-priced trading and data revenues with dividends in order to compete against existing exchanges. Furthermore, by paying larger rebates and charging lower take fees than other maker-taker venues, they increase price competition among exchanges.

Proof of how competitive the industry is, on a platform level, can be seen from the Form 1's from MEMX and MIAX for 2021 (released in 2022). Both show those platforms are running at a significant loss, thanks to net rebates for trading, in order to compete with network benefits offered by other exchange models.⁶⁰

In particular, MEMX's cost of revenues exceeded its trading and data revenues by \$35 million in 2021.⁶¹ This is because its net fees are more negative than other maker-taker venues, which helps MEMX gain market share and puts pressure on incumbents to constrain fees. In 2021, MEMX earned \$200 million in transaction fees, but paid \$251 million in rebates, a loss of \$51 million on net fees alone. On top of that, its operating costs were \$82 million for 4% market share.

In its 2022 filing, MEMX recognized that these losses were by design, noting that "[p]rior to January 3, 2022, MEMX did not charge fees for connectivity to the Exchange... to eliminate any fee-based barriers... when MEMX launched as a national securities exchange in 2020, and [it was successful attracting] a significant number of Members [who are now] directly or indirectly connected to the Exchange."⁶² But, after attracting that "significant number of Members," MEMX introduced fees for membership, connectivity, and market data in 2022 to offset its trading losses.

60 MIAX currently charges for historical data, but not real-time data.

61 "Form 1." MEMX, 28 Jun. 2022, <https://www.sec.gov/Archives/edgar/data/1792834/999999999722003516/9999999997-22-003516-index.htm>

62 Securities and Exchange Commission Release No. 34-94419; File No. SR-MEMX-2022-02. 15 Mar. 2022, <https://www.sec.gov/rules/sro/memx/2022/34-94419.pdf>

Since the founders and owners of MEMX are retail and institutional investors, who are active traders on other exchanges, promoting competition among exchanges and constraining costs on other exchanges benefits them when trading on those other exchanges.

This is explicit from MEMX's inception, with its initial press release stating "MEMX's mission is to increase competition, improve operational transparency, further reduce fixed costs, and simplify the execution of equity trading in the U.S."⁶³

Meanwhile, MIAX Pearl ended 2021 at a deficit of \$79 million.⁶⁴ Importantly, MIAX Pearl is not directly owned by retail and institutional investors, but allows member firms that achieve "certain liquidity volume thresholds" the "right to invest in... the parent holding company of... MIAX Pearl."⁶⁵ Through this program, seven firms have equity rights in MIAX Pearl's equities exchange.

Notably, MIAX Pearl's net fees are even more negative than MEMX's, but its market share is considerably lower. This likely reflects two factors—MIAX Pearl is a newer entrant than MEMX, and its market quality measures are generally worse (Table 1, columns 6-9), indicating that market quality remains an important factor in routing decisions.

4.4.1.3 Queue Priority Models

Inverted venues have the opposite price structure of maker-taker venues, where liquidity providers pay to add liquidity, while liquidity takers earn a rebate.

Naturally, this leads to less supply of liquidity than a venue where providers are paid for their service, and these platforms do not typically perform best on market quality metrics,⁶⁶ like time at the NBBO, quote breadth, and average spread.

The benefit of these platforms is that they cross-subsidize liquidity takers by providing lower effective spreads for urgent orders. In return, these platforms offer their liquidity providers the ability to pay for better queue priority versus other participants at the NBBO, which captures more spreads and leads to faster fills, reducing opportunity costs (see Box 2).

63 "Group of Leading Retail Brokers, Financial Services Firms, Banks, and Global Market Makers Plan to Launch the Only Member-Owned Equities Exchange, MEMX™, Members Exchange." *PRNewswire*, 7 Jan. 2019, <https://www.prnewswire.com/news-releases/group-of-leading-retail-brokers-financial-services-firms-banks-and-global-market-makers-plan-to-launch-the-only-member-owned-equities-exchange-memx-members-exchange-300773713.html>

64 "Form 1." *MIAX*, 28 Jun. 2022, <https://www.sec.gov/Archives/edgar/data/1683823/999999999722003537/9999999997-22-003537-index.htm>

65 "MIAX Equity Rights Program." *MIAX*, <https://www.miaxglobal.com/company/about/membership>

66 Mackintosh, Phil. "What Is the Value of Market Fragmentation?" *Nasdaq*, 30 Jul. 2020, <https://www.nasdaq.com/articles/what-is-the-value-of-market-fragmentation-2020-07-30>

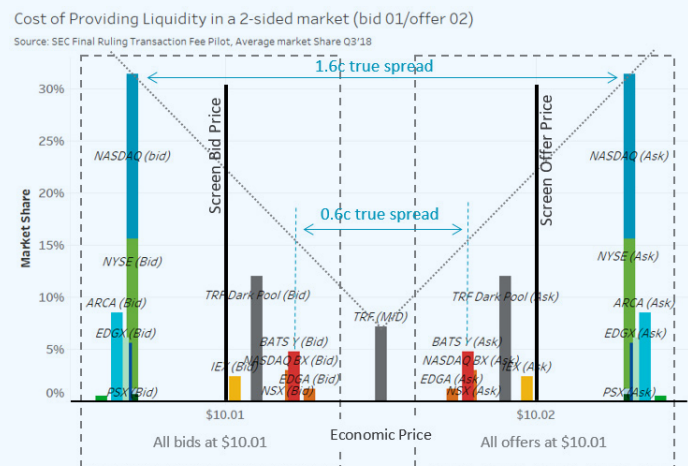
Box 2: Net costs to trade affect queue position and fill rates

The rebate and fee models used on maker-taker and inverted (queue priority) venues create explicit costs that impact the net cost to trade on each venue. That in turn affects the order in which a liquidity taker trades, which affects queue priority and fill probability (an implicit cost).

The diagram below shows the “after exchange fee” prices that a liquidity provider receives. In general, takers pay similar fees. That means a:

- maker-taker venues (far right and left) allow a provider to capture spread plus rebates (making the true explicit spread closer to 1.6 cents, net of fees), while takers pay a similarly wider spread.
- Inverted venues (center right and left) subsidize liquidity takers by charging a provider to quote. The true explicit spread is closer to 0.6 cents, net of fees.

It is cheaper for takers to trade first on inverted venues, where their net costs are lower. That means providers on those venues are more likely to get the first fill – creating time priority and increased fill probability (implicit or opportunity costs) – even though their spread capture is lower.



Data confirms that market makers opportunistically post on inverted venues when spreads are artificially wide, and usually on only one side of the quote.⁶⁷ This also helps exchanges generate effective spreads that are inside the NBBO,⁶⁸ helping exchanges to compete with Price Improvement economics offered by wholesalers.⁶⁹

4.4.1.4 Speed Bump Platforms Add to Provider Spread Capture by Avoiding Trades

More recently, the SEC has approved exchange platforms operating “speed bumps” for U.S. markets.

This market model provides an excellent example of competition at the platform level since it has the highest all-in cost for the user to trade (Figure 2), and the highest net transaction cost of any venue with market share above 0.5% despite offering almost free data and colocation (Table 1, column 12).⁷⁰

The average realized spread is best on IEX, which offsets the fact that the explicit cost to trade on IEX is by far the highest (Figure 3). For Nasdaq, NYSE, and Cboe, their venues with the highest market share are all maker-taker venues, and they have some of the worst realized spreads. This too counterbalances the lower cost to trade on those venues.

Therefore, although Cboe, Nasdaq, and NYSE have explicit all-in costs for users to trade between 25% and 39% lower than IEX (Figure 2, which includes the cost of market data and other fixed costs), the difference in realized spreads offsets those explicit savings.

Analysis of the economics shows that IEX’s competitiveness comes from a combination of cross-subsidizations and implicit

67 Mackintosh, Phil. “What Else Can We Learn From Inverted Venue Usage?” *Nasdaq*, 16 May 2019, <https://www.nasdaq.com/articles/what-else-can-we-learn-from-inverted-venue-usage-2019-05-16>

68 Mackintosh, Phil. “Quantifying the Cost of Maker-Taker Markets.” *Nasdaq*, 8 Oct. 2020, <https://www.nasdaq.com/articles/quantifying-the-cost-of-maker-taker-markets-2020-10-08>

69 Mackintosh, Phil. “A Deeper Dive Into Dark Trades.” *Nasdaq*, 11 Nov. 2021, <https://www.nasdaq.com/articles/a-deeper-dive-into-dark-trades>

70 Mackintosh, Phil. “Who Pays for Price Discovery?” *Nasdaq*, 21 Nov. 2019, <https://www.nasdaq.com/articles/who-pays-for-price-discovery-2019-11-21>

customer savings. For example:

- Although they claim that they have no (or very low) colocation and port fees, they are located in Secaucus, next door to a data warehouse where many brokers buy colocation from Equinix. Instead of eliminating colocation costs, this business model transfers the explicit costs of colocation to a third-party, non-exchange, provider. It also introduces unequal access times, which may benefit low latency customers located closer to their point of presence (POP), and harm slower investors' orders.
- The speed bump order types use data from other price-setting exchanges as an input to their own platform and products. Not surprisingly, their model has been optimized to predominantly use prices from maker-taker exchanges who have the highest quality data (see Figure 8 for formula below).^{71, 72}

Figure 8: IEX's Crumbling Quote Formula Relies on Data From Large Market-Maker Exchanges

$$D := II[BATS] + II[EDGX] + II[NASDAQ]$$

where $II[BATS]$ is an indicator variable that equals 1 if BATS was present on the near side 1 ms ago but is not now, and equals 0 otherwise. $II[EDGX]$ and $II[NASDAQ]$ are defined analogously, so the value of D is always between 0 and 3.

Source: *The Evolution of the Crumbling Quote Signal*, Page 14

- Then, "by design [the D-Limit order type] prevents trading... for a resting D-Limit order compared to a standard limit order."⁷³ This means that their platform uses limit prices based on prices from other exchanges' NBBO orders. When trades start to happen, those copied quotes reprice to lower, better prices before takers can access advertised prices through the speed bump.
- By fading incoming trades, their liquidity providers avoid adverse selection trades. Consequently, spread capture and market maker profits, when trades do occur, are higher (Figure 3). That attracts liquidity providers, who can more than offset high explicit trading fees by implicit trade savings.⁷⁴
- Since their platform ingests high-quality data and delays it, the value of their market data to others is low. Data from professionals in Form ATS-N show that even though IEX's proprietary data had been free for years, some professionals opt out of specific direct feeds on a venue-by-venue basis, and some do not even take free proprietary data. The choice to avoid connecting to some proprietary data also highlights a diseconomy of competition across too many venues. Customers choose to avoid the fixed costs of connecting to more data sources, separate from the direct and regulated costs of the data itself, when its benefits do not offset the costs.⁷⁵ Minimizing the implicit costs of fragmentation and connection is part of other platforms' competitiveness.
- Even though IEX quotes frequently avoid trading, representing 25% of the liquidity they advertise,⁷⁶ they still receive SIP revenue for quotes that fade under the current SIP allocation formula. Current data-pricing rules allow IEX to free-ride off the

71 Mackintosh, Phil. "Who Pays for Price Discovery?" *Nasdaq*, 21 Nov. 2019, <https://www.nasdaq.com/articles/who-pays-for-price-discovery-2019-11-21>

72 "Investors Exchange Rule Book." IEX, 19, May 2023, https://assets-global.website-files.com/635ad1b3d188c10deb1ebcba/64668bd342ce64b3ff7a40f4_Investors%20Exchange%20Rule%20Book%2005-19-23.pdf

73 Ryan, Ronan. "D-Limit Performance & the Fill Rates Race." *IEX*, 3 Mar. 2021, <https://medium.com/boxes-and-lines/d-limit-performance-the-fill-rates-race-4dcd26661a98>

74 "IEX Exchange Fee Schedule." *IEX*, 1 Jul. 2022, <https://exchange.iex.io/resources/trading/fee-schedule/>

75 Mackintosh, Phil. "Dispelling the Complementary Product Theory for Market Data." *Nasdaq*, 20 Aug. 2020, <https://www.nasdaq.com/articles/dispelling-the-complementary-product-theory-for-market-data-2020-08-20>

76 Stockland, Eric. "Leveling the Playing Field for Lit Trading." *IEX*, 17 Dec. 2019, <https://medium.com/boxes-and-lines/leveling-the-playing-field-for-lit-trading-682dc723cef1>

creation of competitive NBBO on other markets, which data shows to be maker-taker markets. The costs to IEX of proprietary data feeds required to peg orders to other exchanges' best prices adds to less than \$1.2 million per year.⁷⁷ This platform earns IEX SIP revenues of approximately \$20 million.⁷⁸

- An additional external cost to investors is also created, but unmeasured, by the lack of a fill. Investors, thinking they can execute at the best price on IEX, find that liquidity instead moves to a worse price, adding time to fill and ultimately resulting in worse prices when those trades do occur.

In summary, this platform is profitable for IEX liquidity providers, who can avoid losing trades, making those traders happy to pay much higher explicit costs. The platform attracts liquidity providers attracted to the IEX D-Limit order type, which in turn adds to exchange SIP data revenues, helping IEX to subsidize data and port costs.

The lesson from this examination of IEX is that different exchanges can offer radically different products and pricing structures to attract order flow. These different approaches manifest as radically different fees for different products and services. Examination of any specific fee in isolation can be quite misleading—and indeed meaningless—as zero or negative fees for products on one side of the platform can be offset by higher fees on the other part of the platform. The only meaningful way to examine and understand exchange fees is by examining the all-in cost to users of interacting with the exchange.

4.4.1.5 Listing v. Non-Listing Platforms

Another differentiation of exchange business models is whether or not they are listing exchanges.

Listing exchanges are critical to the SEC's mission of capital formation.

Listings are also a joint product that supports the listing exchange's platform. Data show primary listing exchanges around the world typically have the most liquidity and the best market makers and spreads.

Moreover, research shows that listing exchanges compete for listings based on market quality.⁷⁹ Potential customers considering listing switches and IPOs frequently want evidence that their chosen exchange has "less volatility, tighter spreads and more depth," along with "more liquidity ... during closing auctions,"⁸⁰ even during periods of high volatility.⁸¹

That ultimately forces listing exchanges to focus their platform on market quality goals in order to retain listings, as the Interactive Brokers switch away from and then back to Nasdaq proved (Box 3^{82, 83}).

77 Mackintosh, Phil. "Dispelling the Complementary Product Theory for Market Data." *Nasdaq*, 20 Aug. 2020, <https://www.nasdaq.com/articles/dispelling-the-complementary-product-theory-for-market-data-2020-08-20>

78 Mackintosh, Phil. "IEX Is All-In on Data Revenues, Quote Fade and (Virtual) Rebates." *Nasdaq*, 1 Apr. 2021, <https://www.nasdaq.com/articles/iex-is-all-in-on-data-revenues-quote-fade-and-virtual-rebates-2021-04-01>

79 Poser, Steven. "Market Making and the NYSE DMM Difference." *NYSE*, 8 Sep. 2021, <https://www.nyse.com/data-insights/market-making-and-the-nyse-dmm-difference>

80 Nasdaq Economic Research. "Switching to Nasdaq Is Good for Your Stock." *Nasdaq*, 15 Sep. 2020, <https://www.nasdaq.com/articles/switching-to-nasdaq-is-good-for-your-stock-2020-09-15>

81 Poser, Steven. "When Volatility Calls, NYSE DMMs Answer." *NYSE*, 18 Feb. 2002, <https://www.nyse.com/data-insights/when-volatility-calls-nyse-dmms-answer>

82 "Interactive Brokers Group to Move Stock Listing to Nasdaq." *Nasdaq*, 23 Sep. 2019, <https://www.nasdaq.com/press-release/interactive-brokers-group-to-move-stock-listing-to-nasdaq-2019-09-23>

83 Mackintosh, Phil. "What's Fair? It Depends on Your Point of View." *Nasdaq*, 3 Oct. 2019, <https://www.nasdaq.com/articles/whats-fair-it-depends-on-your-point-of-view-2019-10-03>

Box 3: Case Study Proving That Market Quality Matters to Issuers

The listing switches of Interactive Brokers provide a natural experiment to highlight the value market efficiency plays in attracting listings.

Interactive Brokers opted to move its listing from Nasdaq to IEX in 2018, but moved it back to Nasdaq in 2019. In making the decision to move back to Nasdaq, the Chairman and Founder of Interactive Brokers, Thomas Peterffy, said:

Last year, we switched to IEX because we believed that their advanced exchange model, including their mid-price orders and crumbling order algorithms, provided the opportunity for substantially better execution prices for orders routed there... Unfortunately, IEX exchange could not gain more listings and there were fewer market-makers trading our stock on IEX than on Nasdaq. We gave it a year and we tried our best, but we now have to accept that, in spite of our good intentions, returning to Nasdaq will be best for our shareholders.⁸⁴

The data support this statement. Our research shows that the spread on Interactive Brokers stock (IBKR) was 83% wider on IEX than on Nasdaq (Figure 3A). Importantly, over the same period, spreads on S&P 500 stocks had increased only 4%.⁸⁵ We estimate this resulted in added costs of more than \$1 million for investors trading IBKR.

Moreover, quotes improved from being at the NBBO 12% of the time on IEX to 96% of the time on Nasdaq, while liquidity was 27% lower on IEX. Lower liquidity contributed to higher volatility for market-on-close orders, leading to an increase in closing price dislocation from 2 cents to 9 cents (Figure 3B), which is estimated to cost investors another \$500,000 in additional costs.

This natural experiment provides a unique example of how listings and trading are joint products, and part of each exchange's platform. The superior market quality at Nasdaq induced Interactive Brokers to return to Nasdaq, which enhances market efficiency via lower costs to trade for investors and reducing cost of capital for Interactive Brokers.

Figure 3A

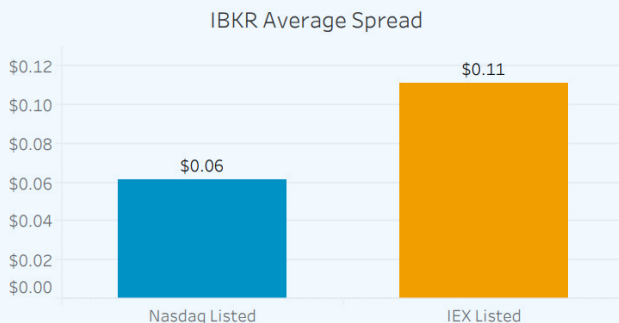
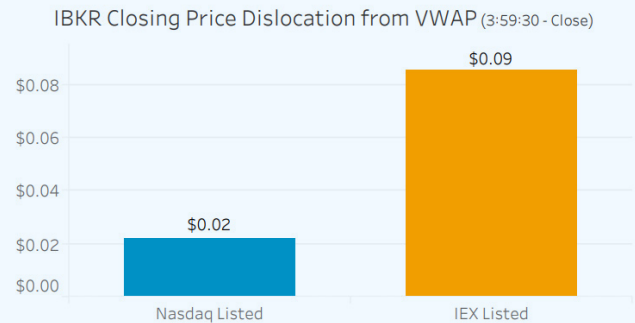


Figure 3B



Source: <https://www.nasdaq.com/articles/whats-fair-it-depends-on-your-point-of-view-2019-10-03>

Despite the benefits of a listing exchange, many exchanges choose not to list stocks. Non-listing exchanges avoid the costs of marketing and providing services and surveillance to issuers, but still benefit from revenues from trading each stock, while listing exchanges have the advantage of better execution quality. This is another aspect of platform competition that is missed by focusing on individual exchange products.

84 "Interactive Brokers Group to Move Stock Listing to Nasdaq." *Nasdaq*, 23 Sep. 2019, <https://www.nasdaq.com/press-release/interactive-brokers-group-to-move-stock-listing-to-nasdaq-2019-09-23>

85 Mackintosh, Phil. "What's Fair? It Depends on Your Point of View." *Nasdaq*, 3 Oct. 2019, <https://www.nasdaq.com/articles/whats-fair-it-depends-on-your-point-of-view-2019-10-03>

4.5 Exchanges Compete Against Non-Exchange Platforms

Exchanges are also competing for trades with other venues who operate their own platforms—often with different regulations and costs, including the artificially regulated cost of inputs from exchanges themselves.

Broker-dealers operate their own platforms that include off-exchange trading facilities, where prime-services and research operations benefit cross-platform sales. Often, costs and cross-subsidization within broker-dealer platforms are opaque and data have shown behaviors exist that are not competitive on the basis of cost.⁸⁶

Wholesale market makers profit from spread crossing orders matched off exchange—and data shows they can capture more spread, at lower costs, from accepting only segmented flow and matching on-exchange NBBO, which even with direct feeds, cost a fraction of their customer profitability.⁸⁷

Competition with Non-Exchange Platforms also works to constrain the fees that exchanges can charge for their services, in addition to the competition among exchange platforms.

4.6 Unbundled Prices and Economic Costs

The fact that these different models exist highlights the innovation and competition within the exchange industry. A one-size-fits-all approach is insufficient for the needs of investors, which may change from moment to moment.

Exchanges compete against each other, and non-exchange venues, for each individual trade.

Large investors, in particular, will multi-home, allowing them to use whichever exchange is likeliest to maximize their utility function for each trade.

The fact that different venues employ disparate models with different fee structures means that direct comparisons between individual products are not a meaningful method to assess competition, and the only meaningful method of assessment is at the platform level. As we have shown in Sections 4.1.1 and 4.1.2, platform competition has already resulted in rough equalization of all-in costs for users across exchange venues.

4.7 Competition and the Consolidated Tape Plans

The consolidated tape plans publish a National Best Bid and Offer (“NBBO”), which, under the Vendor Display Rule (Rule 603), must be provided to the customer at the point of sale. This creates a type of “momentary monopoly,” in the sense that only one exchange can provide the best bid or offer at any given moment in time.

To be sure, the consolidated tape plans are in a unique position as the sole source of the NBBO. This does not, however, undermine the competition among exchanges to be at the NBBO. Under the revenue sharing formula offered by the consolidated tape plans, exchanges are rewarded for the amount of time they are at the NBBO. To be at the NBBO, exchanges are required to compete for liquidity. Moreover, multiple exchanges can be at the best price and, as such, still compete for trade executions. In addition, customers, particularly those with large orders, may seek price improvement on non-exchange venues, and all of the exchanges must continue to compete against non-exchange venues for liquidity. As such, the existence of the consolidated tape plans do not undermine the competition among exchanges, but rather enhance competition as they continue to compete to be at the NBBO.

86 Anand, Amber & Samadi, Mehrdad & Sokobin, Jonathan & Venkataraman, Kumar. (2021). Institutional Order Handling and Broker-Affiliated Trading Venues. *The Review of Financial Studies*. 34. 10.1093/rfs/hhab004.

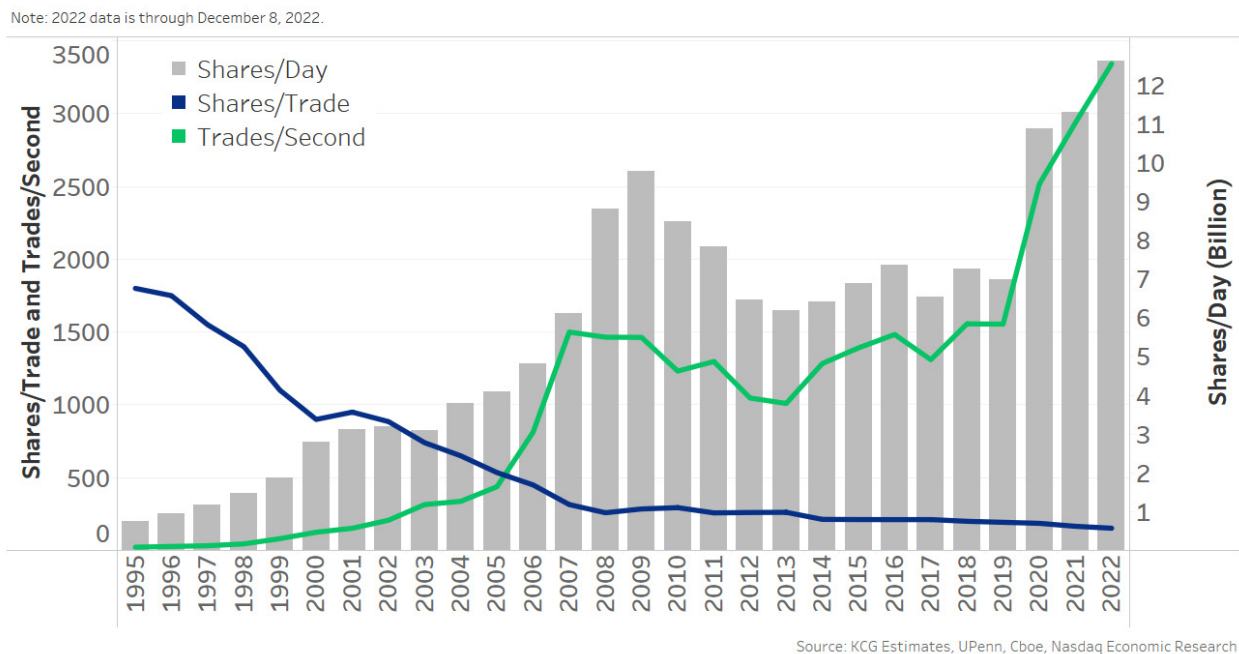
87 Mackintosh, Phil. “What Is Segmentation?” *Nasdaq*, 4 Nov. 2021, <https://www.nasdaq.com/articles/what-is-segmentation-2021-11-04>

4.8 Platform Competition Has In Fact Constrained Market Data Fees

Platform competition has constrained market data fees over the last two decades. For example, fees for the display of depth of book information are at the same nominal level (and lower after accounting for inflation) than they were in 2002. In November of 2002, Nasdaq proposed a fee of \$150 per user per month for its depth of book product, TotalView.⁸⁸ A year later, in October of 2003, Nasdaq lowered fees to \$70 per month for professional users and \$14 per month for non-professional users “in response to the lack of demand by vendors and users.”⁸⁹ Today, those fees have barely changed in nominal terms: professional subscribers pay a monthly fee of \$76 each for display usage of TotalView, and non-professional subscribers of TotalView pay a monthly fee of \$15,⁹⁰ representing a considerable reduction in real terms.⁹¹

Specific non-display fees for TotalView were separated from display usage following the market automation in the 2000s, as algorithms performed an increasingly large proportion of all trading. Volumes increased from fewer than 1 billion shares per day in the mid-1990s to more than 6 billion shares per day by 2007 (Figure 9) and the number of trades per second increased significantly through the early 2000s (green line). It became increasingly clear that it was unfair to charge the same fees to human traders – who traded smaller volumes – and algorithmic traders – who traded much faster and in disproportionately larger volumes.

Figure 9: Daily share volumes increased significantly as the market automated



88 Securities Exchange Act Release No. 46843 (November 18, 2002), 67 FR 70471 (Nov. 22, 2002) (SR-NASD-2002-33); see also Securities Exchange Act Release No. 55007 (December 22, 2006), 72 FR 600 (January 5, 2007) (SR-Nasdaq-2006-053 (recounting history of depth of book fee changes).

89 Securities Exchange Act Release No. 48581 (October 1, 2003), 68 FR 57945 (October 7, 2003) (SR-NASD-2003-111); see also Securities Exchange Act Release No. 55007 (December 22, 2006), 72 FR 600 (January 5, 2007) (SR-Nasdaq-2006-053) (explaining the rationale for the fee reduction).

90 The Nasdaq Stock Market LLC Rules, Equity 7 (Pricing Schedule), Section 123(b)(2).

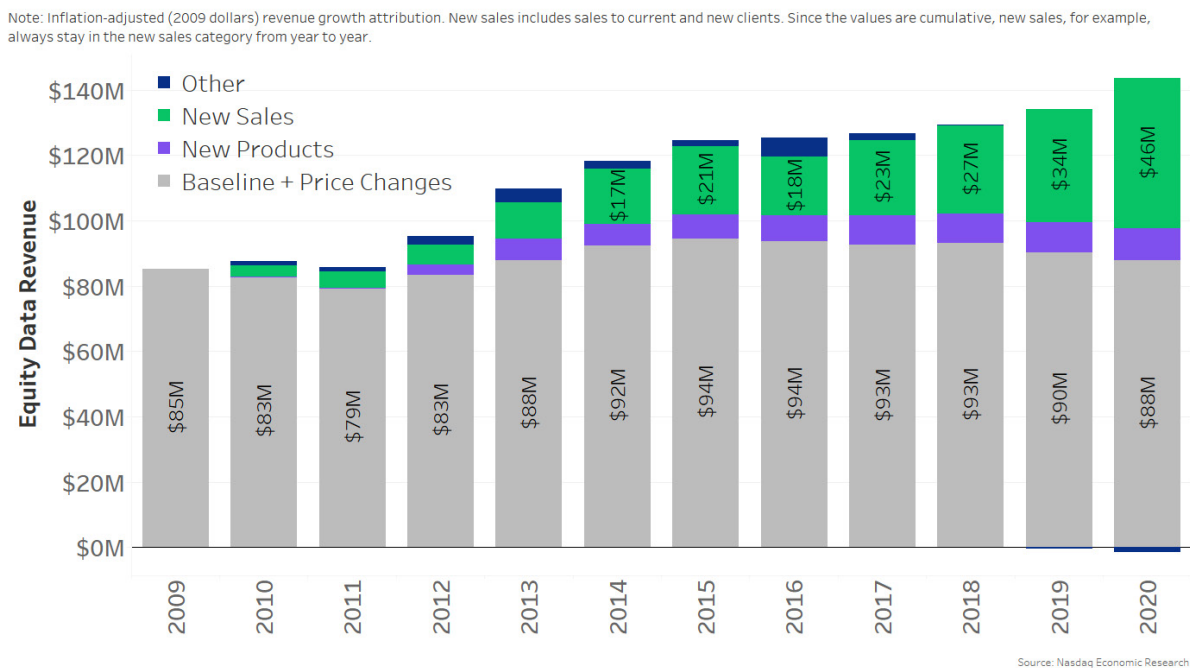
91 The Bureau of Labor Statistics' CPI Inflation Calculator shows that, for Nasdaq's fees to have merely kept up with inflation, the TotalView fees today would have to be \$114.79 for professional subscribers for display usage and \$22.96 for non-professional subscribers – about 50% higher than today's prices. Instead, \$76 in April 2023 is equivalent to \$46.35 in October 2003, when adjusted for inflation. Similarly, \$14 in April 2023 is equivalent to \$8.54 in October 2003.

As a result, in April 2012, specific fees for non-display were created to more fairly allocate costs to those doing the trading. In 2012, those fees were \$300 per server, and they were increased to \$375 per server in January 2016⁹² – after which, they have remained unchanged. As with display fees, this represents a considerable reduction in real terms.⁹³

TotalView is not an isolated example. The constraint on market data fees can be seen through an examination of changes in market data revenue over time. Figure 10 tracks cumulative annual revenue growth, adjusted for inflation, over the decade between 2010 and 2020 to one of three factors: (i) new sales, (ii) new products, and (iii) other factors (one-time revenue adjustments, including mergers and acquisitions).

Figure 10 shows that annual growth is largely driven by new sales—both new customers and existing customers buying additional products—and not by price changes. By 2020, for example, new sales and new products together accounted for 98% of the increase in revenue, while the baseline and fee changes only added 5% (grey bars), and other factors caused a 2% drop. This highlights that, over time, nominal fee increases have been almost entirely outstripped by the rate of inflation. These fees were constrained by the need to compete as a platform.⁹⁴

Figure 10: New customers and products are only Drivers of Growth in Nasdaq data revenues



Platform theory is not just an economic theory—it reflects the business reality faced by investors and exchanges. Our customers have revenues and costs; the difference between the two determines what is available for trading. If fixed costs rise, resources available for trading fall. This is a practical manifestation of the network effect inherent in platforms.

Exchange customers routinely cancel or curtail exchange services. In 2022, for example, Nasdaq reported that the introduction of fees for the five MRX data feeds caused an approximately 15 percent reduction in the number of customers with access

92 Prices are tiered above 10 servers.

93 The Bureau of Labor Statistics' CPI Inflation Calculator shows that, for Nasdaq's fees to have merely kept up with inflation since January 2016, the TotalView fees today would have to be \$480.17 for non-display usage – 28% higher than today's prices. Instead, \$375 in April 2023 is equivalent to \$292.86 in January 2016, when adjusted for inflation.

94 The Nasdaq exchange has sometimes been asked to demonstrate that increases in market data directly lead to a loss of order flow. In fact, market data fees have remained stable over an extended period of time. Nasdaq has not proposed market data fee changes that would impact order flow because it intends to remain competitive as a platform. If Nasdaq had proposed market data fee changes that would have caused its "all in" costs to rise above those of its competitors, it would have become uncompetitive as an exchange and lost order flow.

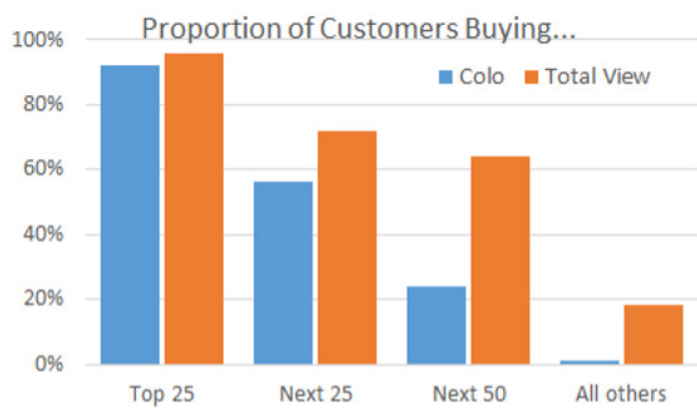
to those feeds, from 34 to 29.⁹⁵ We have also had cancellations of BX and PSX data feeds because the liquidity available on those exchanges has been insufficient to support the cost of market data. On larger exchanges, we have seen high-frequency traders scale back their spending on connectivity by, for example, reducing the bandwidth on their connections, or by replacing sophisticated FPGA technology with standard connections. Customers have also reduced spending on display feeds. All of these actions enforce discipline on the amount exchanges can charge for data and connectivity.

5. Customers' Business Models and Customer Choice

In this section, we demonstrate that the variety of customers operating on exchanges underscores the need for flexibility in pricing to better meet the needs of the users, while also enabling more equitable pricing practices. These are separate competitive forces that constrain the ability of exchanges to charge excessive fees.

Exchange customers have a variety of options when it comes to exchange products, and they exercise that choice. Some access the exchange without purchasing anything from an exchange, instead using third-party routers and data.

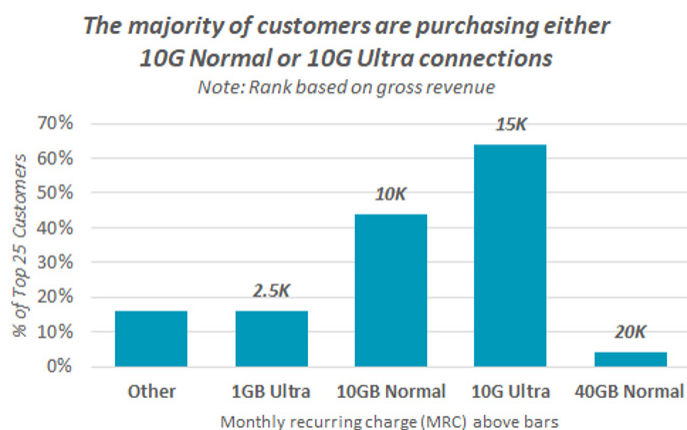
Figure 11: Colocation and Proprietary Data Purchases



For those whose business models necessitate the purchase of some mix of trading, connectivity, and data services, there are a variety of options at different price points, allowing customers to exercise choice, and forcing exchanges to compete on their offerings and prices.

In the case of data, proprietary feeds are not necessary for most customers. In fact, 99% of SIP customers do not purchase direct feeds,⁹⁶ meaning proprietary data is subject to substitution-based competition with the SIP. Even the largest customers, typically international brokers and large market makers, do not all purchase depth data, and fewer purchase colocation services.

Figure 12: Ports Purchases for Top 25 Customers



In fact, outside of our top 100 data customers, less than 20% purchase depth data (Figure 11, rightmost orange bar).⁹⁷ Many of these smaller customers may opt to purchase data from a third-party aggregator, presenting another instance of substitution-based competition. For customers who do purchase proprietary feeds, many profitably use them as an input to their business, whether that be as a hedge fund, a dark pool, or a number of other businesses.

In terms of colocation services, virtually none of our customers outside the top 100 colocation customers buy colocation (Figure 11, rightmost blue bar). For those that do purchase colocation, however, they have options that suit different customers' latency requirements.

95 Securities Exchange Act Release No. 96144 (October 24, 2022), 87 FR 65273 (October 28, 2022) (SR-MRX-2022-22).

96 Mackintosh, Phil. "NMS II: A Strange Way to Fix a Two-Tiered Market." *Nasdaq*, 18 May 2020, <https://www.nasdaq.com/articles/nms-ii-a-strange-way-to-fix-a-two-tiered-market-2020-05-18>

97 Mackintosh, Phil. "Is Free Fair for All?" *Nasdaq*, 29 Jan. 2019, <https://www.nasdaq.com/articles/is-free-fair-to-all-2019-01-29>

In the case of ports, customers again have numerous choices (Figure 12). Depending on how much trading a customer does, they can purchase ports with different bandwidths and latencies. Ports exhibit the common economic practice of nonlinear pricing. For example, a 10GB Ultra port offers 10 times the bandwidth of a 1GB Ultra port for six times the price.

Therefore, within the umbrella of joint products, there are layers of choice available to customers to tailor these inputs to their businesses, enabling customers to maximize the efficiency of their resource allocation. For many would-be customers, that means not purchasing any products from exchanges, and instead routing orders via a broker without incurring the costs or commitments of services from exchanges.

The diversity of joint products is akin to that of exchange business models, resulting from competition and innovation to best meet the needs of customers. Customer choice helps maintain reasonable fees as it provides dimensions on which exchanges must compete. Furthermore, different options promote fair and equitable markets, as one-size-fits-all offerings would lead to inefficient resource allocation by customers. Lastly, the fact that customers can route orders to exchanges without purchasing anything directly from an exchange provides customers with other options to limit costs.

6. Not All Participants on the Platform Have Equal Consumption

Exchanges allow all investors and traders to compete to advertise liquidity at the best prices – which creates quotes. More urgent investors then initiate trades, creating prices used to describe the market and value portfolios.

Different participants use, and benefit from, the marketplace in vastly different ways. Any analysis of exchange fees requires an understanding of the different levels of usage and economics of market participants.

Setting fees at the same level across different types of participants is not fair, or efficient. It makes prices too high for some participants to justify consumption, while subsidizing activities of others. Rarely does it reward the positive externalities some providers create.

6.1 US Equities Markets Are Formed By An Ecosystem Of Market Participants

Figure 13: Markets as an Ecosystem



Specialized participants have emerged, each with different but important roles, in the primary (initial public offerings) and secondary (trading) markets (Figure 13). Exchanges are open to all and create a single market for issuers, investors and liquidity providers, playing a central role in facilitating both capital formation and fair, orderly, and efficient markets.⁹⁸

In order to promote capital formation, listing exchanges provide uniform listing standards that, along with SEC rules requiring corporate accountability via quarterly accounting statements and other disclosures, enhance the transparency of public markets for investors. These rules and regulations promote trust between issuers and investors, creating a safer environment for both sides of the transaction.

Listing exchanges encourage capital formation by bringing together companies and investors.

A number of exchanges engage in initial public offerings (IPOs) and list stocks, and there is intense competition among these exchanges for

98 Mackintosh, Phil. "The Third Annual Intern's Guide to the Market Structure Galaxy." *Nasdaq*, 16 Jun. 2022, <https://www.nasdaq.com/articles/the-third-annual-interns-guide-to-the-market-structure-galaxy>

listings. UTP regulation permits, regardless of the exchange on which a stock is listed, these stocks to be traded on any of the 16 designated exchanges, over 30 dark pools (ATS's) and directly with broker dealers. Given that all exchanges can trade stocks listed on another exchange, all exchanges are engaged in the intense competition for secondary market liquidity (trading), and enable price formation and secondary market liquidity by bringing together companies and investors and producing publicly available quotes.

6.2 Issuers Benefit From Capital Formation and Provide Returns to Investors

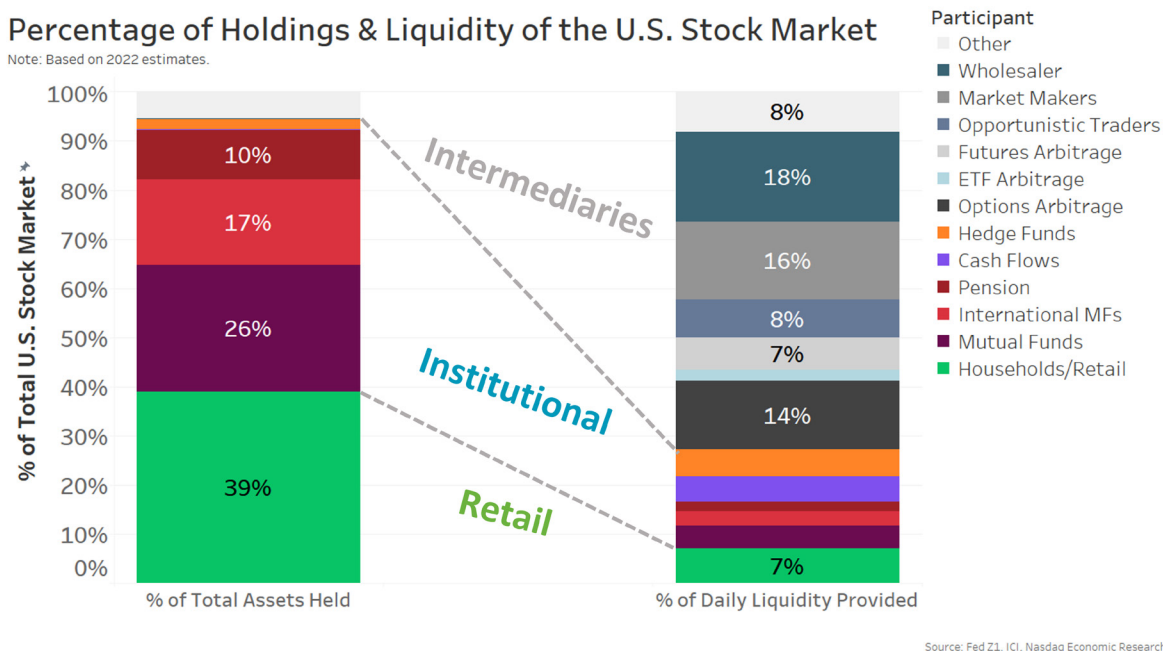
Issuers enjoy the benefits of capital formation, which allows them to make critical investments in their business, grow the economy, increase employment, and provide investment opportunities.

They provide benefits to investors too. When companies choose to list on public markets, investors have more investment choices and likely higher returns.

6.3 Those Who Trade the Least Provide Price Discovery

Long-term investors—typically mutuals funds, index funds, and retail investors—provide most of the market capital to issuers (Figure 14). Their confidence to invest assets in public companies is core to capital formation. The research they do on each company, and the buying and selling that results, provides price discovery that makes asset allocation more efficient across the economy. However, they do relatively little trading and quoting.

Figure 14: Investors Have Majority of Assets; Intermediaries Do Majority of Trading



These participants typically outsource spending on technology and infrastructure, and often trade relatively little on exchanges, despite benefiting most from secondary market liquidity and spreads.

6.4 Those Who Trade the Most Make Markets More Efficient

Data suggests that short-term traders—typically market makers, hedge funds, arbitrageurs, and banks—contribute the majority of daily liquidity to markets (Figure 14). Their focus on short-term opportunities and arbitrage adds liquidity and creates a more orderly and efficient market by ensuring there is always an investor on the other side of the trade.⁹⁹

This creates a positive externality because it helps all traders keep prices as efficient as possible, creating tighter spreads,¹⁰⁰ which reduce transaction costs¹⁰¹ for all investors, even those who trade off exchange.

These participants are also typically heavily invested in technology and infrastructure, despite experiencing lower margins as markets become more and more efficient.

6.5 Not All Market Participants Trade, and Many Who Do Trade Slowly

Technological advances have also played a major role in the efficiency of markets. Computerized trading has led to fewer manual errors, quicker processing, and cheaper and faster trading. This means arbitrage happens very quickly, making markets very efficient. For participants trying to profit from arbitrage opportunities, computing power and trading speed are critical.

However, data needs and speeds and, in turn, costs are dependent on the use case of the customer (Figure 15). The majority of market participants react to news that occurs on a daily or even slower cadence. Humans, by definition, gain no benefit from the costs of high-speed technology.

Many other businesses benefit from the stock market on a daily basis, but do no trading on exchanges at all. That includes media companies, index providers, custodians and prime services businesses, and order management and risk system providers.

These participants have a range of benefits from a stream of public prices from quotes and trades, despite doing no trading at all.

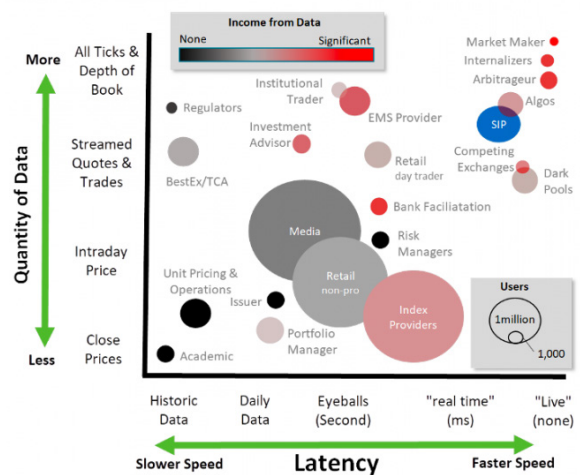
In contrast, our research estimates that ATs earn about \$300 million, if unbundled, in trading revenues, for a combined cost of around \$30 million¹⁰² for the NBBO created by exchanges, while simultaneously reducing competition for public prices and concentrating exchange trading costs for those remaining on exchange.

6.6 Fixed Fees Inefficiently Allocate Utility Across the Market's Varied Participants

In the complex market ecosystem, exchanges are a key cog in supporting the SEC's mission. They stimulate capital formation, create price discovery, and facilitate liquidity.

However, the benefits of exchange products to various businesses are far from equal.¹⁰³

Figure 15: There Are Many Data Options for Many Use Cases



Illustrative purposes only. Size of dots reflects approximate # of users of data (larger = more, smaller = less)
Source: Nasdaq Economic Research

99 Mackintosh, Phil. "Who Is Trading on U.S. Markets?" *Nasdaq*, 28 Jan. 2021, <https://www.nasdaq.com/articles/who-is-trading-on-u.s.-markets-2021-01-28>

100 Mackintosh, Phil. "Three Charts That Show the Importance of a Competitive Bid/Offer NBBO." *Nasdaq*, 4 Dec. 2018, <https://www.nasdaq.com/articles/three-charts-that-show-the-importance-of-a-competitive-bid-offer-nbbo-2018-12-04>

101 Nasdaq Economic Research. "V Is for Volume, and Its Implications for the Access Fee Pilot." *Nasdaq*, 4 Apr. 2019, <https://www.nasdaq.com/articles/v-volume-and-its-implications-access-fee-pilot-2019-04-04>

102 Mackintosh, Phil. "SIP Accounting 101." *Nasdaq*, 25 Mar. 2021, <https://www.nasdaq.com/articles/sip-accounting-101-2021-03-25>

103 Mackintosh, Phil. "What Is Core Data?" *Nasdaq*, 25 Feb. 2021, <https://www.nasdaq.com/articles/what-is-core-data-2021-02-25>

Fees should be set in a way that takes into consideration these differing benefits, and SEC review of fees should reflect the fact that setting fees at different levels to reflect these benefits is not inconsistent with the requirement for fees to be “equitably allocated.” Flat fees that do not take into consideration differing use cases may cause fees to be too high for some classes of consumers, causing them to consume less than would be optimal, while at the same time subsidizing usage for consumers that obtain a high value from the product. Examples of different use cases that should be considered when assessing fees include:

- **Market makers** require their own extensive technology investment, colocation, and proprietary data. They also create a lot of message traffic, but in doing so, create many of the positive externalities from which other investors and issuers benefit.
- **Hedge funds** who trade a lot and make significant profits are able to benefit from sponsored access provided by brokers.¹⁰⁴
- **Human traders** do not benefit from contributing to costs for low-latency technology; 99% of SIP users do not use direct feeds.¹⁰⁵
- **Index providers** earned \$5 billion in revenue in 2021, with only three companies—MSCI, S&P Dow Jones Indices, and FTSE Russell—accounting for more than two-thirds of that revenue.¹⁰⁶ In the case of MSCI, market maker quote data helped its index business earn \$951 million in profit in 2021.¹⁰⁷

6.7 Fees That Vary By User and Usage Are Both Efficient and Fair

As demonstrated above, market participants vary widely with respect to the degree and types of interaction with exchanges, how they use exchange information and services, and the degree to which they capture private benefits from exchange services. Low-latency traders place intense demands on exchanges for low-latency, highly accurate information, while most investors only occasionally demand information at much lower speeds. A few customers place high demand on the exchange; the vast majority do not.

Fees will be most efficient and fair if they vary by use case. Flat fees set according to the most capital-intensive use cases will lead to underutilization by the vast majority of investors, which have no need for low-latency, high-output feeds. Setting fees according to the lightest use cases will lead to underinvestment in low latency products. The way to both finance sufficient investment to meet the needs of power users, as well as the more casual needs of the general investing public is to set fees according to use case.

This is already done for many products. To cite one example, professional subscribers to Nasdaq’s depth of book fees are charged \$76 for display usage, while non-professionals pay a monthly fee of \$15.¹⁰⁸ This type of pricing helps finance the infrastructure investment required for Professionals, and allows for the widespread distribution of financial information to the general investing public, who do not earn wages and commissions from their use of the data.

In fact, the SIP also demonstrates that fees shouldn’t be equal, based on use case.¹⁰⁹ Retail traders get the same data cheaper than professionals, who in turn get the same data cheaper than algorithmic trading firms. This tiered pricing makes economic sense.

Looking at the extreme ends of the spectrum, retail traders, via their broker, are paying a maximum of \$36 per year for the SIP. Algorithmic trading firms, however, pay \$114,000 per year for uncapped use of the SIP. That’s over 3,000 times what retail traders pay per year.

104 *Id.*

105 Mackintosh, Phil. “NMS II: A Strange Way to Fix a Two-Tiered Market.” *Nasdaq*, 18 May 2020, <https://www.nasdaq.com/articles/nms-ii%3A-a-strange-way-to-fix-a-two-tiered-market-2020-05-18>

106 Swink, Sonya. “Index Providers Take Record \$5bn in Revenue in 2021.” *Financial Times*, 24 May 2022, <https://www.ft.com/content/595c3c18-7c13-4e33-9a68-f82f558b7ad6>

107 “Form 10-K.” MSCI, 26 Apr. 2022, <https://ir.msci.com/static-files/c681582e-2a0b-486d-b942-aa38ce59c572>

108 The Nasdaq Stock Market LLC Rules, Equity Rules, Equity 7 (Pricing Schedule), Section 123(b)(2).

109 Mackintosh, Phil. “Equal Is Not Fair.” *Nasdaq*, 30 Nov. 2023, <https://www.nasdaq.com/articles/equal-is-not-fair>

Still, tiered prices are more economically efficient than the same rate for all users because of the value extracted from the SIP by the different groups. A retail trader, trading at human speed, can only extract so much benefit from the SIP. It may not be fair to charge retail traders a flat rate of \$114,000 per year.

In contrast, algorithmic trading firms and off-exchange market makers may trade millions of times per day, make profits of hundreds of millions of dollars, partly based on prices in the SIP. Arguably for those users, the \$114,000 fee per year may be economically insufficient. Our research suggests that, for many, the revenue their platform earns from the SIP is higher than their total costs for market data, even though their trading is predominately off-exchange.¹¹⁰

It's also worth highlighting that, although high-volume traders pay more in total, they pay less than retail traders on a per-use basis.

Under the current pricing structure, even though both groups of users are accessing the same data, they pay very different prices for it. However, those prices better reflect the economic value each group can extract from the same data.

Finally, regulators should consider the economics of the positive externalities created by active market participants. They provide quote data to the rest of the market, keep prices accurate and spreads tight, all of which benefit the market as a whole, including retail traders.

7. Public Markets Create Public Benefits Not Reflected in Exchange Fees

Public markets create public benefits that are not necessarily limited to entities purchasing services directly from an exchange. Knowing whether markets are up or down and what the best prices are at any time helps analysts and advisors allocate assets more profitably for their clients. Constant quoting and trading also lowers the liquidity premium demanded by investors.

A competitive market of actionable quotes available to all also helps protect investors from unreasonable fees and poor executions, thereby improving market efficiency. For example, one study found that, in the US Corporate Bond market, which is far less transparent than the equity market, markups by broker-dealers cost customers \$700 million in one year.¹¹¹

Centralized trading and clearing ensures all can trade at the “best” prices and with minimal settlement frictions.

These benefits accrue without trading, connecting, or in some instances purchasing market data beyond last sale information or quotes for select stocks. By our estimates, improving public spreads by as little as a basis point could save \$2.2 billion in mutual fund shortfall.¹¹² Furthermore, reduced spreads also lower the cost of capital for issuers by \$3.6 billion per basis point, which adds to market valuations and returns.

Consequently, we estimate that promoting on-exchange trading—making bids and offers more competitive and thereby improving public spreads—would increase consumer economic surplus by billions of dollars.

Competitive spreads are also important for issuers, according to research. If you make a stock cheaper to trade, it becomes more attractive to investors.¹¹³

110 Mackintosh, Phil. “SIP Accounting 101.” *Nasdaq*, 25 Mar. 2021, <https://www.nasdaq.com/articles/sip-accounting-101-2021-03-25>

111 Harris, Lawrence. (2015). Transaction Costs, Trade Throughs, and Riskless Principal Trading in Corporate Bond Markets. SSRN Electronic Journal. 10.2139/ssrn.2661801.

112 Mackintosh, Phil. “How Much Does Trading Cost the Buy Side?” *Nasdaq*, 17 Feb. 2022, <https://www.nasdaq.com/articles/how-much-does-trading-cost-the-buy-side>

113 Chen, Honghui & Nguyen, Hoang & Singal, Vijay. (2011). The Information Content of Stock Splits. *Journal of Banking & Finance*. 35. 2454-2467. 10.1016/j.jbankfin.2011.02.005.

That broadening of the investor base, in turn, improves a stock's valuation and reduces the costs of capital for the issuer.^{114,115} In fact, a study in 2009 found that liquidity improvements following stock splits reduced the average companies' cost of equity capital by 17.3%, or 2.4 percentage points per annum.¹¹⁶ Moreover, a 2020 study found that reducing the bid-ask spread by 15.22 bps increased the median U.S. stock value by 69 bps and total U.S. market capitalization by \$54.9 billion.¹¹⁷ Based on this, issuers gain \$3.6 billion per basis point of spread improvement.

We point to the external benefits of public markets to demonstrate that the observed demand for exchange services most likely understates the actual benefits of those services because not all beneficiaries directly purchase from the exchanges. This means that, in assessing whether a specific fee proposal "promote[s] just and equitable principles of trade," prevents "unfair discrimination," provides "reasonable" fees, and prevents "any burden on competition" not necessary to achieve the aforementioned goals, proposals that promote public markets will always be consistent with those principles, as long as nothing in the proposal is directly counter to any of these goals.

8. Conclusion

As we have demonstrated and as the Commission has recognized in the past, the exchange market is competitive. Additionally, exchanges compete as platforms.

If the all-in cost to the user of interacting with an exchange—including the amount of liquidity of the exchange—exceeds market price, customers cease to buy the services of that exchange, and therefore the exchange must adjust one or more of its fees to attract customers. Exchanges are thereby constrained from charging excessive fees for any exchange products, including trading, listings, ports and market data.

This is underscored by the fact that competition has driven explicit and implicit exchange costs to an equilibrium, as evidenced in this paper.

Exchanges, by promoting market transparency, also create public benefits that are not necessarily reflected in the fees generated by competitive markets. New fee proposals that lead to expanded trading in lit markets will generally benefit the market as a whole, provided that nothing in the proposal impairs the competition among the many trading venues available in the market.

Given that the exchange market is competitive and that exchanges compete as platforms, platform competition is the most accurate model of the exchange landscape and should therefore be central to the Commission's economic analysis of exchange fee filings.

The way in which the Commission should integrate platform theory into its economic analysis process is beyond the scope of this paper. However, Nasdaq looks forward to working with the Commission and industry stakeholders in developing a framework to do so.

114 Maloney, Michael & Mulherin, J. (1992). The Effects of Splitting on the Ex: A Microstructure Reconciliation. *Financial Management*. 21. 10.2307/3665840.

115 Mackintosh, Phil. "Stock Splits Save Investors and Issuers." *Nasdaq*, 5 May 2022, <https://www.nasdaq.com/articles/stock-splits-save-investors-and-issuers>

116 Lin, Ji-Chai & Singh, Ajai & Yu, Wen. (2009). Stock splits, trading continuity, and the cost of equity capital. *Journal of Financial Economics*. 93. 474-489. 10.1016/j.jfineco.2008.09.008.

117 Li, Sida & Ye, Mao. (2020). The Tradeoff between Discrete Pricing and Discrete Quantities: Evidence from U.S.-listed Firms. *SSRN Electronic Journal*. 10.2139/ssrn.3763516.

