Complements, Competition, and Exchange Proprietary Data Products

Professor Marc Rysman, Ph.D.

August 13, 2020

Table of Contents

1. QUALIFICATIONS AND ASSIGNMENT

1. My name is Marc Rysman and I am a Professor of Economics at Boston University, where I teach courses on industrial organization, econometrics, antitrust, and regulation. I received my Ph.D. in Economics from the University of Wisconsin at Madison in 1999. My research focuses on industrial organization and competition, and the related issues of antitrust and regulation. I have investigated a variety of industries, including credit ratings agencies, telecommunication, Yellow Pages directories, payment cards, and consumer electronics.

2. From 2009 to 2019, I was a Visiting Scholar at the Federal Reserve Bank of Boston. I have been a Visiting Associate Professor at MIT (2007–2008), a Visiting Scholar at Harvard University (2003–2004, 2014–2015), a Visiting Fellow at Northwestern University (2003), and a Visiting Scholar at the Federal Reserve Bank of Minneapolis (2003).

3. I have won numerous teaching and research awards, including the Neu Family Award for Teaching Excellence in Economics (2006 and 2012), Networks, Electronic Commerce and Telecommunications (NET) Institute Grants (2003, 2005, and 2009), National Science Foundation Grants (2001, 2004, 2006, and 2009), and the Christensen Award in Empirical Economics (1997, with Philip A. Haile, now of Yale University).

4. I have published numerous articles in top peer-reviewed journals in the field of Economics, including in the *American Economic Review*, *Journal of Industrial Economics*, *International Journal of Industrial Organization*, *RAND Journal of Economics*, *Journal of Political Economy*, *Review of Economic Studies*, and the *Journal of Economic Perspectives*. I was an Editor of the *RAND Journal of Economics* during 2014–2020.

5. I was previously asked by the New York Stock Exchange Group ("NYSE Group") to analyze how platform economics applies to stock exchanges' sale of market data products and trading services.[1] I performed an empirical analysis of available data in response to that request, and based on that analysis I concluded, among other things, that stock exchanges are classic examples of platform companies, that there are strong linkages between market data and trading, that the platform nature of stock exchanges means that market data fees cannot be analyzed in isolation without accounting for the competitive dynamics associated with trading services, that competition among equity exchanges is properly understood as being among platforms, and that such platform competition can discipline stock exchanges' overall pricing and profitability.

6. I had undertaken that analysis with a view towards a rule filing with the SEC by NYSE National in support of its establishment of fees for its NYSE National Integrated Feed. In

[1] Rysman, Marc. 2019. "Exchanges as Platforms for Data and Trading." Mimeo ("Rysman Platforms Paper").

response to that filing I understand that Prof. Lawrence Glosten has authored a paper, commissioned by SIFMA, suggesting that platform economics do not discipline the pricing of stock exchange market data products and that such products instead should be viewed as complements allowing for "supra-monopoly" pricing.[2] I have been asked by NYSE Group to submit this response to his paper, which explains the economics of complements as they apply to exchange proprietary data products and points to ways in which Prof. Glosten's reasoning is unsupported and incorrect. I have also been asked to comment on certain aspects of the SEC's request for additional information regarding NYSE National's proposed rule change.[3]

7. NYSE Group provided financial support for this research. I was assisted in my analysis by staff of Cornerstone Research, who worked under my direction.

[2] Glosten, Lawrence R. "Economics of the Stock Exchange Business: Proprietary Market Data." Mimeo, January 2020 ("Glosten Report"). The Glosten Report was attached to the Letter from Robert Toomey, SIFMA to Vanessa Countryman, U.S. Securities and Exchange Commission, "File No. 4–729: SIFMA Comment Letter on Market Data," January 13, 2020.

[3] Request for Information and Additional Comment on a Proposed Rule Change to Establish Fees for the NYSE National Integrated Feed, Release No. 34–89065; File No. SR–NYSENAT–2020–05, U.S. Securities and Exchange Commission, June 12, 2020 ("SEC Request for Information").

2. EXECUTIVE SUMMARY

8. In recent months, it has been suggested that exchange proprietary data products are complements and that this inexorably leads to "supra-competitive" or "supra-monopoly" pricing.[4] This argument is supported by reference to a classic result obtained by French economist Auguste Cournot in the 19th century that monopolist producers of complementary products will set prices for their products above the level that a single joint monopolist would set.[5]

9. This argument is most developed in the Glosten Report, which sets out three conclusions: (a) that exchange proprietary data products are complements; (b) that this complementarity leads to supracompetitive pricing of exchange proprietary data products; and (c) that this complementarity impedes competition for order flow from generating competitive discipline on exchanges' overall platforms, which include data sales.

10. As I show in this paper, the argument that exchange proprietary data products are complements has not been established and is based on incomplete economic logic that contradicts the available empirical evidence. In particular, the Glosten Report fails to define what a complement is and provides no arguments or evidence that convincingly establish that exchange proprietary data products are complements. In Section 3.1, I explain how one would properly define and test for complementarity; in Section 3.2, I explain why the observation that many firms buy proprietary data from all exchanges is not sufficient to show that these products are complements; and in Section 3.3, I present statistics on data purchases by firms trading on NYSE that show that most firms do not buy data from all exchanges.

11. In Section 4.1, I present a simple example of trading firms' financial incentives to purchase exchange proprietary data where these products are substitutes, *not* complements.

---

[4] Glosten Report, pp. 3, 17. This view was also popularized in a blog post by Prof. Craig Pirrong of the University of Houston. Pirrong, Craig. "The Simple (and Very Old) Economics of the Stock Market Data Pricing Controversy." Streetwise Professor, September 20, 2019, https://streetwiseprofessor.com/the-simple-and-very-old-economics-of-the-stock-market-data-pricing-controversy/. The argument was foreshadowed in a 2019 amicus brief submitted by SIFMA that argued that "[t]he most active market participants simply cannot trade competitively, manage the risk of their positions, or effectively satisfy their regulatory obligations to secure the best trades for their clients without purchasing proprietary data from all, or virtually all, of the exchanges. This allows exchanges to reap excessive profits from market data." Brief of Amicus Curiae Investors Exchange LLC in Support of Respondent and Intervenor for Respondent, USCA Case #18-1292 (D.C. Cir.), filed May 13, 2019. The idea also appears in a report filed by Dr. David Evans in his role as expert witness for SIFMA in the litigation that led to the SIFMA circuit court amicus filing, where he asserted that "NASDAQ and NYSE Arca depth-of-book data are complements in the sense that both sources of depth-of-book data are more valuable together" and "[p]roducers could sell more collectively if they lowered their prices because each of their products would become more valuable if the prices of complementary products were also lower." Expert Report of Dr. David Evans, *In the Matter of the Application of Securities Industry and Financial Markets Association for Review of Actions Taken by Self-Regulatory Organizations*, Administrative Proceeding File No. 3–15350, March 6, 2015, ¶ 29 and fn 19.

[5] Cournot, Antoine Augustin. 1897. *Researches into the Mathematical Principles of the Theory of Wealth*. London: Macmillan, & Co., pp. 99–116.

That is, the value of data from NYSE (for instance) is greater if the purchaser does not already have data from NASDAQ than if it does (i.e., there are decreasing marginal returns to purchases of data from different exchanges). As I explain in Section 4.2, this insight is strengthened by the fact that the information conveyed by exchange proprietary data, particularly depth-of-book data of the type included in the NYSE National Integrated Feed, is likely to be correlated across exchanges. In Section 4.3, I adapt the example slightly to consider the specific economics of arbitrage trading across exchanges. Even in cross-exchange arbitrage trading, data from a third exchange is not a complement to data from the first two.

12. In Section 5, I clarify technical terminology that appears in the Glosten Report. First, Prof. Glosten's use of the term "monopolistic competition" is puzzling – monopolistic competition implies free entry of firms and zero profits to producers. It is true that there has been a recent increase in the number of lit and unlit trading centers, and a decrease in concentration among exchanges. However, Prof. Glosten's discussion of exchanges' pricing of proprietary data products emphasizes strategic pricing incentives and not free entry, and thus seems as odds with concept of monopolistic competition.

13. Second, Prof. Glosten's assertion that "platform competition" is not a helpful framework for understanding the pricing of exchange proprietary data products is unsupported. Contrary to Prof. Glosten's depiction, the fact that data purchases are made on a monthly or longer basis while order routing decisions are made at high frequencies does not rule out important links between the two. In previous research (which Prof. Glosten does not engage with), I have provided both conceptual and empirical evidence that the linkages are relevant.[6] Moreover, his argument that the linkage is broken because firms require data from all exchanges is contradicted by statistics on purchases of proprietary data products that I report in Section 3.3.

14. Section 6 takes on two separate questions that arose in the context of the SEC Request for Information. First, I explain that the conclusion that all "sides" of a platform must be analyzed jointly in order to evaluate pricing and competition does not depend on the size of a particular platform. In any case, NYSE Group's share of U.S. equities trading is below thresholds considered indicative of substantial market power. Second, I note that economists are generally wary of using accounting measures of profitability, such as those requested by the SEC, to evaluate competition.

[6] Rysman Platforms Paper.

3. COMPLEMENTS, COMPETITION, AND PURCHASES OF PROPRIETARY DATA PRODUCTS

15. In this section, I set the stage by providing a rigorous and testable definition of complementarity (Section 3.1), I explain why observing that many firms purchase all available data products would not imply that they are complements (Section 3.2), and I show empirically that most firms do not purchase all available data products from all exchanges (Section 3.3).

3.1. What are complements and how would one test for complementarity?

16. A standard definition of complements is "two goods for which an increase in the price of one leads to a decrease in demand for the other."[7] Consider the effects of a price decrease for one good in the presence of complements. A standard result is that consumers would buy more of that good.[8] This price decrease would also increase demand for the complementary good; this means that consumers would be willing to pay more for it and would be willing to buy more of it at the same price.

17. Textbook examples of complements include computers and software and ice cream and fudge sauce, goods that are typically used together and where one enhances the value of the other.[9] Some complements are only ever used together, like right and left shoes; these are known as "perfect complements."[10]

18. Goods for which the relationship is reversed, so that an increase in the price of one leads to an *increase* in the demand for the other, are substitutes. Classic examples of substitutes are goods that satisfy similar needs, like ice cream and frozen yogurt or sweaters and sweatshirts.[11] While such substitute products can be used in place of each other, consumers often purchase several of them – most people own both sweaters and sweatshirts.

19. The notion of complements can be applied to exchange proprietary data products. Data from different exchanges, for instance, would be complements *if* an increase in the price of one led to a *decrease* in the demand for the other (and vice-versa). Prof. Glosten does not engage with this notion – he has not empirically tested, or even directly argued, that this

[7] Mankiw, N. Gregory. 2012. *Principles of Macroeconomics*. Mason: Cengage Learning, p. 70.

[8] The "law of demand" states that demand curves are downward sloping, so that a decrease in price leads to a higher quantity being demanded. *See*, Mankiw, N. Gregory. 2012. *Principles of Macroeconomics*. Mason: Cengage Learning, p. 67.

[9] Mankiw, N. Gregory. 2012. *Principles of Macroeconomics*. Mason: Cengage Learning, p. 70.

[10] Besanko, A. David and Ronald R. Braeutigam. 2011. *Microeconomics*. John Wiley & Sons Inc., p. 93.

[11] Mankiw, N. Gregory. 2012. *Principles of Macroeconomics*. Mason: Cengage Learning, p. 70.

definition of complements actually applies to any specific exchange data products.[12] For example, he does not test whether an increase in the price of any specific exchange proprietary data product has led to a decrease in the demand for another exchange's proprietary data product.

20. A closely related definition of complementarity is that two goods are considered complements if the incremental value of consuming one good is greater when the other good is being consumed than when it is not.[13] In other words, the benefit of consuming both goods together is greater than the sum of the benefits of consuming each separately. Thus, the question of whether exchange proprietary data products are complements can be boiled down to whether the purchase of one exchange proprietary data product would generate more incremental profits to *the purchaser* if it already subscribed to another proprietary data feed than if it did not.[14] That is, if proprietary data products from different exchanges were complements, NYSE's proprietary data would be worth more to its buyer (whether the buyer is a trading firm, a broker, an alternative trading system ("ATS") or dark pool operator, or a redistributor) when the buyer also purchases NASDAQ proprietary data than when it does not.

21. In Section 1 of his submission, Prof. Glosten provides several examples of how purchasers of exchange proprietary data use that data, and argues that subscribing to proprietary data from more or all exchanges can increase profits. However, most products, including substitutes, provide increasing value as consumers accumulate more of them.[15] That does not establish that products are complements. To be a complement, adding a data product must provide *more value* than the previous products. Prof. Glosten's arguments do not make this case or engage with this concept. In Section 4, I develop a simple example in

[12] Prof. Glosten's claim that "NYSE data become more useful when combined with NASDAQ data and vice versa" relies on the definition of complements, but he does not test whether any specific products are in fact complements and he does not explain why this should be the case in any detail. In Section 4, I provide an example in which this is *not* the case. *See,* Glosten Report, p. 2.

[13] For a discussion of the relationship between the two definitions, see Samuelson, Paul A. 1974. "Complementarity: An Essay on the 40th Anniversary of the Hicks-Allen Revolution in Demand Theory." *Journal of Economic Literature*, 12(4): 1255-1289. Samuelson refers to the definition of complementarity in terms of marginal returns as the "Edgeworth-Pareto" definition. Samuelson shows that the definitions can differ if there are important income effects or risk aversion, but those are typically unimportant when the consumers are large firms (which is sometimes, but not always, the case for proprietary market data subscriptions). A well-known paper on complements that uses the Edgeworth-Pareto definition of complements is Gentzkow, Matthew. 2007. "Valuing New Goods in a Model with Complementarity: Online Newspapers." *American Economic Review*, 97(3): 713-744.

[14] In this sense, proprietary market data purchasers' demand functions can be derived from their profit functions, where data products are inputs to their production functions. In this context, inputs are complements if the mixed partial derivative of the production function is positive: if the marginal product of a unit of good A is greater the greater the number of units of good B being used, then inputs A and B are considered complements. *See*, Milgrom, Paul and Chris Shannon. 1994. "Monotone Comparative Statics." *Econometrica*, 62(1): 157–180, p. 172.

[15] For example, automobiles are substitutes, but most consumers would experience an increase in utility if they had another automobile. The additional utility from going from two to three cars is less than going from zero to one or from one to two, but still positive. That is, automobiles provide decreasing returns.

which it is in fact *not* the case. In my example, additional data from different exchanges generate decreasing marginal returns rather than increasing marginal returns, so that exchange proprietary data products are not complements.

3.2. Competition, not complementarity, drives some firms to purchase multiple proprietary data products

22. Products that are purchased together are not necessarily complements. One of Prof. Glosten's arguments that exchange proprietary data products are complements is that "[i]t is very likely that there are many exchange member firms and others that obtain proprietary data from all exchanges."[16] As an initial matter, Prof. Glosten provides no empirical evidence for his statement. But even if true, this would not establish that exchange proprietary data products are complements. It may simply be that the value of proprietary data to those who choose to buy it is high relative to its price. Similarly, it may be a consequence of competition among proprietary data purchasers pushing them to deliver higher quality. Moreover, as I document in Section 3.3, Prof. Glosten's premise is not true empirically – most large trading firms do not purchase proprietary data from all, or even most, exchanges.

23. Some market participants have argued that they must purchase the most sophisticated and complete data feeds from all exchanges in order to be competitive. For example, Doug Cifu, co-founder and chief executive officer of Virtu Financial, has stated that "[w]ithout proprietary data feeds, there's not a firm today, either as a market maker or an institutional agency broker or prop trading firm that can exist. It's just that simple."[17] Prof. Glosten also highlights remarks by Mehmet Kinak, Vice President and Global Head of Systematic Trading and Market Structure at T. Rowe Price, that "[i]f a broker is routing using SIP data, they're not routing my flow. They can route someone else's but they're not eligible to get my flow, period. That's not negotiable."[18]

24. An observation that some buyers purchase all available products, even if true, does not imply that those products are complements. As an example, blueberries and strawberries are substitutes – they satisfy similar desires, and an increase in the price of strawberries would

[16] Glosten Report, p. 3.

[17] "Roundtable on Market Data Products, Market Access Services, and Their Associated Fees," U.S. Securities and Exchange Commission, October 25, 2018, p. 58. Similarly, Simon Emrich, head of market structure strategies at Norges Bank Investment Management, asserted that "brokers can't really be competitive for our sort of trading just using the SIP. They need to have the full depth of book. We depend on them to slice up our orders and trade them over time. We need them to have a full view of the market, not just the top of the book." *See*, "Roundtable on Market Data Products, Market Access Services, and Their Associated Fees," U.S. Securities and Exchange Commission, October 25, 2018, p. 136.

[18] Glosten Report, p. 4. The full quote is "as far as brokers having a choice of whether or not they can use the SIP or direct feeds, that doesn't exist. There is no choice there. If a broker is routing using SIP data, they are not routing my flow." *See*, "Roundtable on Market Data Products, Market Access Services, and Their Associated Fees," U.S. Securities and Exchange Commission, October 25, 2018, p. 65.

reasonably be expected to lead to a decrease in the demand for strawberries and a related increase in the demand for blueberries, both by consumers and the restaurants that serve them. In a market with a single restaurant, the restaurant might offer a parfait with either strawberries or blueberries, whichever happened to have the lowest cost at that moment. However, in a market with several restaurants, they may offer parfaits with both strawberries and blueberries because, although they would have a higher cost, they might be preferred by many patrons and help the restaurant attract clients. In this case, it is competition that drives restaurants to offer both options, but they are still substitutes, not complements, as a higher price of one leads to overall higher demand for the other.

25. Purchasers of proprietary data products are subject to a similar dynamic. For example, large brokerage houses compete to offer their clients high quality execution services. In a world with a single broker, it may minimize its costs and maximize its profits by subscribing only to the SIP, or choose to supplement this with proprietary data products from one or two of the most prominent exchanges. But competition among brokers can drive them to offer higher quality execution services and, to this end, to purchase proprietary data from more exchanges than they might otherwise have chosen to subscribe to, even though those data products deliver decreasing marginal returns in creating trading opportunities (i.e., each additional data product enables the broker to improve execution by a decreasing amount).

26. Similarly, proprietary traders compete to identify and take advantage of profitable trading opportunities. In a world with a single proprietary trading firm, the firm might choose to maximize its profits by focusing on the most easily identifiable and highest return trading strategies, which might require only limited proprietary data from exchanges. But in a world with intense competition among proprietary traders, they may be driven to invest in gaining an edge over their peers, possibly by purchasing more of the data products offered by exchanges.[19]

27. In Cournot's model of complements, the buyer must purchase all available complements in order to derive any benefit, a property which derives from the ways in which the complements can be used. Cournot motivates his presentation with the example of copper and zinc, which he assumes can be used only to produce brass.[20] In that restricted setting, the observation that brass producers purchase both copper and zinc to make brass springs directly from the complementarity of these inputs.

28. But this "perfect complements" setup does not apply to the case of exchange proprietary data products. As I show in Section 3.3, these sources of data can be and are used separately

[19] I provide further discussion regarding this in Section 4.3.

[20] Cournot, Antoine Augustin. 1897. *Researches into the Mathematical Principles of the Theory of Wealth*. London: Macmillan & Co., pp. 99–100.

(i.e., most firms subscribe to some but not all proprietary data products). Any argument that exchange proprietary data products are complements must therefore explain how and why this complementarity arises, and provide empirical support for it. Additional explanation would also be required to show that the "Cournot complements" result would hold in such a setting, which would differ from the traditional setup in important ways. Market outcomes in situations that depart from Cournot's model of monopolist suppliers of complements can be complex and vary according to the particulars of demand for the products, the nature of product differentiation, and market structure.[21]

3.3. Most firms do not purchase data from all exchanges

29. The premise that most large trading firms purchase proprietary data from all (or even most) exchanges is simply not accurate. Empirically, most firms do not purchase all proprietary data products from one exchange or from all exchanges. I explore this question with data available to me on the proprietary data purchases of firms that traded on NYSE. This is a small group of large trading firms. I limit my attention to four NYSE Group exchanges: NYSE, NYSE Arca, NYSE National, and NYSE American.[22] I also limit attention to three prominent proprietary data products: BBO, depth-of-book, and integrated feeds. The tables below present information for December 2018 and June 2020.

30. Table 1 looks at firms' purchases of proprietary data across NYSE Group exchanges. In this table, I count the purchase of any of the proprietary data products I focus on as a purchase of proprietary data by the account in question. For example, if a firm purchased BBO data from NYSE Arca and American, and NYSE IF from NYSE, it would count as a firm that purchased proprietary data from all three of these exchanges. I find that only 26.2% (in December 2018) and 33.0% (in June 2020) of firms purchased proprietary data from all four NYSE Group exchanges. Notably, of the firms analyzed, 14.6% of them in December 2018 and 12.8% of them in June 2020 did not purchase any of these proprietary data products from any of the four NYSE Group exchanges. In both December 2018 and June 2020, only about a third of firms purchased at least one of these proprietary data products from each of Arca, NYSE, and American.

[21] For examples of research generalizing Cournot's result to specific sets of circumstances, *see*, Economides, Nicholas, and Steven C. Salop. 1992. "Competition and Integration among Complements, and Network Market Structure." *The Journal of Industrial Economics* 40(1): 105–123; Quint, Daniel. 2014. "Imperfect Competition with Complements and Substitutes." *Journal of Economic Theory* 152: 266–290.

[22] The data does not cover the NYSE Chicago exchange.

TABLE 1
Data Product Purchases Across Exchanges by Firms That Traded on NYSE in December 2018 or June 2020

	Proportion of Firms	
Subscriptions	**December 2018**	**June 2020**
Arca Only	3.9%	3.2%
NYSE Only	2.9%	4.3%
American Only	0.0%	0.0%
National Only	0.0%	0.0%
Arca and NYSE	11.7%	7.4%
Arca, NYSE, and American	35.0%	33.0%
Arca, NYSE, American, and National	26.2%	33.0%
Arca, NYSE, and National	1.9%	2.1%
Arca, American, and National	0.0%	0.0%
Arca and American	1.9%	1.1%
Arca and National	0.0%	1.1%
NYSE and American	1.9%	2.1%
NYSE and National	0.0%	0.0%
NYSE, American, and National	0.0%	0.0%
American and National	0.0%	0.0%
No NYSE Group Data Purchases	14.6%	12.8%

Source: NYSE

Note: Proportion of firms that subscribed to data products from each combination of exchanges is calculated as the number of firms that traded on NYSE and subscribed to either a depth-of-book, integrated feed, or BBO product from each of the exchanges in that unique combination of exchanges in December 2018 or June 2020 divided by the total number of firms that had traded on NYSE in December 2018 or June 2020, respectively.

31. Next, I look at purchases of integrated feed products across exchanges. More than half of the firms that traded on NYSE (59.6%) did not subscribe to any of the four NYSE Group exchanges' integrated feed products in June 2020. In December 2018, 66.0% of firms that traded on NYSE did not subscribe to any of the four NYSE Group exchanges' integrated feed products. Less than a fifth of firms (14.6% in December 2018 and 19.1% in June 2020) subscribed to integrated feed data from all four NYSE Group exchanges. Notably, most of the firms that subscribed to an integrated feed product in June 2020 subscribed to NYSE National Integrated Feed (81.7% of firms subscribing to an integrated feed product), which was offered free of charge.[23]

[23] On February 3, 2020, NYSE National, Inc. filed with the SEC a proposed rule change to establish fees for the NYSE National Integrated Feed. The proposed rule change became effective on the day of filing but was temporarily suspended by the SEC on April 1, 2020. *See,* "Notice of Filing and Immediate Effectiveness of Proposed Rule Change to Establish Fees for the NYSE National Integrated Feed," Release No. 34-88211; File No. SR-NYSENAT-2020-05, U.S. Securities and Exchange Commission, February 14, 2020; "Suspension of and Order Instituting Proceedings To Determine Whether To Approve or Disapprove a Proposed Rule Change To Establish Fees for the NYSE National

TABLE 2
Integrated Feed Purchases Across Exchanges by Firms That Traded on NYSE in December 2018 or June 2020

	Proportion of Firms	
Integrated Feed Subscriptions	**December 2018**	**June 2020**
Arca Only	1.0%	3.2%
NYSE Only	0.0%	0.0%
American Only	1.9%	1.1%
National Only	2.9%	4.3%
Arca and NYSE	1.0%	1.1%
Arca, NYSE, and American	2.9%	2.1%
Arca, NYSE, American, and National	14.6%	19.1%
Arca, NYSE, and National	3.9%	4.3%
Arca, American, and National	1.9%	1.1%
Arca and American	0.0%	0.0%
Arca and National	2.9%	2.1%
NYSE and American	0.0%	0.0%
NYSE and National	0.0%	0.0%
NYSE, American, and National	0.0%	0.0%
American and National	1.0%	2.1%
No NYSE Group Integrated Feed Purchases	66.0%	59.6%

Source: NYSE

Note: Proportion of firms that subscribed to an integrated feed product from each combination of exchanges is calculated as the number of firms that traded on NYSE and subscribed to an integrated feed product from each of the exchanges in that unique combination of exchanges in December 2018 or June 2020 divided by the total number of firms that traded on NYSE in December 2018 or June 2020, respectively.

32. Although this analysis is limited to four NYSE Group Exchanges, I see no reason why my conclusions would not extend to other exchanges. The data is clear: most firms, even the select set of large firms trading on NYSE, did not purchase all proprietary data products from all exchanges.

33. Although the statistics I present are for firms that trade on NYSE, it appears the same is true for another class of data purchasers: ATS. Prof. Glosten references his own research that finds substantial heterogeneity in how many data products different ATS subscribe to, with about a third relying only on the SIP, some using proprietary data from some but not all exchanges, and others purchasing proprietary data from all exchanges.[24]

34. Information provided by NYSE Group in response to the SEC's Request for Information further confirms that firms need not purchase all proprietary data from all exchanges. I

Integrated Feed," Release No. 34–88538; File No. SR– NYSENAT–2020–05, U.S. Securities and Exchange Commission, April 7, 2020.

[24] Glosten Report, fn 13.

understand that eight firms that subscribed to NYSE National Integrated Feed threatened to cancel their subscriptions once fees were announced, and six of these firms followed through and cancelled their subscriptions. One of the firms that cancelled its subscription to NYSE National Integrated Feed is a large global bank, the sort of large broker-dealer that Prof. Glosten portrays as requiring all exchange proprietary data. This is consistent with exchange proprietary data being substitutes and inconsistent with Prof. Glosten's depiction of a market where all firms must purchase all proprietary data.

4. SIMPLE EXAMPLES OF THE USES OF EXCHANGE PROPRIETARY DATA SUGGEST THAT THEY ARE SUBSTITUTES, NOT COMPLEMENTS

35. An assessment of the motivations that purchasers of exchange proprietary data have for acquiring these data suggests that exchange proprietary data products are substitutes, not complements. To make this point, I develop simple examples of the impact that purchasing proprietary data products can have on traders' profits. As I explain in Section 3, proprietary data products are complements if the demand for one is greater when the trader has purchased the other than when it has not. In the case of trading firms, the demand for data products is driven by the additional profits that they would generate. As I will show in a simple and intuitive example, purchasing proprietary data products from several exchanges has decreasing marginal returns, not increasing marginal returns for the trading firms that purchase the data. The incremental profits of purchasing additional proprietary data products are lower when the trader has already purchased other proprietary data, suggesting that exchanges' proprietary data products are not complements.

36. To focus the discussion and keep my examples as simple as possible, my examples will illustrate the use and properties of exchange proprietary depth-of-book data products. Throughout, I assume that traders have access to the consolidated data feed or SIP, so that they have full information about top-of-book prices and quantities available.[25] For simplicity, I also restrict the trader in my example to using market orders.[26]

37. The examples I present use the simplest framework possible to capture the features that I consider most important for understanding whether exchange proprietary data products are complements in some of the most common applications.[27] I am not attempting to show that proprietary data feeds can never be complements for specific customers pursuing particular business models. A more general point is that understanding whether exchange

[25] Consolidated feed data are assembled by the SIPs, which aggregate data from all exchanges to provide (1) last sale reports, including the price and amount of the latest sale of a security and the exchange where it took place; and (2) best bid and best offer (also known as *top of book*) price quote information across all exchanges. The best bid and offer information reported by the SIPs is limited to "round lots," which for most stocks means orders for blocks with multiples of 100 shares; the consolidated feeds do not report "odd lot" quotes of less than 100 shares. SIP data services collect the required data from each stock exchange and distribute it to subscribers for a fee. By regulation, exchanges must supply the necessary data to the SIP no later than they distribute the data to their proprietary data customers. *See,* "Self-Regulatory Organizations; NYSE Arca, Inc.; Order Setting Aside Action by Delegated Authority and Approving Proposed Rule Change Relating to NYSE Arca Data," Securities Act Release No. 34–59039, December 2, 2008, p. 4.

[26] A version of the example in Section 4.1 that allows for the trader to use limit orders leads to the same conclusion, that exchange proprietary data products are not complements.

[27] These may differ somewhat from the set of features needed to understand other questions about exchanges' proprietary data. For example, in other work focused on the linkages between data and trading, modeling routing delay was important. *See*, Rysman Platforms Paper, pp. 15–17. I abstract from routing delay here, but the example I present can be extended to include routing delay and thereby highlight how access to proprietary data from an exchange can drive a trader to direct order flow to that exchange without changing my conclusion that exchange proprietary data products are not complements.

proprietary data products are complements or not requires careful analysis of the sort that neither Prof. Glosten nor others have provided.

4.1. A simple example showing that depth-of-book data from different exchanges are substitutes, not complements

38. To begin with, suppose there is a single exchange. Assume a buyer is looking to buy 200 shares. The buyer believes it can profit from purchases of these shares if it can acquire them at a price below $21; I refer to this as the buyer's "reservation price."[28] If the buyer does not purchase a depth-of-book data feed, it sees only the top of the book. Suppose it sees that 100 shares are being offered for sale for $19 – this is the top of book offer price. There is another block of 100 shares behind the first, offered at a higher price. For simplicity, let us assume that the price of this block of shares may be either $20 or $25, but the buyer does not know which. I assume these two possibilities are equally likely. Of course, in reality, there is a whole distribution of possible values that this block could take on, but we keep things simple to illustrate my point.

39. Thus, if the buyer submits an order for 200 shares, it will purchase the first 100 at $19. In what follows, we ignore this element of the purchase and focus on the second set of 100 shares. These 100 shares have a 50% chance of transacting at $20 and a 50% chance of transacting at $25. Thus, the expected cost to the buyer is $22.50. The buyer will choose not to purchase at this price, which would be higher than its reservation price. Thus, it will not submit the order for the second set of 100 shares.

40. Suppose now that the buyer subscribes to a depth-of-book data feed and thus knows the order that stands behind the top-of-book order. If the buyer knew that the next offer was $20, the buyer would buy at $20. Thus, the buyer's profit would be ($21 - $20) × 100 = $100. If the buyer knew that the next offer was $25, it would choose not to buy. Thus, with a depth-of-book data subscription, the buyer has an increase in expected profit of $50 (that is, $100 × 50%).

41. In order to study the question of whether depth-of-book data from different exchanges are complements, suppose that there are two exchanges, A and B, with identical situations. Both have top-of-book offers of 100 shares for $19, with offers behind those of $20 or $25 with equal probability.[29] For these purposes, assume the buyer would like to purchase up to

[28] The example can be extended to other reservation prices. For most ranges of reservation prices, the conclusion that the data products are not complements holds.

[29] For simplicity, I assume that these probabilities are independent. That is, that the probability that the second level price on Exchange B is $20 does not depend on the second level price on Exchange A (and vice-versa). In Section 4.2, I discuss how relaxing this artificial simplifying assumption strengthens the conclusion that depth-of-data products from different exchanges are not complements.

300 shares at a price below $21. Thus, the buyer will buy the first 100 shares from each exchange, but faces a question about whether to purchase the third lot of 100 shares.

42. If the buyer does not have any depth-of-book data subscriptions, the buyer's only decision is whether to submit an order for 100 shares to one of the two exchanges. There is a 50% chance that the second offer at Exchange A is for $20, and then the buyer will purchase at that price. If the second offer at A is $25, Exchange A will query Exchange B to see if it has a better price.[30] In this case, there is a 50% chance that the second offer at Exchange B will be for $20, and the buyer will obtain the lot for $20. However, if the level 2 offer at Exchange B also has a price of $25, the buyer will pay $25 for the third lot. Thus, the expected cost for the third lot is: $(0.5 \times 20) + (0.5 \times 0.5 \times 20) + (0.5 \times 0.5 \times 25) = \$21.25$. The buyer will not submit the order for the third lot of 100 shares, and will make zero profit on those shares.[31]

43. Suppose the buyer has a depth-of-book data subscription to Exchange A but not Exchange B. The buyer will know if the second offer at Exchange A is $20 or $25. If the second offer is $20, then the buyer will submit the order for 300 shares. On the third lot, it will buy at $20, and make profits of $100.

44. If it sees that the second order at Exchange A is at $25, then the buyer faces a 50% chance of obtaining a price of $20 at Exchange B and a 50% chance of paying $25. Thus, it faces an expected price of $22.50. The buyer will not submit an order in this case. Thus, with a depth-of-book data feed, the buyer has a 50% of earning $100 and a 50% chance of earning zero on the third lot, for an expected payoff of $50. Subscribing to depth-of-book data from one exchange raises the buyer's expected payoff by $50.

45. Now suppose the buyer has a depth-of-book data subscription for both exchanges. The buyer knows the second order at each exchange. If it sees a price of $20 at either exchange, it

---

[30] Exchange A may do this in observance of the Order Protection Rule. Alternatively, it could reject the order. The Order Protection Rule simply prevents the exchange from executing the order at any price worse than what is available at top-of-book on other exchanges. *See*, "Concept Release on Equity Market Structure," U.S. Securities and Exchange Commission, Release No. 34–61358, January 14, 2010, pp. 26–27 ("Another important type of linkage in the current market structure is the protection against trade-throughs provided by Rule 611 of Regulation NMS. A trade-through is the execution of a trade at a price inferior to a protected quotation for an NMS stock. A protected quotation … must be an automated quotation that is the best bid or best offer of an exchange or FINRA. Importantly, Rule 611 applies to all trading centers, not just those that display protected quotations. Trading center is defined broadly in Rule 600(b)(78) to include, among others, all exchanges, all ATSs (including ECNs and dark pools), all OTC market makers, and any other broker-dealer that executes orders internally, whether as agent or principal … Rule 611 also helps promote linkages among trading centers by encouraging them, when they do not have available trading interest at the best price, to route marketable orders to a trading center that is displaying the best price. Although Rule 611 does not directly require such routing services (a trading center can, for example, cancel and return an order when it does not have the best price), competitive factors have led many trading centers to offer routing services to their customers.").

[31] I describe which exchange the buyer uses, but in this example, it does not matter. The payoff to the buyer is the same regardless of which exchange it submits any orders to.

will submit an order and earn $100 on the third lot. If it sees a second price of $25 at both exchanges, it will not submit. This latter outcome has a 25% chance. Thus, the buyer's expected payoff on the third lot is $75.

46. Thus, having the depth-of-book data subscription for one exchange increases the expected payoff to the buyer by $50 relative to having no subscriptions to depth-of-book data. Having depth-of-book data subscriptions for both exchanges raises the buyer's expected payoff by another $25 to $75. Per the definition of complements that I gave in Section 3.1 above, depth-of-book data from Exchanges A and B would be complements if the sum of the incremental values of subscribing to each without subscribing to the other (here $50 + $50 = $100) were less than the value of subscribing to both (here $75). However, the opposite is true here ($50 + $50 > $75), so depth-of-book data from Exchanges A and B are substitutes, not complements.

4.2. Correlation of information across exchanges strengthens the conclusion that exchanges' data products are not complements

47. Note that I have made an important assumption that biases the above model *in favor of* finding that proprietary data feeds are complements. Implicitly, I have assumed that the orders behind the top-of-book at the two exchanges are uncorrelated. In practice, available liquidity is likely to be correlated across exchanges.[32] If the second order at Exchange A is for $25, then it is more likely that the second order at Exchange B is $25 rather than $20. If that is the case, then the additional value of data at the second exchange is even lower, because the buyer can use information from the first exchange to infer the order book at the second exchange. As an extreme example, suppose the two order books were perfectly correlated, so that if the second order at Exchange A is $25, then the second order at Exchange B is also $25. In that case, subscribing to depth-of-book data from the second exchange provides literally no incremental value at all.[33]

48. The demand and supply of liquidity is likely to be correlated across exchanges because some traders monitor developments and submit orders to several exchanges. For instance, market makers may monitor developments across exchanges and modify or cancel their limit orders on all exchanges as their views about a stock's fundamental value or market trends

[32] Van Kervel, Vincent. 2015. "Competition for Order Flow with Fast and Slow Traders." *The Review of Financial Studies* 28(7): 2094–2127.

[33] It is worth noting that even if the order books are negatively correlated, the marginal value of subscribing to depth-of-book data from both exchanges is reduced. The marginal value of data for the second exchange over the first is maximized with respect to this issue in the case of zero correlation, the case I consider in my example above.

evolve.[34] Similarly, traders seeking immediate execution may route their orders to several exchanges depending on the liquidity available on each.[35]

4.3. Arbitrage strategies do not imply that data from all exchanges are complements

49. We sometimes hear that data products are complements for proprietary traders that employ arbitrage strategies that profit from discrepancies in prices across exchanges.[36] The argument is that such traders need data from multiple exchanges in order to identify arbitrage opportunities; data from one exchange generates no value for such traders, but data from two or more exchanges enables them to identify profitable trading opportunities.

50. My example can be used to assess this claim and show that proprietary data subscriptions for all exchanges are not necessarily complements. The reservation price in my example is $21, but I remain agnostic about where it comes from. One possibility is that it comes from an arbitrage strategy that relies on trading across multiple exchanges from which proprietary market data is critical. To think about this, suppose the price of $21 comes from some Exchange C from which the buyer subscribes to proprietary data. Then, the model above can be seen as an analysis of value from subscribing to depth-of-book data from one or two more exchanges, in addition to Exchange C. The implication of the model is then that, even if an arbitrage strategy leads a firm to subscribe to depth-of-book data across multiple exchanges, the incremental value is not necessarily increasing in the number of exchanges, and subscriptions for all exchanges are not necessarily complements.

51. In this example, depth-of-book data products are complements for arbitrageurs across some but not all exchanges. Cournot's result leading to supracompetitive pricing of complements does not apply to environments with multiple products and complementarities only in the purchase of the first two. Market outcomes in situations that depart from Cournot's simple model of two monopolist suppliers of perfect complements can be complex and vary according to the particulars of demand for the products, the nature of product differentiation, and market structure.[37]

---

[34] Van Kervel, Vincent. 2015. "Competition for Order Flow with Fast and Slow Traders." *The Review of Financial Studies* 28(7): 2094–2127, pp. 2094–2095.

[35] Van Kervel, Vincent. 2015. "Competition for Order Flow with Fast and Slow Traders." *The Review of Financial Studies* 28(7): 2094–2127, p. 2098.

[36] Glosten Report, p. 5. ("[Proprietary traders] are perhaps the second most significant exchange data purchasers. To the extent that these traders are engaged in cross-market (approximate) arbitrage it is obvious that their demand is for the entire data package since the arbitrage requires knowing bids and offers in all lit trading venues. And, again, demand for the data depends upon the price of the entire package not the individual prices charged by the exchanges.")

[37] For examples of research generalizing Cournot's result to specific sets of circumstances, *see*, Economides, Nicholas, and Steven C. Salop. 1992. "Competition and Integration among Complements, and Network Market Structure." *The*

52. Even if one group of consumers views products as complements, products can still be substitutes in the sense of overall demand, and it is overall demand that determines pricing strategy as predicted by the Cournot model. In particular, even if exchanges' proprietary data products are complements in this limited sense for traders that rely on arbitrage strategies, that does not imply that such data products are complements in terms of the overall demand for these products or that these products will be priced at supracompetitive levels. Arbitrage trading is only one example of the trading strategies that proprietary traders may use, and proprietary traders are only one of several group of purchasers of these data products.[38] Therefore, overall demand for exchanges' proprietary data is unlikely to mirror exactly the particular economics of data use for arbitrage trading.

Journal of Industrial Economics 40(1): 105–123; Quint, Daniel. 2014. "Imperfect Competition with Complements and Substitutes." *Journal of Economic Theory* 152: 266–290.

[38] Prof. Glosten asserts that proprietary traders are the second most prominent purchasers of data products, after brokers. *See,* Glosten Report, pp. 4–5.

5. FURTHER CLARIFICATIONS TO PROF. GLOSTEN'S REPORT

53. The Glosten Report introduces terminology used by economists without providing definitions or explanations of how they apply to the sale of exchanges' proprietary data products. In this section, I set out to fill some of the most prominent of these gaps.

54. Putting aside the question of whether exchange proprietary data products are complements, Prof. Glosten's explanation of the economics of firms' decisions to purchase data seems incomplete. He asserts that, if data products are complements, firms are concerned only with the total cost of purchasing data from all exchanges, not with their individual and relative prices.[39] This is true only in the extreme case of perfect complements, such as left and right shoes, where one good is useless without the other.[40] For example, although peanut butter and jelly are complements and typically consumed together, a large spike in the price of peanut butter would likely lead many households to reduce the amount of peanut butter they use relative to jelly. In the same way, one would expect purchasers of exchange proprietary data to react to the relative prices of these products, even if they were complements. Prof. Glosten does not address this issue at all, let alone empirically.

55. Prof. Glosten characterizes "the industrial organization of the proprietary data market" as "monopolistic competition" but does not provide a definition of this term.[41] The monopolistic competition framework used by economists has the following key features: "(a) The products sold are differentiated; (b) Firms themselves set the price of these goods; (c) The number of sellers is large and each firm disregards the effects of its price decisions on the actions of its competitors; (d) Entry is unrestricted and proceeds until profits are reduced to zero or the smallest possible number consistent with the fact that the number of firms is an integer."[42] A widely used textbook summarizes: "the monopolistic competition

[39] Glosten Report, p. 2 ("The decision to purchase data is driven by the price of all data because the exchanges' proprietary market data are complements."). *See also*, Glosten Report, p. 14 ("If NYSE Arca reduces its net fees to trade on its exchange, it may reasonably expect an increase in volume. And this increase in volume may well make NYSE Arca data more valuable. This is not likely to increase its sales of data or have an impact on its price, however, since its increase in volume will likely come from a decrease in volume elsewhere leaving the over-all effect on the value of all exchange data largely unchanged.").

[40] Note that Cournot proved his result only for the case of perfect complements: "[t]o proceed systematically, from the simple to the complex, we will imagine two commodities, (a) and (b), which have no other use beyond that of being jointly consumed in the production of the composite commodity (ab)." Cournot, Antoine Augustin. 1897. *Researches into the Mathematical Principles of the Theory of Wealth*. London: Macmillan, & Co., p. 99.

[41] Glosten Report, p. 8. His explanation that firms producing goods that are not "perfect substitutes" are "monopolistic competitors" leaves out important classes of competition, such as oligopoly. It is common in industrial organization to study markets for products that are substitutes but not perfect substitutes, and that do not conform to the definition of monopolistic competition. Oligopoly models are often appropriate when the number of competitors are relatively small.

[42] Benassy, Jean-Pascal. 1991. "Monopolistic Competition." In *Handbook of Mathematical Economics*, vol. 4, edited by Werner Hildenbrand and Hugo Sonnenschein, 1997-2045. Amsterdam: North-Holland, p. 1999.

model maintains all of the assumptions of perfect competition except that of product homogeneity."[43]

56. The recent history of entry into and fragmentation of equity trading is consistent with the free entry condition of monopolistic competition. Trading of U.S. equities today takes place on 13 registered exchanges and a plethora of ATSs, dark pools, and broker-dealer internalizers. As of February 2020, there were more than 50 dark pools registered with the SEC.[44] Three new exchanges plan to start operations as early as this year: the Members Exchange ("MEMX"), Long-Term Stock Exchange ("LTSE"), and Miami International Holdings ("MIAX PEARL").[45] MEMX and MIAX PEARL have declared their intention to offer proprietary data products.[46]

57. However, Prof. Glosten's evocation of the monopolistic competition framework is puzzling because he does not engage with one of its key characteristics, that there is free entry and that producers make zero profits. Prof. Glosten's discussion of exchanges' pricing of proprietary data products emphasizes strategic pricing incentives and not free entry, and thus seems at odds with concept of monopolistic competition.[47]

58. Prof. Glosten's assertion that "platform competition" is not a helpful framework for understanding the pricing of exchange proprietary data products is also unsupported.[48] He bases this assessment on a claim that the linkages between exchange proprietary data and trading are not likely to be important, so that firms' choices regarding their purchases of

---

[43] Cabral, Luis. 2000. *Introduction to Industrial Organization*. Cambridge, Massachusetts: MIT Press, p. 92.

[44] "Alternative Trading Systems with Form ATS on File with the SEC as of February 29, 2020," U.S. Securities and Exchange Commission, available at https://www.sec.gov/files/node/add/data_distribution/atslist022920.pdf.

[45] MEMX is planning to launch September 2020. *See,* Khalil, Kiays, "New US Stock exchange MEMX will go live in September," *The TRADE*, May 29, 2020, https://www.thetradenews.com/new-us-stock-exchange-memx-will-go-live-in-september/. MIAX also plans to launch in September 2020, though this launch date is pending SEC approval. *See,* "MIAX PEARL Equities Announces Upcoming Testing Dates Exchange Reaffirms September 2020 Launch Date," *CISION,* May 13, 2020, https://www.prnewswire.com/news-releases/miax-pearl-equities-announces-upcoming-testing-dates-exchange-reaffirms-september-2020-launch-date-301058484.html. LTSE planned to launch in Q1 2020, though COVID-19 concerns delayed the launch. *See,* Harty, Declan, "Long-Term Stock Exchange delays launch with coronavirus weighing on Wall Street," *S&P Global Market Intelligence,* March 27, 2020, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/long-term-stock-exchange-delays-launch-with-coronavirus-weighing-on-wall-street-57793626.

[46] "Members Exchange FAQ," MEMX, February 5, 2020, https://memxtrading.com/faq; see also, "MIAX PEARL Equities FAQ," MIAX PEARL, https://www.miaxoptions.com/sites/default/files/knowledge-center/2020-04/MIAX_PEARL_Equities_FAQ_04082020.pdf.

[47] Cabral, Luis. 2000. *Introduction to Industrial Organization*. Cambridge, Massachusetts: MIT Press, p. 92 ("The monopolistic competition model assumes that there is a large number of firms, so that the impact of each firm upon its rivals is negligible (as in the perfect competition model)."). The model of monopolistic competition was developed "not to study strategic aspects between products (such as product positioning and price competition), but rather to abstract from them to simplify the analysis and study other issues, such as the number of products offered by a market economy." Tirole, Jean. 1988. *The Theory of Industrial Organization*. Cambridge, Massachusetts: MIT Press, p. 288.

[48] Glosten Report, pp. 3, 12–14.

exchange proprietary data products have no impact on firms' order routing decisions.[49] Prof. Glosten does not engage with my research on this question in the Rysman Platforms Paper, which provides conceptual and empirical support for the relevance of the linkages he calls into question. Instead, he offers two conceptual arguments.

59. First, Prof. Glosten points to a disconnect in the time scale at which trading and data purchase decisions are made, trading being "on the order of milliseconds" while data purchases are made "on a monthly or longer basis."[50] However, this kind of mismatch in time scales is common on platforms. For example, credit card users decide on a payment method every time they make a purchase, but merchants decide whether to accept Visa or American Express cards over much longer time scales. If data is useful for deciding what exchange to route orders to (as Prof. Glosten agrees is the case),[51] the data subscription decisions made each month can impact the order routing decisions made at high frequencies. Moreover, as Prof. Glosten notes, having additional trading on an exchange makes its data more valuable, so that a trader should be more willing to pay for it.[52] Therefore, there are reasons to expect linkages running in both directions, from trading to data and from data to trading, despite the difference in time frames.

60. Second, Prof. Glosten argues that traders require proprietary data from all exchanges, so the price of an exchanges' proprietary data does not affect trade volume on that exchange.[53] But, as I have shown empirically in Section 3.3, most firms do not buy data from all exchanges, so it cannot be that data from all exchanges are necessary. If firms subscribe to proprietary data from some exchanges but not others, that should impact their decisions on where to route their orders, as I have shown in the Rysman Platforms Paper.

[49] Glosten Report, pp. 12–14.

[50] Glosten Report, p. 13.

[51] *See*, e.g., Glosten Report, pp. 4–5.

[52] Glosten Report, p. 14 ("this increase in volume may well make NYSE Arca data more valuable.").

[53] Glosten Report, p. 14.

6. OBSERVATIONS ON THE SEC'S REQUEST FOR ADDITIONAL INFORMATION

61. In this section, I comment on two issues raised by the SEC in its request for additional information. First, I note that the size of a platform does not alter the conclusion that all sides of the platform must be considered when evaluating competition and pricing. Second, I comment on the limitations of using accounting measures of profitability to evaluate competition and pricing.

62. First, the SEC asks NYSE to clarify "whether platform-based competition functions differently for an exchange with a smaller market share (e.g., NYSE National) as compared to an exchange with a larger market share (e.g., NYSE)."[54] The central implication of platform theory for the assessment of exchange proprietary data fees, that they cannot be considered independently of competition for order flow, does not depend on the size of a platform.

63. The size of a platform may be relevant for evaluating that platform's market power. However, the market structure and dynamics of the equity trading ecosystem suggests that no exchange or exchange group has substantial market power. As already mentioned in Section 5 above, there are 13 registered exchanges and dozens of ATSs, dark pools, and broker-dealer internalizers competing for order flow. Three new stock exchanges are slated to begin operations in 2020, suggesting that barriers to entry are low.[55] The SEC has observed that "[s]ince the adoption of Regulation NMS in 2005, the market for trading services has become more fragmented and competitive."[56]

64. NYSE Group's market share and measures of concentration such as the Herfindahl-Hirschman Index ("HHI") suggest that NYSE Group is not "large" in any sense that would suggest substantial market power.[57] Table 3 presents market shares for each public exchange, their aggregation into the four currently active groups of exchanges (NYSE,

---

[54] SEC Request for Information, at 37127.

[55] MEMX is planning to launch September 2020. *See,* Khalil, Kiays, "New US Stock exchange MEMX will go live in September," *The TRADE*, May 29, 2020, https://www.thetradenews.com/new-us-stock-exchange-memx-will-go-live-in-september/. MIAX also plans to launch in September 2020, though this launch date is pending SEC approval. *See,* "MIAX PEARL Equities Announces Upcoming Testing Dates Exchange Reaffirms September 2020 Launch Date," *CISION,* May 13, 2020, https://www.prnewswire.com/news-releases/miax-pearl-equities-announces-upcoming-testing-dates-exchange-reaffirms-september-2020-launch-date-301058484.html. LTSE planned to launch in Q1 2020, though COVID-19 concerns delayed the launch. *See,* Harty, Declan, "Long-Term Stock Exchange delays launch with coronavirus weighing on Wall Street," *S&P Global Market Intelligence,* March 27, 2020, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/long-term-stock-exchange-delays-launch-with-coronavirus-weighing-on-wall-street-57793626.

[56] "Transaction Fee Pilot for NMS Stocks Final Rule," Securities Exchange Act Release No. 51808, 84 FR 5202, February 20, 2019, p. 5253.

[57] A formal antitrust analysis of market shares would follow a market definition analysis, which I have not conducted. The market shares and concentration statistics I present here are nonetheless informative as they put NYSE Group's size relative to other trading centers in context.

NASDAQ, CBOE, and IEX), and the HHI implied by these shares. NYSE Group's share of trading is 22%, well below the levels that economists consider dominant.[58] The HHI I calculate is very conservative: because data on trading volume for each ATS and dark pool is not available individually, I take each trade reporting facility ("TRF"), where many such trading venues report their trades, as unitary actors. With this, I calculate an upper bound HHI of 2,140. This is below the threshold of 2,500, above which the Federal Trade Commission and the Department of Justice consider markets to be "highly concentrated."[59]

TABLE 3
Market Shares in U.S. Equity Trading Volume, by Number of Shares Traded, June 2020

	Shares Traded	Market Share
Public Exchanges		
NYSE	34,583,389,595	11.28%
NYSE American	1,381,993,716	0.45%
NYSE Arca	26,637,707,910	8.69%
NYSE Chicago	648,860,370	0.21%
NYSE National	4,464,562,476	1.46%
NYSE Total	***67,716,514,067***	***22.08%***
NASDAQ	54,905,155,704	17.90%
NASDAQ BX	2,608,086,911	0.85%
NASDAQ PSX	1,646,975,767	0.54%
NASDAQ Total	***59,160,218,382***	***19.29%***
BYX Equities	5,262,903,080	1.72%
BZX Equities	16,945,504,908	5.53%
EDGA Equities	4,636,640,952	1.51%
EDGX Equities	19,739,075,839	6.44%
Cboe Total	***46,584,124,779***	***15.19%***
IEX	5,617,745,414	1.83%
Trade Reporting Facilities		
NASDAQ TRF Carteret	93,259,396,905	30.41%
NASDAQ TRF Chicago	576,489,276	0.19%
NYSE TRF	33,779,670,063	11.01%
TRF Total	***127,615,556,244***	***41.61%***
All Trading	***306,694,158,886***	

Source: Cboe Global Markets

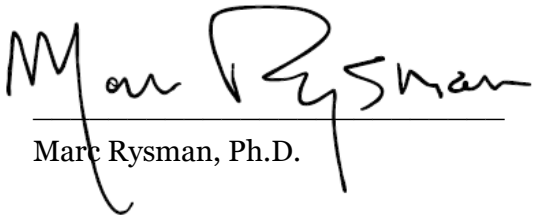
Note: Statistics shown include trading activity for the period 5/29/20 through 6/30/20.

[58] Motta, Massimo. 2004. *Competition Policy: Theory and Practice*. Cambridge: Cambridge University Press, p. 118 (surveying market share thresholds used to evaluate monopolization conduct, none of which suggest a market share below 40% is cause for concern). "Competition and Monopoly: Single-Firm Conduct Under Section 2 of the Sherman Act," U.S. Department of Justice, September 2008, p. 22 (The Department of Justice "is not aware … of any court that has found that a defendant possessed monopoly power when its market share was less than fifty percent. Thus, as a practical matter, a market share of greater than fifty percent has been necessary for courts to find the existence of monopoly power."). Substantial market power could exist with lower market shares in markets where consumers tend to use a single provider (single-homing). *See*, Armstrong, Mark. 2006. "Competition in Two-Sided Markets." *The RAND Journal of Economics*, 37 (3): 668–691. That issue is likely unimportant in the case where traders tend to access multiple trading venues.

[59] United States Department of Justice and the Federal Trade Commission, "Horizontal Merger Guidelines," August 19, 2010, p. 19.

65. Second, the SEC has requested information on NYSE National's profit margins, returns on assets, or other metrics" that could be used to assess "the presence of competition."[60] The SEC requests this information "for the entirety of NYSE National and for each of its business lines (including proprietary market data products, consolidated market data products, market connectivity services, and transaction services)."[61] Although competition among platforms would limit the overall profitability of platforms as a whole, economists have long recognized that accounting data do not always reliably reflect economic profitability and therefore can be unreliable for evaluating the competitiveness of an industry.[62] For example, economists have found that accounting measures of profitability can deviate from the analogous economic concepts due to accounting procedures over which firms have some discretion or the way some costs are recorded.[63] These difficulties are even more pronounced for measures of profitability for units within a firm, as the allocation of costs necessarily introduces an element of arbitrariness.

Executed August 13, 2020



Marc Rysman, Ph.D.

[60] SEC Request for Information, at 37127.

[61] SEC Request for Information, at 37127.

[62] Fisher, Franklin and John McGowan. 1983. "On the Misuse of Accounting Rates of Return to Infer Monopoly Profits." *American Economic Review*, 73 (1): 82–97; Baker, Jonathan B. and Timothy F. Bresnahan. 2008. "Economic Evidence in Antitrust: Defining Markets and Measuring Market Power." In *Handbook of Antitrust Economics*, edited by Paolo Buccirossi, 1–42. Cambridge, MA: The MIT Press, p. 19 ("The Lerner Index can be difficult to measure because of well-known problems in the measurement of marginal cost. These include conceptual difficulties in relating accounting measures to economic concepts. For example, accountants define cost categories for audit purposes that do not necessarily track economist's concepts; that present difficulties in the accounting treatment of depreciation, that may not capture opportunity costs in accounting data, and that show average variable costs not equal to marginal cost where the marginal cost curve is not horizontal. Indeed the academic literature in empirical industrial organization economics commonly treats the level of marginal cost as unobservable even when some of its determinants, like input prices and scale, can be observed.").

[63] Schmalensee, Richard. 1989. "Inter-industry Studies of Structure and Performance." *Handbook of Industrial Organization* vol. 2, edited by Richard Schmalensee and Robert Willig, 951–1009. Amsterdam: North Holland, pp. 960–966.