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February 13, 2019

VIA ELECTRONIC DELIVERY

Mr. Brent J. Fields
Secretary
U.S. Securities and Exchange Commission
100 F Street NE
Washington, DC 20549

Re: Roundtable on Market Data and Market Access (Release No. 4-729)

Dear Mr. Fields:

Nasdaq, Inc. respectfully submits this letter and attached statement of Janusz A. Ordover and Gustavo Bamberger (the "Expert Statement"), two experienced and highly credentialed economists, in response to the Commission's Roundtable on Market Data and Market Access held on October 25 and 26, 2018 ("Roundtable"). The Expert Statement describes the theory of "Platform Competition" and its application to the economics of pricing of services offered by national securities exchanges, including those operated by Nasdaq. This theory was discussed at the Roundtable and has played a role in multiple administrative and judicial proceedings regarding the pricing of market data products offered by exchanges.[1]

Most recently, Commissioners Peirce and Roisman suggested in a proceeding in the market-data setting that the exchanges have three potential paths for analyzing what constitutes a "fair and reasonable" fee under Section 6(b) of the Exchange Act. In particular, the Commissioners suggested the exchanges should "fully assess the platform theory and identify how customers who pay for a particular product or service exert competitive pressure on an exchange as a platform."[2]

In the attached Expert Statement, Ordover and Bamberger use a platform-based approach to examine exchanges' pricing of connectivity services, a topic the Commission is currently

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1 *See NetCoalition v. SEC*, 615 F.3d 525 (D.C. Cir. 2010); *NetCoalition v. SEC*, 715 F.3d 342, 354 (D.C. Cir. 2013).

2 Comm'r Hester M. Peirce & Comm'r Elad L. Roisman, *Joint Statement on the Application of SIFMA for Review of Action Taken by NYSE Arca, Inc., and NASDAQ Stock Market LLC* (Oct. 16, 2018), *available at* https://www.sec.gov/news/public-statement/peirce-roisman-statement-101618.

considering in the context of proposed rule changes by the BOX Market LLC.[3] In particular, they explain that the "proper approach from the economics and public policy standpoint is to view connectivity as one of the services that Nasdaq offers that is related to its trading function and which is produced on a platform that is characterized by joint and common costs." Ordover & Bamberger Expert Statement at 25. In other words, "the provision of connectivity services (and other 'ancillary' products and services offered by Nasdaq, such as market data) is inextricably linked to the provision of trading services, so that, as a matter of economics, it is not possible to appropriately evaluate the pricing of connectivity services in isolation from the pricing of trading and other 'joint' services offered by Nasdaq." *Id.* at 2. Applying that economic model, Ordover and Bamberger conclude that "competition from other exchanges and other rivals for equity trading constrains the pricing of connectivity services" and that the "feasibility of supra-competitive pricing for connectivity services is constrained by traders' ability to shift at least some trades elsewhere, which lowers the activity on the exchange and, in the long run, reduces the demand for connectivity services from the exchange." *Id.* at 2, 3.

In its Order Instituting Proceedings, the Commission asked commenters to address whether BOX's proposed connectivity fee is consistent with the provisions of the Securities Exchange Act of 1934 requiring that an exchange's fees be "reasonable and equitably allocated"; "designed to perfect the mechanism of a free and open market and the national market system, protect investors and the public interest, and not be unfairly discriminatory"; and "not impose an unnecessary or inappropriate burden on competition."[4] In addressing these issues, Nasdaq believes that it is important for the Commission to have a full understanding of the economics of securities exchanges and the competitive forces that constrain exchanges' pricing of connectivity services. The attached Expert Statement addresses those issues in detail.

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3 BOX Connectivity Fee Filings and Related Suspension Orders, File Nos. SR-BOX-2018-24 and SR-BOX-2018-37; Order Granting Petition for Review of Order Temporarily Suspending BOX Exchange LLC's Proposal to Amend the Fee Schedule on BOX Market LLC, Release No. 34-84614, File No. SR-BOX-2018-24, 83 Fed. Reg. 59,432 (Nov. 23, 2018).

4 Suspension of and Order Instituting Proceedings to Determine Whether to Approve or Disapprove a Proposed Rule Change to Amend the Fee Schedule on the BOX Market LLC Options Facility to Establish BOX Connectivity Fees for Participants and Non-Participants Who Connect to the BOX Network, Release No. 34-84168, File No. SR-BOX-2018-24, 83 Fed. Reg. 47,947, 47,949 (Sept. 21, 2018) (citing 15 U.S.C. § 78f(b)(4), (5), (8)); *see also* Notice of Filing of a Proposed Rule Change to Amend the Fee Schedule on the BOX Market LLC ("BOX") Options Facility to Establish BOX Connectivity Fees for Participants and Non-Participants Who Connect to the BOX Network; Suspension of and Order Instituting Proceedings to Determine Whether to Approve or Disapprove the Proposed Rule Change, Release No. 34-84823, File No. SR-BOX-2018-37, 83 Fed. Reg. 65,381, 65,384 (Dec. 20, 2018) (citing 15 U.S.C. § 78f(b)(4), (5), (8)).

Nasdaq submits that, when a platform-based approach is used to assess exchanges' connectivity fees (or their fees for other services, such as market data), it is clear that their pricing decisions are subject to significant constraints attributable to the exchanges' intense competition to offer trading services. Those competitive constraints foreclose the possibility of supra-competitive pricing for connectivity services and ensure that exchanges' connectivity fees are reasonable, protect investors and the public interest, and do not impose any unnecessary or inappropriate burdens on competition within the meaning of the Exchange Act.

Sincerely,

Jeffrey S. Davis

Attachment(s)

Statement of Janusz A. Ordover and Gustavo Bamberger

I. Introduction.

1. I, Janusz A. Ordover, am an Emeritus Professor of Economics and a former Director of the Masters in Economics Program at New York University where I taught beginning in 1973. From 1991 – 1992, I served as Deputy Assistant Attorney General for Economics at the Antitrust Division of the United States Department of Justice. As the chief economist for the Antitrust Division, I was responsible for formulating and implementing the economic aspects of antitrust policy and enforcement of the United States, including co-drafting the 1992 U.S. Department of Justice and Federal Trade Commission *Horizontal Merger Guidelines*. I also had ultimate responsibility for economic analyses conducted by the Department of Justice in connection with its antitrust investigations, and litigation and regulatory work. In addition, I am a Senior Consultant to Compass Lexecon, a leading economic consulting firm.

2. I have authored and co-authored numerous articles on industrial organization economics, law and economics, antitrust, and intellectual property. In particular, I have written and testified on the issues of pricing of information as well as on the benefits and costs of regulatory interventions in markets. My curriculum vitae, which contains a complete list of my publications, is attached as Appendix A.

3. I, Gustavo Bamberger, am an Executive Vice President of Compass Lexecon. I received a B.A. degree from Southwestern at Memphis, and M.B.A. and Ph.D. degrees from the University of Chicago Graduate School of Business. I have provided expert testimony on a variety of economic issues to federal courts, the U.S. Federal Energy Regulatory Commission, the U.S. International Trade Commission, the U.S. Department of Transportation, U.S. state regulatory agencies, the Canadian Competition Tribunal, the New Zealand Commerce Commission and the High Court of New Zealand. A copy of my curriculum vitae is attached as Appendix B.

4. We have been asked by counsel for Nasdaq Inc. to discuss the economics of equity trading exchanges, and to evaluate the extent to which competitive forces constrain the prices of "connectivity services" offered by Nasdaq Inc.[1] Nasdaq Inc. owns the Nasdaq Stock Market, in which customers can trade stocks listed on the Nasdaq Stock Market ("Nasdaq stocks") and stocks listed on other exchanges ("non-Nasdaq stocks"). Nasdaq also owns and operates the Nasdaq BX and Nasdaq PSX equity exchanges. The Nasdaq equity exchanges and rival exchanges offer a variety of products, including, but not limited to, trading services; listing services; "collocation" services; and a variety of data products. For the purpose of this statement, we refer to the three equity exchanges collectively as "Nasdaq."

5. As we discuss in this statement, we find that the provision of connectivity services (and other "ancillary" products and services offered by Nasdaq, such as market data) is inextricably linked to the provision of trading services, so that, as a matter of economics, it is not possible to appropriately evaluate the pricing of connectivity services in isolation from the pricing of trading and other "joint" services offered by Nasdaq. We conclude that Nasdaq is subject to significant competitive forces from other trading exchanges and other rivals. This means that competition among exchanges and other rivals can be expected to constrain the aggregate return that Nasdaq earns from its sale of a portfolio of products, including trading and connectivity services. In particular, connectivity services are an "input" into trading, so excessive pricing of such services would raise the costs of trading on Nasdaq relative to its rivals and thus discourage trading on Nasdaq. That is, competition from other exchanges and other rivals for equity trading constrains the pricing of connectivity services.

6. Connectivity services to the Nasdaq equity exchanges cannot be obtained elsewhere, but this does not enable Nasdaq to exercise monopoly power over customers that purchase those services. The National Best Bid and Offer ("NBBO") regulation of the Security

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1. We provide a description of the equity exchange connectivity services offered by Nasdaq Inc. later in this statement.

and Exchange Commission ("SEC") requires "brokers to trade at the best available ask (lowest) price and the best available bid (highest) price when buying and selling securities for customers," which may require brokers to purchase connectivity services from Nasdaq (and other exchange operators), but we understand that no broker is required to purchase any particular level of connectivity to fulfill the NBBO regulation. Furthermore, many purchasers of connectivity services are not brokers and thus do not need to purchase those services. In general, even if some customers are required to purchase a product from a particular supplier, the price that the supplier sets for the product depends on the choices of customers that do not have to purchase the product. Using economics terminology, the price charged to "inframarginal" customers (those willing to pay more than the going price) is constrained by the actions of "marginal" customers (those who are just indifferent to paying the going price and not purchasing).[2]

7. The feasibility of supra-competitive pricing for connectivity services is constrained by traders' ability to shift at least some trades elsewhere, which lowers the activity on the exchange and, in the long run, reduces the demand for connectivity services from the exchange. Although the NBBO regulation determines, to some extent, the platform on which

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2. To use a simple example, suppose some cola drinkers will only drink Coca-Cola, and some will only drink Pepsi, regardless of the price of the two products. One might conclude that these customers might end up paying a very high price for each can of cola, whichever one they buy. This conclusion is wrong: if a substantial number of consumers will switch between Coke and Pepsi depending on their relative prices, then the seller will moderate its prices to avoid the loss of marginal consumers. In particular, if the sellers cannot readily distinguish between the two groups of cola drinkers, the market price of each cola will depend on the competition between Coke and Pepsi for the consumers who respond to price signals, i.e., the marginal customers. Thus, competition for "marginal" cola drinkers protects the "only Coke" and "only Pepsi" drinkers. One might reason that this argument fails because Nasdaq – unlike Coke and Pepsi – can distinguish between consumers and will price according to consumer type. However, this counterargument does not hold up: in particular, if the buyer who is an inframarginal buyer for service X can reduce or reallocate its purchases of other services it obtains from the exchange, such ability to reallocate purchases of services other than product X will act as a constraint on how much the exchange can price for X even to inframarginal buyers.

some trades occur, the size and depth of displayed liquidity can influence the decision about where to fill orders larger than the number of shares available at the displayed NBBO.[3] As we discuss later in this report, Nasdaq and other exchanges pay substantial "rebates" to traders to provide liquidity to their exchanges. In general, exchanges would have no incentive to pay such rebates unless participants in the equity markets had the ability to shift a substantial number of trades between exchanges or other trading platforms. The SEC has previously found "that if competitive forces are operative (i.e., effectively imposing price discipline), the self-interest of the exchanges themselves will work powerfully to constrain unreasonable or unfair pricing behavior."[4]

8. As we show later in this statement, competition among exchanges and alternate trading platforms (i.e., "over-the-counter" trading) is robust. Given the robust level of competition, it is our view that economic efficiency is enhanced if Nasdaq and other exchanges determine what pricing strategies will best conduce to the recovery of their aggregate costs – including a return on capital – of running an exchange business. Each trading exchange will make its pricing decisions based on its individual circumstances and the business strategies of the exchange. Moreover, these decisions can change over time as the forces of competition reveal whether these strategies are profitable or not. Because the products and services offered by an exchange are inextricably linked, competition is properly evaluated at the exchange level, not at the level of any individual product or service or at the level of any customer or category of customers. Regulatory forbearance is thus fully warranted in the absence of any showing of a lack of competition at the exchange level.

9. The rest of our statement is organized as follows. In Section II, we discuss the economics of equity exchanges, and show that the traditional criteria for product-level efficient

3. https://www.investopedia.com/terms/n/nbbo.asp.
4. In the Matter of the Application of Securities Industry and Financial Markets Association for Review of Action taken by NYSE Arca, Inc., and Nasdaq Stock Market LLC, Admin. Proc. File No. 3-15350, October 16, 2018, at 1.

pricing do not apply to exchanges, so that it is not possible to evaluate whether an exchange has "substantial market power" by evaluating the pricing of individual products offered by the exchange. In Section III, we provide a description of the equity exchange industry, and explain that exchanges compete in a variety of ways. Finally, in Section IV, we explain that the prices of Nasdaq's connectivity services cannot be evaluated in isolation.

II. ECONOMICS OF EXCHANGES.

A. Economic Characteristics of Exchanges.

10. Exchanges have a variety of economic characteristics that, taken together, distinguish them from many other industries. On the *cost* side, which is the flip side of the production side, exchanges such as Nasdaq incur a variety of "joint and common" costs. An important feature of those costs is that they comprise substantial fixed costs of providing a service but relatively low "incremental" costs of producing an additional unit of service (or serving an additional customer).[5] On the *demand* side, exchanges are a quintessential example of multi-sided "platforms." Such platforms facilitate interactions among two or more "sides," i.e., distinct groups of customers.

11. Trading services, connectivity services and market data are "joint products" – multiple products or services that are generated by the same production technology. These joint products, to a large extent, reflect "joint and common costs" – costs that are incurred on

5. How fixed costs in industries with large fixed costs and relatively low incremental costs – including telecoms and railroads – are recovered has been widely studied in the economics literature. This literature also discusses the substantial economic inefficiencies introduced by the regulation of pricing in these industries. See, for example, Douglas W. Caves, Laurits R. Christensen and Joseph A. Swanson, "The High Cost of Regulating U.S. Railroads," *Regulation*, January/February 1981; Douglas W. Caves, Laurits R. Christensen and Joseph A. Swanson, "The Staggers Act, 30 Years Later," *Regulation*, Winter 2010-2011; and Robert W. Crandall, "The Effects of Rapid Technological Change on Regulatory Policies in the Communications Sector," August 17, 2018.

behalf of more than one product or service and thus, potentially, are linked to more than one revenue source. As an example, expenditures on building, creating, maintaining, and upgrading a digital trading platform are needed to support a trading exchange and connectivity services – that is, without an exchange, there would be no demand for connections to the exchange. Similarly, without an exchange, no market data would be created. That is, Nasdaq incurs "joint costs" to produce "joint products," such as trades, connectivity services and market data.[6]

12. Joint products are found in a variety of industries. Consider, for example, the owner and operator of a fitness center. Such a business incurs certain costs – the cost of building or renting a gym; the cost of purchasing and maintaining gym equipment – that can be used to offer a variety of services, such as access to equipment; regularly scheduled classes (e.g., spin classes); and the services of a personal trainer.[7] That is, one set of costs incurred by the fitness center owner supports a variety of revenue streams. The fitness center owner can attempt to recover its costs by charging different amounts to different customers. For example, one fitness center may offer a flat monthly fee that includes all other services (classes, lockers, and so forth) without an additional charge, i.e., for "free," which of course they are not. Another gym may compete by offering a lower monthly fee, but charge members for classes, lockers, trainers, and other ancillary services. No matter what cost-recovery (fee) strategy is chosen, a financially viable fitness center must, on a forward-looking basis, cover its aggregate costs, although different owners may choose different pricing strategies (e.g., relatively low membership fees with relatively high fees for additional services vs. relatively high membership fees with relatively low fees for additional services), while different customers may prefer one model over the other depending on whether they plan to exercise often or only rarely, for example. In competitive industries (e.g., providing fitness center services), it is commonplace

6. In principle, an exchange could outsource the provision of connectivity services to a third party. However, the third-party provider would have to gain access to Nasdaq's facility (e.g., to collocate equipment) to access Nasdaq's trading engine.
7. In addition to the joint costs, some services may require incurring additional costs that are attributable to a specific service (e.g., wages paid to a personal trainer).

for rival firms to choose different pricing strategies to offer a variety of different products, allowing customers to choose which product or combination of products best meets their needs.

13. A fitness center is characterized by low marginal costs, meaning the cost of admitting one additional member is relatively low. The marginal cost will differ somewhat based upon the services each new member chooses to utilize which may affect the cost recovery model the fitness center chooses. For example, permitting one additional member to utilize an existing set of equipment is often zero or close to it. The cost of permitting an additional member to attend a class or set of classes is somewhat higher as attendance is limited to a certain number of spots. The marginal cost of offering personal training services to an additional member is higher still as personal trainers may be costly and have limited availability (even these costs may differ depending on whether the personal trainer is on salary or paid per training session). The cost-recovery model of the fitness center must account for the joint products and costs incurred in offering a variety of related or multi-sided services.

14. In a similar vein, Nasdaq offers a variety of products, and consumers are able to choose which product or combination of products best meets their needs. For example, some customers may want a premium service (the equivalent of a personal trainer) and so choose to pay for the lowest-latency, highest-capacity service available. Other customers may instead choose to pay less for a slower or lower-capacity service (the equivalent of a fitness center member who pays only for access to gym equipment but no personal services).

15. Production characterized by high fixed costs and low (or zero) incremental costs of providing an additional unit of service to an existing customer is common in a variety of industries in which products or services are delivered electronically. For example, in the software industry, developing new software (or an app) typically requires a large initial investment (and continuing large investments to “upgrade” the software), but once the software is developed, the incremental cost of providing that software to an additional user is typically

small, or even zero (e.g., software or an app can be downloaded over the internet after being purchased at zero marginal cost).

16. On the demand side, trading exchanges are a quintessential example of a multi-sided "platform." Such platforms facilitate interactions among two or more "sides," i.e., distinct groups of customers. Although there is no universally accepted definition of a multi-sided platform, they share at least two common features. First, multi-sided platforms are characterized by inter-side "externalities". What this means is that the 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. Loosely speaking, in the simplest case, the more (and the "higher quality") customers there are on one side of the platform, the more demand there is for the services of the platform from the customers on the other side of the platform. Credit-card platforms, which link merchants and credit-card holders, are a widely cited example of a two-sided platform in the economics literature.

17. Because of this interdependence of the two "sides," the platform owner must ensure the continued participation of customers on both sides. This could be challenging given the "chicken-and-the egg" problem – in the case of trading exchanges it is critical to have both providers and takers of liquidity (buyers and sellers) availing themselves of the platform's services. In general, liquidity providers may be reluctant to post their willingness to trade on an exchange if there are only a few "takers" of liquidity on that exchange because the likelihood that a posted order is "hit" (i.e., a match is found) is relatively low. Similarly, liquidity takers may not want to trade on an exchange if there are not enough liquidity providers because the relative lack of providers may increase the costs of filling out a buy/sell order.[8]

18. The second characteristic feature of these types of platforms is that, due to the inter-side demand externalities discussed above, the platform owner/operator is concerned not

8. As we have discussed, while brokers are required to access the NBBO, the size and depth of displayed liquidity can influence the decision about where to fill orders larger than the displayed NBBO.

only about the level of the relevant prices on each side of the platform, but also of the price structure (i.e., the ratio of prices charged to each side of a transaction mediated by a platform). In the case of a platform offering trading services, the platform owner may choose to charge a "negative price" (in the form of rebates) to one side of the transaction and a "positive price" to the other side. Concretely, the exchange may decide to charge a positive price to takers of liquidity and a negative price (subsidy) to providers of liquidity.

B. The Traditional Criteria for Product-Level Efficient Pricing do not Apply to Exchanges.

19. These distinguishing features of exchanges – (1) joint products and joint costs; (2) high fixed costs, low incremental costs; and (3) inter-side externalities that lead to two-sided pricing – imply that, in general, the traditional prescriptions for product-level efficient pricing – that is, that prices should be equal to "marginal" or product-specific "incremental" costs – do not apply to exchanges for a variety of reasons.

20. First, in an industry characterized by substantial joint and common costs, there is no sound economic basis for allocating some portion of joint costs to any one of the various joint products. Thus, while, by definition, it is possible to estimate the marginal or incremental cost of a given product, there is no economically sound methodology for allocating or attributing any portion of the joint costs to any given product, service, or customer. This means that there is 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. That is, although there are incremental costs associated with a portfolio of products, as well as with any particular product, it is not possible to appropriately associate an average cost with any specific product in the portfolio.

21. Consider the example of the fitness center we discussed earlier. If a fitness center competes by offering a low monthly fee but a higher charge for lockers, the choice to price lockers above marginal cost does not support a credible claim that the gym owner is

exercising substantial market power in the rental of lockers. Nor does it support a credible argument that members need regulatory oversight to protect them from overpayment for lockers. Conversely, another gym owner who charges a higher monthly fee but gives away lockers for free cannot be said to be exercising substantial market power merely because it is charging a higher monthly fee. Moreover, the fact that these two gym owners are employing different pricing strategies does not suggest an absence of competition between them. Quite the opposite; it is commonplace for suppliers with joint products to use heterogeneous strategies for attracting customers.

22. So too in the case of exchanges, one exchange might choose to offer its market data for "free" while charging relatively more for trading services (or paying out lower rebates to liquidity providers), while another exchange might charge more for its market data while charging less for trading services (or paying out greater rebates to liquidity providers). That heterogeneity in pricing strategies can be a hallmark of intense competition and it can be beneficial for consumer welfare. When there is effective competition, regulation of pricing strategies is likely to have pernicious effects by reducing the range of choices available to the public.

23. The calculation of an average cost requires an allocation of the joint and common costs, which could be substantial across the portfolio of products, but each such allocation is as arbitrary as any other one.[9] At best, one can ascertain whether the revenues from the product fall short of its incremental cost, which means that the product is being subsidized by other products, or whether the product subsidizes other products because its revenues exceed its incremental cost *plus* the full joint and common costs. These bounds establish a price range

9. Joint and common costs are routinely allocated for accounting purposes. However, it is widely understood that measures of accounting cost often do not reflect economic costs. See, for example, Franklin M. Fisher and John J. McGowan, "On the Misuse of Accounting Rates of Return to Infer Monopoly Profits," *American Economic Review*, 1983, vol. 73, issue 1, 82 – 97.

that is, essentially, quite uninformative from a policy standpoint. Moreover, as we have discussed, even this range is irrelevant in the case of two-sided (or multi-sided) platforms.

24. Second, in an industry characterized by high fixed costs and low (or zero) incremental costs, product-level prices equal to incremental costs would not allow a firm to cover its joint and common fixed costs. That is, such pricing is not feasible when there are increasing returns to scale (such as those resulting from the presence of fixed costs) because if all sales were priced at incremental cost, the vendor would be unable to defray the forward-looking costs of providing the service and would (ultimately) go bankrupt and would have to exit the industry.

25. Consider again the example of the fitness center owner. If the fitness center only charged the incremental cost of serving an additional member, it would not be able to cover its fixed costs, such as the costs of the equipment that is used by its members or building the fitness center in the first place. Likewise, an exchange that only recovered its incremental costs would not be able to cover its potentially far more substantial fixed costs. By the same token, it cannot be said that a fitness center or an exchange is exercising substantial market power if it charges rates above marginal cost for some (or even all) of its services.

26. Third, the economics of pricing on two-sided platforms can also mandate that prices to one side – but not both – be below the cost of providing a product, service, or functionality to the customers on that side. As we have discussed, this multi-sidedness of trading exchanges generally leads to exchanges charging a “negative price” to one side of the platform. In particular, in the case of Nasdaq, customers who provide liquidity receive substantial rebates from Nasdaq. Indeed, in 2017, Nasdaq exchanges paid out in rebates to liquidity providers 91.4 percent of the trading fees it received from liquidity takers.

27. This type of two-sided pricing plays such an important role in operating Nasdaq’s trading business that Nasdaq’s “net receipts” from many of its customers are <u>negative</u>. That is, Nasdaq pays more in cash rebates to many customers than it receives from all other services

that Nasdaq sells to those customers (i.e., including fees for ancillary services such as connectivity services and market data). For example, of Nasdaq's 10 largest customers for connectivity services in 2017 (which accounted for 45.5 percent of Nasdaq's connectivity services revenue in 2017), five received more in rebates from Nasdaq than the total of all the fees each customer paid to Nasdaq. That is, half of Nasdaq's largest customers for connectivity services do not pay anything to Nasdaq for use of the Nasdaq trading exchange – instead, Nasdaq pays them.[10] Because such customers contribute no funds to cover Nasdaq's fixed costs, it would not be economically feasible for Nasdaq to charge its other customers no more than some measure of "incremental" cost for the services it provides them.

C. It is Not Possible to Determine Whether an Exchange has "Substantial Market Power" by Evaluating Whether Any Single Price is Above the "Competitive Level."

28. For a firm or industry selling a "standard" product or service, the extent to which the firm or industry has "substantial market power" (sometimes referred to as "monopoly power") could, in principle, be evaluated by comparing prices to "marginal" or "incremental" costs. For the reasons we discussed in the prior section of this statement, such a test is not appropriate in an industry with the economic characteristics of trading exchanges.

29. Given that "marginal" cost pricing is generally not feasible in industries with the cost and demand characteristics of an exchange, some deviations from such pricing are unavoidable. One alternative to the current market-driven prices might be to implement through regulatory fiat a uniform price to all customers equal to the average total cost (including a return to capital) of operating the exchange, including the costs of providing connectivity services and market data. It is, however, well known that such uniform average cost pricing is not socially efficient. In general, economic efficiency in these circumstances requires that customers whose

10. We understand that in some cases, a customer will purchase connectivity services from a third-party reseller that purchases those services from Nasdaq. Nasdaq does not have information on the fees paid to resellers by such customers.

demand is more responsive to price changes pay prices closer to marginal (or incremental) cost while customers who are less responsive to price changes pay prices that deviate more significantly from marginal costs.

30. This type of pricing is "value-driven" in so far as the magnitude of a customer's demand elasticity correlates with its willingness-to-pay for the product or service in question. Such "value-driven" pricing is common and widely accepted in a variety of industries, including the securities industry. For example, Nasdaq sells the same market data to both "Professional/Corporate" and "Non-Professional" market participants, but Non-Professional per-subscriber fees are far lower than Professional/Corporate per-subscriber fees. We understand that this type of price differentiation – i.e., lower fees for retail investors – is common in the securities industry and is not considered "unreasonable or unfair pricing behavior." Indeed, there is nothing problematic with such pricing either from an efficiency or public policy perspective, once it is realized that neither marginal cost pricing nor uniform pricing are desirable. On the contrary, differential pricing by a vender who faces competition across the lines of its business is generally desirable.[11]

31. As a matter of public policy, this means that regulators (such as the SEC) should foster policies that will facilitate competition among exchanges and not try to meddle into the structure of prices. Regulating individual prices in an industry characterized by joint products and joint costs as well as inter-side externalities can be expected to result in economic inefficiencies and even a possible failure of some suppliers. For example, if the prices charged for ancillary services such as connectivity services or market data were regulated, exchanges could be forced to increase the fees charged for taking liquidity, reduce the rebates paid to liquidity providers, or both. Because exchanges compete with a variety of over-the-counter

11. As we have discussed, some customers may choose a "premium" connectivity service, while other customers may choose a lower-price option. We understand that no regulation requires a customer to purchase a premium connectivity service. In particular, we understand that the SEC's NBBO regulation does not require brokers to purchase any particular level of connectivity services from Nasdaq.

unregulated alternatives, including “dark pools,” such an increase in trading fees likely would result in a lower share of all trading being “lit” (i.e., publicly observable), which could reduce the transparency of equity markets in the United States to the detriment of the trading public as well as engendering macroeconomic inefficiencies from the possible misallocation of investible funds.[12]

32. Furthermore, heterogeneity in the mix of pricing across services is beneficial and desirable. Competition is enhanced and consumers benefit when competitors with joint products and/or multisided platforms can employ varying competitive strategies and adjust their strategies in response to changes in competition and consumer demand. Likewise, different customers generally will differ in terms of their preferences as well as in their willingness to pay for the services available through the platform. For example, one customer may prefer lower trading fees (or negative fees, in the form of rebates) and may be willing to accept relatively higher fees for data, connectivity, or other services; on the other hand, another customer may prefer lower fees for data or connectivity and may be willing to accept higher trading fees as a trade-off. Competitive heterogeneity is beneficial for these customers, as it gives them options to pursue the venue(s) with the competitive offerings that best suit their businesses. Conversely, an artificial limitation on competitive heterogeneity through over-regulation of isolated elements of pricing of platform offerings is likely to suppress competition and harm at least some customers who would prefer the combinations of offerings that are foreclosed by regulation.

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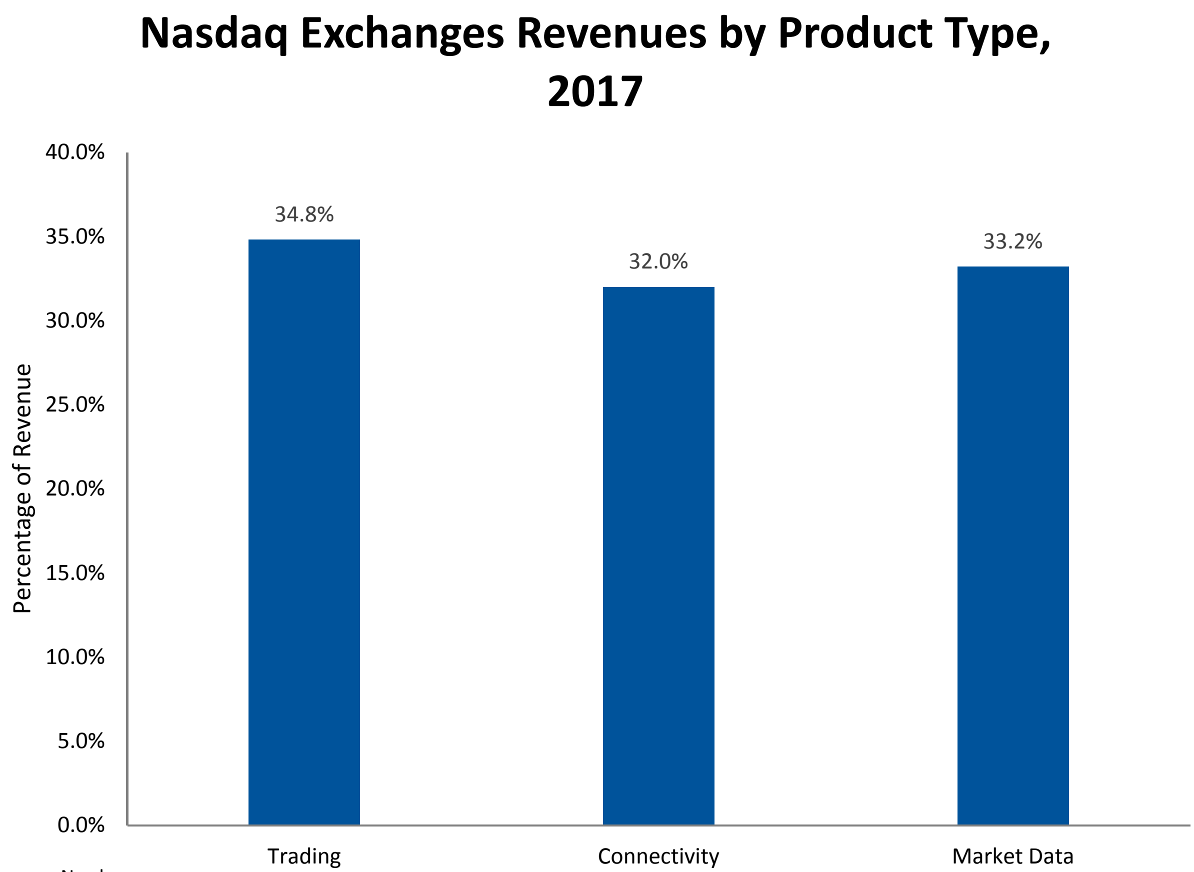
12. Dark pools are multilateral organizations that “pool” the orders of traders. The identities of traders in dark pools, and the bid and offer prices made available to subscribers, and the prices at which they trade, are not generally known. For this reason, trading in such venues and other over-the-counter trading is sometimes referred to as “dark,” to distinguish it from trading on exchanges, which is referred to as “lit.” Lit trading provides substantially more transparency than trading in dark pools.

D. Competition Among Exchanges Can Be Expected to Constrain the Overall Return Earned by an Exchange and Ensures Reasonable Prices for Individual Services.

33. As we have discussed, trading exchanges sell a portfolio of products and services which are characterized by joint costs. The total return that a trading exchange earns reflects the revenues it receives from the portfolio of products it offers and the aggregate costs it incurs. In 2017, for example, trading services accounted for 34.8 percent of Nasdaq's total revenues; connectivity services accounted for 32.0 percent; and market data accounted for 33.2 percent.[13] See Figure 1.

13. Revenues from options trading and index services are excluded from our analysis. In some cases, Nasdaq allocates revenues from connectivity revenues to equities and options. Trading services include net revenues from takers and providers of liquidity and revenue from related services.

Figure 1



Source: Nasdaq.

34. Although each exchange offers a portfolio of products and services to potential customers, different exchanges have chosen different strategies regarding the prices they set. For example, some exchanges choose to pay relatively high rebates to attract customers; other exchanges may choose to charge relatively low prices for market data to attract customers.

35. In a competitive exchange industry, any attempt by an exchange to raise the price of a single product or service so as to earn an overall supra-competitive rate of return (i.e., raising the price of one product or service without, all else equal, an offsetting reduction in the price of another product or service) will be expected to lead to a loss of business to rivals who offer a more attractively priced portfolio of products and services.

36. In the next section of this report, we show that the exchange industry is highly competitive, consisting of several exchange operators that compete with each other and a variety of alternative trading platforms, including dark pools. When competition constrains the

overall profits earned by a supplier, such as is the case with exchanges, “differential” pricing – for example, charging relatively higher prices to customers with relatively inelastic demand for a product – will, on balance, tend to benefit all customers as compared to, for example, uniform pricing.

III. DESCRIPTION OF THE EQUITY EXCHANGE INDUSTRY.

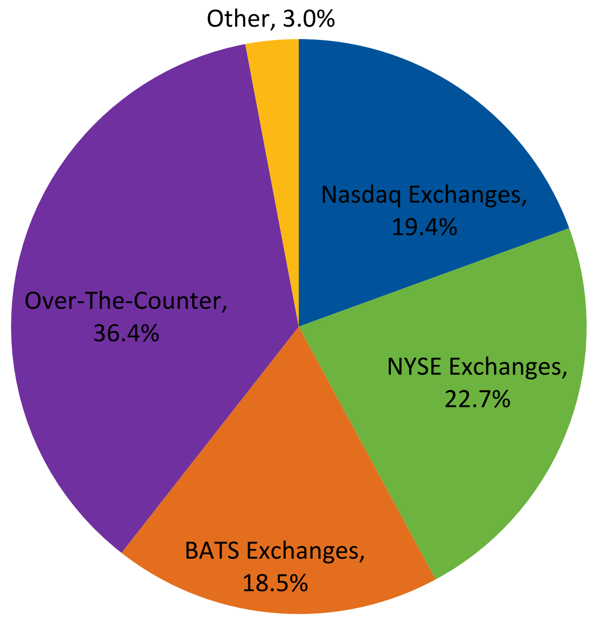
A. Background.

37. Trading exchange operators, including Nasdaq, the New York Stock Exchange (“NYSE”) and BATS Global Markets (“BATS”), compete by offering a portfolio of products that include the provision of trading services; listing services; connectivity services; and market data. The business of offering equity trading services is intensively competitive. Exchanges like those operated by Nasdaq, NYSE and BATS compete with each other to provide trading services; they also compete with a variety of alternate trading platforms that allow over-the-counter trading. Different trading exchanges or platforms may choose different pricing strategies for different services and competition between exchanges and alternate platforms will render a final verdict as to which of the various models best serve the needs of heterogeneous members of the investing public and, ultimately, the economy.

38. Over-the-counter trading comprises the activities of numerous entities, including dark pools. An alternative trading system that today trades as a dark pool might also choose to provide lit quotes in competition with exchanges, and, in the limit, become an exchange itself. Figure 2 presents the trading shares by exchange operator for 2018, as well as the aggregate share of over-the-counter trading. Figure 2 shows that no single exchange operator accounts for even 25 percent of trading in U.S. equities. Indeed, 50 percent more trades occur over-the-counter than on the exchanges of any single operator.

Figure 2

Exchange Operator and Over-The-Counter Shares of Trading, 2018



Source: Nasdaq.

39. Figure 3 shows trading shares by operator and aggregate over-the-counter share since 2008. The rapid rise of BATS, and the substantial increase in over-the-counter trading (including dark pools), indicates that the business of trading equities is not characterized by substantial barriers to entry or expansion.[14]

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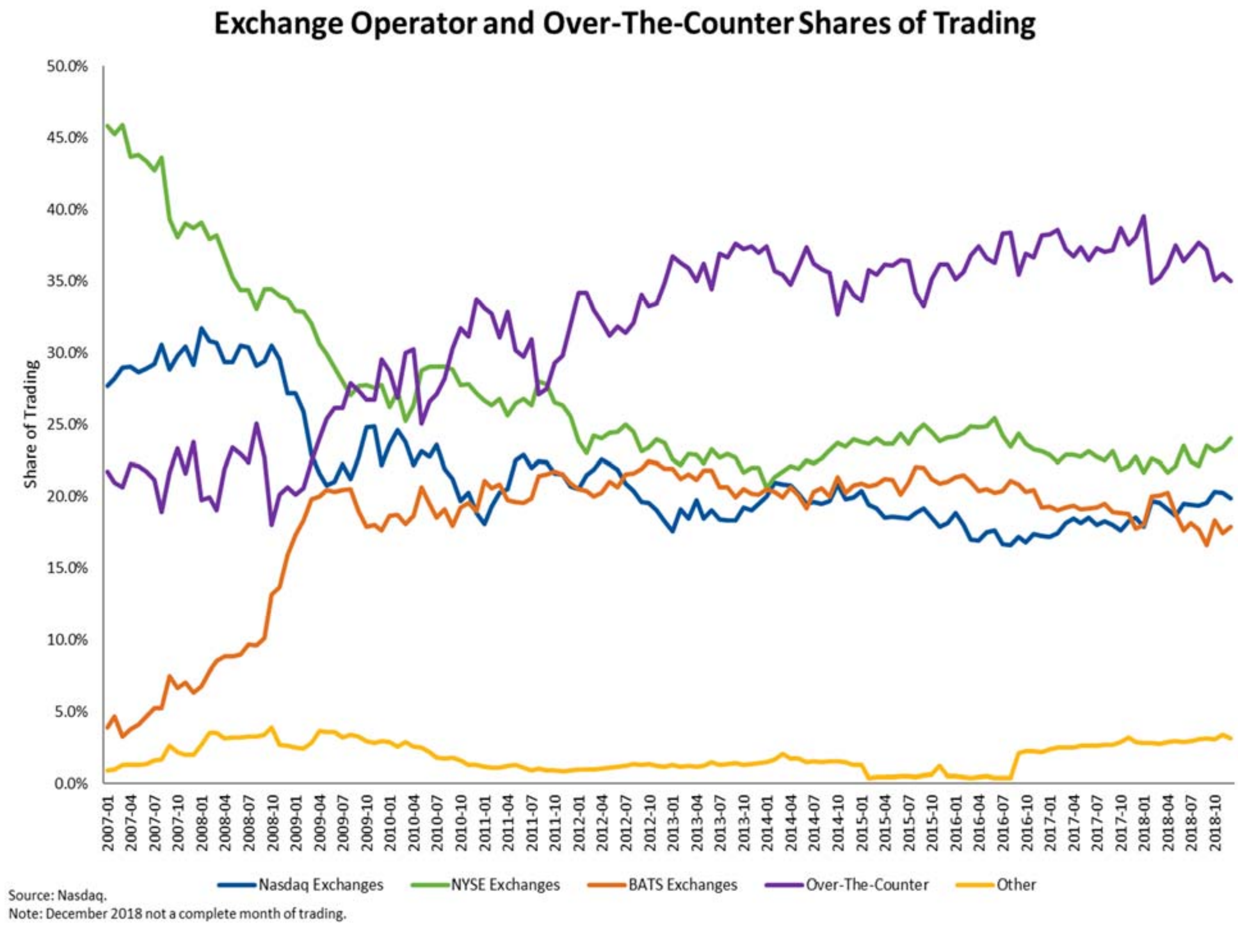
14. BATS acquired Direct Edge, a rival exchange operator, in 2014. Both BATS and Direct Edge began as alternative trading platforms. See Jacob Bunge, "BATS, Direct Edge in Talks to Merge: Deal Would Create Second-Largest U.S. Stock-Market Operator," *Wall Street Journal*, August 23, 2013 ("Direct Edge traces its roots to the 1998 launch of an electronic-trading platform called Attain. BATS was founded in 2005 by Tradebot, a high-frequency trading firm.").

Figure 3



40. The merger of BATS with rival exchange operator Direct Edge, which was approved by the SEC in 2014, has been described as further increasing the competition faced by Nasdaq and NYSE for the business of providing trading services:

> The merged Bats Global Markets, whose owners include Goldman Sachs Group Inc., Morgan Stanley, Credit Suisse (CSGN) Group AG, Citadel LLC, Citigroup Inc. (C) and KCG Holdings Inc. (KCG), will run four exchanges that claim more than 20 percent of daily equity volume to challenge NYSE for the most market share. NYSE and Nasdaq, which converted to public companies about a decade ago, have battled growing competition from Bats and Direct Edge as well as alternative trading venues run by some of the same Wall Street firms that once owned them. Combining the broker-owned exchanges will only heighten the threat, according to Brad Katsuyama, chief executive officer of IEX Group Inc., which runs a dark pool aimed at large investors. "The combination of Bats and Direct Edge now has all the large brokers sitting around the same table, which is definitely not a positive thing for NYSE and Nasdaq given the percentage of orders concentrated with these brokers," said Katsuyama, whose IEX venue plans to become an exchange.[15]

15. Sam Mamudi, Bloomberg, "Bats-Direct Edge Merger Puts Traders in Control of Venues," January 31, 2014.

41. BATS was acquired by CBOE Holdings in 2017. Before its acquisition, BATS was owned, in substantial part, by large users of trading services supplied by Nasdaq and others, including Bank of America Merrill Lynch, Citadel, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, Instinet, J. P. Morgan and Morgan Stanley. These and other firms can easily re-enter the exchange business. Indeed, some of the prior owners of BATS, as well as other major financial firms, recently announced "plans to launch a new low-cost stock exchange to challenge the New York Stock Exchange and Nasdaq Inc."[16] Owners of the proposed new exchange include Morgan Stanley; Fidelity Investments; Citadel; Bank of America Merrill Lynch; UBS; Virtu Financial Inc.; Charles Schwab; E*Trade; and TD Ameritrade.[17]

B. Exchanges Compete in a Variety of Ways.

42. Nasdaq competes with U.S. and foreign exchanges for listing services (i.e., whether a stock will be listed on Nasdaq, another U.S. exchange, or a foreign exchange). Once a stock is listed on a U.S. exchange, Nasdaq and its U.S. rivals compete to execute trades of shares in those stocks, no matter on which exchange a stock is listed (e.g., shares of Amazon or Microsoft can be traded on any U.S. equity exchange). Nasdaq also competes with U.S. exchanges for the sale of ancillary products, such as connectivity services and market data.

43. The provision of ancillary products such as connectivity services and market data is inextricably linked to the provision of trading services. If Nasdaq did not offer trading services, there would be no demand for its connectivity services, and, similarly, Nasdaq would have no market data to sell. Each of these products and services is generated, at least in part, from the same production technology – that is, a trading exchange created and maintained by Nasdaq. The business of providing trading services at the same time creates the business of

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16. Alexander Osipovich, Wall Street Journal, January 7, 2019, "Wall Street Firms Plan New Exchange to Challenge NYSE, Nasdaq: Morgan Stanley, Fidelity and Citadel Securities among backers of new 'Members Exchange'" ("WSJ 2019").
17. See WSJ 2019.

providing connectivity services (i.e., connections to the trading engine which makes trades) and market data (i.e., data on the trades made on the exchange). As we have discussed, multiple products or services that are generated by (are the output of) the same underlying production technology are joint products. For example, in the context of exchanges, quotes are a classic example of joint products: quotes (i) provide information on the possibility of trading on the exchange; and (ii) are a source of valuable market data. Quotes, in turn, are generally paid for through rebates and generate direct revenue streams.[18]

44. In order to obtain listings and garner transactions, Nasdaq and its rivals compete on the fees they charge and provide a host of financial incentives to participate on the exchange. Nasdaq and its rivals also compete on the quality and the breadth of services that they provide. Exchanges, including Nasdaq, compete for transactions, in part, by paying rebates to customers who provide liquidity by posting orders on the platform because, as we have discussed, all else equal, an exchange with a “deep book” is more attractive to liquidity takers (i.e., those market participants that wish to trade “at the market”). Nasdaq pays hundreds of millions of dollars per year in the form of liquidity rebates to induce customers to post orders on its exchange. These rebates are not just discounts from “list” prices but are “real” dollars. Indeed, as we have discussed, five of Nasdaq’s 10 largest customers for connectivity services in 2017 each received more in rebates from Nasdaq than the total of all the fees each customer paid to Nasdaq.

IV. THE PRICES OF NASDAQ’S CONNECTIVITY SERVICES CANNOT BE EVALUATED IN ISOLATION.

45. As we have discussed, it is commonplace in competitive industries for rival firms to choose different pricing strategies to offer a variety of different products, allowing customers to choose which product or combination of products best meets their needs. Just as a fitness

18. As of July 2018, we understand that all U.S. National Equities Exchanges except IEX paid rebates to at least some providers of liquidity.

center owner may offer a variety of products at different prices to appeal to different customers, Nasdaq offers a variety of connectivity services at different prices to appeal to different customers. Later in this section, we provide a detailed description of Nasdaq's connectivity services and how they are priced.

46. In prior sections of this statement, we explained that, given the economic characteristics of exchanges, it is not appropriate to evaluate the pricing of individual products or services in isolation.[19] That discussion applies to connectivity services. For example, it is not appropriate to evaluate whether Nasdaq has substantial market power by comparing the price of a connectivity service to the "marginal cost" of providing that service. For example, even if the marginal cost of providing a connection to an additional customer were only the cost of a cable connecting the customer to Nasdaq, it would be an economic error to claim that any price for the service that was more than the cost of the cable is evidence that Nasdaq exercises substantial market power in its sale of connectivity services or in some way harms the customer (who, as we have discussed, may be receiving substantial rebates from Nasdaq on another side of the platform), in the same way that if the marginal cost of providing software to an additional customer were zero, it would be an economic error to claim that any (positive) price for the software is evidence that the software's developer has substantial market power.

47. Nasdaq's portfolio of services includes a variety of connectivity and other data center services. These services include physical links, of varying types and capacities, between Nasdaq's systems and those of its customers, as well as virtual order entry "ports" into Nasdaq's systems that enable customers to engage in trading activity. Nasdaq offers different data center options for its customers to connect to its systems and receive information including

19. For competitive reasons, an exchange may respond to a rival's pricing on an individual product or service. For example, suppose that exchange A chooses to reduce the price of a service, such as connectivity services. All else equal, such a price reduction reduces the "all-in" price of trading in exchange A. Exchange B may respond to this increased competition from exchange A by reducing its price for connectivity services.

collocation, direct connectivity, point-of-presence connectivity, and connectivity to market data feeds. Similarly, Nasdaq offers different types of ports to perform different functions.

48. Nasdaq's connectivity services can be grouped into three categories: (1) connectivity for trading; (2) connectivity to market data feeds; and (3) ports. Connectivity services for trading (many of which can also be used for market data), themselves, take a variety of forms:

- Nasdaq offers customers the opportunity to purchase cabinet space in its Carteret, New Jersey data center and to collocate with its servers there. Pricing for collocation includes installation and monthly fees, and depends on the amount of dedicated or shared cabinet space that the customer wants to rent in the data center; the amount of power the customer requires; whether the customer needs to cross-connect with other customers or to telecommunications providers; the extent of the supporting services the customer requires (such as cooling fans, patch cords, equipment storage); the bandwidth of the connection it wants to purchase; and whether the customer wants Nasdaq to provide technical support services.
- Customers also may choose to connect their systems from a remote data center to Nasdaq's data center using a telecommunications circuit. Pricing for these "direct circuit" connections includes installation and monthly fees. Pricing depends upon the bandwidth of the customer's circuit connection to Nasdaq.
- Customers may directly connect to Nasdaq's switches at "points-of-presence" or "POPs," which are data centers located in geographic locations other than Nasdaq's Carteret facility. Nasdaq, in turn, connects these POPs to its Carteret facility. Pricing for POP connectivity includes installation and monthly fees; pricing depends upon the bandwidth of the customer's connection to the POP.

- Customers may connect to Nasdaq though Nasdaq-approved extranet providers. For this option, the extranet provider maintains a direct connection to Nasdaq and offers its clients access to that connection at varying bandwidths and prices.
- Finally, a customer may connect to Nasdaq by entering into an agreement to share access with a third-party technology provider or another broker-dealer ("service provider") that is collocated or has some form of connectivity in Nasdaq's data center. In certain instances, the service provider may offer the customer the ability to collocate with the provider or it may enable the customer to connect remotely. Pricing for this option is customized by the service provider.

49. In addition, connectivity to market data feeds can take the following forms:

- Nasdaq's customers purchase the ability to receive third-party market data feeds to which they subscribe via fiber optic connections. Pricing includes installation fees and monthly fees.
- Nasdaq's customers can also avail themselves of a low-latency wireless millimeter wave and microwave connectivity to market data feeds from Nasdaq and other exchanges; and they can also purchase dedicated wireless connections to popular exchange data centers. Pricing includes installation fees and monthly fees.

50. Ports provide customers with virtual gateways into various Nasdaq systems to perform tasks such as order entry, cancellation, and execution, trade reporting, routing, and risk management. Different types of ports support different data protocols, which in turn have different functionalities and latencies and work in different markets. Port access is billed on a monthly basis. Pricing for ports varies depending upon the exchange, the type of port, its usage, and in certain instances, the number of users assigned to the port. Customers often purchase multiple ports to ensure that they have adequate capacity to conduct their trading and other activities.

51. In general, connectivity services are inextricably linked to trading – almost every purchaser of Nasdaq's connectivity services also trades on a Nasdaq exchange. That is, most customers that purchase connectivity services do so as part of a portfolio of services including trading services. If Nasdaq did not offer an attractive exchange on which to trade – including the price of connectivity services – customers could reduce their trading on Nasdaq exchanges (e.g., by posting liquidity on other exchanges). As we have discussed, it is not appropriate to evaluate whether Nasdaq has substantial market power by analyzing Nasdaq's prices on individual products when those products are part of a portfolio offered by Nasdaq to its customers.

52. Indeed, as we noted in an earlier section, half of Nasdaq's 10 largest purchasers of connectivity and other data center services in 2017 received more from Nasdaq in rebate payments than they paid Nasdaq for all services, so that those customers paid an overall negative price for the portfolio of services they purchased from Nasdaq. We see no economic basis for any claim that any of those customers somehow paid a higher-than-competitive price for connectivity services. The overarching conclusion is that the pricing of connectivity services should not be analyzed in isolation. The proper approach from the economics and public policy standpoint is to view connectivity as one of the services that Nasdaq offers that is related to its trading function and which is produced on a platform that is characterized by joint and common costs as well as inter-side externalities. As such, it is appropriate to assess Nasdaq's pricing decisions in their totality from the vantage point of inter-exchange competition.

Appendix A

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EDUCATION

1968-1973 Columbia University, New York, New York
Graduate Department of Economics and European Institute of the School of International Affairs
Doctoral Dissertation: Three Essays on Economic Theory (May 1973), Ph.D. 1973

1967-1968 McGill University, Montreal, Canada
Departments of Economics and Political Science

1963-1966 Warsaw University, Warsaw, Poland
Department of Political Economy, B.A. (equiv.), 1966

HONORS

2016 "2016 Competition Economist Individual Expert of the Year," voted by Who's Who Legal

2015 "2015 Competition Economist Individual Expert of the Year," voted by Who's Who Legal

2011 "The Economist of the Year 2010" voted by the Global Competition Review

1973 Columbia University: Highest distinction for the doctoral dissertation

1971-1972 Columbia University: Honorary President's Fellow

1969-1971 Columbia University: President's Fellow

1967-1968 McGill University: Honors Student

1964, 1965 Warsaw University: Award for Academic Achievement, Department of Political Economy

Who's Who in the World
Who's Who in America
Who's Who in the East

PROFESSIONAL EXPERIENCE

September 2015-present Emeritus Professor of Economics, Dept. of Economics, NYU

June 1982 - 2015 Professor of Economics
Department of Economics, New York University, New York, New York

Sept. 1996 - Aug. 2001	Director of Masters in Economics Program Department of Economics, New York University, New York, New York
Summer 1996-2000	Lecturer International Program on Privatization and Reform Institute for International Development, Harvard University, Cambridge, Massachusetts
Aug. 1991 - Oct. 1992	Deputy Assistant Attorney General for Economics Antitrust Division United States Department of Justice, Washington, D.C.
Sept. 1989 - July 1990	Visiting Professor of Economics School of Management, Yale University, New Haven, Connecticut Lecturer in Law Yale Law School
Mar. 1984 - June 1988	Visiting Professor of Economics Universita Commerciale "Luigi Bocconi," Milan, Italy
June 1982 - Feb. 1985	Director of Graduate Studies Department of Economics, New York University
Sept. 1982 - June 1986	Adjunct Professor of Law (part-time) Columbia University Law School, New York, New York
Feb. 1982 - June 1982	Acting Director of Graduate Studies Department of Economics, New York University
June 1978 - June 1982	Associate Professor of Economics Department of Economics, New York University
Sept. 1979 - May 1990	Lecturer in Economics and Antitrust New York University Law School
Sept. 1977 - June 1978	Member, Technical Staff Bell Laboratories, Holmdel, New Jersey Associate Professor of Economics Columbia University Visiting Research Scholar Center for Law and Economics, University of Miami, Miami, Florida
Sept. 1973 - Aug. 1977	Assistant Professor of Economics New York University
Summer 1976	Fellow, Legal Institute for Economists, Center for Law and Economics, University of Miami
Summer 1976	Visiting Researcher Bell Laboratories, Holmdel, New Jersey

OTHER PROFESSIONAL ACTIVITIES

2011	Organizer Session on the 2010 Agencies Horizontal Merger Guidelines, 2011 Spring Meetings, Antitrust Section, American Bar Association, Washington DC
2010 – present	Member ABA Section of Antitrust Law, Economics Task Force
2006 - present	Special Consultant Compass Lexecon (formerly Compass), an FTI Company, Washington, D.C.
2003 - 2006	Director Competition Policy Associates, Inc. ("Compass"), Washington, D.C.
1997 – 1999	Consultant Inter-American Development Bank, Washington, D.C.
1997 – 2009	Board of Editors *Antitrust Report*
1995 – 2001	Consultant The World Bank, Washington, D.C.
1998 – 2004	Senior Consultant Applied Economic Solutions, Inc., San Francisco, California
1995 - 2000	Senior Affiliate Cornerstone Research, Inc., Palo Alto, California
Various	Testimony at Hearings of the Federal Trade Commission
1994 - 1996	Senior Affiliate Law and Economics Consulting Group, Emeryville, California
1994 - 2000	Senior Affiliate Consultants in Industry Economics, LLC, Princeton, New Jersey
1993 - 1994	Director Consultants in Industry Economics, Inc., Princeton, New Jersey
1992 - 1993	Vice-Chair (*pro tempore*) Economics Committee, American Bar Association, Chicago, Illinois
1990 - 1991 1992 - 1995	Senior Consultant Organization for Economic Cooperation and Development, Paris, France
1991	Member *Ad hoc* Working Group on Bulgaria's Draft Antitrust Law The Central and East European Law Initiative American Bar Association
1990 - 1991	Advisor Polish Ministry of Finance and Anti-Monopoly Office Warsaw, Poland

1990 - 1991	Member Special Committee on Antitrust Section of Antitrust Law, American Bar Association
1990 - 1991	Director and Senior Advisor Putnam, Hayes & Bartlett, Inc., Washington, D.C.
1990 - 1996	Member Predatory Pricing Monograph Task Force Section of Antitrust Law, American Bar Association
1989	Hearings on Competitive Issues in the Cable TV Industry Subcommittee on Monopolies and Business Rights of the Senate Judiciary Committee Washington, D.C.
1989	Member EEC Merger Control Task Force, American Bar Association
1988 - present	Associate Member American Bar Association
1987 - 1989	Adjunct Member Antitrust and Trade Regulation Committee, The Association of the Bar of the City of New York
1984	Speaker, "Industrial and Intellectual Property: The Antitrust Interface" National Institutes, American Bar Association, Philadelphia, Pennsylvania
1983 - 1990	Director Consultants in Industry Economics, Inc.
1982	Member Organizing Committee Tenth Annual Telecommunications Policy Research Conference, Annapolis, Maryland
1981	Member Section 7 Clayton Act Committee, Project on Revising Merger Guidelines American Bar Association
1980	Organizer Invited Session on Law and Economics American Economic Association Meetings, Denver, Colorado
1978 - 1979	Member Department of Commerce Technical Advisory Board Scientific and Technical Information Economics and Pricing Subgroup
1978 – present	Referee for numerous scholarly journals, publishers, and the National Science Foundation

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

American Economic Association
American Bar Association

PUBLICATIONS

A. Journal Articles

"FRAND and the Smallest Saleable Unit," with J. Kattan and A. Shampine, *Antitrust Chronicle,* September, vol. 1, Autumn 2016, available at www.competitionpolicyinternational.com

"Exclusionary Discounts," with Greg Shaffer, *International J. of Industrial Org.*, vol. 31, 569-86, September 2013

"Coordinated Effects in Merger Analysis: An Introduction," *Columbia Bus. Law Review*, No. 2, 2007, 411-36.

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"Archimedean Leveraging and the GE/Honeywell Transaction," with R. J. Reynolds, *Antitrust Law Journal*, vol. 70, no. 1, 2002, 171-98.

"Entrepreneurship, Access Policy and Economic Development: Lessons from Industrial Organizations," with M. A. Dutz and R. D. Willig, *European Economic Review*, vol. 4, no. 4-6, May 2000.

"Parity Pricing and its Critics: Necessary Condition for Efficiency in Provision of Bottleneck Services to Competitors," with W. J. Baumol and R .D. Willig, *Yale Journal on Regulation*, vol. 14, Winter 1997, 146-63.

"Competition and Trade Law and the Case for a Modest Linkage," with E. Fox, *World Competition, Law and Economics Review*, vol. 19, December 1995, 5-34.

"On the Perils of Vertical Control by a Partial Owner of Downstream Enterprise," with W.J. Baumol, *Revue D'économie industrielle*, No. 69, 3e trimestre 1994, 7-20.

"Competition Policy for Natural Monopolies in Developing Market Economy," with R.W. Pittman and P. Clyde, *Economics of Transition*, vol. 2, no. 3, September 1994, 317-343. Reprinted in B. Clay (ed.), *De-monopolization and Competition Policy in Post-Communist Economies*, Westview Press 1996, 159-193.

"The 1992 Agency Horizontal Merger Guidelines and the Department of Justice's Approach to Bank Merger Analysis," with M. Guerin-Calvert, *Antitrust Bulletin*, vol. 37, no. 3, 667-688. Reprinted in *Proceedings of the 1992 Conference on Bank Structure and Competition: Credit Markets in Transition*, Federal Reserve Bank of Chicago, 1992, 541-560.

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“Herfindahl Concentration, Rivalry and Mergers,” with A. O. Sykes and R. D. Willig, *Harvard Law Review*, vol. 95, June 1982, 1857-1875.

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“Costly Litigation and the Tort Law: Single Activity Accidents,” *Journal of Legal Studies*, June 1978, 243-261.

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Regulation of Economic Activity Program, National Science Foundation, Microeconomic Analysis of Antitrust Policy, Principal Investigator, April 1, 1983 - March 31, 1984.

Economics Division of the National Science Foundation, "Political Economy of Taxation," Principal Investigator, Summer 1982.

Sloan Workshop in Applied Microeconomics (coordinator), with W.J. Baumol (Principal Coordinator), September 1977 - August 1982.

Economics Division of the National Science Foundation, “Collaborative Research on the Theory of Optimal Taxation and Tax Reform,” July 1979 to September 1980, with E.S. Phelps.

Division of Science Information of the National Science Foundation for Research on “Scale Economies and Public Goods Properties of Information,” W.J. Baumol, Y.M. Braunstein, M.I. Nadiri, Fall 1974 to Fall 1977.

National Science Foundation Institutional Grant to New York University for Research on Taxation and Distribution of Income, Summer 1974.

Appendix B

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EDUCATION

Ph.D., UNIVERSITY OF CHICAGO, 1987, GRADUATE SCHOOL OF BUSINESS

M.B.A., UNIVERSITY OF CHICAGO, 1984, GRADUATE SCHOOL OF BUSINESS

B.A., SOUTHWESTERN AT MEMPHIS, 1981

EMPLOYMENT

COMPASS LEXECON (formerly Lexecon), Chicago, Illinois (3/87-Present): Executive Vice President

UNIVERSITY OF CHICAGO, (1984, 1986): Lecturer

GOVERNORS STATE UNIVERSITY, (1986): Community Professor

UNIVERSITY OF CHICAGO, (1982-1986): Teaching Assistant

UNIVERSITY OF CHICAGO, (1982-1986): Research Assistant

ACADEMIC HONORS AND FELLOWSHIPS

University of Chicago Fellowship, 1981-1984

H.B. Earhart Fellowship, 1985-1986

RESEARCH PAPERS

"Antitrust and Higher Education: Was There a Conspiracy to Restrict Financial Aid?" co-authored with D. Carlton and R. Epstein, RAND Journal of Economics, (Vol. 26, No. 1, Spring 1995, pp. 131-147).

“Antitrust and Higher Education: MIT Financial Aid (1993),” co-authored with D. Carlton, in The Antitrust Revolution: Economics, Competition, and Policy, John Kwoka and Lawrence White, eds., 1998.

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Affidavit and Testimony of Gustavo Bamberger, Between Uber Canada Inc., Uber B.V., Rasier Operations B.V., Uber International B.V., and Uber Technologies Inc., Applicants and City of Toronto: Ontario Court Of Justice, Information Nos. 58949, 58950, 58952, 59023, 59024, April 13, 2017 (Affidavit); and July 7, 2017 (Testimony).

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