Make and Take Fees in the U.S. Equity Market

Laura Cardella[a], Jia Hao[b], and Ivalina Kalcheva[c*]

[a]Rawls College of Business
Texas Tech University

[b]Stephen M. Ross School of Business
University of Michigan

[c]School of Business Administration
University of California, Riverside

September 9, 2014

Abstract

We study the effect of liquidity-based make and take trading fees, charged by the U.S. stock exchanges, on market outcomes for the period 2008 – 2010. Our exchange-level analysis reveals that an exchange's trading activity is decreasing in its net fee (the net difference between the access fee and the liquidity rebate) relative to that of other exchanges and that an increase in the take fee decreases trading activity relatively more than an increase in the make fee. These changes in trading volume are generally not accompanied by a significant change in quoted or net-of-fees spreads, at least not at the exchange level in the aggregate.

Keywords: maker-taker, taker-maker, fees, rebates, access fees, liquidity rebates, spread, volume
JEL classification codes: G1, G2

*The emails for the authors are laura.cardella@ttu.edu, jiahao@umich.edu, and ivalina.kalcheva@ucr.edu, respectively. The authors are indebted to Hank Bessembinder. The authors also thank Robert Battalio, David Brown, Eric Cardella, George Cashman, Jack Cooney, Sanjiv Das, Robert Hendershott, Hoje Jo, Chris Lamoureux, Laurence Lescourret, Andrei Nikiforov, Glenn Pfeiffer, Atulya Sarin, Rick Sias, Rick Smith, Robert Van Ness, Drew Winters, Kuncheng Zheng as well as seminar participants at the Financial Management Association 2012 Conference (FMA NASDAQ Best Paper Award in Market Microstructure), University of Arizona, Texas Tech University, Wayne State University, Santa Clara University, West Virginia University, University of California - Riverside, University of Mississippi, Chapman University and the European Financial Management Association 2014 Conference (EFMA) for helpful comments. Earlier versions of this manuscript were titled "Competition in Make-Take Fees in the U.S. Equity Market."

1. Introduction

In recent years, equity and options markets in the U.S. and Europe have been charging fees or paying rebates on a per-share basis upon order completion, based on whether an order takes or makes liquidity. Orders that "take" liquidity, are marketable orders, which are either market orders or buy (sell) limit orders whose limits are at or above (below) the current market price. Conversely, orders that "make" liquidity, are nonmarketable orders, which are orders to buy (sell) limit orders with a limit price below (above) the current market price.[1] With the implementation of these fees and rebates, depending on whether an order makes or takes liquidity, the platforms attempt to alter the relative supply of liquidity provision versus demand in order to attract order flow, increase the number of transactions, and ultimately, boost revenue. Typically, customers' orders that make liquidity, are given a rebate by the exchange, while customers' orders taking liquidity, are charged a fee by the exchange (also called an access fee).[2] However, it is possible, although not common, for exchanges to charge a fee to orders that make liquidity, and provide a rebate to orders that take liquidity. A rebate is essentially a negative fee from the perspective of an exchange. Thus, for the remainder of the paper we will refer to an exchange's positive fees (i.e., fees charged to market participants by the exchange and thus inflows) as well as negative fees or rebates (i.e., outflows) as "*fees*." We denote the net fee charged by an exchange, which is the sum of the make fee and take fee (equivalent to the net difference between the access fee and the liquidity rebate), as the *total fee*; a positive total fee provides revenue for the exchange, when trades are completed, for providing services (Colliard and Foucault (2012), Harris (2013)).[3]

In the U.S., the use of these liquidity-based trading fees became widespread after the

[1] SEC's Regulation National Market System (Reg NMS) defines accessing or taking liquidity as those orders that execute against a protected quotation on an exchange.

[2] Liquidity rebates for equities are often of the order of magnitude of 20 cents per 100 shares, while fees for removing liquidity are usually 25 cents per 100 shares. Rule 610(c) of Regulation NMS caps the take access fees for equities to 30-cents per 100 shares. According to Citadel, in June 2010, the access fee cap equaled approximately 0.0160% of the average stock execution price for retail investors (`http://www.sec.gov/comments/s7-09-10/s70910-19.pdf`).

[3] Some of the services that the exchanges offer are collecting orders, displaying orders when permitted, and arranging trades when possible (Harris, 2013).

implementation of the SEC's Regulation National Market System (Reg NMS) in 2007, and by 2010, all 14 registered equity exchanges in the United States employed these trading fees. The recent debate focuses on whether these trading fees should be banned and is primarily centered on the effect of these fees on particular types of market participants, (e.g., high-frequency traders or retail traders), or particular types of securities (e.g., more liquid or less liquid). An important question is what is the effect of liquidity-based trading fees on the benefits obtained by all parties involved - makers, takers, and exchanges (Foucault, 2012). In this paper, we take on the task of empirically examining the impact of the liquidity-based make and take trading fees on market outcomes from the perspective of exchanges. In particular, we start from the premise that the objective of an exchange is to maximize revenue, and thus the primary concern for exchanges is how fees affect trading volume and market share (Ibid.).[4] An exchange will care about the impact of the fees on the bid-ask spread insofar as a small bid-ask spread makes the platform more attractive for takers (Ibid.). Our analysis of the effect of liquidity-based trading fees focuses on the overall benefit for the market as a whole (i.e., the total effect to both make and take sides of the market), rather than addressing the impact of the fees to participants on a specific side of the market or the equilibrium prices in the market. In this paper, by means of exchange-level analysis, we explore the effect of make and take fees on trading volume, market share, and the bid-ask spread across exchanges.

To assess the relation between liquidity-based fees, and trading volume, market share, and quoted and net-of-fees spreads, we construct a sample that includes data from January 1, 2008 to December 31, 2010 across all registered exchanges in the U.S.[5] Fee data is hand-collected from the SEC filings and press announcements and includes: make fees, take fees and the

[4]In recent years, the listing and trading functions of exchanges have been decoupled, and trading has fragmented across trading venues as new entrants such as BATS-X, BATS-Y, Direct Edge, and the like, have gained significant market share.

[5]The list of registered exchanges is available at `http://www.sec.gov/divisions/marketreg/mrexchanges.shtml`. Our sample includes the NYSE Amex LLC (formerly the American Stock Exchange), BATS Exchange Inc., BATS Y-Exchange Inc., NASDAQ OMX BX Inc. (formerly the Boston Stock Exchange), Chicago Board Options Exchange Incorporated (CBOE Stock Exchange [CBSX]), Chicago Stock Exchange Inc., EDGA Exchange, Inc., EDGX Exchange, Inc., International Securities Exchange LLC (ISE), the Nasdaq Stock Market LLC, National Stock Exchange Inc. (formerly the Cincinnati Stock Exchange), New York Stock Exchange LLC, NYSE Arca Inc., and NASDAQ OMX PHLX Inc. (formerly Philadelphia Stock Exchange).

corresponding total fees. Exchanges have different fees for securities listed on three "Tapes." Tape A securities are listed on the NYSE exchange, Tape B securities are listed on the NYSE-Arca-, Amex-, and regional exchanges, and Tape C securities are Nasdaq listed. We record the fees for each tape and exchange and conduct our analysis at the exchange level. The sample includes 108 tape-exchange fee-change events. We study make and take fees from the perspective of the exchanges rather than that of market participants or individual firms.

We find evidence that an increase in an exchange's total fee is associated with a reduction in the exchange's trading volume and the corresponding market share. Our results show that a reduction by 1 cent per 100 shares 19.04% reduction in the total revenue per day on an exchange. We further find that an exchange's volume and market share are not equally sensitive to changes in make versus take fees. In particular, we document that an increase in the take fee decreases trading activity relatively more than an increase in the make fee. Therefore, revenue from a 1 cent increase in take fee is less than revenue from a 1 cent increase in the make fee. On the flip side if the take fee is reduced by 1 cent the exchange' revenue decreases 17.51%, while if the make fee is reduced by 1 cent the exchange's revenue decreases 18.91%. Therefore, an exchange can reduce its revenue less by reducing its take fee rather than its make fee. The results in terms of trading volume and market share are driven primarily when the exchange's quoted spread is small.

Interestingly, at the exchange level in the aggregate, a change in the exchange's trading activity, due to a change in liquidity-based trading fees, does not occur concurrently with a change in the exchange's quoted and the net-of-fees spreads. We document, however, that an exchange's quoted and net-of-fees spread decrease in its own trading activity and increase in the trading activity on the rivals exchanges.

A minor amount of evidence shows that the quoted bid-ask spread estimated in dollar terms is negatively related to the take fee but not to the make fee when the exchange's quoted spread is small. This suggest that an increase in the take fee leads to an increase in the bid price and/or a decrease in the ask price posted by investors submitting nonmarketable orders. This may be due to investors being more willing to pay a concession for an immediate execution

when the quoted spread is already small.

Therefore, our results suggest that from the exchange's perspective, a change in the liquidity-based trading fees have an economically significant effect on the exchange's trading volume and market share and ultimately on the exchange's revenue but not on the aggregated, exchange level, quoted and net-of-fees spread.[6] This result is not irreconcilable with a hypothesis that the effect of these trading fees on the transaction costs is nontrivial for a particular type of a market participant and trading strategy in a particular security.

The next section provides an overview of the history and structure of the liquidity based trading fees. Section 3 reviews the related literature and develops our empirical predictions. Section 4 explains the design of our empirical tests, introduces the variables of interest, and provides summary statistics of our sample. The results are reported in Section 5 and 6. Section 8 discusses robustness tests. Section 9 concludes.

2. History and Overview of Liquidity Based Trading Fees

The origins of the liquidity based trading fees can be traced back to the 1990s. A trading platform called Island, an electronic communications network (ECN), opened doors in 1996 to begin competing with Nasdaq Stock Market. In 1997, Jeff Citron and Josh Levine, who developed Island ECN, decided to pay a rebate to brokers who added liquidity and charge a fee for brokers who took liquidity. Matthew Andersen, who was chief executive of Island at the time said that they hoped to jump-start the market, and that turned out to be exactly correct (Spicer, 2009). With the strategy of paying rebates for adding liquidity, Island's market share of reported Nasdaq trades increased from approximately 3% in 1997 to almost 13% in 1999 and in many of the most active Nasdaq-listed stock Island was the number one daily market participant ahead of all other market makers and ECNs.[7] Every ECN and exchange soon followed, and the rivalry in attracting order flow through liquidity rebates (and take fees) reached its climax when Attain ECN charged non-subscribers a 150 cent per 100 shares access

[6] We acknowledge that specific securities' trading volume and market share can be affected differently by fee changes depending on firm characteristics. The security-level analysis is not studied in the current paper.

[7] The historical growth of Island can be found at `http://www.hofstra.edu/pdf/biz_mlc_concannon1.pdf`.

fee in 1998 (Harris, 2013). At the time, the SEC issued an interpretive letter that limited access fees to 30 cents per 100 shares, also known as 30 mils, and in 2005, Rule 610(c) of Reg NMS formally capped the take access fees for equities to 30-cents per 100 shares (Ibid.).

In the mid 2000s, the pricing structure of liquidity-based fees and rebates gained widespread adoption as a standard pricing model across equity and options markets in the U.S. and Europe.[8] From an exchange's perspective, the liquidity-based fees can be either positive or negative; when fees are negative, they are rebates from the exchange to the traders.[9] That is, exchanges may elect to subsidize one side, the make or the take, in order to balance any discrepancies in participation rates between makers and takers of liquidity.[10] In the typical structure, the term "make fee" is often used to refer to the rebate paid by the exchange to the market participant associated with providing liquidity, and the terms "take fee" or "access fee" is often used to refer to fee paid by the market participant to the exchange associated with removing liquidity. Empirically, the make fee is most often a rebate from the exchange to the market participant for orders that add liquidity. The idea is that exchanges pay rebates to liquidity makers to increase the number of non-marketable orders, which increases liquidity and, in turn, attracts marketable orders. Consequently, the increased number of executed transactions generates revenue for the

[8]These liquidity-based fees are different from the so called "SEC Fees." Under Section 31 of the Securities Exchange Act of 1934, self-regulatory organizations (SROs) – such as the Financial Industry Regulatory Authority (FINRA) and all of the national securities exchanges – must pay transaction fees to the SEC based on the volume of securities that are sold on their markets. These fees are designed to recover the costs incurred by the government, including the SEC, for supervising and regulating the securities markets and securities professionals. More information on these fees could be found at: `http://www.sec.gov/answers/sec31.htm`. The most recent level of the Section 31 Fees could be found at: `http://www.sec.gov/divisions/marketreg/mrfreqreq.shtml`.

[9]The trading fees are closely related to the literature on payment for order flow, which generally refers to the practice of dealers or trading locales paying brokers for retail order flow (Easley, Kiefer, and O'Hara, 1996; Blume and Goldstein, 1997; Kandel and Marx, 1999; Battalio and Holden, 2001; Battalio, Shkilko, and Van Ness, 2011). Traditionally, it is reported that this payment is approximately 1 to 2 cents per share from the market maker to the retail broker for orders that the retail broker sends to the market maker. Payment for order flow is similar to negative take fees that are payments to investors submitting market orders (see the discussion in footnote 13 in Colliard and Foucault (2012)).

[10]The trading fees are also closely related to the industrial organization literature on "two-sided markets." Two-sided markets are defined by Rochet and Tirole (2006) as "markets in which one or several platforms enable interactions between end-users (buyers and sellers) and try to get the two sides "on board" by appropriately charging each side. That is, platforms court each side while attempting to make, or at least not lose, money overall." A two-sided market is one in which the volume of transactions between the end users depends on the structure of the fees and not only on the overall level charged by the platform . Specifically, the price structure (the distribution of the total fee between maker and takers) affects the economic outcome (volume, profits, efficiency and/or welfare) (see p.657 in Rochet and Tirole (2006)).

platform and increases its market share with respect to its competitors. Alternatively, if an exchange were to observe many nonmarketable orders but few transactions, it can choose to reduce fees or provide rebates to liquidity takers. For example, in 2010, BATS-Y advertised that they offered a rebate of $0.02 per 100 shares for traders removing liquidity.[11]

In terms of the magnitude of the liquidity-based trading fees charged by equity exchanges, rebates for liquidity provision are often of the order of magnitude of 20 cents per 100 shares, while fees for removing liquidity are usually 25 cents per 100 shares. Thus, the net revenue exchanges earn from these fees is the sum of the make fee and the take fee, i.e., the total fee is 5 cents per 100 shares. A negative total fee has also been observed in practice. For example, in 2009, Direct Edge introduced a fee structure involving a rebate of 32 cents per 100 shares and a removal rate of 28 cents per 100 shares resulting in a loss to the exchange on the amount of 4 cents per 100 shares. It has been argued by practitioners that one possible motivation for implementing this strategy is to gain market share in a long term.

Exchanges have different fees for securities listed on each of the three Tapes. Tape A securities are listed on the NYSE exchange, Tape B securities are listed on the NYSE-Arca-, Amex-, and regional exchanges, and Tape C securities are Nasdaq listed. Exchanges also typically have adopted multiple levels of "tiered" pricing, based on volume and liquidity provision. That is, exchanges offer more attractive high-tier pricing to high-volume market participants (based on a minimum total executed volume per month) who also provide high levels of liquidity (based on a minimum limit order volume per month), while other traders who do not meet these thresholds are charged the less attractive basic-tier pricing. Compared with basic tier pricing, rebates are higher and take fees are lower for the higher tier pricing levels.[12] The tier pricing is evaluated over the prior month and fees are assessed on a monthly basis.

Even though exchanges have diversified revenue sources, trading fees are an important source

[11]Nasdaq OMX BX, Direct Edge's EDGA, and CBSX exchanges have operated similar pricing structures.

[12]Overtime, these tiers have become increasingly complex and segmented based on liquidity provision, removal, and overall volume. Since 2010, unique tiers have emerged including tiers specifically for market participants removing large amounts of liquidity and tiers specifically for participants submitting large blocks of displayed liquidity. Alternatively, BATS exchange has maintained a simplified pricing structure without tiers. As a result complex trading fees on some exchanges, the transparency of fees and rebates have been called into question.

of revenue.[13] For example, in 2010 Nasdaq reported that revenue from take fees totaled $1.600 billion, while make side rebates totaled $1.094 billion, which generated a total fee revenue of $0.506 billion (2010 10K Report). To put this in perspective, Nasdaq's net income in 2010 was $0.395 billion. Further, exchanges potentially earn significant revenue from the sale of trade and quote data; this magnifies the importance of trading activity, which depends, in part, upon the pricing structure of liquidity based trading fees.

On one hand, trading fees represent revenue for the exchanges, however, there are also costs associated with make and take fees (Angel, Harris, and Spatt (2011, 2013) and Harris (2013)). Some of the main considerations that arise with the adoptions of make and take fees and rebates include: (1) an agency problem between brokers and their clients when the clients do not receive the liquidity rebates or when business models prevent brokers from passing on the access fees; (2) a transparency problem since quoted spreads are different from the more economically meaningful net-of-fee spreads; and (3) an incentive to route market orders for execution in venues that do not charge access fees like dealers who internalize their client order flows, dealers who pay brokers to preference their customers orders them, and various dark pools that match buyers and sellers (Ibid.). A detailed discussion and possible solutions to these issues can be found in Angel, Harris, and Spatt (2011, 2013) and Harris (2013).

3. Related Literature Review and Empirical Predictions

In this paper, we study how liquidity-based trading fees affect equity markets outcomes from the perspective of the exchanges. Specifically, we first, examine the relation between liquidity-based trading fees and an exchange's trading activity, as measured by the volume of transacted shares and the corresponding market share (the percentage of the total number of transacted shares on all exchanges accounted by the volume of transacted shares by an exchange). Second, we investigate the relation between the liquidity-based trading fees and an exchange's quoted and net-of-fees spreads.

[13]Exchanges have gone through "demutualization," where a nonprofit member-owned mutual organization is transformed into a for-profit shareholder corporation, and if publicly traded like Nasdaq, must file a 10K Report (Macey and O'Hara, 2005).

Understanding how liquidity-based trading fees impact exchange's volume of transacted shares is of clear importance given that an increase in the volume of transacted shares improves market welfare, i.e., it benefits the participants on both the make and take sides of the market (Alexandrov and Spulber, 2013; Rochet and Tirole, 2003). That said, it is important to better understand how liquidity-based trading fees charged by exchanges impact trading volume (number of transacted shares) across exchanges. Besides looking at exchange's trading volume in number of shares we also look at the corresponding market share of the exchange's trading volume as a measure of trading activity. The market share of an exchange's trading volume is closely related to the exchange's profitability; hence, increasing market share is an important objective and valuable consideration of an exchange's business strategy. More importantly, while the number of total transacted shares on an exchange could be considered an "internal measure," market share is a relative measure against external benchmarks.

Theory suggests that all else equal a platform's trading volume and market share could be either negatively or positively related to the total fee it charges (Colliard and Foucault, 2012; Brolley and Malinova, 2012). One would generally expect the "demand for trading" to decrease with an increase in an exchange's total fee, i.e., a downward sloping demand curve for trading (Foucault, Kadan, and Kandel, 2013; Colliard and Foucault, 2012; Constantinides, 1986). However, an increase in the total fee can be associated with an increase in trading activity, i.e., an upward sloping demand curve for trading, due to heterogeneous patience levels across investors (Colliard and Foucault, 2012). Specifically, with an increase in the net fee, patient investors submit more aggressive quotes, increasing the likelihood of a transaction. By empirically examining how total fees impact trading activity at the exchange level, we are able to shed light on which of these hypotheses holds.[14]

The more interesting question is whether trading activity is more sensitive to fee changes on one side of the market. If the answer is yes, then an exchange could potentially influence market

[14]Exploring the relationship between trading activity and the total fee charged by the exchange is not inconsistent with the view of markets as being two-sided. As shown in Alexandrov and Spulber (2013), a two-sided market can be characterized as a one sided market in which the intermediary is concerned with the difference between the demand and supply of the two sides of the market.

outcomes, such as trading activity and ultimately expected profit, by changing the allocation of fees between make and take sides, all else equal (Rochet and Tirole, 2003, 2006; Foucault, Kadan, and Kandel, 2013). Therefore, studying the sensitivity of trading activity to the take fee versus the make fee is important for the exchanges. We empirically explore the extent to which the sensitivities of the trading activity are different to changes in the make fee and the take fee.

Theoretical models predict that the trading activity will decrease in both the make and the take fee (Constantinides (1986), Foucault, Kadan, and Kandel, 2013). Following the intuition of endogenous trading as in Constantinides (1986) trading activity decreases in both the make and the take fees. If trading is endogenous, investors accommodate large fees by reducing the frequency and volume of trade (Constantinides, 1986). Said differently, investors alleviate the cost by reduced trading and because the utility costs of not trading are small.[15] Using the intuition of endogenous trading, if the make fee is increased, the makers can be better off refraining from posting nonmarketable orders, which will reduce the overall number of executed transactions between makers and takers. Similarly, if the take fee is increased, the takers can be better off refraining from posting marketable orders which will also reduce the overall number of executed transactions between makers and takers. Foucault, Kadan, and Kandel (2013) theoretical model also predicts that the trading activity will decrease in both the make and the take fee. The intuition however is different. Traders, in the Foucault, Kadan, and Kandel (2013) model, must monitor the market and react fast to grab profitable opportunities. The amount of monitoring depends on the potential benefits vs. the costs of monitoring. Traders monitoring decisions are determined by the trading fees, where a reduction in the trading fees is essentially a decrease in the cost of monitoring. Any change in the aggregate monitoring intensities translates into a change in the same direction for the trading activity. For example, an increase in the makers's monitoring cost reduces their individual monitoring levels, other things being equal. The marginal benefit of monitoring for takers is then smaller as they are

[15]Constantinides (1986) presents and equilibrium model with a risky and riskless assets. The investor intends to maintain a constant ratio of the two assets, which requires continuous costly rebalancing. Thus, a no-trade zone arises around the optimal ratio. The no-trade zone will be wider the greater the cost of trading.

less likely to find a good price when they inspect the market. Consequently, takers monitor the market less intensively, even though their own monitoring cost has not changed.

Given the above, we expect to find that both the make and the take fee to be negatively related to trading activity. Holding the make fee constant, an increase in the take fee will reduce the exchange's trading activity and vice versa, i.e., holding the take fee constant, an increase in the make fee will also reduce the exchange's trading activity but not necessarily with the same amount. Therefore, we provide empirical evidence on the magnitude of the difference in sensitivities between changes in the make fee and changes in the take fee and exchange's trading activity. Specifically, we explore whether the take fee, which is the fee charged to marketable order flow, has a different effect on the trading activity than the make fee, which is the fee charged to nonmarketable order flow when posted.

After we investigate the relationship between trading activity and trading fees, we focus on exchanges' spreads. We assess how an exchange's quoted spread and net-of-fees spread relate to an exchange's net fee and whether these spreads are equally sensitive to changes in make versus take fees. According to theory the effect of the trading fees on the quoted bid-ask spread is ambiguous and warrants our empirical investigation (Colliard and Foucault, 2012; Foucault, Kadan, and Kandel, 2013). In particular, the quoted bid-ask spread can increase or decrease when the total fee is increased, depending on whether this increase is achieved by increasing the make fee (in which case the quoted bid-ask spread widens) or the take fee (the quoted bid-ask spread then decreases) (Colliard and Foucault, 2012). In the first case scenario, when the make fee is increased, the net effect is a decrease in the bid price and an increase in the ask price posted by investors submitting nonmarketable orders because investors are willing to pay greater concession to avoid the make fee. In the second case scenario, when the take fee is increased, the net effect is an increase in the bid price and a decrease in the ask price posted by investors submitting nonmarketable orders because investors are more willing to pay a concession for an immediate execution. The increase in the take fee, however, is not entirely neutralized by a decrease in the quoted spread and therefore the net effect is that the net-of-fees spread, i.e., the difference between the ask price plus the take fee and the bid price minus the

take fee or alternatively the traded bid-ask spread plus twice the take fee, always increases in the total fee. Therefore, in contrast to the ambiguous relationship between the quoted bid-ask spread and the total fee, the net-of-fees spread always increases in the total fee (Colliard and Foucault, 2012). When the take fee increases, sellers must post more attractive offers to prevent buyers acting as takers from switching to being makers. The drop however in the ask price is less than the increase in the take fee so that the burden of an increase in the take fee is borne by makers and takers. The main assumption that drives this result is the fact that investors can switch from being a taker to acting as a maker and vice versa.

We further investigate the possibility that the effect of trading fees on market outcomes is more pronounced when tick size is a binding constraint on the bid-ask spread (Foucault, Kadan, and Kandel, 2013). Quotes must be expressed as multiples of a minimum monetary unit (the tick size), which in U.S. is one cent, and for this reason traders cannot fully neutralize the make and takes fees in the prices. That is, we expect to find that the total fee, the make fee and the take fee are negatively related to trading activity particularly when the tick-size is binding, i.e., when the quoted bid-ask spread is small.

Three recent empirical studies adopt event study methodology by focusing on a single-fee-change event to explore the effect of the change on market microstructure characteristics such as spreads and volume. Malinova and Park (2014) study the effects of a single-fee-change event, an introduction of a negative make fee, for a subsample of stocks on the Toronto Stock Exchange. They find that the liquidity rebate structure leads to decreased spreads, increased depth, increased volume, and intensified competition in liquidity provision.[16] Skjeltorp, Sojli, and Tham (2013) also study a single-fee-change event - an increase of the rebate on the take side by 100%, from a cent to two cents per 100 shares on the Boston Stock Exchange and document positive cross-sided liquidity externalities where liquidity demand begets liquidity supply. Lastly, Lutat (2010) looks at a reduction in the fee for making liquidity from positive fee to free of charge on the SWX Europe Exchange and the resulting impact on market liquidity.

[16]Yao and Ye (2014) look at Direct Edge exchange that operates two trading platforms, EDGA and EDGX. These platforms are almost identical except for the fee structure. Yao and Ye (2014) show that the taker-maker market takes a high market share for stocks with relatively high tick sizes.

He finds that the make fee reduction does not affect spreads, but leads to an increase in the number of shares quoted at the top of the order book. [17]

We contribute to this literature in a complementary way by providing a comprehensive analysis of the effect of liquidity-based trading fees on exchange characteristics such exchange trading volume and corresponding market share as well as exchange quoted and net-of-fees spreads. Specifically, rather than looking at a single event or examining the fees from the perspective of market participants, we investigate the effects of these fees on market outcomes from the perspective of the exchanges by conducting analysis at the exchange level. Further, in implementing our exchange-level analysis we use daily data on all fee change events across all registered exchanges in the U.S. during a three-year period. This gives us the advantage of examining the effect of make and take fees and the overall effect experienced by trading platforms. Thus, our cross-sectional analysis of trading fees at the exchange level extends prior literature and deepens our understanding of the role of trading platforms.

4. Data and Methodology

In this section, we first describe the overall empirical methodology. Then we describe the essence of the data related to the make and take trading fees and rebates and explain the construction of our variables followed by summary statistics. To conclude this section, we use our hand-collected data and calculate a range of how much money is transferred among makers, takers, and exchanges in aggregate for our sample period.

4.1. Methodology

To establish an overall relation between an exchanges's trading activity and the total (net) fees, received by the exchanges from the market participants, we regress proxy measures

[17]Recently, the make-and-take fee pricing model has been introduced on the options markets as well. Battalio, Shkilko, and Van Ness (2011) and Anand, McCormick, and Serban (2012) explore the make-and-take fee pricing model and the payment-for-order flow model in application to equity options exchanges and show that evaluations of market quality that ignore taker fees can be misleading and that neither structure dominates on all dimensions. Relatedly, Harris (2013) shows that quoted prices are more informative when adjusted for make and takes fees. His results strongly suggest that maker-taker pricing has affected average bid-ask spreads and average quotation sizes for stocks often trading at one-tick spreads. Battalio, Corwin, and Jennings (2014) document a negative relation between take fees and limit order execution quality and the relative take fee level.

for trading activity, estimated at the tape-exchange's level, on our net fee variables, the construction of which is explained in detail in the next subsection. To study the sensitivities of an exchange's trading activity to make fees versus take fees, we perform regression analysis where the dependent variable is again a proxy measure for trading activity, estimated at the tape-exchange level, but now the independent variables are the separate make fee and take fee variables instead of the combined total fee. To directly study the sensitivities, we test whether the difference between the coefficient associated the make fee variable and the coefficient associated with the take fee variable is different from zero. If the difference between these two coefficient is zero, we can infer that a unit change in the make fee has the same effect on the average tape-exchange trading as a unit change as a unit change in the take fee. Consequently, in these circumstances, what mattes is the sum of the make fee and take fee – i.e., the total fee, and an exchange cannot affect its trading activity in a tape by changing the allocation of the total fee between the two sides of the market.

To explore the relationship between spreads and fees we follow the same regression methodology as just described but now the dependent variable are spread variables. Specifically, first we regress the spread variables estimated at the exchange's level, quoted or net-of-fees spread, on the net fee variables. In like manner described in the previous paragraph, to study the sensitivities of the exchange's quoted and net-of-fees spread to the make fees versus the take fees, we regress an exchanges's spread variables for a tape on the make fee and take fee variables and test whether the difference between the two coefficients is different from zero. If this difference is zero, we can infer that a unit change in the make fee has the same effect on the tape-exchange level spread as a unit change in the take fee.

In our case, the number of cross-sectional units is relatively small (we have 14 exchanges and each one reports fees for three tapes, which gives 42 cross-sectional units at the most) and the number of time periods is relatively large (we have three years of daily data), the first-differencing transformation is preferred to fixed effects.[18] Therefore, in all regression specifications we "difference-out" the tape-exchange fixed effects by estimating the relationship

[18]For relevant material for this discussion see Wooldridge (2002), Chapter 10.

between changes of variables. In this way, we both eliminate the constant unobserved effect over time and the autocorrelation in the error terms. All regressions specification also include date fixed effects to control for time variation in the first-difference of the dependent variable. All specifications also include controls for overall volume across tapes and exchanges. Given that our regression analysis is performed in changes of the variables, we essentially test how market outcomes change on the fee change event, and as such potentially partially mitigates some endogeneity concerns that might arise doing analysis in levels. In a separate robustness section, we describe two other approaches to establish validity of our results.

4.2. Variables

4.2.1. Fee Variables

We use SEC filings and press announcements made by the registered exchanges to hand-collect daily data on the make and take fees for the period January 1, 2008 – December 31, 2010.[19] We record the make fees as well as the take fees in dollars per 100 shares for Tape A, Tape B, and Tape C on every registered U.S. equity exchange. These fees can be either positive or negative (when negative, they are rebates from the exchange to the traders). The exchange earns the sum of the make fee and the take fee, i.e., the total (net) fee.

Exchanges have adopted multiple levels of fees, "tiers," based on volume and liquidity provision as already discussed in Section 2. Therefore, for each tape-exchange, we construct two distinct fee variables to capture the different degrees of pricing attractiveness. The first one we refer to as "basic fee" (make or take), which is the fee charged to market participants who do not qualify for any volume or liquidity thresholds. The second one we refer to as "competitive

[19]It is important to note that Regulation NMS, which is a structural change affecting order execution and fees, was implemented by the end of December 2007. The regulation consists of four main parts, one of which is Rule 611, the Order Protection Rule (also known as the trade-through rule). This rule requires that exchanges route marketable orders to other exchanges that provide better prices; however, the rule does not take access fees or rebates into consideration in determining the best price. There are, however, exceptions to this rule – e.g., the Intermarket Sweep Orders (ISO), which allows the initiator of an order to designate the market that the order executes on. Chakravarty, Jain, Upson, and Wood (2012) show in a sample of 120 stocks that ISO orders represent 46% of trades and 41% of volume in the period from August 20, 2007 to May 30, 2008, representing 197 trading days. We do not believe that Rule 611 "caused" the make and take fees per se, although Regulation NMS "cleared regulatory impediments to electronic trading and thereby led to increased competition between market centers" (p.4, Angel, Harris, and Spatt, 2011). This is not the focus of the current manuscript.

fee" (make or take), which is the fee charged to market participants who qualify for the highest tier offered on an exchange, which is the most favorable pricing available from the perspective of the market participant. In the case there are no volume tiers, we record the fee that is offered to all market participants. The following are the fee variables we consider:

- *Nom_Make_Basic* and *Nom_Take_Basic* (*Nom* stands for nominal) are the make fee and the take fee, respectively, offered to traders who do not qualify for higher volume-based tiers. *Nom_Total_Basic* is the sum of *Nom_Make_Basic* and *Nom_Take_Basic*.

- *Nom_Make_Comp* and *Nom_Take_Comp* are the make fee and the take fee, respectively, offered to traders who qualify for the highest volume-based tier offered and thus capture the most favorable pricing available on an exchange. *Nom_Total_Comp* is the sum of *Nom_Make_Comp* and *Nom_Take_Comp*.

In the data, we cannot identify the volume that was transacted at each pricing tier. Therefore, in our regression analysis we assume that either all volume is executed at the basic tier pricing or all volume is executed at the most competitive pricing tier. In doing so, we essentially look at the two extreme cases – the relationship between volume and fees at the basic tier and at the most competitive tier.

Next, we consider the relative attractiveness of the nominal fees just described by also examining the fees charged on other exchanges for the same tape of securities. Doing so allows us to examine the effect of fee changes that make a particular tape-exchange relatively more or less attractive than its rivals. A natural approach would be to take the distance from the cross-sectional mean or median, but this approach does not capture the dispersion or clustering of exchanges' fees. We design a measure, relative-to-rivals fee, that captures the full distribution and, specifically, the distance of an exchange's fees from each of its rivals' fees. At each point in time, the exchanges are ordered from the lowest to highest nominal fee – i.e., Fee_1, Fee_2, $\ldots Fee_n$, then the relative fee measure for exchange i is defined as:

$$\text{Relative Fee Measure}_i = \sum_{k=1,k<i}^{i} |Fee_i - Fee_k| - \sum_{k=i,k>i}^{n} |Fee_i - Fee_k|. \quad (1)$$

The relative-to-rivals fee for exchange i is measured as the sum of all distances from Fee_i to Fee_k for each rival k where $k < i$ minus the sum of all distances from Fee_i to Fee_k for each rival k where $k > i$. When an exchange increases its fee, in nominal terms, the fees charged on other exchanges become increasingly more attractive. The relative fee, versus the nominal fee, captures the *relative attractiveness* of the fee change to the fees charged by the other exchanges.[20] We denote the relative-to-rivals fee measure with *Rel* – e.g., *Rel_Make_Basic*.

It is important to note the benefit we gain by studying the relative fee measures, which are the nominal fee measures transformed using Eq.1. Namely, while the nominal fee measures gauge absolute magnitude, the relative-to-rival fee measures provide an evaluation of the relative magnitude of fee attractiveness compared to the menu of fees available on other exchanges. The comparative nature of the relative-to-rival fee variables allows us to quantify an exchange's fee change after taking into account the distribution of its rival's fees.

4.2.2. Trading Activity and Spread Variables

Data are also collected from NYSE's Trade and Quote (TAQ) database.[21] In order to test the relationship between fees and trading activity, we need proxies for trading activity. Given that the fees are applied per share and the same fee is applied to all securities in a tape, we aggregate the individual security volume to the tape-exchange level. Thus, our measure of volume, Vol, is the volume in billions of shares traded on an exchange in a tape. We construct a corresponding market share measure, MS, which is the number of shares traded on an exchange in a tape

[20]The following is intended to illustrate the construction of the relative-to-rivals fee. Suppose there are a total of four exchanges: E, F, G, and H. Each exchange has a total fee per 100 shares: 0.01, 0.02, 0.03, 0.04, respectively (the mean level of total fee for the basic tier reported in Table 1 is 0.033). Consider the relative-to-rivals fee for exchange F. This is calculated as the sum of the distance to exchange E, the negative distance to exchange G, and the negative distance to exchange H. Thus, (0.02-0.01)-(0.03-0.02)-(0.04-0.02)= -0.02. In this sense, should the total fee on exchange, E, G, or H change, the relative-to-rivals fee on exchange F will adjust to reflect this change. For example, if exchange H were to increase its fee, to 0.05, the relative-to-rivals fee on exchange F would decrease to -0.03 to reflect that fact that exchange F's fee is now more attractive. Similarly, if exchange H decreased its fee to 0.03, the relative-to-rivals fee on exchange F would now be -0.01 to reflect the fact that its relative attractiveness has decreased.

[21]The Appendix discusses the Consolidated Quotes (CQ) and Consolidated Trades (CT) files with regard to what the data encompass, data management, and how to merge these databases with CRSP. We use CRSP to identify the tape of a security.

divided by the sum of shares traded in that tape across all exchanges.[22] In our regression analysis, we first detrend the measures for trading activity. We avoid imposing a linear trend by instead taking the first difference (see p.294 in Lo and Wang, 2000).

We also test the relationship between fees and quoted prices.[23] On every exchange, for each individual security, we calculate the daily time-weighted average quoted bid-ask spread in dollars per share and in percentage of the bid-ask midpoint. We then take the median each day across all time-weighted individual-security quoted spreads within each tape on an exchange as our measure of typical quoted spread at the tape-exchange level (the best bid and offer [BBO] in each tape at the market center).[24,25] We denote the tape-exchange BBO in dollars as *$BBO* and in percentage as *%BBO*. For each tape-exchange, we also calculate the corresponding true economic net-of-fees spread, which is the spread that an investor pays on a liquidity-demanding round-trip transaction in the presence of fees. The net-of-fees spread in dollars per share is equal to *$BBO* plus twice the take fee per share (for the basic or the competitive tier) and is denoted with *$NetBBO_Basic* and *$NetBBO_Comp*. Correspondigly, the net-of-fees spread in percentage of the bid-ask midpoint is denoted with *%NetBBO_Basic* and *%NetBBO_Comp*. In our regression anaylsis we use the log transformation of these variables.

To control for overall volume, (1) in the trading activity regression specifications we include the variable, *Tape_Vol*, which the detrended daily volume by first-differencing of a tape aggregated across exchanges in billions of shares and (2) in the spread regression specifications we include the variable, *Log_Exchange_dVol*, which is the logarithm of daily dollar volume in millions on a tape-exchange and the variable, *Log_Rivals_dVol*, which the logarithm of the total

[22]The SEC requires that as of March 2, 2007, all nonexchanges must report to a trade reporting facility, which in turn reports to the consolidated tape (footnote 3, O'Hara and Ye, 2011). TAQ reports the aggregated volume combined for all TRF/ADFs. Thus, in estimating our market share measure from TAQ, we take into account the trades reported as TRF/ADFs as well.

[23]As explained in the Appendix, the Consolidated Quotes Files in TAQ report quote updates from all registered exchanges, and this updated quote will be the best bid and offer (BBO) prevailing at the market center.

[24]The distribution of the time-weighted individual-security quoted spreads is positively skewed, and in this case, the median better represents the typical spread compared to the average at the tape-exchange level. We require that we have at least two individual securities' observation in a day in tape-exchange.

[25]We note that the measurement issues discussed in Holden and Jacobsen (2014) do not bias our results because our regression analysis is performed with variables in changes.

daily dollar volume in millions on rival exchanges (Stoll, 1989).

4.3. Summary Statistics

Our sample period is from January 1, 2008 to December 31, 2010. In our sample, we have 108 tape-exchange fee change events.[26]

Table 1 reports summary statistics, including mean, median, and standard deviation for the fee measures, volume, market share, and spreads across daily tape-exchange observations for our sample period, across all tapes. We start with 32,801,938 daily security-exchange observations for our sample period that are then aggregated to 18,362 daily tape-exchange observations for trading activity variables and 18,282 daily tape-exchange observations for spread variables.[27]

Panel A in Table 1 shows that the fee variables exhibit variation. On average, the make fee charged to all market participants is -$0.199 per 100 shares, which is negative and thus a rebate. The make fee charged to high-volume-high-liquidity market participants is -$0.229 per 100 shares, which represents a larger rebate on average. The take fee for the high-volume and high-liquidity market participants is $0.240 per 100 shares, which is less than the mean take fee charged to all market participants, $0.249 per 100 shares.[28] Not surprisingly, on average, the pricing menu offered to customers that qualify for the most competitive pricing is more attractive than the fees offered to all market participants. The fact that, on average, exchanges choose to subsidize one side of the market, in particular the make side, first suggests that exchanges are trying to balance discrepancies in participation rates between the two sides and second, exchanges are trying to increase the number of nonmarketable orders to increase liquidity in hopes of boosting their order flow.

[26]Out of the 108 events, there are 12 cases in which the total fee charged on a tape-exchange decreased from a positive total fee to a negative total fee. There are 85 cases that included a change in make fee on either the basic or high tier and 84 cases of a change in the take fee on either the basic or high tier. We exclude one event for Tape B securities on Nasdaq exchange on February 1, 2008 because it is an outlier event in which the total fee changed by 69 cents per 100 shares. The average fee change is an increase of 1 cent per 100 shares.

[27]After the filtering procedure described in the Appendix, we lose some spread observations.

[28]The SEC adopted Rule 610(c) of Regulation NMS to cap access fees on equity markets to 30 cents for 100 shares. Therefore, it is possible that the optimal take fee is beyond the imposed cap. The median value for the *Nom_Take_Basic* shown in the second column is 30 cents per 100 shares, which is the maximum allowed take fee by the SEC. The median for the *Nom_Take_Comp* is 28 cents per 100 shares, which is 2 cents less than the imposed cap on the take fee.

Panel A in Table 1 also provides summary statistics on the net fee, or the total fee, charged by an exchange. *Nom_Total_Basic*, which is the sum of the make and take fees charged to all market participants, has a mean of \$0.050 per 100 shares.[29] *Nom_Total_Comp*, which is the total fee catered for traders that meet certain volume/liquidity thresholds, has a mean of \$0.011 per 100 shares. In terms of revenue, a given tape-exchange earns roughly only 1 cent from the competitive pricing level, while it earns 5 cents from the basic pricing level per 100 shares. In fact, focusing on the median values reveals that a tape-exchange typically earns nothing from the traders transacting at the competitive pricing menu since the median *Nom_Total_Comp* is zero. The median of the *Nom_Total_Basic* is 4 cents per 100 shares.

Panel B reports the relative-to-rivals fees, which captures the exact position, and not just the level, of an exchange's fees relative to the fees charged by its industry rivals. These variables are zero on average by construction for each daily cross-section. The median values show that there is fee clustering. For example, the medians for the relative make fee variables, *Rel_Make_Basic* and *Rel_Make_Comp*, are negative (-0.260 and -0.235, respectively), which indicates that there are some tape-exchanges that offer much greater make fees or alternatively offer smaller rebates than most other tape-exchanges. The medians for the relative take fee variables, *Rel_Take_Basic* and *Rel_Take_Comp*, are positive (0.220 and 0.190, respectively), which demonstrates that there are a few tape-exchanges that offer much lower take fees than other tape-exchanges.

Panel C in Table 1 reports the trading activity variables used in the later analysis. Across all tape-exchange observations in our sample, there are on average 0.182 billion shares traded in a tape on an exchange. Aggregating the volume in a tape across exchanges, the average daily tape volume is 2.338 billion shares and ranges from 0.230 billion shares to 9.803 billions shares (untabulated). The average market share of an exchange in tape-level trading volume is 7.574% and the median is 1.507%.

Panel D shows that the average tape-exchange *\$BBO* is \$0.197. Across all registered exchanges, the lowest tape-exchange dollar spread (untabulated) occurred on BATS Y-

[29]Interestingly, a negative total fee has also been employed by exchanges for some periods of time (e.g., Direct Edge, NYSE Amex).

Exchange for all three tapes (ranging from \$0.016 to \$0.018). The highest tape-exchange dollar spreads in Tape A, Tape B, and Tape C occurred on CBOE Stock Exchange, Chicago Stock Exchange, and CBOE Stock Exchange, respectively (ranging from \$0.250 to \$0.655). When we adjust *\$BBO* for fees, we add twice the take fee per share. The net-of-fee spreads variables, *\$NetBBO_Basic* and *\$NetBBO_Comp*, are both greater than the quoted spread, *\$BBO*. The average *\$NetBBO_Basic* is only slightly greater than *\$NetBBO_Comp*, but the medians are the same. While appearing similar, these variables are estimated differently due to the difference between the take fee offered on the basic and competitive tier pricing, which is \$0.009 per 100 shares (\$0.2490 Basic take fee - \$0.2400 Competitive take fee).

The dollar quoted bid-ask spreads is increasing in share price, so the quoted bid-ask spread measured in percentage provides a more accurate picture than the dollar spread. The percentage spread measures the round-trip trading cost of a \$1000 position in an asset. The average tape-exchange level spread measured in percentage, *%BBO*, is 1.271% (reported in Panel D). The lowest tape-exchange level spreads in percentage (untabulated) occurred on BATS Y-Exchange for Tape A and Tape B securities (0.093% and 0.082%) and on NASDAQ OMX PHLX Inc. Exchange (formerly Philadelphia Stock Exchange) for Tape C securities (0.157%). The highest spreads in Tape A, Tape B, and Tape C occurred on CBOE Stock Exchange, Chicago Stock Exchange, and CBOE Stock Exchange, respectively (ranging from 2.149% to 4.407%). As is the case when spreads are measured in dollar terms, now again when the spreads are measured in percentage terms, the net-of-fees spreads variables (basic and competitive) are both greater that the quoted spread variable. However, now in percentage terms, the net-of-fees spread for the competitive pricing level and the net-of-fees spread for the pricing menu offered to all market participants are quite different. The mean and the median for the *%NetBBO_Basic* are 1.320% and 1.318%, while the mean and the median for the *%NetBBO_Competitive* are 0.716% and 0.714%, respectively.

4.4. Money Transfer

Note that Table 1 reports summary statistics of the variables of interest on a *tape-exchange* level. Now, we are interested in obtaining upper and lower boundaries of money transfer due to make-and-take fees among exchanges, makers, and takers. Using our hand-collected fee data, we calculate a range of how much money is transferred among makers, takers, and exchanges in aggregate for 2008 through 2010 and report results in Table 2.

Recall that the "basic fee" measure offers the least competitive pricing for market participants, but generates the most revenue per trade for the exchange, and the "competitive fee" offers the most favorable pricing for market participants, but provides the least amount of revenue for the exchange. Assuming the "basic fee" is applied to all transacted shares provides us with the upper bound of money transfer, or the most an exchange can hope to earn. On average, across securities in all tapes, an exchange is paid \$1.171 million per day by takers and rebates \$0.710 million to makers, thus an exchange retains \$0.460 million (Panel A, Column (1)). Assuming that all transacted shares are subject to the "competitive fee" pricing level gives us the lower bound of average daily money transfer to an exchange. In this case, an exchange makes much less on average, \$0.132 million per day (Panel B, Column (1)). The money that all exchanges retain in aggregate for the whole sample period ranges from \$889.571 million (approximately 12% of the aggregate amount paid by takers, Panel B, Column (3)) to \$3,095 million (approximately 40% of the aggregate amount paid by takers, Panel A, Column (3)). Therefore, the exchanges retained as little as 12% and as much as 40% from the fees that takers paid, and the other 88% to 60% were paid as rebates to makers of liquidity.

5. Regression Results – Nominal Fees

In this section, we report the results of our nominal fee regression models and in the next section, Section 6, we report the results of our relative-to-rivals fee regression models. Section 8 report the results of two robustness tests.

5.1. Trading Activity

In order to test the relation between trading activity and nominal fees, we employ regression approach in changes of the variables as described in the Methodology section. We use two proxies for trading activity as dependent variables that are both detrended by taking the first difference. Our first dependent variable is ΔVol which is the change in the detrended volume in billions of shares on a tape-exchange and our second dependent variable is ΔMS which is the change in the detrended market share of an exchange in percentage of all traded shares in a certain tape. The independent variables of interest are the nominal fee measures in changes. Table 8 reports the results. Panel A reports results when the independent variable of interest is the nominal net fee, Panel B when the independent variable of interest is the nominal make and take fees and Panel C reports the estimates of the difference between the parameters associated with the nominal make and take fee variables reported in Panel B. In all trading activity regression specifications we include the control variable, $\Delta Tape\_Vol$, which is the change in the detrended total volume measured in billions of shares across all exchanges in a tape each day, to control for changes in overall tape volume, unrelated to fees.[30]

Columns (1) through (4) in the table reports results when the dependent variable is one of the proxies for trading activity, ΔVol (Columns (1) and (2)) and ΔMS (Columns (3) through (4)). For the regression specifications in Columns (1) and (2), Panel A and B, the coefficient on the control variable $\Delta Tape\_Vol$ is positive and significant, which shows that as the volume across all exchanges increases, the volume on a tape-exchange also increases on average. The coefficient on this control variable is negative and significant in Columns (3) through (4), Panel A and B, when the dependent variable is *MS*. This is likely attributed to the fact that during our sample period, there were a number of new registered exchanges that consistently gained market share.

[30]The results in Table 8 are robust to log transformation of the trading activity variables, volume and market share. The results are also robust if we do not log-transform the spread variables.

5.1.1. Nominal Total Fee

In Panel A, Table 8, Columns (1) through (4) the independent variable of interest is total (net) fee. Column (1) reports results from a regression specification where the dependent variable is a change in the detrended volume, ΔVol, and the independent variable of interest is ΔNom_Total_Basic, which is the change in the total fee offered to market participants that do not meet volume/liquidity thresholds. The coefficient is negative (-0.235) and statistically significantly different from zero. In Column (2), we report results from regressing changes in volume, ΔVol, on ΔNom_Total_Comp, which is the change in the total fee offered to market participants that meet higher volume/liquidity thresholds. The point estimate is -0.223 (p-value of 0.00). The observed negative association between changes in volume and changes in the total fee indicates that the volume on an exchange in a tape of securities increases when the total fee decreases. This finding is consistent with predictions that the trading rate on an exchange is affected by changes in its total fee (Colliard and Foucault, 2012).

We also explore the relationship between market share and total fee, where an exchange's market share is the percentage of traded shares in a tape. Results are reported in Panel A, Columns (3) and (4), of Table 8. In Column (3), the coefficient associated with ΔNom_Total_Basic is negative and significant (-4.978, p-value of 0.00), and in Column (4), the coefficient associated with ΔNom_Total_Comp is also negative -2.400 but insignificant. The results indicate that on average, when an exchange decreases its total fee, the market share of the exchange increases especially for the basic pricing level.

One reason changes in tape-exchange market share are more sensitive to "basic" fee changes than "competitive" fee changes could be that switching costs are higher for the market participants that qualify for the more competitive pricing menu.[31] Further, the fact that exchanges offer two pricing menus is consistent with second-degree price discrimination, in which exchanges offer better prices to large-quantity clients and effectively capture more

[31]For example, if a trading firm places its servers and computers within the same facility as the exchange's matching engine in order to get faster access to market data (known as "co-location"), it will experience higher switching costs in the event it has to move.("Not so fast!" by John D'Antona Jr. and Peter Chapman, Traders Magazine, August 28th, 2010.)

consumer's surplus. Exchanges are not able to differentiate between different types of customers in terms of volume and liquidity preferences. As a result, they provide incentives for customers to essentially self-select into either the basic or competitive fee scheme based on their volume and liquidity preferences. Hence, the market participants who qualify for the more competitive pricing are the ones that, on average, have higher gains from trade (due to potentially large amounts of shares to trade or informational advantages). Therefore, small changes in their transaction costs do not affect their high willingness to trade. On the contrary, for lower-volume-liquidity traders who transact at the basic tier pricing, the gains from trade are less and, therefore, these traders are more sensitive to small changes in transaction costs.

To determine whether the changes in the trading activity associated with changes in the total fee are economically meaningful, we explore the change in revenue an exchange would experience for a change in the basic pricing tier. Using our regression results in Table 8, Panel A, Column 1, we see that a decrease in the total fee of 1 cent per 100 shares ($0.01) increases daily volume by 0.00235 billion shares on an exchange for a given tape of securities. The average daily traded number of shares for a tape of securities on an exchange is 0.1818 billion and the average total basic fee is $0.0498 per 100 shares (Table 1). Thus, the average daily revenue for an exchange is 181,800,000*(0.0498/100) =$90,536.40 per tape. Now consider a 1 cent reduction in the basic tier pricing for the total fee from $0.0498 per 100 shares to $0.0398 per 100 shares. The reduction of 1 cent per 100 shares increases the daily traded volume for securities in that tape by 0.00235 billion, from 0.1818 billion to 0.18618 billion shares (0.18415 = 0.1818 + 0.00235). As a result, the daily revenue after the fee decrease of 1 cent per 100 shares is ($0.0398/100)*184,150,000 = $73,291.70 Therefore, the reduction of 1 cent per 100 shares increases the daily trading volume by 0.00235 billion shares and decreases the daily revenue from $90,536.40 to $73,291.70, i.e., a reduction of $17,244.70 in a day. Employing the Total-Revenue Test, the demand for trading is inelastic since the revenue changes in the same direction as the total fee. Even though the demand for trading is inelastic the effect of a fee change on exchange revenue could be economically quite significant. A reduction by 1 cent per 100 shares (this is 20.08% reduction in price, 100*[(0.0398-0.0498)/0.0498]) leads to

a 100*(-$17,244.70 / $90,536.40) = 19.04% reduction in the total revenue for a given tape of securities per day on an exchange.

Consistent with the results when the dependent variable is daily volume, evaluated at the average fee, the percentage market share is inelastic to changes in the total fee per 100 shares as the ratio of the percent change in market share over the percent change in the total fee is less than unity. When the total fee on the basic tier decreases from the average total fee of $0.0498 (Panel A, Table 1) to $0.0398 per 100 shares (a 1-cent or 20% decrease), market share increases from 7.5737% (the average daily market share of an exchange for a tape of securities shown in Panel B, Table 1), to 7.6234% (estimated as 7.5737+0.0497), which is an increase of 0.65% in a single day. Thus, the market-share elasticity is less than unity (estimated as (0.65%/20%)*($0.0498/7.5737%)).

We find that on average, total fee is negatively related to exchange's trading activity as measured by volume and market share. Thus, our results support that hypothesis that the "demand for trading" decreases with the exchange's net fee (Colliard and Foucault, 2012) and are consistent with a downward-sloping demand curve for trading. We do not find support for the conjecture that due to heterogeneous patience across investors, an increase in total fee can be associated with an increase in trading activity.

5.1.2. Nominal Make and Take Fees

Next, we empirically investigate the sensitivities of the exchange's trading activity to changes in the make fees versus take fees in nominal terms. Panel B of Table 8 follows the methodology in Panel A, where instead of total fee, we include both the make fee and take fee as separate independent variables in the same regression specification. Panel C reports the estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. The regression results are reported in Panel B and C in Table 8, Columns (1) through (4).

First, we regress the change in the detrended volume on both the change in nominal make fees and the change in nominal take fees for the basic-level pricing and report results in Column (1) of Panel B. The coefficient on ΔNom_Make_Basic is -0.177 and the coefficient

on ΔNom_Take_Basic is -0.389; both are statistically significant. The difference between the two coefficients is positive and statistically significant, as reported in Panel C, Column (1) (the difference is 0.212 and the p-value is 0.01). This indicates that a unit increase in the take fee, on average, is associated with a larger decrease in volume than a unit increase in the make fee. We note that our dependent variable, trading volume, captures the net effect of the participants' actions on both sides of the market because for each transacted share there is a maker and a taker. Said differently, in this paper, we do not draw any inferences about either the effect of the make fee on the nonmarketable order flow (the make side) or the effect of the take fee on the marketable order flow (the take side) or any cross effects that might exist. What we capture by studying the total number of transacted share on a particular exchange is the net effect of make and take fee changes on the market welfare and in particular the sensitivity of the market welfare to changes in these fees.

To determine whether the changes in the trading activity associated with changes in the make fee are economically meaningful, we explore the change in revenue an exchange would experience for a fee change in the basic pricing tier. Using our regression results in Table 3, Column 1, Panel B, we see that a decrease in the make fee of 1 cent per 100 shares increases daily volume by 0.00177 billion shares on an exchange for a given tape of securities, while a decrease in the take fee of 1 cent per 100 shares increases daily volume by 0.00389 billion shares. Therefore, the same absolute change in the take fee of 1 cent has 20% more effect on the change in volume than a change in the make fee (estimated as (0.00389-0.00177)/0.00177).

The regression results in Table 3, Column 1, Panel B and Panel C provides us with the opportunity to assess the impact on revenue of changes in make and take fees. We evaluate two scenarios: first, we consider a 1 cent change in the take fee when the make fee is held constant and second, we consider a 1 cent change in the make fee when the take fee is held constant. These two scenarios gauge the effect on market outcomes if the total fee changes by 1 cent via the take fee or if the total fee changes by 1 cent via the make fee. At the average make and take fee the revenue for an exchange is \$90,536.40 (estimated as 181,800,000*(0.2490-0.1992)/100). A 1 cent increase in the take fee leads to an increase of the revenue to \$106,390.18 (estimated

as (181,800,000-3,890,000)*(0.259-0.1992)/100), holding the make fee unchanged, while a 1 cent increase in the make fee leads to an increase of the revenue to $107,657.94 (estimated as (181,800,000-1,770,000)*(0.2490-0.1892)/100), holding the take fee unchanged. Taken together these changes in fees translate to a 17.51% (($106,390.18-$90,536.40)/ 90,536.40) increase in the total revenue when the take fee is increased by 1 cent and the make fee is held constant, while when the make fee is increased by 1 cent and the take fee is held constant the exchange's revenue increases by 18.91% ($107,657.94-$90,536.40)/ 90,536.40). An exchange can increase its revenue more by increasing its make fee rather than its take fee. Because volume is more sensitive to changes in take, increasing the take fee reduces volume more than an increase in the make fee. As a result, revenue from a 1 cent increase in take fee is less than revenue from a 1 cent increase in the make fee. On the flip side if the take fee is reduced by 1 cent the exchange' revenue decreases 17.51%, while if the make fee is reduced by 1 cent the exchange's revenue decreases 18.91%. Therefore, an exchange can reduce its revenue less by reducing its take fee rather than its make fee.

Column (2) in Panel B shows the results of regressing changes in volume on changes in the make and take fees for the most competitive pricing offered on an exchange. The coefficient on ΔNom_Make_Comp is -0.144 and on ΔNom_Take_Comp is -0.392. Both coefficients are significant, and the difference in the coefficients reported in Panel C is positive and significant (the difference is 0.249 and the p-value is 0.01). Thus, also for the competitive-tier pricing level, a change in the take fee is associated with a greater change in volume than a change in the make fee at the tape-exchange level.

Columns (3) and (4) of Panel B report results for the effect of changes in make and take fees on changes in market share. The results reported in Panel C, Columns (3) and (4), show that the breakdown of the total fee does affect market share since the differences between the coefficients on make and take fees are significant (p-values of 0.01).

The reported negative effect of an increase in the make fee and the take fee on volume is as predicted by theory (Constantinides (1986), Foucault, Kadan, and Kandel, 2013). More importantly we provide evidence that a change in the make fee does not have the same effect

as a change in the take fee on total number of transacted shares and as a result an exchange can affect the trading activity on its platform by changing the allocation of the net total fee to both sides of the market (Foucault, Kadan, and Kandel, 2013).

Our exchange level analysis provides evidence that in the U.S. equity market, the volume of transactions as well as exchange's market share in trading volume depends not only on the overall level of net fees charged by the platform but also on the structure of these fees. Our results suggest that on average, an exchange could change its volume and market share for a tape of securities by changing the allocation of the total fee between makers and takers. For example, should an exchange decide to increase its total fee in a tape by one unit, our results thus far indicate it would be better for the exchange to increase its make fee (or provide less rebate in the case the make fee is negative), as this would lead to a smaller reduction in volume than an increase in the take fee. Hence, if we consider the impact of fees on trading activity at the exchange level for a tape of securities, we generally do not find evidence consistent with the conjecture that on average market participants fully neutralize a change in the make fee or take fee by adjusting their quoted prices.[32] If the traders fully neutralize changes in these fees, we would have observed no effect on volume when changing allocation of the total fee between makers and takers.

In the following subsection, we specifically explore the relationship between quoted and net-of-fees spread and the make and take fees, to study whether, on average, market participants adjust their prices to reflect changes in the fees.

5.2. Quoted Spread and Net-of-Fees Spread

In exploring the relation between exchange's quoted and net-of-fees spreads and nominal fees, we again employ regression approach in changes of the variables. Table 8, Columns (5) through (8) report the results of regressing a change in an exchange's best bid and offer (BBO) quoted spread in dollars, $\Delta\$BBO$, and in percentage, $\Delta\%BBO$, respectively, on a change in our nominal

[32]On a separate note, while beyond the analysis of this study, we acknowledge that for some particular securities or for some subgroup of securities, market participants may neutralize changes in the make-and-take fees by changing their quoted prices (Foucault, Kadan, and Kandel, 2013).

fee measures. Table 8, Columns (9) through (12) report the results of regressing a change in an exchange's best bid and offer (BBO) quoted net-of-fees spread in dollars, $\Delta\$NetBBO$, and in percentage, $\Delta\%NetBBO$, respectively, on a change in our nominal fee measures. Recall that the net-of-fees spread at the tape-exchange level estimated as the difference between the ask price plus the take fee and the bid price minus the take fee or, alternatively, as the quoted bid-ask spread plus twice the take fee. This variable is a proxy for the true economic spread, which is the cost paid on an immediately executed round-trip transaction in the presence of fees.

In these regression specifications we include the following control variables – *Log_Exchange_dVol*, which is the logarithm of daily dollar volume in millions on a certain exchange in a certain tape and *Log_Rivals_dVol*, the logarithm of daily dollar volume in millions on the rival exchanges in the same tape. The reason we include these control variables is because it is well known that quoted spreads differ significantly across securities not only because of characteristics such as stock price and variance but also because of volume of trading (Stoll, 1989, among others).

5.2.1. Nominal Total Fee

In the previous section, we showed that an increase in the total fee leads to a reduction in trading activity at the exchange level. The fact that an exchange's net fees affect trading activity is evidence that changes in the net fee are not completely offset by changes in quotes. Our results so far are consistent with the hypothesis that traders do not fully adjust the effect of the fees in quoted prices.

We now turn our attention to specifically test whether there is association between changes in exchange's quoted and net-of-fees spreads and changes in the net fee. The results are reported in Table 8, Panel A, Columns (5) through (12). None of the coefficients associated with the total fee (Panel A), or the make and take fee (Panel B) are significantly different from zero. Recall that the results in the previous section show that an increase in the total fee reduces trading activity. Taken together, these results illustrate that an increase in the total fee is associated with a reduction in trading activity and no effect on the quoted and net-of-fees spreads at the

tape-exchange level.

With a couple of exceptions in all regression specifications in Table 8, the coefficient on the control variable $\Delta Log\_Exchange\_dVol$, which is the logarithm of daily dollar volume in millions on a tape-exchange, is negative and significant. This negative association between volume and spread is consistent with prior literature (Demsetz (1968), Copeland and Galai (1983)). The coefficient on the control variable ΔLog_Rivals_dVol, which is the logarithm of the daily dollar volume in millions on all rival exchanges, is positive and significant in all regression specifications. This shows that the quoted spread of an exchange is wider when rival exchanges exhibit higher trading activity. Taken together, the observed relationship among quoted spreads, an exchange's volume, and its rivals' volume provides some indication of the extent to which the market environment has changed in the stock exchange industry since the decoupling of the trading and listing functions and the impact on the competition among exchanges (see footnote (19)).

The fact that we do not find significant relationship between spreads and fees could be because our observations are at the exchange level. However, because we find a relationship between fees and $\Delta Log\_Exchange\_dVol$ and ΔLog_Rivals_dVol the aggregated spreads are probably not the main reason why we do not find any relation between changes in fees and changes in spreads. Another possibility of why spreads are not related to fees could be simply because traders do not change their quotes in response to fee changes but simply switch their trading strategies.

5.2.2. Nominal Make and Take Fees

Now we assess whether changes in quoted and net-of-fees spreads are equally sensitive to changes in make versus take fees. Columns (5) through (12) in Panel B of Table 8 show regression results when the dependent variables are again the change in exchange's quoted and net-of-fees spreads and the independent variables of interest are the change in the make fee and the change in the take fee. Panel C reports the difference between the estimated regression coefficients on the change in the make and take fee in Panel B. Results in Panel B reveal that there is no significant relationship between quoted spreads, net-of-fees spread and make

and take fees. More importantly, Panel C demonstrates that none of the differences between the parameters for make and take fees reported in Panel B are significant. This leads to the conclusion that only the level of the total fee and not its allocation to the make and take sides affects the quoted and net-of-fees spreads.

For the full sample of all traded securities, aggregated to tape-exchange level, our results demonstrate that the allocation of the total fee between makers and takers is relevant for an exchange's trading activity as measured by volume and market share and that traders do not fully neutralize changes in make and take fees by adjusting quoted prices at the tape-exchange level. Our results are contrary to common perception that market participants fully neutralize changes in make and take fees. These results, however, are not necessarily inconsistent with finding that allocation does or does not matter for certain types of securities since our analysis focuses on the tape-exchange level versus security-exchange level. For example, it is possible that the make/take allocation at the security level is dependent upon different security-level characteristics like, for instance, traders' interest in an asset (an inclusion/deletion of a stock from the S&P 500 index will cause buying/selling pressure from index funds, for instance). That is, it could be the case that factors affecting demand elasticity for the asset in the absence of frictions will affect whether and how make/take fees will matter.

The results provide evidence that a change in the make fee is not significantly different from a change in the take fee in terms of their effect on the true economic spread at the tape-exchange level as well as the quoted spread at the exchange level. This indicates that changing the allocation of the total fee between makers and takers is irrelevant to the spread adjusted for fees on a tape exchange as well as the quoted spread. Our results in terms of whether allocation matters for the quoted spreads lead to the same conclusion that the breakdown of the total fee between makers and takers is irrelevant. In short, we show that the make/take breakdown is irrelevant for both the quoted spreads and net-of-fees spreads.

In conclusion, this section reported regression results when the variables of interest were the total, make, and take fees, in nominal terms. In summary, the results show that an increase in the nominal total fee is associated with a decrease in the exchange's trading activity and no

effect on both the quoted and the net-of-fee spread at the exchange level. Further, an increase in the nominal take fee decreases trading volume more than an increase in the nominal make fee. We find that the sensitivities of the quoted spread as well as the net-of-fees spread are the same for the same changes in the nominal take fee versus the nominal make fee.

6. Regression Results – Relative-to-Rivals Fees

In order to illustrate the relationship between the exchanges' trading activity and spreads and *the relative attractiveness of the fees* compared to fees charged by other exchanges, we now turn our attention to the relative-to-rivals fee introduced in Section 4. Looking at the association between exchange's trading activity and spreads, and the relative-to-rivals fees we are able to (1) examine the effect of fee changes that make a particular exchange relatively more or less attractive than its rivals in terms of pricing and (2) helps ensure the soundness of our results reported in Section 5.

We perform the same regression specifications as in Table 8 and so Table 4 replicates Table 8 with the exception that now the nominal fees are replaced with their relative-to-rivals fee equivalents. In summary, the regression results reported in Table 4 validate the results reported in Table 8. We document that not only the the nominal level of the fees matter but their relative attractiveness compared to the fees that the rival exchanges charge is also important. The relative-to-rivals fee variables capture the attractiveness of an exchange's fee compared to fees on all rival exchanges, specifically the distance (proximity of fees across exchanges) and not just the absolute level of the fee.

For example, in Columns (1) and (2), Panel A, Table 4, we regress changes in detrended volume on changes in the relative-to-rivals basic fee measure and changes in the relative-to-rivals competitive fee measure, respectively. The point estimates are -0.033 (p-value of 0.01) and -0.024 (p-value of 0.00). Thus, if an exchange offers a low nominal fee compared to fees being charged in rival exchanges, decreasing its fee further – i.e., increasing the distance to rivals offering higher nominal total fees, also has a positive effect on its own volume. For instance, in the extreme case when an exchange offers the lowest nominal total fee, reducing that fee

further can incentivize some market participants to utilize that exchange.

Columns (3) and (4), Panel A, Table 4, show the results from estimating a regression where the dependent variable is now ΔMS and the independent variable of interest are again the corresponding relative-to-rivals transformation of the nominal fee measures for the basic and competitive pricing, respectively. The coefficients are -0.406 (p-value of 0.02) and -0.339 (p-value of 0.07), respectively. Therefore, decreasing the relative-to-rival total fee has a positive effect on market share and this relationship is more pronounced for the relative-to-rivals total basic fee measure versus the relative-to-rivals total competitive fee measure. Recall that the results reported in Table 8, Panel A, Columns (3) and (4) also showed that the negative association between exchange's market share and the nominal total fee is more pronounced for the competitive nominal total fee versus the basic nominal total fee. As already discussed previously, this result is consistent with the fact that switching costs are higher for the market participants that qualify for the more competitive pricing menu. Further, market participants who qualify for the more competitive pricing are the ones that, on average, have higher gains from trade, due to large amounts of shares to trade or informational advantages, and thus small changes in the fees do not affect their disposition to trade. In summary, when the nominal fee variables are replaced with the relative-to-rivals fee variables we reach the same conclusion as reported in Section 5.

Further, there is no association between the total fee and the quoted and net-of-fees spreads regardless of whether the total fee is expressed in its nominal or relative-to-rivals analogue. Panel A, Columns (5) through (12) in Table 4 confirm the results reported in Panel A, Columns (5) through (12) in Table 8.

The results in terms of the sensitivities of exchanges' characteristics, trading activity and spreads, to a unit change in make fee versus the take fee are similar regardless of whether the fees are measured in nominal or their relative analogue. The results reported in Panel B and C in Table 4, Columns (1) through (4) confirm the results reported in Table 8. Consequently, in a relative sense as well as in nominal sense, a decrease in the take fee increases exchange's trading activity, measured as volume and market share, more than a decrease in the make

fee. The results in terms of the sensitivities of the quoted spread and the net-of-fees spread at the exchange level to changes in the relative-to-rivals make and take fees document that a unit change in the make and a change in the take fee in their relative terms have the same unit change on spreads (Columns (5) through (12), Panel B and C in Table 4). Recall that we reported the same results when the fees are in their nominal equivalents are the same ((Columns (5) through (12), Panel B and C in Table 8).

7. Do instances with relatively small spreads drive the results?

Our main results in terms of exchange's trading activity show that an increase in the total fee decreases the trading activity on an exchange and moreover that an increase in the take fee decreases trading activity relatively more than an increase in the make fee. We expect to find that this relationship is more pronounced when the tick size is a binding constraint on bid-ask spread, i.e., when the quoted bid-ask spread is relatively small (Foucault, Kadan, and Kandel (2013)).

To explore this hypothesis, we proceed in the following way. Recall the construction of our variable *$BBO*. In particular, we start by first calculating the daily time-weighted average quoted bid-ask spread in dollars per share on every exchange for each individual security and then aggregate these securities' level observations each day within each tape on an exchange by looking at the median. To investigate the conjecture that the liquidity-based trading fees have bigger impact when the quoted bid-ask spread is relatively small, instead of aggregating *all* transacted shares in a day to a tape-exchange observation, we aggregate shares that are transected below the median of the daily individual securities' time-weighted average quoted bid-ask spread in dollars per share on each exchange. We also aggregate shares that are transected above the median of the daily individual securities' time-weighted average quoted bid-ask spread in dollars per share on each exchange. Said differently, on each day on each tape and exchange we create two exchange-level variables. For example, in terms of volume we have $\Delta\, Vol\_Below$ and $\Delta\, Vol\_Above$, where *Vol_Below* is the detrended volume in billions of shares by aggregating shares that were transacted at below the median of the individual securities' BBO

on each day on each tape-exchange (where the median BBO is the median across the individual securities' time-weighted average dollar quoted spreads for securities) and ΔVol_Above is the detrended volume in billions of shares by aggregating shares that were transacted at above the median BBO on each day on each tape-exchange where the median BBO is the median across the individual securities' time-weighted average dollar quoted spreads for securities.

We start by looking at the below-median-securities-BBO subsample. By doing that we study how the fees impact exchange's volume when the tick is presumably binding constraint to the bid-ask spread. Table 5 and 6 show the results for when the variables of interest are the nominal fee measures and the relative fee measures, respectively. The reported coefficients in Table 5 and 6 are essentially the same as the ones reported in Table 3 and 4 where we aggregated all transacted shares in a day in a tape-exchange regardless of how large the BBO is.

Next, we look at the above-median-securities-BBO subsample and run the same regression specifications as the one in Table 5 and 6 but now aggregating shares that are transacted at above-median-securities-BBO subsample (results untabulated). None of the coefficients associated with our fee measures, nominal or relative terms, is statistically significant from zero. These are results are consistent with the hypotheses that allocation matters most when the tick-size is a binding constraint on the bid-ask spread.

We caution however that even though we split at the median of the individual securities' time-weighted average dollar quoted spread on each day on each tape-exchange some spreads are not particular binding. For example, the distribution of the tape-exchange dollar quoted BBOs in the below-median-securities-BBO subsample looks like this – the minimum is \$0.01, the 25th% is \$0.02, the median is \$0.03, the 75th% is \$0.08 and the maximum is \$1.18. Therefore, next, we keep only observation those tape-exchange observations for which the exchange's quoted spread is less than the median of 3 cents. The results are reported in Table 7 and Table 8. In terms of the trading activity results the coefficients associated with the fee mesures are slightly greater in Table 7 and 8 compared to Table 3 and 4.

To look into the other extreme case when the tick-size is less binding we look again at the above-median-securities-BBO subsample on each day on each tape-exchange. In this subsample

the distribution of the bbos look like this - the minimum is \$0.01, the 25th% is \$0.12, the median is \$0.30, the 75th% is \$0.60 and the maximum is \$6.29. Because we are interested in the extreme case when the exchange level bbo are large we then look at observation when the bbo is greater than the median of 30 cents. We do not tabulate these results. All coefficeints are essentially statistically insignificant. Thus we conclude that the trading activity results are driven primarily by the low bbo observations.

In Table 5, 6, 7 and 8 the coefficients associated with the fee variables are mostly insignificant. The results reported in Table 3 and 4 that there is no relationship between fees and spreads at the exchange level still persist with an exception. Columns (5) and (6), Panel B in Tables 5, 6, 7 and 8 reveals a negative association between a change in the dollar quoted bid-ask spread and a change in the take fee charged to traders that do not qualify for higher volume-based tiers. More importantly the results reported in Columns (5) and (6), Panel C in Tables 5, 6, 7 and 8 show that a change in the take fee has more effect on the BBO than a change in the make fee when the BBOs are relatively small.

8. Robustness Tests

To help ensure the validity of our results, we conduct two main tests of robustness in this section. As already discussed in the section that focused on our main methodology we use first-differencing transformation of our variables. This approach is preferred to fixed effects when the cross-sectional units is relatively large compared to to the number of time periods. On one hand, first-differencing the variables eliminates the constant unobserved effect over time and the autocorrelation in the error terms. First-differencing also allows to test how exchange's characteristics change on the fee change event, and as such potentially avoids endogeneity issues that might arise doing analysis in levels. On the other hand, first-differencing creates zeros in the data due to the fact that fees do not change every day. We deal with this issue in two ways. First, to all regressions specifications reported in Table 8 and Table 4 we add a dummy variable, which is an indicator variable that takes the value of one for a tape-exchange on days when a fee change occurs and is zero otherwise. Second, we perform a subsample analysis where we

keep only the observations when changes in the fees occurred. Results generally hold.

9. Conclusion

Recently, the predominant pricing model on equity exchanges is the make and take fees and rebates pricing model. The model has been adopted on all registered U.S. equities exchanges. The use of the fees has become widespread as more exchanges employ the model as a tool to gain market share and trading volume. The effect of these fees on the U.S. equity exchange industry is largely undocumented and not well understood from the exchange's perspective.

We examine the relationship among fees, volume, market share, quoted, and net-of-fees spreads in the United States for the period January 1, 2008 through December 31, 2010, across more than a dozen registered exchanges. Our exchange-level analysis for tapes of securities provides evidence that a decrease in the total fee increases an exchange's volume and market share in a tape. We show that a change in the total fee has no effect on both the quoted as well as the net-of-fees spread. The negative association between total fee and trading activity measures is consistent with a downward-sloping demand curve for trading.

Moreover, our results show that not only does the level of the total fee matter for volume and market share, but the allocation of the total fee to makers and takers affects volume and market share. We find that a decrease in the take fee increases the trading activity on an exchange more than a decrease in the make fee. Given that generally the fees charged to the takers are positive and the fees charged to makers are negative – i.e., rebates, this result implies that, on average, an exchange is able to increase its volume more by decreasing its take fee by one unit than by increasing its rebate provided to liquidity makers. We do not find that the fee structure has any effect on the quoted prices and the net-of-fees spreads, at least as inferred by median security-level BBO at the tape-exchange level.

We note that our results are based on tape-exchange-level analysis and that the optimal make-and-take fee structure can depend on security-level characteristics (Foucault, Kadan, and Kandel, 2013). Further analysis is needed to address the impact of these fees for different types of securities depending on their characteristics.

This study is an attempt at determining the overall effect of the make-and-take fee pricing model on exchanges. The way in which the fees affect market participants and the role of regulators are topics beyond the scope of this paper but of great importance. For example, high-frequency trading firms have been known to design strategies directed at capitalizing on make-and-take fee structures across markets.[33] The effects of these activities on the market as a whole and on long-term investors is still under debate.[34] Given our findings that these fees affect trading activity on an exchange, we believe that exploring the avenues through which fees affect trading strategies, behavior, and profitability is an interesting and relevant topic for future research.

[33] "What's behind high-frequency trading" by Scott Patterson and Geoffrey Rogow, *Wall Street Journal*; "Who's afraid of high-frequency trading?" by Jonathan Spicer and Herbert Lash, *Reuters*; "Serving all, not just the elite few" by Sal Arnuk and Joseph Saluzzi, *The New York Times*.

[34] Regulators are particularly interested in the topic of the maker-taker pricing model. For example, the Securities and Exchange Commission has requested comment with regard to the impact of these make and take pricing models within the marketplace. In a recent filing, they ask, "Are liquidity rebates unfair to long-term investors because they necessarily will be paid primarily to proprietary firms engaging in passive market making strategies? Or do they generally benefit long-term investors by promoting narrower spreads and more immediately accessible liquidity? Do liquidity rebates reward proprietary firms for any particular types of trading that do not benefit long-term investors or market quality?" (SEC 34-61358)

Appendix: Data Management Details

The Consolidated Tape Association (CTA)[35] oversees the dissemination of real-time trade and quote information. Market centers send their trades and quotes to Consolidated Tape System (CTS) and to Consolidated Quotation System (CQS).[36] Market centers are required, as authorizing Self-Regulatory Organizations (SROs) per the CTA Plan, to report their trade activity within 90 seconds of execution time to CTS; otherwise the trade report must be designated as a late report. The current participants of the CTA as of March 18, 2010, include the American Stock Exchange, Boston Stock Exchange, Chicago Board Options Exchange, Chicago Stock Exchange, Financial Industry Regulatory Authority, International Securities Exchange, Nasdaq Stock Market, National Stock Exchange, New York Stock Exchange, NYSE Arca, and Philadelphia Stock Exchange.

The TAQ (Trades and Quotes) database is the primary source of historical trade and quote data for U.S. equities coming from the CQS and CTS. Academicians usually have access to TAQ through Wharton Research Data Services (WRDS).[37] TAQ on WRDS have two components: the Consolidated Quotes Files and the Consolidated Trades Files. We will talk about each one in turn.

Consolidated Quotes Files on TAQ

The Consolidated Quotes Files report quotations, more specifically a quote update (a quote is valid until a new quote comes in), from more than 10 market centers as of January 2010. If a market center would like to cancel its quote, typically it will post an extremely small bid (e.g., \$0.01) or an extremely large offer (e.g., \$201,000) (the so-called stub quote). For most market centers, this updated quote will be the best bid and offer (BBO) prevailing at the market center. The only exception is quotes coming from Nasdaq and the ADFs. From the BBO reported from all market centers, we could establish the prevailing National Best Bid and Offer (NBBO) at any point of time.

[35] http://www.nyxdata.com/cta

[36] http://sec.gov/divisions/marketreg/marketinfo/appendixq.pdf

[37] http://wrds.wharton.upenn.edu/

The variable EX in TAQ contains data for the exchange on which the quote occurred. More specifically, EX = A for Amex,[38] EX = B for Boston, EX = C for NSX (National Stock Exchange, formerly the Cincinnati Stock Exchange[39]), EX = D for NASD ADF and NASD, EX = N for NYSE, EX = P for Arca,[40] EX = T for NASDAQ,[41] EX = X for Philadelphia, EX = I for ISE,[42] EX = M for Chicago, EX = W for CBOE, EX = Z for BATS. The Consolidated Quotes File contains information about the bid price and the size of it, the offer price and the size of it, quote condition and that Nasdaq market marker for each NASD Quote (variable "MMID" in TAQ[43]), and the symbol of the security.

There are some specifics about the way Nasdaq reports its quotes in the CQ files in TAQ, during the process of becoming a regular market participant as a stock exchange. There are three important dates on TAQ CQ files: November 25, 2002, May 15, 2006, and February 12, 2007. Further, we take into account whether a security is (1) NYSE listed, AMEX listed, and Arca listed or (2) Nasdaq listed. Thus, we have the following case scenarios:

- The security is NYSE listed, AMEX listed, and Arca listed and the period is
  - *Case A. Before Friday, May 12, 2006*: Nasdaq quotes have EX = T identifier on TAQ with the MMIDs reported, i.e., individual dealer quotes. There are no quotes with EX = D identifier.

[38]NYSE Euronext acquired American Stock exchange on October 1, 2008. More details about the history of American Stock Exchange could be found at `http://www.nyse.com/pdfs/AmexTimeline.pdf` and about NYSE Euronext at `http://www.nyse.com/pdfs/NYSEEuronextTimeline-web.pdf`.

[39]The Cincinnati Stock Exchange moved to Chicago in 1995 and changed its name to National Stock Exchange in 2003.

[40]The Pacific Stock Exchange used to be a floor-based market, but it merged with Archipelago (an ECN) and later NYSE and Archipelago merged to form NYSE Group Inc. More details could be found at: `http://www.nyse.com/pdfs/nysegrouptimeline.pdf` and `http://www.nyse.com/pdfs/NYSEEuronextTimeline-web.pdf`.

[41]EX = Q only in the CT files. See next section.

[42]As of December 23, 2008, Direct Edge Holdings (Direct Edge), the parent company of Direct Edge ECN, and the International Securities Exchange (ISE) completed the transaction through which the ISE Stock Exchange has become a wholly owned subsidiary of Direct Edge Holdings. Upon completion of the transaction, ISE also gained a significant equity stake in Direct Edge. For more information, go to `http://www.directedge.com/AboutDirectEdge/Announcements/ViewNewsletterDetail.aspx?NewsletterID=51`.

[43]The market maker identification (MMID) data field provides an additional classification layer among NASDAQ dealers and ECNs. For example, TRIM denotes Trimark, a NASDAQ dealer, while BRUT denotes the BRUT ECN. The National Securities Clearing Corporation provides a listing of NASDAQ market makers and their MMIDs in the Member Directory at `www.nscc.com` and `http://www.dtcc.com/customer/directories/nscc.php`. (see footnote 13, p. 90 from GAO report).

- *Case B. Monday, May 15, 2006 - Friday, February 9, 2007*: Nasdaq quotes have EX = D identifier on TAQ with MMIDs reported. There are no quotes with EX = T identifier.
- *Case C. After Monday, February 12, 2007*: Nasdaq quotes have EX = T identifier with no MMIDs reported or the "CAES" MMID reported,[44] i.e., Nasdaq reported quotes are treated as standard market participant. ADF quotes have EX = D identifier with MMIDs reported.[45]

- The security is Nasdaq listed and the period is
  - *Case D. Before Friday, November 22, 2002*: Nasdaq quotes have EX = T identifier on TAQ with no MMIDs reported – i.e., best Nasdaq dealer quotes for Nasdaq stocks. There are no quotes with EX = D identifier. In the cases when MMIDs are not reported, we could consider that this is the Nasdaq BBO quote for Nasdaq-listed securities.
  - *Case E. After Monday, November 25, 2002*: Nasdaq quotes are identified with EX = T while NASD ADF quotes are identified with EX = D. MMIDs are not reported

[44]CAES (Computer Assisted Execution System) is an NASD interdealer automated execution system for listed 19c-3 securities. CAES is the NASD link to ITS (Intermarket Trading System). If an NASD dealer wishes to make markets in listed securities, he or she must register as an ITS/CAES market maker for those securities. CAES is a NASDAQ system that allows its members to quote NYSE-listed stocks. For details, go to `http://www.sec.gov/rules/sro/nd9975o.htm` and `http://www.sec.gov/rules/sro/nd9953/frucher1.htm`. "NAQS" stands for NASD Alternative Quotation System. "NAQS" replaced "CAES" as of May 15, 2006.

[45]The TAQ manual notes that "As of Monday, May 15, 2006, through Friday, March 2, 2007, Nasdaq quotes in NYSE-listed, AMEX-listed and Arca listed stocks will appear on TAQ with an exchange code of D only." We download CQ data for GM, which is a NYSE-listed stock for the period May 1, 2006, through March 15, 2007. We observe that on Friday, May 12, 2006, the Nasdaq quotes are identified with EX = T and the MMIDs are reported including MMID = CAES and that there are no quotes with EX = D identifier. We also observe that on Monday, May 15, 2006 the Nasdaq quotes are identified with EX = D and the MMIDs are reported and that there are no quotes with EX = T identifier. This is consistent with the TAQ Manual. However, as of Monday, February 12, 2007 (not Friday, March 2, 2007, as noted in TAQ Manual), Nasdaq quotes of NYSE-, Amex-, and Arca-listed securities have an exchange code of T (the MMIDs are not reported consistent with the fact that this is the time when Nasdaq quotes are treated as a regular market participant), while ADF quotes have a code of D with MMIDs reported. We contacted WRDS and they agreed that the data are not consistent with the TAQ Manual at this point.

for both cases[46].

Consolidated Trades Files on TAQ

The Consolidated Trades files report transactions with the time[47] they got recorded, the symbol of the security (variable *Symbol*), number of shares traded (variable *Size*), actual trade price per share (variable *Price*), the market center on which the trade occurred (variable *EX*)[48], correction indicator (variable *CORR*), sale condition (variable *COND*) and combined "G" Rule 127, and stopped stock trade indicator (variable *G127*). We eliminate from the sample trades with a correction code greater than 1 – i.e., corr in (0,1) following Bessembinder (1999) and Kyle, Obizhaeva, and Tuzun (2010).

We use only trades for which TAQs CORR field is equal to zero or one and for which the COND field is either blank or equal to *, @, E, F, I, J, or K. We only include trades with positive prices or quantities. We eliminate trades with prices more than (less than) 150% (50%) of the previous trade price if the prior price is more than $2 per share. We do not delete observations for which price is less or equal to $2.

As of May 15, 2006, Monday through March 2, 2007, Friday Nasdaq trades in NYSE-listed, AMEX-listed, and Pacific- (Arca-) listed stocks will appear on TAQ with an exchange code of D only. As of March 5, 2007, Monday, Nasdaq trades of NYSE-, Amex-, and Arca-listed stocks will have an exchange code of T, while ADF and TRF trades will have a code of D. T will no

[46]EX = D was added for NASD on Friday, May 31, 2002 according to the CQS Revision #19. We downloaded CQ data from TAQ for MSFT, which is a Nasdaq-listed stock for the period May 1, 2002 through Dec 31, 2002. We observe that on Friday, November 22, 2002, we have quotes with EX = T (no MMIDs reported and no quote with EX = D). We observe that on Monday, November 25, 2002, we have both quotes with EX = T and quotes with EX = D. MMIDs are not reported for both cases. Thus, TAQ reflects the CQS change on Monday, November 25, 2002.

[47]Variable *TTIM* is trade time and reflects the time at which the trade entered CTS. The TAQ Manual says "Beginning in June 1995, the trade time for NYSE and AMEX issues is the Consolidated Trade System (CTS) time stamp. Beginning in March 1997, the trade time for Nasdaq issues is the NTDS time stamp. Previously, the time shown for all trades was the time the message was received by IGS, which is approximately 3 seconds later than the CTS time stamp."

[48]More specifically, EX = A for AMEX, EX = N for NYSE, EX = B Boston, EX = P for Arca, EX = C for NSX, EX = T/Q NASDAQ, EX = D for NASD ADF and TRF, EX = X for Philadelphia, EX = I for ISE, EX = M for Chicago, EX = W for CBOE, EX = Z for BATS, and EX = 1 for Nasdaq prints in Nasdaq stocks Aug/Sep 2006 only. For some observations, EX = 8 and there is no information for it in the TAQ Manual. We find, however, that for the period 2005 through 2008 less than 1% of the trades have exchange code equal to 8, so we exclude this data.)

longer appear for trades in Nasdaq stocks as of June 28, 2006 (T will not appear until Nasdaq becomes an exchange.). These trades will have an exchange identifier of "Q". When Nasdaq became an exchange, Nasdaq executions are represented with a "Q," while "D" will include Trade Reporting Facility(TRF) prints and ADF trades.

As of May 15, 2006, through March 2, 2007, Nasdaq trades and quotes in NYSE-listed, AMEX-listed, and Arca-listed (formerly Pacific Stock Exchange) stocks will appear on TAQ with an exchange code of D only. As of March 5, 2007, Nasdaq trades of NYSE-, Amex-, and Arca-listed stocks will have an exchange code of T, while ADF and TRF trades will have a code of D. T will no longer appear for trades in Nasdaq stocks as of June 28, 2006. These trades will have an exchange identifier of Q.

As of May 15, 2006, Nasdaq trades and quotes in NYSE-listed, AMEX-listed, and Arca-listed stocks will appear on TAQ with an exchange code of D only. T will not appear again when Nasdaq became an exchange.

Merging TAQ and CRSP

The CRSP "NCUSIP" variable has correct historical values (unlike "CUSIP," which is a header variable that contains current data only), and the first eight characters of the TAQ Master File variable "CUSIP" can be used to match with CRSP's NCUSIP. Thus we (1) get SYMBOL-CUSIP links from TAQ master files, (2) get PERMNO-NCUSIP- ticker links from CRSP, and (3) merge above two by using the common variable of CUSIP. Comerton-Forde, Hendershott, Jones, Moulton, and Seasholes (2010) note that the symbol in TAQ and ticker in CRSP match only 90% of the time in their CUSIP matched sample, suggesting that using the TAQ master file to obtain CUSIPs is constructive.

References

Alexandrov, Alexei, and Daniel F. Spulber, 2013, Transactions in two-sided markets, Working Paper.

Amihud, Yakov, and Haim Mendelson, 1986, Asset pricing and the bid-ask spread, Journal of Financial Economics 17, 223–249.

Amihud, Yakov, and Haim Mendelson, 1992, Transaction taxes and stock values, in modernizing U.S. securities regulation – Economic and legal perspective, Irwin Professional Publishing, Burr Ridge, Illinois, New York, New York.

Anand, Amber, Tim McCormick, and Laura Serban, 2013, Incentives for liquidity provision: Is the make-take structure the answer? Working Paper.

Angel, James J., Lawrence E. Harris, and Chester S. Spatt, 2011, Equity trading in the 21st century, Quarterly Journal of Finance 1, 1–53.

Angel, James J., Lawrence E. Harris, and Chester S. Spatt, 2013, Equity trading in the 21st century: An update, Working paper.

Battalio, Robert, Shane A. Corwin, and Robert H. Jennings, 2014, Can brokers have it all? On the relation between make take fees & limit order execution quality, Working Paper.

Battalio, Robert, and Craig W. Holden, 2001, A simple model of payment for order flow, internalization, and total trading cost, Journal of Financial Markets 4, 33–71.

Battalio, Robert, Andriy Shkilko, and Robert Van Ness, 2011, To pay or be paid? The impact of taker fees and order flow inducements on trading costs in U.S. options markets, Working Paper.

Bessembinder, Hendrik, 1999, Trade execution costs on Nasdaq and the NYSE: A post-reform comparison, Journal of Financial and Quantitative Analysis 34, 387–407.

Blume, Marshall E., and Michael A. Goldstein, 1997, Quotes, order flow, and price discovery, The Journal of Finance 52, 221–244.

Brolley, Michael, and Katya Malinova, 2012, Informed trading and maker-taker fees in a low-latency limit order market, Working Paper.

Chakravarty, Sugato, Pankaj Jain, James Upson, and Robert Wood, 2012, Clean sweep: Informed trading through intermarket sweep orders, The Journal of Financial and Quantitative Analysis 47, 415–435.

Colliard, Jean-Edouard, and Thierry Foucault, 2012, Trading fees and efficiency in limit order markets, Review of Financial Studies 25, 3389–3421.

Comerton-Forde, Carole, Terrence, Hendershott, Charles M. Jones, Pamela C. Moulton, and Mark S. Seasholes, 2010, Time variation in liquidity: The role of market maker inventories and revenues, The Journal of Finance 65, 295–331.

Copeland, Thomas E., and Dan Galai, 1983, Information effects on the bid-ask spread, The Journal of Finance 38, 1457–1469.

Demsetz, Harold, 1968, The cost of transacting, The Quarterly Journal of Economics 82, 33–53.

Easley, David, Nicholas M. Kiefer, and Maureen O'Hara, 1996, Cream-skimming or profit-sharing? The curious role of purchased order flow, The Journal of Finance 51, 811–833.

Foucault, Thierry, 2012, Pricing liquidity in electronic markets, in Foresight: The Future of Computer Trading in Financial Markets. Final Project Report, The Government office for Science (Driver Review, 18).

Foucault, Thierry, Ohad Kadan, and Eugene Kandel, 2013, Liquidity cycles and make/take fees in electronic markets, The Journal of Finance 68, 299–341.

Harris, Larry, 2013, Maker-taker pricing effects on market quotations, Working paper.

Holden, Craig W., and Stacey Jacobsen, 2014, Liquidity measurement problems in fast, competitive markets: Expensive and cheap solutions, The Journal of Finance 69, 1747–1785.

Kandel, Eugene, and Leslie M. Marx, 1999, Payments for order flow on Nasdaq, The Journal of Finance 54, 35–66.

Keynes, John Maynard, 1936, The general theory of employment, interest, and money, Macmillan Cambridge University Press.

Kyle, Albert S., Anna A. Obizhaeva, and Tugkan Tuzun, 2010, Trading game invariance in the TAQ dataset, Working Paper.

Lo, Andrew W., and Jiang Wang, 2000, Trading volume: definitions, data analysis, and implications of portfolio theory, Review of Financial Studies 13, 257–300.

Lutat, Marco, 2010, The effect of maker-taker pricing on market liquidity in electronic trading systems Empirical evidence from european equity trading, Working paper.

Macey, Jonathan R., and Maureen O'Hara, 2005, From markets to venues: securities regulation in an evolving world, Stanford Law Review 58, 563–599.

Malinova, Katya, and Andreas Park, 2014, Subsidizing liquidity: The impact of make/take fees on market quality, Journal of Finance forthcoming.

McInish, Thomas H., and Robert A. Wood, 1992, An analysis of intraday patterns in bid/ask spreads for NYSE stocks, The Journal of Finance 47, 753–764.

O'Hara, Maureen, and Mao Ye, 2011, Is market fragmentation harming market quality?, Journal of Financial Economics 100, 459–474.

Rochet, Jean-Charles, and Jean Tirole, 2003, Platform competition in two-sided markets, Journal of the European Economic Association 1, 990–1029.

Rochet, Jean-Charles, and Jean Tirole, 2006, Two-sided markets: a progress report, RAND Journal of Economics 37, 645–667.

Skjeltorp, Johannes A., Elvira Sojli, and Wing Wah Tham, 2012, Identifying cross-sided liquidity externalities, Working Paper.

Spicer, Jonathan, 2009, Lure of rebates drives US trading despite selloff, Reuters April 24.

Stoll, Hans R., 1989, Inferring the components of the bid-ask spread: Theory and empirical tests, The Journal of Finance 44, 115–134.

Wooldridge, Jeffrey M., 2002, Econometric analysis of cross section and panel data, The MIT Press, Cambridge, Massachusetts.

Yao, Chen and Mao Ye, 2014, Tick size constraints, market structure, and liquidity, Working Paper.

Table 1
Summary Statistics, January 1, 2008 – December 31, 2010

This table reports mean, median, and standard deviation for fee, trading activity, and spread measures. *Nom_Make_Basic* and *Nom_Take_Basic* are the nominal make fee and the nominal take fee, respectively, offered to traders that do not qualify for higher volume-based tiers. *Nom_Total_Basic* is the sum of *Nom_Make_Basic* and *Nom_Take_Basic*. *Nom_Make_Comp* and *Nom_Take_Comp* are the nominal make fee and the nominal take fee, respectively, offered to traders that qualify for the high volume-based tier. *Nom_Total_Comp* is the sum of *Nom_Make_Comp* and *Nom_Take_Comp*. *Rel* stands for "relative-to-rivals" and is estimated as per Eq.(1). All nominal fee measures are in dollars per 100 shares. *Exchange Volume in a Tape* is the executed trading volume on an exchange across all securities that belong to a certain tape in billions of shares. Correspondingly, *Market Share of Exchange Volume in a Tape* is the market share of an exchange in percentage of all traded shares in a tape. *Tape Volume* is the daily trading volume in a tape aggregated across exchanges in billions of shares. *$Tape-Exchange Quoted Spread* is the dollar quoted spread calculated for each tape on each exchange as the daily median across individual securities' time-weighted average dollar quoted spreads. *$Tape-Exchange Net-of-Fees Spread – Basic* and *$Tape-Exchange Net-of-Fees Spread – Competitive* are the dollar net-of-fees quoted spreads estimated as *$Tape-Exchange Quoted Spread* plus twice the take (basic or competitive) fee per share. Calculated in the same manner, *%Tape-Exchange Quoted Spread* is the corresponding percentage quoted spread while *%Tape-Exchange Net-of-Fees Spread – Basic* and *%Tape-Exchange Net-of-Fees Spread – Competitive* are the corresponding percentage net-of-fees quoted spreads. There are 18,362 daily tape-exchange observations for the trading activity and fee variables and 18,282 for the spread variables.

Variable	Mean	Median	St.Dev.
Panel A: Nominal Make, Take, and Total Fees			
Nom_Make_Basic $/100 shares	-0.1992	-0.2500	0.1078
Nom_Take_Basic $/100 shares	0.2490	0.3000	0.1022
Nom_Total_Basic $/100 shares	0.0498	0.0400	0.0768
Nom_Make_Comp $/100 shares	-0.2288	-0.2700	0.1137
Nom_Take_Comp $/100 shares	0.2400	0.2800	0.0993
Nom_Total_Comp $/100 shares	0.0112	0.0000	0.0647
Panel B: Relative Make, Take, and Total Fees			
Rel_Make_Basic	0.0000	-0.2600	0.9243
Rel_Take_Basic	0.0000	0.2200	0.9097
Rel_Total_Basic	0.0000	-0.1000	0.6746
Rel_Make_Comp	0.0000	-0.2350	0.9997
Rel_Take_Comp	0.0000	0.1900	0.8861
Rel_Total_Comp	0.0000	-0.0450	0.6106
Panel C: Trading Activity			
Exchange Volume in a Tape	0.1818	0.0283	0.2970
Market Share of Exchange Volume in a Tape	7.5737	1.5075	9.7527
Tape Volume	2.3375	1.3742	1.6863
Panel D: Quoted and Net-of-Fees Spreads			
$Tape-Exchange Quoted Spread	0.1972	0.1069	0.2564
$Tape-Exchange Net-of-Fees Spread – Basic	0.2022	0.1124	0.2564
$Tape-Exchange Net-of-Fees Spread – Competitive	0.2020	0.1124	0.2565
%Tape-Exchange Quoted Spread	1.2707	0.6464	1.7069
%Tape-Exchange Net-of-Fees Spread – Basic	1.3200	0.7157	1.7173
%Tape-Exchange Net-of-Fees Spread – Competitive	1.3183	0.7138	1.7174

Table 2
Money Transfer in Millions of Dollars Among Exchanges, Makers and Takers, January 2008 – December 2010

This table reports upper and lower boundaries of money transfer in millions of dollars among exchanges, makers, and takers. Panel A reports the upper boundary of money transfer, while Panel B reports the lower boundary of money transfer. Specifically, we first multiply the nominal make fee per share, the nominal take fee per share, and the nominal total fee per share for the basic tier by the number of shares traded each day for each tape-exchange – i.e., we assume that all shares are transacted at the basic tier pricing level, which provides us with the upper boundary on money transfer among parties. Similarly, we next multiply the nominal make fee per share, the nominal take fee per share, and the nominal total fee per share for the competitive tier by the number of shares traded each day for each tape-exchange – i.e., we assume that all shares are transacted at the competitive tier pricing level, which provides us with the lower boundary on money transfer among parties. Then we aggregate the data across tapes within each exchange. The observations are exchange-day observations in millions of dollars. The number of the exchange-day observations is 6,727. Column (1) reports the average across all exchange-day observations. Next, for each exchange we aggregate across days and report the average across exchanges in Column (2). The sum across exchanges and all days is reported in Column (3).

	Average Money Transfer in an Exchange on a Day	Average Money Transfer in an Exchange	Total Money Transfer Across Exchanges and Days
	(1)	(2)	(3)
Panel A: Upper Boundary — All Shares Transacted at the Basic Tier			
Takers paid	1.171	562.505	7,875.074
Makers paid	-0.710	-341.410	-4,779.742
Exchanges earned	0.460	221.095	3,095.332
Panel B: Lower Boundary — All Shares Transacted at the Competitive Tier			
Takers paid	1.124	540.389	7,565.454
Makers paid	-0.992	-476.849	-6,675.882
Exchanges earned	0.132	63.541	889.571

Table 3

Nominal Fees - Full Sample Regressions Analysis

This table reports regressions results in changes of variables for the full sample of daily tape-exchange observations during the period from January 1, 2008 to December 31, 2010. Panel A reports results when the independent variable of interest is the total fee (the sum of the make fee and take fee), and Panel B reports results when the independent variables of interest are the make fee and take fee. Panel C reports estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. All fee measures are nominal fees in dollars per 100 shares and are explained in Table 1. Columns (1) through (4) report results when the dependent variables are our proxies for trading activity. *Vol* is the detrended volume in billions of shares on a tape-exchange. *MS* is the detrended market share of an exchange in percentage of all traded shares in a certain tape. Columns (5) through (8) reports result when the dependent variables are measures for quoted spreads. *$BBO* is the log of the dollar quoted spreads calculated for each tape on each exchange as the daily median across the individual securities' time-weighted average dollar quoted spreads. *%BBO* is the log of the corresponding quoted spread in percentage of the bid-ask midpoint. Columns (9) through (12) report results when the dependent variables are net-of-fees spreads. *$NetBBO* is the log of the tape-exchange dollar quoted spreads plus twice the take fee (basic or competitive) per share. *%NetBBO* is the log of the percentage of the bid-ask midpoint net of fees. *Tape_Vol* is the detrended daily volume of a tape aggregated across exchanges in billions of shares. *Log_Exchange_dVol* is the logarithm of daily dollar volume in millions on a tape-exchange and *Log_Rivals_dVol* is the logarithm of the total daily dollar volume in millions on rival exchanges. All specifications include date fixed effects. The *p*-values are shown in parentheses. Δ denotes the change in a variable.

Independent Variables	Trading Activity				Quoted Spreads				Net-of-Fees Spreads			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
	Δ*Vol*	Δ*Vol*	Δ*MS*	Δ*MS*	Δ*$BBO*	Δ*$BBO*	Δ*%BBO*	Δ*%BBO*	Δ*$NetBBO_Basic*	Δ*$NetBBO_Comp*	Δ*%NetBBO_Basic*	Δ*%NetBBO_Comp*
Panel A: Total Fee												
Δ*Nom_Total_Basic*	-0.235		-4.978		0.065		-0.165		0.129		-0.074	
	(0.012)		(0.000)		(0.811)		(0.595)		(0.616)		(0.804)	
Δ*Nom_Total_Comp*		-0.223		-2.400		0.036		-0.154		0.126		-0.037
		(0.039)		(0.115)		(0.909)		(0.668)		(0.674)		(0.915)
Δ*Tape_Vol*	0.081	0.081	-0.095	-0.095								
	(0.000)	(0.000)	(0.000)	(0.000)								
Δ*Log_Exchange_dVol*					-0.017	-0.017	-0.008	-0.008	-0.017	-0.017	-0.009	-0.009
					(0.002)	(0.002)	(0.179)	(0.179)	(0.001)	(0.001)	(0.123)	(0.124)
Δ*Log_Rivals_dVol*					0.193	0.192	0.127	0.127	0.187	0.187	0.121	0.122
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470
R^2	0.4124	0.4123	0.0886	0.0879	0.1388	0.1388	0.1287	0.1287	0.1387	0.1387	0.1280	0.1280
Panel B: Make Fee and Take Fee												
Δ*Nom_Make_Basic*	-0.177		-4.368		0.066		-0.146		0.078		-0.121	
	(0.066)		(0.001)		(0.814)		(0.649)		(0.772)		(0.694)	
Δ*Nom_Take_Basic*	-0.389		-6.630		0.061		-0.215		0.270		0.054	
	(0.001)		(0.000)		(0.854)		(0.576)		(0.398)		(0.883)	
Δ*Nom_Make_Comp*		-0.144		-1.320		0.051		-0.114		0.077		-0.078
		(0.198)		(0.402)		(0.875)		(0.759)		(0.805)		(0.826)
Δ*Nom_Take_Comp*		-0.392		-4.713		0.003		-0.239		0.231		0.052
		(0.002)		(0.007)		(0.992)		(0.564)		(0.504)		(0.896)
Δ*Tape_Vol*	0.081	0.081	-0.095	-0.095								
	(0.000)	(0.000)	(0.000)	(0.000)								
Δ*Log_Exchange_dVol*					-0.017	-0.017	-0.008	-0.008	-0.017	-0.017	-0.009	-0.009
					(0.002)	(0.002)	(0.177)	(0.177)	(0.001)	(0.001)	(0.126)	(0.126)
Δ*Log_Rivals_dVol*					0.193	0.193	0.127	0.127	0.187	0.187	0.121	0.122
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470
R^2	0.4125	0.4125	0.0887	0.0883	0.1388	0.1388	0.1287	0.1287	0.1387	0.1387	0.1280	0.1281
Panel C: Estimating Differences Between the Parameters for Make Fee and Take Fee in Panel B												
Δ*Nom_Make_Basic*-Δ*Nom_Take_Basic*	0.212		2.263		0.004		0.068		-0.192		-0.175	
	(0.023)		(0.084)		(0.987)		(0.824)		(0.455)		(0.554)	
Δ*Nom_Make_Comp*-Δ*Nom_Take_Comp*		0.249		3.392		0.047		0.125		-0.154		-0.130
		(0.007)		(0.009)		(0.859)		(0.683)		(0.544)		(0.657)

Table 4

Relative Fees - Full Sample Regressions Analysis

This table replicates Table 8 and now the nominal fee variables are replaced with their relative-to-rivals analogue. This table reports regressions results in changes of variables for the full sample of daily tape-exchange observations during the period from January 1, 2008 to December 31, 2010. Panel A reports results when the independent variable of interest is the total fee (the sum of the make fee and take fee), and Panel B reports results when the independent variables of interest are the make fee and take fee. Panel C reports estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. All fee measures are "relative-to-rival" fees and are explained in Table 1. Columns (1) through (4) reports results when the dependent variables are our proxies for trading activity. *Vol* is the detrended volume in billions of shares on a tape-exchange. *MS* is the detrended market share of an exchange in percentage of all traded shares in a certain tape. Columns (5) through (8) reports result when the dependent variables are measures for quoted spreads. *$BBO* is the log of the dollar quoted spreads calculated for each tape on each exchange as the daily median across the individual securities' time-weighted average dollar quoted spreads. *%BBO* is the log of the corresponding quoted spread in percentage of the bid-ask midpoint. Columns (9) through (12) report results when the dependent variables are net-of-fees spreads. *$NetBBO* is the log of the tape-exchange dollar quoted spreads plus twice the take fee (basic or competitive) per share. *%NetBBO* is the log of the percentage of the bid-ask midpoint net of fees. *Tape_Vol* is the detrended daily volume of a tape aggregated across exchanges in billions of shares. *Log_Exchange_dVol* is the logarithm of daily dollar volume in millions on a tape-exchange and *Log_Rivals_dVol* is the logarithm of the total daily dollar volume in millions on rival exchanges. All specifications include date fixed effects. The *p*-values are shown in parentheses. Δ denotes the change in a variable.

Independent Variables	Trading Activity				Quoted Spreads				Net-of-Fees Spreads			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
	Δ*Vol*	Δ*Vol*	Δ*MS*	Δ*MS*	Δ*$BBO*	Δ*$BBO*	Δ*%BBO*	Δ*%BBO*	Δ*$NetBBO_Basic*	Δ*$NetBBO_Comp*	Δ*%NetBBO_Basic*	Δ*%NetBBO_Comp*
Panel A: Total Fee												
Δ*Rel_Total_Basic*	-0.033		-0.406		-0.057		-0.061		-0.045		-0.052	
	(0.006)		(0.016)		(0.098)		(0.124)		(0.170)		(0.172)	
Δ*Rel_Total_Comp*		-0.024		-0.339		-0.076		-0.061		-0.061		-0.049
		(0.061)		(0.066)		(0.044)		(0.163)		(0.090)		(0.236)
Δ*Tape_Vol*	0.081	0.081	-0.095	-0.095								
	(0.000)	(0.000)	(0.000)	(0.000)								
Δ*Log_Exchange_dVol*					-0.017	-0.017	-0.008	-0.008	-0.017	-0.017	-0.009	-0.009
					(0.002)	(0.002)	(0.181)	(0.181)	(0.001)	(0.001)	(0.124)	(0.125)
Δ*Log_Rivals_dVol*					0.193	0.193	0.127	0.127	0.187	0.188	0.122	0.122
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470
R^2	0.4124	0.4123	0.0881	0.0880	0.1389	0.1390	0.1288	0.1288	0.1387	0.1388	0.1280	0.1281
Panel B: Make Fee and Take Fee												
Δ*Rel_Make_Basic*	-0.028		-0.346		-0.057		-0.058		-0.049		-0.054	
	(0.020)		(0.042)		(0.102)		(0.145)		(0.142)		(0.161)	
Δ*Rel_Take_Basic*	-0.049		-0.621		-0.056		-0.070		-0.032		-0.044	
	(0.000)		(0.001)		(0.157)		(0.127)		(0.406)		(0.313)	
Δ*Rel_Make_Comp*		-0.019		-0.261		-0.076		-0.057		-0.065		-0.051
		(0.159)		(0.161)		(0.048)		(0.198)		(0.076)		(0.229)
Δ*Rel_Take_Comp*		-0.042		-0.580		-0.077		-0.073		-0.050		-0.045
		(0.004)		(0.005)		(0.068)		(0.135)		(0.221)		(0.337)
Δ*Tape_Vol*	0.081	0.081	-0.095	-0.095								
	(0.000)	(0.000)	(0.000)	(0.000)								
Δ*Log_Exchange_dVol*					-0.017	-0.017	-0.008	-0.008	-0.017	-0.017	-0.009	-0.009
					(0.002)	(0.002)	(0.178)	(0.178)	(0.001)	(0.001)	(0.126)	(0.126)
Δ*Log_Rivals_dVol*					0.193	0.193	0.127	0.127	0.187	0.188	0.122	0.122
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470	17,470
R^2	0.4126	0.4125	0.0884	0.0883	0.1389	0.1390	0.1289	0.1288	0.1388	0.1388	0.1281	0.1281
Panel C: Estimating Differences Between the Parameters for Make Fee and Take Fee in Panel B												
Δ*Rel_Make_Basic*-Δ*Rel_Take_Basic*	0.021		0.275		-0.006		0.011		-0.017		-0.009	
	(0.017)		(0.026)		(0.978)		(0.696)		(0.479)		(0.733)	
Δ*Rel_Make_Comp*-Δ*Rel_Take_Comp*		0.023		0.318		0.002		0.016		-0.015		-0.006
		(0.007)		(0.010)		(0.944)		(0.579)		(0.528)		(0.832)

Table 5

Nominal Fees - Below-Median-Securities-BBO Regressions Analysis

This table reports regressions results in changes of variables for the full sample of daily tape-exchange observations during the period from January 1, 2008 to December 31, 2010. Panel A reports results when the independent variable of interest is the total fee (the sum of the make fee and take fee), and Panel B reports results when the independent variables of interest are the make fee and take fee. Panel C reports estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. All fee measures are nominal fees in dollars per 100 shares and are explained in Table 1. Instead of aggregating all transacted shares to a tape-exchange,we now aggregate shares that were transacted at below the median BBO on each day on each tape-exchange where the median BBO is the median across the individual securities' time-weighted average dollar quoted spreads for securities. Columns (1) through (4) report results when the dependent variables are our proxies for trading activity. *Vol_below* is the detrended volume in billions of shares. *MS_below* is the detrended market share. Columns (5) through (8) reports result when the dependent variables are measures for quoted spreads. *$BBO_below* is the log of the dollar quoted spreads calculated for below-median securities as the median time-weighted average dollar quoted spreads. *%BBO* is the log of the corresponding quoted spread in percentage of the bid-ask midpoint. Columns (9) through (12) report results when the dependent variables are net-of-fees spreads. *$NetBBO* is the log of the tape-exchange dollar quoted spreads plus twice the take fee (basic or competitive) per share. *%NetBBO* is the log of the percentage of the bid-ask midpoint net of fees. *Tape_Vol* is the detrended daily volume of a tape aggregated across exchanges in billions of shares. *Log_Exchange_dVol* is the logarithm of daily dollar volume in millions on a tape-exchange and *Log_Rivals_dVol* is the logarithm of the total daily dollar volume in millions on rival exchanges. All specifications include date fixed effects. The *p*-values are shown in parentheses. Δ denotes the change in a variable.

Independent Variables	Low BBO Trading Activity				Low BBO Quoted Spreads				Low BBO Net-of-Fees Spreads			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
	Δ*Vol* _*Below*	Δ*Vol* _*Below*	Δ*MS* _*Below*	Δ*MS* _*Below*	Δ*$BBO* _*Below*	Δ*$BBO* _*Below*	Δ*%BBO* _*Below*	Δ*%BBO* _*Below*	Δ*$NetBBO* _*Basic*	Δ*$NetBBO* _*Comp*	Δ*%NetBBO* _*Basic*	Δ*%NetBBO* _*Comp*
Panel A: Total Fee												
Δ*Nom_Total_Basic*	-0.226		-7.950		0.037		-0.064		0.150		0.133	
	(0.010)		(0.000)		(0.890)		(0.845)		(0.549)		(0.671)	
Δ*Nom_Total_Comp*		-0.224		-5.797		-0.043		-0.220		0.110		-0.008
		(0.026)		(0.009)		(0.889)		(0.562)		(0.705)		(0.982)
Δ*Tape_Vol*	0.074	0.074	-0.005	-0.005								
	(0.000)	(0.000)	(0.876)	(0.877)								
Δ*Log_Exchange_dVol*					-0.024	-0.024	-0.025	-0.025	-0.024	-0.024	-0.024	-0.024
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ*Log_Rivals_dVol*					0.103	0.103	0.090	0.090	0.091	0.092	0.076	0.076
					(0.000)	(0.000)	(0.005)	(0.005)	(0.000)	(0.000)	(0.013)	(0.012)
N	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470
R^2	0.4069	0.4068	0.0038	0.0032	0.1495	0.1495	0.1376	0.1376	0.1484	0.1484	0.1343	0.1344
Panel B: Make Fee and Take Fee												
Δ*Nom_Make_Basic*	-0.174		-7.476		0.322		0.109		0.270		0.143	
	(0.055)		(0.000)		(0.250)		(0.748)		(0.297)		(0.659)	
Δ*Nom_Take_Basic*	-0.368		-9.236		-0.734		-0.536		-0.176		0.106	
	(0.001)		(0.000)		(0.028)		(0.187)		(0.569)		(0.784)	
Δ*Nom_Make_Comp*		-0.149		-4.792		0.292		-0.015		0.251		-0.002
		(0.153)		(0.037)		(0.366)		(0.970)		(0.404)		(0.996)
Δ*Nom_Take_Comp*		-0.384		-7.946		-0.762		-0.660		-0.192		-0.022
		(0.001)		(0.002)		(0.035)		(0.133)		(0.567)		(0.957)
Δ*Tape_Vol*	0.074	0.074	-0.005	-0.005								
	(0.000)	(0.000)	(0.875)	(0.873)								
Δ*Log_Exchange_dVol*					-0.024	-0.024	-0.026	-0.026	-0.024	-0.025	-0.024	-0.024
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ*Log_Rivals_dVol*					0.103	0.103	0.090	0.090	0.092	0.092	0.076	0.076
					(0.000)	(0.000)	(0.005)	(0.005)	(0.000)	(0.000)	(0.013)	(0.012)
N	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470
R^2	0.4071	0.4071	0.0039	0.0034	0.1503	0.1503	0.1378	0.1379	0.1486	0.1486	0.1343	0.1344
Panel C: Estimating Differences Between the Parameters for Make Fee and Take Fee in Panel B												
Δ*Nom_Make_Basic*-Δ*Nom_Take_Basic*	0.194		1.760		1.055		0.645		0.446		0.036	
	(0.025)		(0.357)		(0.000)		(0.048)		(0.073)		(0.906)	
Δ*Nom_Make_Comp*-Δ*Nom_Take_Comp*		0.234		3.154		1.054		0.644		0.442		0.021
		(0.006)		(0.096)		(0.000)		(0.047)		(0.074)		(0.947)

Table 6

Relative Fees - Below-Median-Securities-BBO Regressions Analysis

This table replicates Table 5 and now the nominal fee variables are replaced with their relative-to-rival analogue. This table reports regressions results in changes of variables for the full sample of daily tape-exchange observations during the period from January 1, 2008 to December 31, 2010. Panel A reports results when the independent variable of interest is the total fee (the sum of the make fee and take fee), and Panel B reports results when the independent variables of interest are the make fee and take fee. Panel C reports estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. All fee measures are nominal fees in dollars per 100 shares and are explained in Table 1. Instead of aggregating all transacted shares to a tape-exchange,we now aggregate shares that were transacted at below the median BBO on each day on each tape-exchange where the median BBO is the median across the individual securities' time-weighted average dollar quoted spreads for securities. Columns (1) through (4) report results when the dependent variables are our proxies for trading activity. *Vol_below* is the detrended volume in billions of shares. *MS_below* is the detrended market share. Columns (5) through (8) reports result when the dependent variables are measures for quoted spreads. *$BBO_below* is the log of the dollar quoted spreads calculated for below-median securities as the median time-weighted average dollar quoted spreads. *%BBO* is the log of the corresponding quoted spread in percentage of the bid-ask midpoint. Columns (9) through (12) report results when the dependent variables are net-of-fees spreads. *$NetBBO* is the log of the tape-exchange dollar quoted spreads plus twice the take fee (basic or competitive) per share. *%NetBBO* is the log of the percentage of the bid-ask midpoint net of fees. *Tape_Vol* is the detrended daily volume of a tape aggregated across exchanges in billions of shares. *Log_Exchange_dVol* is the logarithm of daily dollar volume in millions on a tape-exchange and *Log_Rivals_dVol* is the logarithm of the total daily dollar volume in millions on rival exchanges. All specifications include date fixed effects. The *p*-values are shown in parentheses. Δ denotes the change in a variable.

Independent Variables	Low BBO Trading Activity				Low BBO Quoted Spreads				Low BBO Net-of-Fees Spreads			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
	Δ*Vol* _*Below*	Δ*Vol* _*Below*	Δ*MS* _*Below*	Δ*MS* _*Below*	Δ*$BBO* _*Below*	Δ*$BBO* _*Below*	Δ*%BBO* _*Below*	Δ*%BBO* _*Below*	Δ*$NetBBO* _*Basic*	Δ*$NetBBO* _*Comp*	Δ*%NetBBO* _*Basic*	Δ*%NetBBO* _*Comp*
Panel A: Total Fee												
Δ*Rel_Total_Basic*	-0.028		-0.488		-0.030		-0.068		-0.015		-0.041	
	(0.011)		(0.046)		(0.385)		(0.105)		(0.646)		(0.308)	
Δ*Rel_Total_Comp*		-0.020		-0.657		-0.058		-0.105		-0.038		-0.073
		(0.097)		(0.014)		(0.124)		(0.022)		(0.276)		(0.095)
Δ*Tape_Vol*	0.074	0.074	-0.005	-0.004								
	(0.000)	(0.000)	(0.882)	(0.882)								
Δ*Log_Exchange_dVol*					-0.024	-0.024	-0.025	-0.025	-0.024	-0.024	-0.024	-0.024
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ*Log_Rivals_dVol*					0.103	0.103	0.090	0.091	0.091	0.092	0.076	0.077
					(0.000)	(0.000)	(0.005)	(0.005)	(0.000)	(0.000)	(0.013)	(0.012)
N	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470
R^2	0.4069	0.4068	0.0031	0.0032	0.1496	0.1497	0.1378	0.1379	0.1484	0.1485	0.1344	0.1346
Panel B: Make Fee and Take Fee												
Δ*Rel_Make_Basic*	-0.024		-0.429		-0.005		-0.054		-0.002		-0.039	
	(0.033)		(0.083)		(0.884)		(0.199)		(0.947)		(0.329)	
Δ*Rel_Take_Basic*	-0.044		-0.701		-0.119		-0.116		-0.060		-0.045	
	(0.001)		(0.013)		(0.003)		(0.017)		(0.104)		(0.329)	
Δ*Rel_Make_Comp*		-0.015		-0.584		-0.030		-0.090		-0.024		-0.072
		(0.235)		(0.032)		(0.428)		(0.052)		(0.492)		(0.105)
Δ*Rel_Take_Comp*		-0.038		-0.885		-0.144		-0.152		-0.081		-0.077
		(0.006)		(0.003)		(0.001)		(0.003)		(0.039)		(0.117)
Δ*Tape_Vol*	0.074	0.074	-0.004	-0.004								
	(0.000)	(0.000)	(0.883)	(0.884)								
Δ*Log_Exchange_dVol*					-0.024	-0.024	-0.026	-0.026	-0.024	-0.025	-0.024	-0.024
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ*Log_Rivals_dVol*					0.103	0.104	0.091	0.091	0.092	0.092	0.076	0.077
					(0.000)	(0.000)	(0.005)	(0.005)	(0.000)	(0.000)	(0.013)	(0.012)
N	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470	17470
R^2	0.4071	0.4070	0.0032	0.0033	0.1506	0.1507	0.1380	0.1381	0.1487	0.1488	0.1344	0.1346
Panel C: Estimating Differences Between the Parameters for Make Fee and Take Fee in Panel B												
Δ*Rel_Make_Basic*-Δ*Rel_Take_Basic*	0.019		0.272		0.114		0.061		0.057		0.005	
	(0.015)		(0.133)		(0.000)		(0.047)		(0.014)		(0.848)	
Δ*Rel_Make_Comp*-Δ*Rel_Take_Comp*		0.022		0.300		0.113		0.061		0.056		0.005
		(0.005)		(0.095)		(0.000)		(0.046)		(0.016)		(0.867)

Table 7

Nominal Fees - Below-Median-Exchange-BBO within Below-Median-Securities-BBO Regressions Analysis

This table reports regressions results in changes of variables for the sample of daily tape-exchange observations during the period from January 1, 2008 to December 31, 2010 with *$BBO_below* also below the 50th percentile. Panel A reports results when the independent variable of interest is the total fee (the sum of the make fee and take fee), and Panel B reports results when the independent variables of interest are the make fee and take fee. Panel C reports estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. All fee measures are nominal fees in dollars per 100 shares and are explained in Table 1. Instead of aggregating all transacted shares to a tape-exchange,we now aggregate shares that were transacted at below the median BBO on each day on each tape-exchange where the median BBO is the median across the individual securities' time-weighted average dollar quoted spreads for securities. Columns (1) through (4) report results when the dependent variables are our proxies for trading activity. *Vol_Below* is the detrended volume in billions of shares. *MS_below* is the detrended market share. Columns (5) through (8) reports result when the dependent variables are measures for quoted spreads. *$BBO_Below* is the log of the dollar quoted spreads calculated for below-median securities as the median time-weighted average dollar quoted spreads. *%BBO* is the log of the corresponding quoted spread in percentage of the bid-ask midpoint. Columns (9) through (12) report results when the dependent variables are net-of-fees spreads. *$NetBBO* is the log of the tape-exchange dollar quoted spreads plus twice the take fee (basic or competitive) per share. *%NetBBO* is the log of the percentage of the bid-ask midpoint net of fees. *Tape_Vol* is the detrended daily volume of a tape aggregated across exchanges in billions of shares. *Log_Exchange_dVol* is the logarithm of daily dollar volume in millions on a tape-exchange and *Log_Rivals_dVol* is the logarithm of the total daily dollar volume in millions on rival exchanges. All specifications include date fixed effects. The p-values are shown in parentheses. Δ denotes the change in a variable.

Independent Variables	Low-BBO Trading Activity				Low-BBO Quoted Spreads				Low-BBO Net-of-Fees Spreads			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
	ΔVol _Below	ΔVol _Below	ΔMS _Below	ΔMS _Below	$\Delta\$BBO$ _Below	$\Delta\$BBO$ _Below	$\Delta\%BBO$ _Below	$\Delta\%BBO$ _Below	$\Delta\$NetBBO$ _Basic	$\Delta\$NetBBO$ _Comp	$\Delta\%NetBBO$ _Basic	$\Delta\%NetBBO$ _Comp
Panel A: Total Fee												
Δ*Nom_Total_Basic*	-0.347		-15.940		-0.121		-0.154		0.043		0.092	
	-0.013		(0.000)		(0.738)		(0.698)		(0.896)		(0.807)	
Δ*Nom_Total_Comp*		-0.631		-16.916		0.132		-0.022		0.498		0.409
		(0.001)		(0.001)		(0.788)		(0.968)		(0.262)		(0.426)
Δ*Tape_Vol*	0.114	0.115	-0.106	-0.106								
	(0.000)	(0.000)	(0.042)	(0.041)								
Δ*Log_Exchange_dVol*					0.014	0.014	-0.006	-0.006	0.010	0.010	-0.008	-0.008
					(0.068)	(0.068)	(0.484)	(0.483)	(0.137)	(0.139)	(0.304)	(0.300)
Δ*Log_Rivals_dVol*					0.059	0.059	0.045	0.044	0.052	0.052	0.029	0.030
					(0.039)	(0.041)	(0.159)	(0.161)	(0.045)	(0.045)	(0.335)	(0.324)
N	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722
R^2	0.6471	0.6473	0.0708	0.0700	0.1887	0.1887	0.1913	0.1913	0.1830	0.1832	0.1839	0.1841
Panel B: Make Fee and Take Fee												
Δ*Nom_Make_Basic*	-0.304		-15.475		0.049		-0.048		0.111		0.100	
	(0.030)		(0.000)		(0.892)		(0.904)		(0.733)		(0.792)	
Δ*Nom_Take_Basic*	-0.606		-18.662		-1.113		-0.771		-0.358		0.045	
	(0.000)		(0.000)		(0.007)		(0.088)		(0.334)		(0.917)	
Δ*Nom_Make_Comp*		-0.509		-15.440		0.606		0.277		0.694		0.437
		(0.008)		(0.004)		(0.225)		(0.614)		(0.125)		(0.403)
Δ*Nom_Take_Comp*		-0.812		-19.087		-0.567		-0.464		0.209		0.367
		(0.000)		(0.001)		(0.266)		(0.408)		(0.650)		(0.490)
Δ*Tape_Vol*	0.115	0.115	-0.106	-0.107								
	(0.000)	(0.000)	(0.042)	(0.040)								
Δ*Log_Exchange_dVol*					0.012	0.012	-0.007	-0.007	0.010	0.010	-0.008	-0.008
					(0.109)	(0.106)	(0.409)	(0.410)	(0.166)	(0.167)	(0.300)	(0.294)
Δ*Log_Rivals_dVol*					0.060	0.059	0.045	0.045	0.052	0.052	0.029	0.030
					(0.036)	(0.039)	(0.154)	(0.159)	(0.043)	(0.045)	(0.334)	(0.323)
N	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722
R^2	0.6476	0.6478	0.0709	0.0702	0.1913	0.1913	0.1921	0.1922	0.1835	0.1837	0.1839	0.1841
Panel C: Estimating Differences Between the Parameters for Make Fee and Take Fee in Panel B												
Δ*Nom_Make_Basic*-Δ*Nom_Take_Basic*	0.302		3.187		1.162		0.723		0.469		0.055	
	(0.000)		(0.203)		(0.000)		(0.004)		(0.024)		(0.819)	
Δ*Nom_Make_Comp*-Δ*Nom_Take_Comp*		0.303		3.647		1.173		0.741		0.484		0.069
		(0.000)		(0.143)		(0.000)		(0.003)		(0.020)		(0.774)

Table 8

Relative Fees - Below-Median-Exchange-BBO within Below-Median-Securities-BBO Regressions Analysis

This table replicates Table 7 and now the nominal fee variables are replaced with their relative-to-rival analogue.This table reports regressions results in changes of variables for the sample of daily tape-exchange observations during the period from January 1, 2008 to December 31, 2010 with *$BBO_below* also below the 50th percentile. Panel A reports results when the independent variable of interest is the total fee (the sum of the make fee and take fee), and Panel B reports results when the independent variables of interest are the make fee and take fee. Panel C reports estimates of the difference between the parameters of the corresponding make fee and take fee in Panel B. All fee measures are nominal fees in dollars per 100 shares and are explained in Table 1. Instead of aggregating all transacted shares to a tape-exchange,we now aggregate shares that were transacted at below the median BBO on each day on each tape-exchange where the median BBO is the median across the individual securities' time-weighted average dollar quoted spreads for securities. Columns (1) through (4) report results when the dependent variables are our proxies for trading activity. *Vol_below* is the detrended volume in billions of shares. *MS_Below* is the detrended market share. Columns (5) through (8) reports result when the dependent variables are measures for quoted spreads. *$BBO_Below* is the log of the dollar quoted spreads calculated for below-median securities as the median time-weighted average dollar quoted spreads. *%BBO* is the log of the corresponding quoted spread in percentage of the bid-ask midpoint. Columns (9) through (12) report results when the dependent variables are net-of-fees spreads. *$NetBBO* is the log of the tape-exchange dollar quoted spreads plus twice the take fee (basic or competitive) per share. *%NetBBO* is the log of the percentage of the bid-ask midpoint net of fees. *Tape_Vol* is the detrended daily volume of a tape aggregated across exchanges in billions of shares. *Log_Exchange_dVol* is the logarithm of daily dollar volume in millions on a tape-exchange and *Log_Rivals_dVol* is the logarithm of the total daily dollar volume in millions on rival exchanges. All specifications include date fixed effects. The *p*-values are shown in parentheses. Δ denotes the change in a variable.

Independent Variables	Low BBO Trading Activity				Low BBO Quoted Spreads				Low BBO Net-of-Fees Spreads			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
	Δ*Vol_Below*	Δ*Vol_Below*	Δ*MS_Below*	Δ*MS_Below*	Δ*$BBO_Below*	Δ*$BBO_Below*	Δ*%BBO_Below*	Δ*%BBO_Below*	Δ*$NetBBO_Basic*	Δ*$NetBBO_Comp*	Δ*%NetBBO_Basic*	Δ*%NetBBO_Comp*
Panel A: Total Fee												
Δ*Rel_Total_Basic*	-0.032		-1.022		-0.029		-0.002		-0.012		0.022	
	(0.031)		(0.013)		(0.445)		(0.970)		(0.731)		(0.574)	
Δ*Rel_Total_Comp*		-0.042		-1.726		-0.022		-0.002		0.010		0.034
		(0.022)		(0.001)		(0.651)		(0.971)		(0.815)		(0.492)
Δ*Tape_Vol*	0.115	0.115	-0.105	-0.105								
	(0.000)	(0.000)	(0.044)	(0.044)								
Δ*Log_Exchange_dVol*					0.014	0.014	-0.006	-0.006	0.010	0.010	-0.008	-0.008
					(0.066)	(0.068)	(0.484)	(0.483)	(0.136)	(0.144)	(0.299)	(0.292)
Δ*Log_Rivals_dVol*					0.060	0.060	0.044	0.044	0.052	0.053	0.029	0.030
					(0.038)	(0.039)	(0.161)	(0.161)	(0.043)	(0.043)	(0.338)	(0.323)
N	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722
R^2	0.6470	0.6471	0.0695	0.0701	0.1888	0.1887	0.1913	0.1913	0.1830	0.1831	0.1839	0.1841
Panel B: Make Fee and Take Fee												
Δ*Rel_Make_Basic*	-0.027		-0.969		-0.008		0.011		-0.002		0.024	
	(0.070)		(0.020)		(0.838)		(0.799)		(0.962)		(0.550)	
Δ*Rel_Take_Basic*	-0.054		-1.258		-0.124		-0.056		-0.057		0.016	
	(0.001)		(0.006)		(0.003)		(0.223)		(0.132)		(0.723)	
Δ*Rel_Take_Comp*		-0.061		-1.925		-0.097		-0.046		-0.026		0.029
		(0.002)		(0.000)		(0.051)		(0.398)		(0.565)		(0.584)
Δ*Tape_Vol*	0.115	0.115	-0.105	-0.105								
	(0.000)	(0.000)	(0.044)	(0.044)								
Δ*Rel_Make_Comp*		-0.032		-1.619		0.019		0.022		0.030		0.038
		(0.083)		(0.002)		(0.696)		(0.681)		(0.501)		(0.459)
Δ*Log_Exchange_dVol*					0.012	0.012	-0.007	-0.007	0.009	0.009	-0.008	-0.009
					(0.107)	(0.109)	(0.413)	(0.412)	(0.171)	(0.179)	(0.292)	(0.285)
Δ*Log_Rivals_dVol*					0.060	0.060	0.045	0.045	0.053	0.053	0.029	0.030
					(0.035)	(0.037)	(0.157)	(0.158)	(0.042)	(0.042)	(0.337)	(0.322)
N	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722	8722
R^2	0.6475	0.6476	0.0697	0.0703	0.1918	0.1918	0.1921	0.1922	0.1839	0.1839	0.1840	0.1841
Panel C: Estimating Differences Between the Parameters for Make Fee and Take Fee in Panel B												
Δ*Rel_Make_Basic*-Δ*Rel_Take_Basic*	0.027		0.288		0.116		0.067		0.055		0.008	
	(0.001)		(0.209)		(0.000)		(0.004)		(0.004)		(0.703)	
Δ*Rel_Make_Comp*-Δ*Rel_Take_Comp*		0.286		0.306		0.116		0.068		0.055		0.008
		(0.000)		(0.180)		(0.000)		(0.003)		(0.004)		(0.686)