*Subsidizing Liquidity: The Impact of Make/Take Fees on Market Quality**

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Abstract

In recent years most equity trading platforms moved to subsidize the provision of liquidity. Under such a make/take fee structure, submitters of limit orders typically receive a rebate upon execution of their orders, while submitters of market orders pay higher fees. We study the impact of this, now prevalent, fee structure on market quality, trader costs, and trading activity by analyzing the introduction of liquidity rebates on the Toronto Stock Exchange. Using a proprietary dataset, we find that the liquidity rebate structure leads to decreased spreads, increased depth, increased volume, and intensified competition in liquidity provision. Explicitly accounting for exchange fees and rebates, we find that trading costs for market orders did not decrease and that revenues for liquidity providers increase. The rebates have led to an increase in intermediation by liquidity providers, but we find no evidence that this increase led to higher costs for retail traders.

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The equity trading landscape has changed dramatically over the last decade. World-wide, most public markets moved away from human interactions and are now organized as electronic limit order books, where traders either post passive limit orders that offer to trade a specific quantity at a specific price or submit active market(able) orders that "hit" posted limit orders. Posters of passive limit orders provide, or "make", liquidity, submitters of active market orders "take" liquidity. In contrast to traditional intermediated markets, limit order books rely on the voluntary provision of liquidity and must offer enough of it to attract trading. As a result, many trading venues have come to charge "makers" and "takers" different fees, often subsidizing passive trading volume.

This practice, known as make/take fees, is controversial. The subsidies have been argued to cause excessive intermediation by attracting traders that solely focus on capturing fee rebates and that prevent trades between two "natural" parties, particularly disadvantaging retail traders.[1] Make/take fees are a key component in a larger debate on high-frequency trading, market fragmentation, order routing requirements, and dark pool trading. Regulators around the world have imposed or are considering imposing rules on trading fees.[2] This paper provides empirical evidence on the advantages and disadvantages of make/take fees.

Despite the controversy surrounding make/take fees, from an economic perspective, it is not clear that the breakup of the exchange fee into take fees and make rebates should matter. With a limit order book traders can decide whether to submit a passive order and be a supplier of liquidity or whether to submit an active order and demand liquidity. Intuitively, rebates make passive orders cheaper and so, ceteris paribus, one would expect more traders to submit passive orders. The resulting increase in competition lowers each order's execution probability and thus, to increase the chance of one's order to get filled, traders will improve the bid-ask spread. Absent frictions, benefits from rebates would be

[1] See "Rise of the machines: Algorithmic trading causes concern among investors and regulators", The Economist July 30th 2009, or "Small investors pay the price for high-frequency trading", The Globe and Mail, January 31, 2011, or IIROC 11-0225, comments by TD Securities.

[2] The SEC, imposed a 30-cent ceiling for 100-share equity trades. In a recent consultation paper, the Committee of European Securities Regulators, CESR, poses the question of the possible downsides of make/take fees. And, in response to the May 6, 2010 "Flash-Crash", the CFTC-SEC advisory committee suggests to "consider incentives to supply liquidity that vary with market conditions."

competed away. Thus if the quoted bid-ask spread included active fees, a change in the breakup of make and take fees would have no effect. Instead, what should affect trading costs is the total fee that the trading venue charges, i.e. the take fee minus the rebate, because this fee reflects the price of trading services. This point was also made in Angel, Harris, and Spatt (2010); Colliard and Foucault (2011) provide a theoretical model that builds on this argument.

Our analysis is based on trading fee changes on the Toronto Stock Exchange (TSX) and uses a proprietary database.[3] The TSX phased in the liquidity fee rebates on two distinct dates, introducing them on October 01, 2005 for all securities that were crosslisted with NASDAQ or AMEX and on July 01, 2006 for the remainder of the securities (including those crosslisted with NYSE). We study the 2005 change, after which an active marketable order incurred a per share fee of \$.004 and a passive limit order that is "hit" received a per share fee rebate of \$.00275. For instance consider a trade for 100 shares on the TSX. The trader submitting the market order (the "taker") pays 100×\$.004=\$.4 cents, the trader who had posted the passive order that was "hit" receives a rebate on his/her exchange fee of 100×\$.00275=\$.275; the TSX thus obtains 100×(\$.004- \$.00275)=\$.125. Active orders for stocks that did not move to the new make/take fee structure incurred a cost of 1/55 of 1% (1.8 basis points) of the dollar value of the transaction and passive orders were free.

In our data, we have a dual change in that both the make/take breakdown and the total fee changes. However, for a significant subset of the companies in our data, the change in the total fee is very minor whereas the change in the make/take fee breakup is significant. The analysis of this sample, which we refer to as the fee-neutral subsample, thus reveals insights on the effect of the breakup. Our results for the entire sample commonly coincide qualitatively with those of the fee-neutral subsample. In the introduction we will focus on the results for the entire sample.

Our empirical strategy is an event study on the introduction of the fee rebates. Since the

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change affected the incentives for liquidity provision for only a subset of companies, we are able to control for market wide conditions by matching securities that were affected with securities that were not. We then perform tests using a difference-in-differences approach to capture the marginal impact of the fee structure change on market quality, trader costs and revenues, volume, and competition for liquidity provision.

We assess market quality by standard measures, namely, the bid-ask spread and depth. We find that, compared to the control group, securities that were crosslisted on NASDAQ or AMEX experienced a substantial decrease in their time weighted quoted spreads and an increase in their quoted depth. To access the impact of the fee change on liquidity takers, we study changes in transaction costs, which are proxied by the effective spread. For a buyer initiated transaction, the effective spread is twice the difference between the average per share price and the prevailing midpoint of the quoted bid and offer prices. We observe a marked decline in effective spreads, but after adjusting the effective spread to account for the exchange fees, we find no evidence that transaction costs have declined.

A liquidity maker's per share revenue is commonly proxied by the magnitude of the price reversal after a transaction, and it is measured by the realized spread. For a buyer initiated transaction, the realized spread is twice the difference between the average per share price and the midpoint of the quoted bid and offer prices several minutes after the transaction. We observe a decline in the realized spread for the full sample and no change for the fee-neutral subsample. Accounting for rebates, benefits increase. Furthermore, the price impact decreases, which suggests that at least part of the decrease in the effective spread stems from reductions in adverse selection, possibly caused by the entry of new traders.

A key objective of subsidizing liquidity provision is for the exchange to attract more volume. We indeed find an increase in volume, which is somewhat surprising considering that transaction costs, taking fees into account, did not go down. We investigate this puzzle further by analyzing trading of the crosslisted securities on U.S. markets.[4] Our

[4]Another possible explanation for the increase in volume is that the additional cost from the new billing

results indicate that the increase in volume on the TSX is driven, in part, by the migration of volume from U.S. markets to the TSX.

A potential argument against fee rebates is that they have led to excessive intermediation and to segregation of markets into makers and takers, with retail traders in particular falling into the latter category. The criticism is that to capture liquidity rebates, an intermediary such as an algorithm "injects" itself between two "natural" traders who would have otherwise transacted on their own, taking the passive side of both transactions. The intermediary then collects the rebates on both transactions, while both "natural" traders are forced to pay the spread and the taker fee.

To assess the validity of this criticism, we proceed in two steps. We first analyze changes in intermediation, and we then evaluate the net costs of trading for different groups of traders. The data does not identify intermediaries, and we classify traders as intermediaries based on their liquidity providing activities.[5] We proxy for the extent of intermediation by computing volume of trades that occur between an intermediary and a non-intermediary, as a fraction of the total volume, per security, per day, and we find an increase.

We also analyze directly whether retail investors' trading costs changed. The data does not directly identify trades that stem from retail investors. We classify traders as managing retail orders if (a) they regularly trade small quantities, in particular oddlots (i.e. trades that are not in multiples of 100 shares) and (b), to screen out some sophisticated traders that may use oddlots in arbitrage strategies, we require that they display only limited short sale activity. Odd-lot trades never enter the book, are always cleared by a designated trader, and are thus unlikely to be used by, for instance, an order-splitting algorithm. We thus assert that odd-lot trades are mainly used by retail traders.[6] To assess a trader's net cost of trading, we combine the active cost, i.e. the fee adjusted effective spread, with the

system was not borne by the investors who submitted the orders as there is heterogeneity in the way that brokerages pass on exchange fees to their customers.

[5] We are not able to classify traders on the basis of their inventory behavior, as securities in our sample are crosslisted with U.S. exchanges and can potentially be traded across the border.

[6] We emphasize that odd-lot trades are used *very* differently in Canada compared to the United States and none of the alleged benefits for odd-lot trades that are discussed in, for instance, O'Hara, Yao, and Ye (2011) apply in Canada.

passive benefit, i.e. the rebate adjusted realized spread, per stock per day, and scale these by their average July net costs to ensure comparability between trader groups. We find that net costs decreased for retail traders, in particular for the group of fee-neutral securities.

Finally, with the introduction of fee rebates, ceteris paribus, it becomes cheaper to post limit orders. It is then imaginable that institutions see the introduction of rebates as an opportunity to enter the market for liquidity provision. To asses the extent of competition, we count the number of improvements in the best bid and offer prices and depth, and the number of liquidity providing market participants that are involved in transactions. We also compute the Herdindahl Index of market concentration,[7] with regard to traders' market shares of the fraction of passive limit order volume that the respective traders provide.[8] We find a significant increase in the number of improvements in the bid ask spread and depth, which we show to be driven by improvements in depth. The number of spread improvements, on the other hand, declines. Since the average depth also increases, we conclude that after the fee change, traders compete more aggressively on depth. We find a decrease in the Herfindahl Index and an increase in the number of liquidity providing entities. We thus conclude that traders compete more aggressively for liquidity provision.

Colliard and Foucault (2011) provide a theoretical guidance for the effects of a fee change. They show that trader welfare is affected only by the total fee, i.e. the sum of maker and taker fees, and that the make/take fee composition has no impact, provided the tick size is zero, because quotes adjust to neutralize any fee redistribution. We support this finding and show that for fee-neutral securities quoted spreads decline but cum-spread fees remain unaffected.

Foucault, Kadan, and Kandel (2009) find theoretically that the optimal make/take fee composition depends on the relative levels of competition among the liquidity providers

[7]The Herfindahl-Hirschman Index (see, e.g. Tirole (1988); see also Hirschman (1964)) is widely used as a proxy for the competitiveness of a given industry — for instance, the U.S. Department of Justice and the Federal Trade Commission use it to assess the effects of a merger on competition — and it is computed as the sum of the squared market shares. The higher the index, the lower the level of competition.

[8]In traditional dealer markets, market share in liquidity is synonymous with market share in volume and the Herfindahl index for the concentration of market making is computed based on dealers' shares of volume (see Ellis, Michaely, and O'Hara (2002) and Schultz (2003)).

and liquidity demanders, and on the relative monitoring costs for these two groups. They argue that the lower fee (or a rebate) on the liquidity makers will increase the trading rate and aggregate welfare only under some conditions (for instance, when liquidity providers have higher monitoring costs than liquidity demanders, or when the level of competition among liquidity providers is low compared to that among liquidity demanders). When these conditions are not satisfied, the optimal make/take fee structure would impose higher fees on makers rather than on takers. Put differently, when there is a minimum tick size and when traders don't switch between being takers and makers, exchanges can use make/take fees to balances the demand and supply for liquidity. Our work also relates to Degryse, Van Achter, and Wuyts (2011) who theoretically study the impact of clearing and settlement fees on liquidity and welfare. They show that higher trading costs may arise, even when more aggressive trading strategies decrease (observable) spreads. Barclay, Kandel, and Marx (1998) study the effect of changes in bid-ask spreads on volume and prices and find that higher transaction costs reduce trading volume. Lutat (2010) studies the introduction of a make/take fee structure with asymmetric fees on makers and takers (but no rebates) on the Swiss Stock Exchange, and he finds no effect on quoted spreads and an increase in depth.

The next section reviews trading on the TSX and the details of the fee changes. Section 2 describes the data, the sample selection, and the regression methodology. Section 3 summarizes our main findings on market quality in particular with regards to the costs and benefits to the active and passive sides, Section 4 analyzes net costs of retail traders, Section 5 presents results on volume and intermediation, Section 6 discusses competition. Section 7 concludes. Appendix 7 compares the results for the TSX with U.S. markets. Tables and figures are appended. We provide a supplementary appendix in a separate document where we discuss additional variables, alternative specifications, and a longer horizon analysis.

1 The Toronto Stock Exchange and its Trading Fees

1.1 Trading on the TSX

The Toronto Stock Exchange (TSX) has been an electronic-only trading venue since it closed its physical floor in 1997. In 2005, the TSX had the largest number of listed companies, and it was the sixth largest exchange world-wide in terms of market capitalization of traded securities and twelfth largest in dollar trading volume.[9]

Trading on the TSX is organized in an upstairs-downstairs structure. Orders can be filled by upstairs brokers (usually these are very large orders), who have price improvement obligations, or they can be cleared via the consolidated (electronic) limit order book. The TSX limit order book generally follows the so-called price-time priority.[10] It is constructed by sorting incoming limit orders lexicographically, first by their price ("price priority") and then, in case of equality, by the time of the order arrival (earlier orders have "time priority"). Transactions in the limit order book occur when active orders — market orders (orders to buy or sell at the best available price) or marketable limit orders (e.g. a buy limit order with a price higher than the current best ask) — are entered into the system. Unpriced market orders occur very infrequently on the TSX, and in what follows we will use the term "active order" for the marketable portion of an order, and we use "passive order" for a standing limit order that is hit by an active order. Active orders "walk the book", i.e., if the order size exceeds the number of shares available at the best bid or offer price, then the order continues to clear at the next best price. In our sample, about 5-7% of active orders walk the book.

All orders must be sent to the TSX by registered brokers (the Participating Organizations (P.O.)). Trading is organized by a trading software (the trading engine), and our data is the audit trail of the processing of the trading engine. We describe the data in more detail in Section 2. Orders of sizes below round lot size (for the companies in our sample

[9]Source: *World Federation of Exchanges*.

[10]The TSX also allows broker priority in the sense that active and passive orders submitted by the same broker at the same price have priority over earlier-submitted orders at the same price. Broker preferencing is, however, immaterial for our analysis.

this size is 100 shares) are cleared by the equity specialist, referred to as the Registered Trader (RT). Similarly, portions of orders that are not multiples of the round lot size (e.g. 99 shares of a 699 share order) will be cleared by the RT, after the round lot portion of the order has cleared (e.g. the 99 shares of a 699 share order will clear after, and only if, the 600 shares have cleared). Furthermore, the RT has the obligation to provide minimum fills when there are no standing limit orders, but the RT's powers are small compared to those of the NYSE designated market maker (formerly referred to as the specialist).[11]

The TSX with its public, electronic limit order book thus largely relies on its users to voluntarily supply liquidity by posting limit orders. This system contrasts traditional arrangement where dealers are institutionally obliged to make a market.

1.2 Details of the Change in Trading Fees

The TSX was a monopolist for equity trading in Canada during our sample period, and the lack of market fragmentation allows us to isolate the impact of liquidity rebates. When fee rebates were introduced in Europe or the U.S., on the other hand, these markets were already beginning to fragment.

The TSX phased in the liquidity rebates on two discrete dates, introducing them on October 01, 2005 for the TSX companies that were crosslisted on NASDAQ or AMEX (the TSX uses the term "inter-listed"); on July 01, 2006 all remaining companies switched. We focus on the 2005 change of fees.[12] Fees for stocks that were crosslisted on the NYSE were the same as for the TSX-only companies.

The 2005 fee change was originally planned to be a one year trial. The TSX did not formally provide reasons for the particular choice of the new fee structure, nor did they explain their choice of the trial group. It is the authors' opinion that the TSX wanted

[11] Subject to tight rules, the RT has the right to participate in orders to unload a pre-existing inventory position that she or he built up in the process of providing liquidity to markets. The RT has no informational advantage on the order flow compared to other traders.

[12] We restrict attention to the 2005 change for two reasons: first, in 2006 there was a change in the level of fees simultaneously with the switch to a make/take fee structure. Second, a difference-in-differences analysis in 2006 has less statistical power because the treatment group, non-crosslisted securities, is much larger than the control group, crosslisted securities.

to match the make/take fee system that had been introduced on U.S. markets earlier, in order to remain competitive in the trading of crosslisted securities. Further, NYSE securities are, on average, very large in terms of price and market capitalization. A trial for these securities would thus have been riskier than that for NASDAQ crosslisted securities, because an unsuccessful switch may have lead led to high revenue losses.

Prior to October 01, 2005, all TSX securities were subject to the so-called value-based trading fee system, under which the active side of each transaction incurred a fee based on the dollar amount of the transaction (1/50 of 1% a the dollar-amount in the months immediately preceding October 01) and the passive side incurred no fee or rebate. On October 01, TSX-listed securities that were also crosslisted with NASDAQ and AMEX switched to a volume-based trading regime, under which for each traded share the active side had to pay a fee of \$.004 and the passive side obtained a rebate on its exchange fees of \$.00275. All other securities remained at the prevailing value-based regime, although, the fees were slightly reduced — after October 01, 2005, active orders incurred a fee of 1/55 of 1% of the dollar-amount of the transaction and passive orders remained free. The value based taker fee per trade is capped at \$50, the volume based taker fee and maker rebate are capped at \$100 and \$50, respectively.[13]

Exchange fees under the value based system depend on the price of the underlying stock, fees under the volume based system do not. Compared to the value based fee structure, the new volume based fees yields the TSX a higher per share fee revenue for securities that trade below \$6.875. Liquidity takers pay less for securities that trade above \$22.[14] Figure 1 illustrates the different fee systems as functions of the security price.

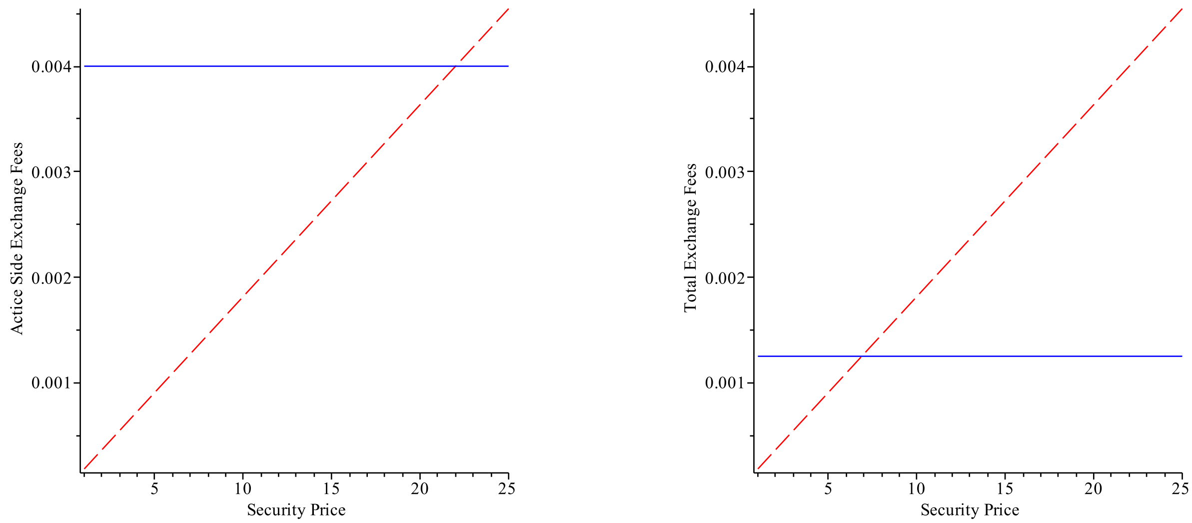
In other words, for some stocks total fees increased, and for others total fees decreased. We will exploit this feature of the change in our analysis of subsamples.

[13]The S.E.C. capped taker fees in the U.S.A. in August 2005 to be no larger than \$.003 per share. To this date there is no regulated fee cap in Canada, but by now fees have declined. Adjusted by the exchange rate ($\approx$1.2 Canadian dollars per 1 U.S. dollar), taker fees in Canada were slightly larger than the S.E.C. cap.

[14]Total fees coincide for the price $p = \$6.875$, which solves $p \times 1/55 \times 1\% = (\$.004 - \$.00275)$. Active fees coincide for the price $p = \$22$, which solves $p \times 1/55 \times 1\% = \$.004$.

Figure 1
Per Share Exchange Fees.

The left panel plots the exchanges fees for active orders for the volume and value based system; the right panel plots the total exchanges fees (active fees minus passive rebate) for the two systems. Dashed lines are for value based fees, solid lines are for volume based fees.



Value based taker fee=price$\times \frac{1}{55} \times 1\%$
Volume based taker fee= \$0.004

Value based total fee=taker−maker= price$\times \left(0 + \frac{1}{55} \times 1\%\right)$
Volume based total fee=taker−maker= \$0.004 – \$0.0275

2 Data, Sample Selection, and Methodology

2.1 Data Sources

Our analysis is based on a proprietary dataset, provided to us by the Toronto Stock Exchange (TSX). Data on market capitalization, monthly volume, splits, and (inter-) listing status is obtained from the monthly TSX e-Reviews publications. Data on the CBOE's volatility index VIX is from Bloomberg. We analyze the effect of the fee structure change by looking at a 4 month window (2 months before and 2 months after the introduction of the liquidity rebates), from August 01, 2005 to November 30, 2005. The TSX participating organizations are billed at the end of each month, and the event window was chosen to include the month immediately following the change as well as one month after the first bill that was based on the new fee structure. In the supplementary appendix we discuss the results from an analysis in which we extend the horizon to ± 6 months; our result are robust. We exclude trading days that have no or limited U.S. trading (an example is U.S. Thanksgiving and the Friday following it); information on scheduled U.S. market closures is obtained from the NYSE Calendar. We further exclude November 21, 2005, as the TSX data for this day contained several recording errors.

The TSX data is the input-output of the central trading engine, and it includes all messages that are sent to and from the brokers. For all messages, the data contains the public content (i.e. information disseminated publicly to data subscribers) and the private content (i.e. information only provided to the broker). Messages include all orders, cancellations and modifications sent to the limit order book, all trade reports, and all details on dealer (upstairs) crosses. Further, the data contains all other system messages, for instance, announcements about trading halts and freezes, estimated opening prices, indications that there is too little liquidity in the book (the spread is too wide), and so on.

Each message consists of up to 500 subentries, such as the date, ticker symbol, time stamp, price, volume, and further information that depends on the nature of the message. For instance, order submission, notification and cancellation messages contain information about the order's price, total and displayed volume, the orders's time priority, broker ID, trader ID, order number (new and old for modifications), and information about the nature of the account (e.g. client, inventory or equity specialist). For each order that is part of the trade, the data additionally contains information on whether an order was filled by a registered trader and where it was executed (e.g. in the public limit order book, with a specialist outside the limit order book (for oddlots), in the market for special terms orders, or crossed by a broker). The liquidity supplier rebates only affect trades that clear via the limit order book. Consequently, we exclude opening trades, oddlot trades, dealer crosses, trades in the special terms market, and trades that occur outside normal trading hours.

Importantly for the construction of the liquidity and competition measures, the transaction data specifies the active (liquidity demanding) and passive (liquidity supplying) party, thus identifying each trade as buyer-or seller-initiated. Finally, one useful system message is the "prevailing quote". It identifies the best bid and ask quotes as well as the depth at the best quotes, and it is sent each time there is a change in the best quotes or the depth at these quotes. This message allows us to precisely identify the prevailing quote at each point in time. The presence of the instant quote updates is crucial for the analysis. Despite the availability of all order submission and cancellation messages, reconstructing the prevailing quote (let alone the limit order book) from these message is computationally intractable, since orders on the TSX do not cancel at the end of the day and may remain in the book for days or months.[15]

2.2 Sample Selection

We construct our sample as follows. Out of the 3,000+ symbols that trade on the TSX, we focus on common stock and exclude debentures, preferred shares, notes, rights, warrants, capital pool companies, stocks that trade in US funds, companies that are traded on the TSX Venture and on the NEX market, exchange traded funds, and trust units. Differently to commonly applied filters, we retain companies with dual class shares. This is due to a peculiarity of the Canadian market, where, as of August 2005, an estimated 20-25% of companies listed on the TSX made use of some form of dual class structure or special voting rights, whereas in the United States, only about 2% of companies issue restricted voting shares (see Gry (2005)).

We require that the companies had positive volume in July 2005, according to the TSX e-Review, and were continuously listed between July 2005 and November 2005. We exclude securities that had stock splits, that were under review for suspension, that had substitutional listings, and that had days with an average midquote below $1. We exclude Nortel (symbol: NT) because it was involved in a high profile accounting scandal at the time of our sample period (along with Worldcom and Enron). Finally, we omit companies that have less than 10 transactions per day on more than 5% of the trading days.

We determine a company's crosslisted status from the TSX e-Reviews. We then clas-

[15]The TSX also allows for a variety of order types, for instance, orders that are to be executed in full or cancelled, orders that are to be executed in a fixed number round lots only, and it would computationally challenging to keep track of all order attributes.

sify companies as "crosslisted with NASDAQ or AMEX" in our 2005 sample if they were crosslisted with NASDAQ or AMEX from August to November 2005 and non-crosslisted with NASDAQ and AMEX if they were not crosslisted from August to November. Companies that changed their cross-listing status during the sample period or for which the cross-listing status was unclear were omitted from the sample.

We are then left with 65 NASDAQ and AMEX crosslisted companies and 180 TSX only and NYSE crosslisted companies. In what follows, we will refer to companies that are crosslisted with NASDAQ and AMEX as "crosslisted", and we will refer to companies that are listed only on the TSX or that are crosslisted with NYSE as "non-crosslisted".

2.3 Matched Sample

We construct the matched sample as follows. Using one-to-one matching without replacement, we determine a unique non-crosslisted match for each of the crosslisted securities based on closing price, market capitalization, and a level of competition for liquidity provision, as measured by the Herfindahl Index (formally defined in the next subsection).

One-to-one matching without replacement based on closing price and market capitalization has been shown to be the most appropriate method to test for difference in trade execution costs; see Davies and Kim (2009). We additionally include a measure of competition as a matching criterium, for three reasons. First, our treatment group, the crosslisted securities, is not a random sample, and liquidity provision in the average crosslisted stock is systematically more competitive than in the average TSX only stock, even controlling for market capitalization.[16] Second, the focus of this study is not only trade execution costs but also other variables that are affected by competition, such as traders' behavior, welfare and the levels of intermediation.[17] Finally, we aim to identify the impact of the introduction

[16]Taking matches only from the group of NYSE crosslisted stocks would generate very poor matches since NYSE crosslisted companies are much larger and trading in these stocks is much more competitive than NASDAQ/AMEX crosslisted companies. Our matched sample does contain some stocks that are crosslisted with NYSE, but only those that are comparable.

[17]When matching only on price and market capitalization, the results for most liquidity measures, including spreads (the variable of interest in Davies and Kim (2009)), are similar.

of the liquidity rebates, and according to Foucault, Kadan, and Kandel (2009), who study the make/take fees theoretically, this impact depends on the competition among traders.

We randomize the order of matching by sorting the stocks in the treatment group (i.e. the crosslisted securities) alphabetically by symbol. The match for each treatment group security i is then defined to be a control group security j that minimizes the following matching error:

$$matcherror_{ij} := \left|\frac{p_i - p_j}{p_i + p_j}\right| + \left|\frac{MC_i - MC_j}{MC_i + MC_j}\right| + \left|\frac{HHI_i - HHI_j}{HHI_i + HHI_j}\right|, \tag{1}$$

where p_i, MC_i, and HHI_i denote security i's July 2005 closing price, market capitalization as of the end of July 2005, and the average July 2005 value of the Herfindahl Index at the broker level, respectively. Tables 11 and 12 contain the list of crosslisted companies and their matches.

2.4 Measuring Competition: The Herfindahl Index

We quantify competition among traders by the Herfindahl Index. The index is widely used to assess market concentration and it is computed as the sum of the squared market shares. We study the market for liquidity provision. In an electronic limit order book, liquidity is provided by passive orders and a trader's market share is the fraction of passive limit order volume that this trader provides.[18] The Herfindahl Index for different levels of liquidity providing entities (e.g., broker, trader) per day t per security i is

$$HHI_{it} = \sum_{k=1}^{n_t} \left(\frac{passive\ volume_{it}^k}{\sum_{k=1}^{n_t} passive\ volume_{it}^k} \right)^2, \tag{2}$$

where n_t is the number liquidity providing entities on day t in security i and $passive\ volume_{it}^k$ is the $k-$th entity's total passive volume for that day and security. Higher values of

[18] Weston (2000), Ellis, Michaely, and O'Hara (2002) and Schultz (2003) use the Herfindahl Index of market concentration to assess competition for market making in dealer markets; their indices are based on NASDAQ dealers' shares of volume.

the index correspond to higher levels of market concentration and thus to lower levels of competition (value 1 corresponds to monopolistic liquidity provision).

We consider two levels of liquidity providing entities, namely, the broker and the trader level. At the broker level, the passive volume per security per day is the total intraday passive volume of that broker, excluding dealer crosses. The "broker level HHI" does not differentiate between trades that brokers post by client request and those that they post on their own accounts to make a market. The "trader level HHI" refers to traders that we classify as liquidity providers; we discuss this classification further in Section 4.

We also compute the number of liquidity providing brokers and liquidity providing traders to shed some light on possible changes in competition indices.

2.5 Panel Regression Methodology at the Company Level

For each security in our sample and for each match, we compute a number of liquidity and market activity measures. We note that, for instance, the quoted bid-ask-spread, i.e. the difference between the quoted ask and bid prices experienced an across-the-board increase between October and November 2005. Our panel regression analysis employs a difference in differences approach and thus controls for market-wide fluctuations. To additionally control for U.S. events that may affect crosslisted securities differentially, we include the CBOE volatility index VIX. Figure 3 illustrates the co-movement of spreads and the VIX.[19] For each measure, we run the following regression[20]

$$\textit{dependent variable}_{it} = \beta_0 + \beta_1 \textit{fee change}_t + \beta_2 \mathsf{VIX}_t + \sum_{j=1}^{8} \beta_{2+j} \textit{control variable}_{ij} + \epsilon_{it}, \quad (3)$$

where *dependent variable*$_{it}$ is the time t realization of the measure for treatment group security i less the realization of the measure for the ith control group match; *fee change*$_t$ is an indicator variable that is 1 after the event date and 0 before; VIX_t is the closing value of

[19]Our results for U.S. markets and our longer horizon analysis both further support our view that our results are not driven by the temporary volatility increase.

[20]This regression methodology is similar to that in Hendershott and Moulton (2011). We discuss an alternative methodology in the internet appendix; the alternative specification provides similar results.

CBOE's volatility index for day t, and *control variable*$_{ij}$ are security level control variables for the company and its match: the log of the market capitalization, the log of the closing price, and the July 2005 (pre-event window) share turnover and the daily midquote return volatility.[21] Summary statistics for our treatment and control groups are in Table 2.

We conduct inference in all regressions in this paper using double-clustered Cameron, Gelbach, and Miller (2011) standard errors, which are robust to cross-sectional correlation and idiosyncratic time-series persistence.[22] For brevity we display only the estimates for the coefficient β_1 on the fee change dummy, and we omit the estimates for the constant as well as estimates for the coefficients on VIX and on the controls. The number of observations roughly equals the number of companies in the treatment group multiplied by the number of trading days (correcting for a small number of missing observations when a company or its match did not trade for a day), at most 5,200 observations.

2.6 Panel Regressions for Subsamples

The switch from value to volume based billing implies that for securities priced below \$6.875 total exchange fees increased, that for priced securities above \$22 trading became unambiguously cheaper, and that for securities with prices between \$6.875 and \$22, market orders became more expensive but total exchange fees decreased. Liquidity rebates, of course, increased for all price levels.

We thus report the results on the split of the sample into securities with prices below \$6.875, between \$6.875 and \$22, and above \$22. About half of the crosslisted companies have prices below \$6.875, and nine have prices above \$22. This split is natural with regards to the fees. However, it is not possible to use this subsample segmentation to differentiate between changes caused by the total fees relative to changes in the difference between maker and taker fee, commonly referred to as the maker-taker spread.

[21]In untabulated regressions we further controlled for company fixed effects. We also used dynamic instead of the July 2005 static controls for prices. In both cases, the results are similar.

[22]Cameron, Gelbach, and Miller (2011) and Thompson (2010) developed the double-clustering approach simultaneously. We follow the former and employ their programming technique. See also Petersen (2009) for a detailed discussion of (double-) clustering techniques.

To disentangle the change in the total fee from the change in the maker-taker spread, we thus construct a subsample of securities for which the change in total exchange fees is minor. The analysis for this subsample can then yield insights in particular into the effect of liquidity rebates and the effect of an increased spread between maker and taker fees. In what follows, we will refer to this split as the *fee-neutral split*.

Specifically, the fee neutral split aims to divide the symbols into equal sized group and to generate a group of medium-priced securities for which (a) the average change in the total fee is neutral and (b) there are similar numbers of securities with small increases and decreases in costs.[23] With 65 companies, the middle group should have 22 companies, 11 with increased and 11 with decreased fees. Translated into July closing prices, this group comprises of companies priced between \$4.36 and \$12.05; 23 companies have prices below \$4.36, 20 have prices above \$12.05. The equal weighted average difference in total exchange fees between value and volume based billing in basis points, $(\frac{1}{55}\frac{1}{100} - \frac{0.004-0.00275}{\text{price}}) \times 10,000$, is -.003, the July-volume-weighted average is .0008.[24]

In discussing our results we focus on the fee-neutral subsample. For both three-way splits we estimated the following equations

$$\begin{aligned} \textit{dependent variable}_{it} \;=\; & \beta_0 + \beta_1 \textit{fee change}_t \times \textit{highest group}_i \\ & + \beta_2 \textit{fee change}_t \times \textit{medium group}_i + \beta_3 \textit{fee change}_t \times \textit{lowest group}_i \\ & + \beta_4 \textit{highest group}_i + \beta_5 \textit{medium group}_i \\ & + \beta_6 \mathsf{VIX}_t + \sum_{j=1}^{8} \beta_{6+j} \textit{control variable}_{ij} + \epsilon_{it}, \end{aligned} \tag{4}$$

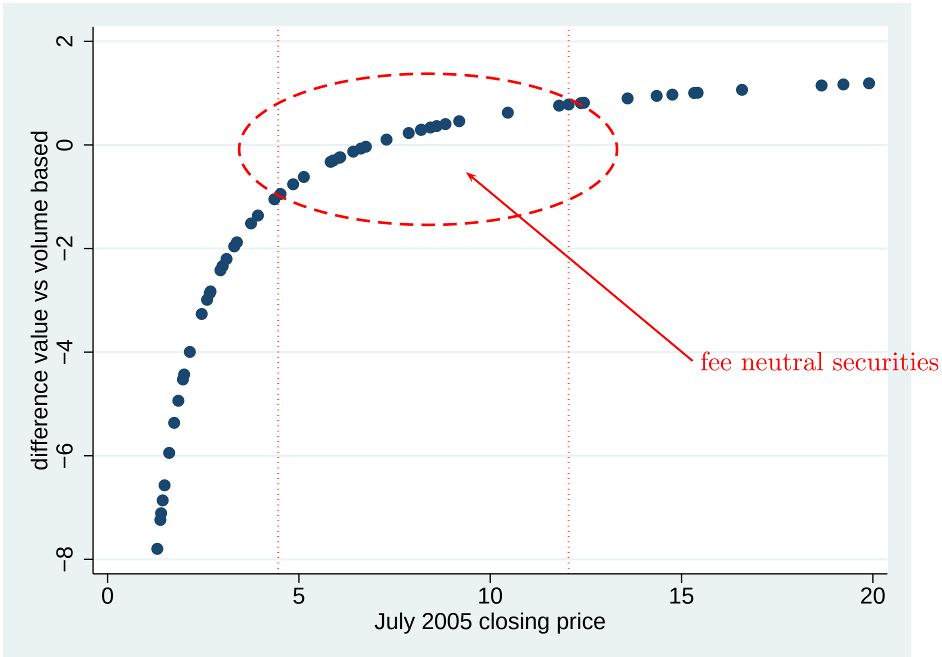
where $\textit{highest group}_i$ is an indicator variable that equals 1 if security i has a cost difference above .8bps, where $\textit{medium group}_i$ is an indicator variable that equals 1 if security i has a cost difference in $(-1.1\text{bps}, .8\text{bps})$, and $\textit{lowest group}_i$ is an indicator variable that equals 1 if security i has a cost difference below 1.1bps; similarly for the other subsample

[23] We analyzed a number of subsamples specifications using a variety of bounds and obtained very similar results.

[24] Moreover, compared to the proportional quoted spread, that is, the bid-ask spread divided by the midpoint, the absolute value of the fee change in this region is small, on average less than 2.2%.

Figure 2
Differences in Exchange Fees for our Sample.

The panel plots the difference of value vs. volume based total exchange fees, $1/55 \times 1/100 - (\$.004 - \$.00275)/p$, measured in basis points, against the July 2005 closing price, for the companies in our sample of crosslisted securities; we omit 9 stocks that have prices above \$22 to improve the exposition of the graph.



classification.[25]

We report only the estimates of interest, i.e. the estimated coefficients on the terms of $\textit{fee change}_t$ interacted with $\textit{highest group}_i$, $\textit{medium group}_i$, and $\textit{lowest group}_i$. Results from tests for differences in the coefficients are indicated in the respective tables.

In what follows, we present our findings for the time and transaction weighted measures; we also performed the analysis for the volume and active order weighted measures; the results are similar and we omit them.

2.7 Panel Regression Methodology using per-Trader Data

Our data identifies the unique trader ID that submitted a trade. We can thus analyze trading costs on the trader level and we can analyze whether there was a differential effect

[25] In the supplementary appendix to this paper we also present results from subsample regressions where we split the sample by above vs. below the median of market capitalization, percentage of volume traded on the TSX relative to U.S. markets, and competition for liquidity provision.

of the fee change on the trading costs for different types of traders.

Brokers commonly funnel particular types of orders flows through different trader IDs. For instance, they may send their retail flow through one ID, use another for their proprietary desk, have one for their institutional flow, and have designated IDs for the clients that they allow to access the market directly (so-called direct market access (DMA) clients). Our data does not explicitly identify the source of the order flow, and we classify trader IDs by their trading characteristics.

Specifically, we classify a trader ID as *retail* by the share of odd-lot volume and the share of sales that were short sales. We assert that *retail* flow is most likely to consist of small size orders and, in contrast to an agency algorithms, more likely to contain oddlot transactions, where oddlot transactions are trades with size below one standard trading unit (100 shares for all symbols in our sample). It is important to stress that odd-lot trades are used *very* differently in Canada compared to the United States. On many U.S. trading venues, oddlots can be entered in the limit order book, they can be used to "ping" for fully hidden orders, and they can be used to avoid being listed on the consolidated tape. None of this is a concern in Canada. In Canada, odd-lot trades are always cleared by the Registered Trader and they are never passive and never enter the limit order book, and thus there is no benefit (real or perceived) in submitting odd-lot orders instead of round lot orders.[26] Oddlots may, however, be used by sophisticated traders in ETF or cross-border arbitrage strategies. We assert that such traders are likely also using short sales as part of their strategy. Retail clients, on the other hand, would be unlikely to be able to short stock easily. Out of the traders that pass our odd-lot test, we thus de-select the sophisticated, non-retail types of traders by the extent of their short-selling.

Formally, a traderID (defined as a unique combination of a broker, userID, and account

[26] See O'Hara, Yao, and Ye (2011)), for an analysis of odd-lot trades in there U.S. One may wonder if oddlots can be used strategically to trigger the registered trader's obligation by shredding a large order into odd-lots and thereby forcing the RT into trading at prices that are better than those posted in the public book. However, Canada's Universal Market Integrity Rule 2.1 forbids this practice. (See IIROC notice 10-0113 from April 23, 2010: "In essence, [Rule 2.1] stipulates that an order can not be shredded to intentionally trigger a market makers obligation to fill the shredded portions of the order.") Oddlots account for just 1.1% of the dollar trading volume in our sample period.

type) is classified as trading on behalf of a retail client if this traderID (*i*) has a fraction of oddlot limit order book transactions above 1% (we also used a 5% threshold, with similar results), (*ii*) is a client account (as opposed to, say, inventory or equity specialist), and (*iii*) has a short sale volume as a share of its total sale volume below 10%.

We perform our analysis by extracting all traderIDs that were part of at least one transaction in either the crosslisted and matched securities. Of these 2,274 traders, we classify 306 as retail traders; the remaining traders are classified as non-retail. We then compute average per trader costs and benefits per day per stock for the group of retail and non-retail traders. We exclude oddlot trades in the computation of the net costs, for consistency with the rest of our analysis.We then estimate the following equation

$$\begin{aligned} \textit{dependent variable}_{it} &= \beta_0 + \beta_1 \textit{fee change}_t \times \textit{retail}_i + \beta_2 \textit{fee change}_t \times \textit{non-retail}_i \\ &+ \beta_3 \textit{retail}_i + \beta_4 \times \mathsf{VIX}_t + \sum_{j=1}^{5} \beta_{25+j} \textit{control variable}_{ij} + \epsilon_{it}, \quad (5) \end{aligned}$$

where $\textit{fee change}_t$ is the fee change dummy as in the analysis before, $\textit{retail}_i$ is a dummy that is 1 if trader i is classified as retail, $\textit{cross-listed}_i$ is 1 if the costs for i are for an crosslisted security. We include the volatility index VIX and the same $\textit{control variables}_{ij}$ as in (3). Coefficients of interest are β_1 and β_2. A similar formulation is used when we analyze the effect in the price-based subsamples.

3 Market Quality

3.1 Quoted Liquidity

We measure quoted liquidity using time and trade weighted quoted spreads and depth. The *quoted spread* is the difference between the lowest price at which someone is willing to sell, or the best offer price, and the highest price at which someone is willing to buy, or the best bid price. We express the spread measures in basis points as a proportion of a prevailing quote midpoint.[27] *Share depth* is defined as average of the number of shares that can be traded on the bid and offer side; the *dollar depth* is the dollar amount that can be traded at the bid and the offer. We use logarithms of the depth measures to ensure a more symmetric distribution since several Canadian companies, particularly, non-crosslisted ones, historically have very large depth. High liquidity refers to large depth and small spreads.

The transaction weighted spread and depth are the prevailing spread and depth averaged over transactions, and they capture the impact of the fee change on executions. The time weighted measures additionally reflect the availability of liquidity throughout the day.

Results. Figure 4 shows a marked decline in the quoted spread after the event date and an increase in the dollar depth. The panel regression results for the change in the quoted spread are in the first two columns of Table 3. The first column depicts the time weighted quoted spreads, the second column displays the trade weighted quoted spreads.

The average price for crosslisted companies on July 31, 2005, was $12.67, the median price was $6.62. The size of the rebate in 2005 was ¢.275 per share, which translates into 4.34 and 8.31 basis points at the average and median prices, respectively, for a round-trip transaction (i.e., a simultaneous passive buy and sell). We observe that the estimate on the time weighted quoted spread declines by 14.05 basis points, the trade weighted quoted spread declines by 9.79 basis points. The latter is roughly the amount of the rebate at the median price and around double the rebate at the mean price. These results are significant at the 1% level.We further observe that there is a marked decline in the quoted spread for fee-neutral securities, consistent with Colliard and Foucault (2011).

Table 4 displays the results of our panel regressions on depth. We find that time and trade weighted dollar depth increase significantly. We further observe significant increases in depth for the group of fee-neutral securities. These observations are consistent with the notion that traders try to take advantage of the rebates by offering more shares for trade.

In summary, quoted liquidity improves in that spreads become tighter and more dollar volume can be traded at the best bid and offer prices.

[27]In untabulated regressions, we have also analyzed at the dollar-spreads; the results are similar.

3.2 Effective Liquidity and Cum-Fee Costs

Quoted liquidity only measures posted conditions, whereas effective liquidity captures the conditions that traders decided to act upon. The costs of a transaction to the liquidity demander are measured by the *effective spread*, which is is the difference between the transaction price and the midpoint of the bid and ask quotes at the time of the transaction. This measure also captures the costs that arise when the volume of an incoming order exceeds the posted size at the best prices. For the t-th trade in stock i, the proportional effective spread is defined as

$$espread_{ti} = 2q_{ti}(p_{ti} - m_{ti})/m_{ti}, \qquad (6)$$

where p_{ti} is the transaction price, m_{ti} is the midpoint of the quote prevailing at the time of the trade, and q_{ti} is an indicator variable, which equals 1 if the trade is buyer-initiated and -1 if the trade is seller-initiated. Our data includes identifiers for the active and passive side for each transaction, thus precisely signing the trades. Further, our data is message by message, as processed by the trading engine, and it includes quote changes. The prevailing quote is thus precisely identified as the last quote before the transaction.

The effective spread, which is often considered to be the best measure for transaction costs, does not include exchange fees. To determine a liquidity demander's total cost, it is important to explicitly account for these fees. We thus compute

$$fee\ adjusted\ espread_{ti} = (2q_{ti}(p_{ti} - m_{ti}) + 2 \times exchange\ fee_{ti})/m_{ti}, \qquad (7)$$

where $exchange\ fee_{ti}$ is the per share fee to remove liquidity. Before the change of fees it is $1/50 \times 1\% \times p_{ti}$ for all securities, and after the change it is $1/55 \times 1\% \times p_{ti}$ for non-crosslisted stocks and \$.004 for crosslisted stocks. Colliard and Foucault (2011) refer to this measure as the "cum-fee" spread.

The change in liquidity provider profits is measured by decomposing the effective spread into its permanent and transitory components, the *price impact* and the *realized spread*,

$$espread_{ti} = priceimpact_{ti} + rspread_{ti}. \tag{8}$$

The price impact reflects the portion of the transaction costs that is due to the presence of informed liquidity demanders, and a decline in the price impact would indicate a decline in adverse selection. The realized spread reflects the portion of the transaction costs that is attributed to liquidity provider revenues. In our analysis we use the five-minute realized spread, which assumes that liquidity providers are able to close their positions at the quote midpoint five minutes after the trade.[28] The proportional five-minute realized spread is defined as

$$rspread_{ti} = 2q_{ti}(p_{ti} - m_{t+5\ \mathrm{min},i})/m_{ti}, \tag{9}$$

where p_{ti} is the transaction price, m_{ti} is the midpoint of the quote prevailing at the time of the t-th trade, $m_{t+5\ \mathrm{min},i}$ is the midpoint of the quote 5 minutes after the t-th trade, and q_{ti} is an indicator variable, which equals 1 if the trade is buyer-initiated and -1 if the trade is seller-initiated.

As with effective spreads, we further want to explicitly account for the impact of liquidity rebates, and thus compute

$$rebate\ adjusted\ rspread_{ti} = (2q_{ti}(p_{ti} - m_{t+5\ \mathrm{min},i}) + 2 \times fee\ rebate_{ti})/m_{ti}, \tag{10}$$

where $fee\ rebate_{ti}$ is the per share maker fee rebate. It is 0 for all securities before the fee change. After the change it is 0 for non-crosslisted stocks and \$.00275 for crosslisted stocks.

As rebates potentially make the provision of liquidity more attractive, the question arises whether we observe changes in traders' order submission strategies. We thus analyze whether there are changes in the ratio of active volume relative to total submitted passive volume.

[28] In untabulated regressions, we have also analyzed the 1- and 30-minute realized spreads; the results are similar.

Results. Figure 5 plots the effective spread and the price impact for the treatment group of crosslisted securities and the control group, Figure 6 plots the fee adjusted effective spread and the rebate adjusted realized spreads. The figures suggests that the change in the fee structure led to a decrease in the effective spread and price impact and to a tentative increase in fee adjusted effective spread and the rebate adjusted realized spread.

The third column of Table 3 shows that after the fee change effective spreads fell significantly, by about 10.23 basis points. In untabulated regressions, we find a decrease in the dollar size of effective spreads (i.e. when (6) is multiplied with m_{ti}) of about .56 cents for the full sample. This finding extends to the subsample of fee-neutral securities. Focussing only on effective spreads and omitting exchange fees may give the misleading impression that liquidity demanders unambiguously benefit. Table 5 shows that the fee adjusted effective spreads did not decreased (there is a statistically insignificant increase). For the subsample of fee-neutral securities we find no change in the exchange-fee adjusted spread, and we thus confirm Colliard and Foucault (2011)'s result that the make/take fee difference has no effect on takers' revenues so long as the total fees remain unchanged.

The decline in transaction costs, as measured by the effective spread, can be due to liquidity makers foregoing some of their revenue, or it can be attributed to a change in trade informativeness. The fourth column of Table 3 shows that there is a decline of 5.59 basis points in 5-minute realized spreads. However, accounting for liquidity rebates, we observe that the benefit to passive trading actually increased, by 7 basis points. For the subgroup of fee-neutral securities we observe no change in the realized spread and an increase in the rebate adjusted benefit, by 6bps (significant at the 6% level). Further, the price impact declines for the total sample and for the fee-neutral subsample. We conclude that the liquidity providers share some portion of the rebate by lowering their revenue and also that adverse selection, measured by the price impact, declines. The decline in adverse selection is consistent with the idea that narrower spreads attract new, price-sensitive uninformed traders and informed traders with weaker information. Our findings on an increase in volume that we discuss in Section 5 further support this idea.

Colliard and Foucault (2011) provide theoretical guidance for the effects of a fee change. They argue that only the total fee affects the cum-fee spread, whereas the make/take fee difference plays no role. For our sample of fee-neutral securities, total fees stayed almost constant and the make/take fee difference increased. Consistent with Colliard and Foucault, we find that the fee adjusted effective spreads remain unaffected. Decomposing the effective spread into its transitory and permanent component, i.e. the realized spread and the price impact, and adjusting for rebates, we find that benefits to liquidity providers increased. This increase is attributed mostly to the change in the price impact. Our findings thus indicate that changes in fee *structure* entice marginal traders to enter the market.[29]

4 The Impact of Make/Take Fees on Retail Investors

There are two concerns that are commonly raised about make/take fees. First, make/take fees may generate "unfair" transfers from takers to makers of liquidity by penalizing the active order flow. Second, make/take fees may affect the traders' order submission strategies, so that some traders specialize in the provision of liquidity (to receive rebates), forcing others to "cross the spread" more often (and to pay the exchange fee).[30]

Our results for the set of fee-neutral stocks indicate that the total costs of the active side remain unchanged, while the benefits to the passive side increase. We attribute this decline to the reduced price impact and our findings don't support the claim of "unfair" transfers from takers to makers.

In this section, we will address the second concern and analyze whether particular groups of traders were differentially affected by the introduction of liquidity rebates. Our focus is on the costs and benefits to retail traders. Specifically, we compute the *net cost* and share of passive volume per trader per day, in basis points, per day per stock averaged over retail and non-retail traders respectively. In our regressions, we present the effect on

[29]One reason for entry is that end-users often pay flat fees that do not account for exchange fees.

[30]See, for instance, The Globe and Mail (a major Canadian National newspaper) which asserts that "the money [to pay the rebates] often comes out of the retail investors pocket".(*Globe and Mail*, "Small investors pay the price for high-frequency trading", January 31, 2011.)

the net costs as well as the effect on the net costs, scaled by the average July 2005 net costs. Since the net costs of retail traders exceed, on average, those of non-retail traders by factor 3, the scaled measure allows a comparison of the relative effects.

To compute the net costs, each time a trader is on the active side, we add half of the fee adjusted effective spread (counting it as a trade cost) and each time this trader is on the passive side we subtract half of the rebate adjusted realized spread (counting it as a trade benefit). We volume-weight this measure and average it over all retail and non-retail traders respectively for each stock to obtain the average net cost per stock per day for the two groups. For instance, suppose that on a given day a trader participated in 2 transactions: this trader was on the active side of a 100 share transaction, with a fee adjusted effective half spread of 5 bps, and on a passive side of a 200 share transaction, with a rebate adjusted realized half spread of 1 bps. This trader's per share net cost is $\textit{net cost} = (5 \cdot 100 - 1 \cdot 200)/300 = 1\text{bps}$.

The main question that we want to address, is whether the group of retail traders, who are considered to be less sophisticated and less flexible, benefit or suffer from the fee change. We also investigate whether the differential impact of the trading fee change is driven by retail investors being crowded out of the passive side and being forced to "cross the spread". Table 10 reveals that overall net costs declined for both retail and non-retail traders, though not significantly for either group. We further observe that retail traders trade actively more often. Since their fees did not change, this change could owe merely to a generally greater interest in trading (and, assuming that retail flow is "uninformed", this would be consistent with our finding on the price impact).

For the subsample of fee-neutral securities, we find no change in the costs for either retail or non-retail traders, even though they are on the active side relatively more often. When scaling the costs by their average July 2005 costs, however, we find that retail traders experienced a significant decrease in their costs.

We thus conclude that retail investors did not suffer and may have benefitted from the introduction of make/take fees, at least, for the two months following the event.

5 Volume and Intermediation

One key question is whether changes in fees have any effect on trading behavior. We study the impact of the fee change on the number of shares traded, the dollar amount of all trades, and the number of transactions. To understand if there are changes in intermediation, we further decompose these numbers into volumes between different types of traders.

Aggregate Volume. Figure 7 displays a marked increased in dollar volume. Table 6 displays our results on share and dollar volume, measured in logarithms, and the number of transactions, and confirms the observation from the plot. Namely, our results suggest that after the fee change volume, dollar volume, and the numbers of transactions increased significantly. We observe an increase across the board, for all subsamples (though the increase is not always statistically significant). We thus conclude that the introduction of the make/take fee structure did have an effect on trading activity.

The increase in volume is somewhat surprising because the demand for liquidity went up even though transaction costs did not decline for the liquidity demand side (Section 3.2). There are three explanations. First, the TSX cross listed stocks may have attracted volume from U.S. markets. Our analysis in Appendix 7 shows some support for this notion. Second, an increase in volume could also be caused by traders who are attracted by the lower quoted spreads and who don't care about the exchange fees. Retail traders in particular often pay flat fees for transactions. Since retail traders also traded on the active side more often and since the price impact declined, the volume may be partially driven by retail traders. Third, there may be an increase in intermediation that merely leads to an "illusion" of increased volume. We investigate this last point now.

Intermediated Volume. Increased volume may be caused when an intermediary, such as an algorithm programmed to take advantage of fee rebates, is able to "inject" itself between two traders who would have otherwise transacted on their own. Practitioners sometimes refer to this as a situation when a "natural" trade is substituted with two intermediated trades. We proxy for the extent of intermediation by the volume that is traded between intermediaries and non-intermediaries, as a fraction of the total volume. (We also used transactions instead of volume, with similar results.)

Even with the very detailed data, there is no entry that unambiguously identifies intermediaries. We classify liquidity providing traderIDs as intermediaries by their daily activities, per stock per day. Specifically, we classify a trader as an intermediary for a particular symbol on a particular day if the underlying account is an equity specialist account or if the following three conditions are satisfied: (*i*) this trader's fraction of passive volume exceeds 60%, (*ii*) this trader is sufficiently present in that he or she is involved in at least 10 transactions or at least 30% of transactions (whichever one is smaller), and finally (*iii*) this trader is not classified as a retail trader.[31,32] We use a daily classification for intermediaries, rather than an ex ante one, to account for the possibility of exit and entry. Our retail classification is as in Section 4.[33]

Table 7 presents our findings on intermediated trades. We find that the fraction of intermediated volume has increased by about 3%, and that the fraction of volume between two non-intermediaries has declined by about 4%. These changes are similar across all subsamples, though with varying degrees of statistical significance.

6 Competition in Liquidity Provision

With the introduction of fee rebates, ceteris paribus, it becomes cheaper to post limit orders. It is then imaginable that institutions see the introduction of rebates as an opportunity

[31]We have used other thresholds for trading activity and obtained similar results.

[32]A finer classification would additionally require that intermediaries have mean-reverting inventories. In our case, however, securities in the treatment group are crosslisted and absent knowledge of the traders' U.S. market activities, we cannot rule out that a non-mean-reverting inventory based on our data is, in fact, mean-reverting. More to the point, the market making institutions that we try to identify, are presumably very sophisticated and will most likely be active in both markets. In an early version of the paper, we only considered traders that trade on inventory or equity specialist accounts as intermediaries, restricting attention to trades where a client is on the active side and an intermediary is on the passive side of a trade. This approach, however, is too restrictive in that it rules out that the possibility that clients, too, can make a market (and they often do) if they access the market directly. Results from this analysis are in the internet appendix.

[33]Classifying retail traders based on their daily fractions of oddlots is not possible, as oddlot transactions are relatively infrequent even for retail traders.

to enter the market for liquidity provision. To asses the extent of competition, we count the number of improvements of the best bid and offer prices and depth, the number of liquidity providing market participants that are involved in transactions, and we compute the Herdindahl Index of market concentration (introduced in Section 2.4).

6.1 Improvements in the Quoted Bid-Ask Spread and Depth

The first column in Table 9 summarizes our findings on the total number of spread and depth improvements. We find a significant increase in the number of improvements, which indicates increased competition. The second and third columns show that this increase is driven by improvements in depth, while the number of spread improvements declines. These changes are similar across all subsamples. Since the average depth also increased, we conclude that after the fee change, traders compete more aggressively on depth.

The decline in the number of spread improvements is consistent with our finding that average depth increases. As depth increases, ceteris paribus, fewer trades walk the book and there may be fewer opportunities to improve the spread after the book was depleted. Furthermore, since quoted spreads decline, there is less room for improving the spread.

Our finding on the increase in the number of quote improvements is consistent with Foucault, Kadan, and Kandel (2009) who predict, in particular, that the liquidity providers' monitoring activity increases as their fee decreases.

6.2 Market Participation and Concentration

The increase in the number of quote improvements could be driven by two factors: first, existing traders may compete more aggressively, and second, the liquidity rebates may have attracted new traders. We focus here on the Herfindahl Index at the level of the liquidity providers or intermediaries (as defined in in Section 5). Our index is based the shares of passive volume that intermediaries provide, and it captures the first factor.

The last column of Table 8 displays our results on the HHI. The displayed decline in the index signifies reduced market concentration and increased competition. These changes are similar across all subsamples.

To assess market participation, we count the number of liquidity providing brokerages and, as a finer measure, the number of intermediaries (as classified in Section 5), per security per day. The first two columns in Table 8 reveal that the number of brokers and intermediaries increased significantly after the change. This change is in part driven by entry in the market where total fees increased. This is not surprising because the relative value of rebates for passive trading is very large for these stocks and passive benefits have increased strongly for this group of stocks.

We thus conclude that competition in the market for liquidity provision increased and that this increase is at least in part driven by market entry.

7 Conclusion

The introduction of fee rebates for passive volume on the Toronto Stock Exchange led to a substantial decline in bid-ask spreads, an increase in depth, and an increase in volume. The changes in spreads are consistent with theoretical predictions, but the increase in volume appears puzzling, as transaction costs, accounting for both the spread and the exchange fees, did not go down. We attribute part of this increase to volume migration from U.S. markets and in part to increased participation of formerly absent traders, and we conclude that the introduction of the make/take fee system has increased the TSX's competitiveness.

We further find that after the introduction of the fee rebates, liquidity providers compete more aggressively for market share in the "make" market and that they participate in more trades. We interpret the latter finding as an increase in intermediation. Contrary to popular claims, we find no evidence that retail traders were harmed by the market structure change. However, the increase in intermediation and the decreased passive trading by retail traders is an issue that may merit a longer term analysis.

Finally, even though liquidity providers lower their spreads in response to the fee change, when taking rebates into account, liquidity providers' per share revenues increase. This finding together with an increase in competition for liquidity provision suggests that competition in depth is at least as important as competition in spreads.

Appendix: Comparison to U.S. Markets

The fee change on the TSX affected trading in NASDAQ/AMEX interlisted securities on the TSX, and to the best of our knowledge there were no significant market structure changes in the U.S. during the 80 days around the October 01, 2005 event date.

As a robustness check for our main results, we now compare Canadian and U.S. markets. We perform this comparison on two levels. First, we compare the trading statistics for the NASDAQ/AMEX interlisted securities on the TSX to the trading statistics for the same companies on U.S. markets. Second, we match each of the NASDAQ/AMEX interlisted TSX securities with a U.S. security and perform a difference in differences analysis for U.S. markets. Depending on the ease with which investors can trade on both sides of the border, the effects of the fee change should be similar to those of our main analysis in one or the other of these two comparisons. If cross-border trading and settlement were impossible, the effects of the fee change should manifest themselves in the first comparison, and there should be no effect for the second comparison. If, on the other hand, all investors could trade and settle freely in either market, there should be no effect for the first comparison and the effects of the fee change should be concentrated in the second comparison.

The results of the U.S.–Canada comparison are consistent with our main analysis. We find that, for the NASDAQ/AMEX interlisted securities, effective and time-weighted quoted spreads on the TSX dropped, relative to U.S. markets, and that trading activity increased. We further find an increase in transactions in interlisted securities relative to their U.S. matches. We also observe declines in effective and quoted spreads for NASDAQ/AMEX interlisted TSX securities relative to their U.S. matches, but these are not statistically significant.

Relating our results for the Canadian market with developments on U.S. markets is, however, challenging, for a number of reasons.

First, U.S. equity markets had a different structure, were more fragmented, and had different trading rules. For instance, the TSX was a public limit order book so that traders were able to trade directly against posted orders, whereas NASDAQ was a (dealer) quotation system in which, among other things, posted depth did not necessarily reflect available depth.

Second, Canadian interlisted companies, although small by U.S. standards, are important for Canadian investors and mutual funds, and Canadian investors thus pay close attention to these stocks. U.S. companies of equivalent size will likely receive less attention. When analyzing our Canadian data, we control for the competitiveness of liquidity provision (and thus account for differences in the market attitude) in selecting the non-interlisted matches for the NASDAQ/AMEX interlisted securities. The U.S. data lacks the necessary information, thus the U.S. market trading in interlisted TSX securities is likely to be more competitive than in their U.S. matches.

Third, to the best of our knowledge, the ease with which U.S. investors may settle trades in Canada and vice versa is security dependent. Consequently, for some securities the effect of the fee change should manifest itself in the comparison of the NASDAQ/AMEX interlisted securities in Canada and the U.S., whereas for others the effect should be present in the comparison of the NASDAQ/AMEX interlisted TSX securities and their U.S. matches. We have no information on the ease of cross-border trading and thus perform each comparison for the entire sample of the interlisted securities. The coefficient estimates (in magnitude) for the U.S. market comparisons are thus not readily comparable to those in our main analysis, and the estimates are also noisier. Finally, note that cross-border arbitrage in interlisted securities alone is insufficient to tighten spreads to the point that they are identical, because arbitrage merely resolves crossed quotes.

We obtain data for U.S. markets from the TAQ database, and we obtain data on market capitalization, primary listing exchange, and July 2005 closing prices from the

CRSP database. To identify the trading direction for each trade, we apply the Bessembinder (2003) variation on the Lee and Ready (1991) algorithm. Quoted spreads with absolute \$-value above \$10 are omitted, as are negative prices and negative sizes; further data cleaning methods are as in Bessembinder. To obtain U.S. matches for the NASDAQ/AMEX interlisted TSX securities we proceed in two steps. First, we find the three best matches (without replacement) for each interlisted security (the matching algorithm first finds the best for each, then the second best, then the third best), based on July 2005 price and market capitalization, restricting attention to securities that have NASDAQ or AMEX as their primary exchanges. For these matches, we compute daily trading statistics, eliminate symbols that trade less than ten times on more than 4 days in the sample period. Second, for each interlisted company we find the single best match (without replacement) out of the remaining set of U.S.based symbols, based on July 2005 closing price, market capitalization, and average July 2005 time-weighted quoted spread. Including the pre-sample spread as a matching characteristic allows us to at least partially address the possible differences in competitiveness and investor attention that we discussed above.

The precise table of Canadian companies and their matches has been omitted to save space but it is available from the authors upon request. When comparing dollar values for Canadian and U.S. traded securities, we adjusted the daily statistic by the noon exchange rate (as posted by the Bank of Canada).

We discuss our methodology for the comparison of trading in interlisted securities on the TSX and on U.S. markets; the methodology for the comparison of trading in interlisted securities and their U.S. matches on U.S. markets is similar. To understand the differential impact of the fee change, we run regressions similar to those in Subsection 2.5,

$$\textit{dependent variable}_{it} = \beta_0 + \beta_1 \textit{fee change}_t + \beta_2 \mathsf{Volatility}_t + \sum_{j=1}^{3} \beta_{2+j} \textit{control variable}_{ij} + \epsilon_{it}, \tag{11}$$

where $\textit{dependent variable}_{it}$ is the time t realization of the measure on the TSX for security i less the realization of the measure for the same security in U.S. markets; $\textit{fee change}_t$ is an indicator variable that is 1 after the event date and 0 before; $\mathsf{Volatility}_t$ is the day t realization of the Canadian market volatility index, MVX, to control for the differential reaction to Canadian market conditions. Finally, *control variable*$_{ij}$ are security level control variables for the company: the July 2005 log of the market capitalization and the log of the closing price, and the July 2005 turnover, return volatility and share of dollar volume that is traded on the TSX.

TAQ data does not allow us to compute all of the statistics for U.S. data that we have for Canadian data. We focus on time weighted and transaction weighted quoted spreads, transaction weighted effective and 5-minute realized spreads, share volume, dollar volume, share depth and dollar depth, and transactions.

We find statistically significant declines for trading in interlisted securities on the TSX relative to the U.S. for effective spreads (-2.3 bps) and time-weighted quoted spreads (-2.5 bps), and we find significant increases for share and dollar volume (about 12%) and the number of transactions (+55 per day). Table 13 summarizes these findings. We find no effect of the fee change on transaction weighted quoted spreads, 5-minute realized spreads, or the depth measures.

Comparing interlisted securities with their U.S. matches, we find statistically significant effects only for the number of transactions, where we observe that interlisted securities trade less frequently. We further observe a decline in effective spreads of about 3 bps for interlisted securities; this effect, however, is not statistically significant at conventional levels (12%). We omit the result tables for brevity; they are available from the authors.

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Table 1

Summary Statistics on Trading Activity for Interlisted Companies and their Non-Interlisted Matches

The table lists aggregate trading volume numbers, excluding the special terms market, for the August-November 2005 sample period for NASDAQ/AMEX-interlisted companies and their respective matches. Percentage numbers are for the share that the respective number has of total volume.

		NASDAQ/AMEX interlisted		Non-interlisted	
Total	Share Volume	1,770,296,833		2,071,693,788	
	Dollar Volume	$ 19,248,788,076		$ 25,129,033,184	
	Transactions	1,928,665		1,416,447	
Intraday		1,273,415,400	71.9%	1,315,331,900	63.5%
		$ 14,493,879,792	75.3%	$ 15,492,998,428	61.7%
		1,786,993	92.7%	1,227,048	86.6%
Dealer Crosses		423,157,100	23.9%	659,064,800	31.8%
		$ 3,122,736,978	16.2%	$ 7,706,941,599	30.7%
		5,025	0.3%	7,362	0.5%
Open		25,508,400	1.4%	43,733,300	2.1%
		$ 334,181,977	1.7%	$ 548,233,994	2.2%
		25,005	1.3%	36,780	2.6%
Market on Close		13,117,100	0.7%	14,956,100	0.7%
		$ 231,319,584	1.2%	$ 561,597,097	2.2%
		7,971	0.4%	6,676	0.5%
Afterhours		30,395,272	1.7%	32,366,195	1.6%
		$ 863,201,821	4.5%	$ 554,935,802	2.2%
		2,879	0.1%	2,302	0.2%
Oddlots		4,703,561	0.3%	6,241,493	0.3%
		$ 203,467,924	1.1%	$ 264,326,263	1.1%
		100,792	5.2%	136,279	9.6%
Equity Specialist		113,584,749	6.4%	154,278,550	7.4%
(all trades, including oddlots)		$ 1,733,578,471	9.0%	$ 1,752,836,439	7.0%
		339,564	17.6%	385,755	27.2%
Active Orders		1,225,929		767,493	
% of active orders that "walk the book"		4.95%		7.37%	
Active Orders by Clients		795,841,300	45.0%	928,218,900	44.8%
		$ 8,853,069,263	46.0%	$ 10,431,954,670	41.5%
		1,209,763	62.7%	940,109	66.4%
Submitted Passive Volume		26,651,815,271		5,873,220,066	
Submitted Passive Orders		33,706,281		4,351,394	

Table 2
Pre-sample Summary Statistics of Interlisted Companies and their Matches

The table lists selected summary statistics for the NASDAQ/AMEX-interlisted companies and their matches for the pre-sample month of July. Unless otherwise specified, the numbers are average per day per company. intraday volume refers to transactions that occur in the open market during regular trading hours (9:30-16:00), excluding oddlot trades, special terms orders and dealer crosses.

		NASDAQ/AMEX interlisted	Non-interlisted
Total intraday July 2005 share volume	Mean	3,017,085	4,036,102
	StD	(4,403,553)	(9,634,998)
	Median	1,435,500	1,887,600
Total intraday July 2005 dollar volume		$ 39,948,342	$ 41,926,636
		($95,813,233)	($123,737,341)
		$ 10,409,636	$ 13,509,303
Total July 2005 transactions		4784	3533
		(6547)	(5338)
		2554	2011
Closing price end July 2005		$ 12.67	$ 12.81
		($18.06)	($17.84)
		$ 6.62	$ 6.63
Market capitalization end July 2005		$ 1,466,613,617	$ 1,659,052,517
		($4,791,028,537)	($6,361,965,269)
		$ 508,000,000	$ 458,400,000
Time weighted quoted spread (in bps)		62.97	82.24
		(47.00)	(46.77)
		51.42	80.97
Time weighted quoted spread (in cents)		4.33	5.96
		(4.22)	(5.03)
		3.28	4.02
Time weighted dollar depth		$ 16,185	$ 21,923
		($13,708)	($16,900)
		$ 12,560	$ 17,162
Herfindahl Index broker level		0.216	0.228
		0.065	0.064
		(0.201)	(0.225)
Herfindahl Index trader level		0.446	0.559
		0.167	0.197
		(0.444)	(0.553)
Number of brokers		13.74	13.10
		(5.31)	(5.46)
		13.00	12.16
Number of broker-inventory traders		6.43	5.02
		(5.47)	(5.90)
		4.37	3.47

Table 3
Panel Regressions Results for Marginal Changes in Bid-Ask Spreads

Dependent variables are treatment group value minus control group value for time weighted and trade weighted quoted spread, effective spread, and 5-minute realized spread and price impact. All spreads and the price impact are measured in basis points of the prevailing midquote.

Specifications that apply to this and all subsequent tables. The treatment group in 2005 are the NASDAQ and AMEX interlisted securities. Each dependent variable is regressed on a dummy variable set equal to one for dates after October 01, 2005 and zero before, daily market volatility as measured by the CBOE VIX index, and the following control variables for the security and its match: log(market capitalization) and log(price) at July 31, 2005, and dollar turnover and return volatility in July 2005. Coefficients for volatility, control variables, and the constant are not reported for brevity. The full sample for 2005 is 65 securities. Standard errors are in parentheses; * indicates significance at the 10% level, *+ at the 6% level, ** at the 5% level, **+ at the 2%, and *** at the 1% level. Standard errors are robust to time series and cross-sectional correlation. Results from subsample regressions are presented for the two subsamples discussed in Section 2.5. We report only the coefficient estimates for the interaction terms; see Section 2.5 for the full specification for the estimated equation. We test for equality of coefficients, where “Yes” indicates that we reject the hypothesis.

	time weighted quoted spread	trade weighted quoted spread	effective spread	5 min realized spread	5 min price impact
full sample	-14.0523***	-9.7868***	-10.2267***	-5.5852***	-4.6415**
	(3.799)	(3.021)	(3.330)	(2.012)	(2.125)
	– Split into equal sized Zones with Neutral Fee Change –				
Decrease in fees	-5.1385*+	-2.4215	-2.2574	-1.5043	-0.7531
	(2.635)	(1.982)	(2.069)	(1.502)	(1.498)
Fee-neutral companies	-16.1477**+	-9.9968**	-10.3514**	-2.9416	-7.4099*
	(6.315)	(4.422)	(4.963)	(2.983)	(4.332)
Increase in fees	-19.7992**+	-15.9948**	-17.0419**	-11.6654**+	-5.3764
	(8.057)	(6.921)	(7.516)	(4.986)	(4.706)
Different coefficient?					
Decrease vs increase	Yes*	Yes*	Yes*+	Yes*+	–
Decrease vs neutral	Yes*	–	–	–	–
Increase vs neutral	–	–	–	–	–
	– Split by Fee Thresholds –				
cheaper market & total	-4.2578	-2.6820	-2.5811	-1.2572	-1.3239
	(4.074)	(3.242)	(3.594)	(2.670)	(2.514)
costlier market, cheaper total	-14.4906**+	-8.7277**	-9.0377**	-6.0813**+	-2.9564
	(6.039)	(4.110)	(4.435)	(2.451)	(3.109)
costlier market & total	-16.3615***	-12.3525**+	-13.0196**+	-6.4084*	-6.6112*
	(5.849)	(4.959)	(5.458)	(3.680)	(3.743)
Different Coefficient?					
Cost all ↘ vs Cost total ↘	Yes*	–	–	–	–
Cost all ↘ vs Cost all ↗	–	–	–	–	–
Cost all ↗ vs Cost total ↘	–	–	–	–	–

Table 4
Panel Regressions for Depth at the Best Bid and Offer Prices

Dependent variables are treatment group value minus control group value for the trade weighted and time weighted depth. Depth is measured in the log of the number of shares and the log of the dollar amount. Specifications for the panel regression and significance levels are as in Table 3.

	share depth throughout the day	share depth at transaction	$ depth throughout the day	$ depth at transaction
full sample	0.0799*	0.0690	0.1079**+	0.0971**
	(0.044)	(0.043)	(0.046)	(0.046)
	– Split into equal sized Zones with Neutral Fee Change –			
Decrease in fees	0.0829	0.0715	0.0954	0.0841
	(0.070)	(0.060)	(0.073)	(0.064)
Fee-neutral companies	0.1268***	0.1130**	0.1578***	0.1443**+
	(0.047)	(0.051)	(0.054)	(0.057)
Increase in fees	0.0325	0.0247	0.0711	0.0631
	(0.086)	(0.089)	(0.088)	(0.091)
Different coefficient?				
Decrease vs increase	–	–	–	–
Decrease vs neutral	–	–	–	–
Increase vs neutral	–	–	–	–
	– Split by Fee Thresholds –			
cheaper market & total	0.0927	0.0659	0.0449	0.0180
	(0.087)	(0.071)	(0.111)	(0.093)
costlier market, cheaper total	0.1561***	0.1541***	0.2029***	0.2013***
	(0.060)	(0.056)	(0.055)	(0.051)
costlier market & total	0.0272	0.0147	0.0632	0.0504
	(0.063)	(0.066)	(0.067)	(0.070)
Different Coefficient?				
Cheaper all vs total	–	–	–	–
Cheaper all vs costlier all	–	–	–	Yes*
Costlier all vs cheaper total	–	Yes*	Yes*	Yes*

Table 5
Panel Regressions for Transaction Costs and Rebate Benefits

Dependent variables are treatment group value minus control group value for costs for active orders and trading benefits for passive orders, as described in (7), (10), and the ratio of market order volume to limit order volume. Costs and benefits are measured in basis points of the prevailing midquote. Specifications for the panel regression and significance levels are as in Table 3.

	effective cost of an active order	effective benefit of an executed passive order	ratio market to limit orders
full sample	4.4173	6.9823***	2.1756***
	(3.806)	(2.284)	(0.702)
	– Split into equal sized Zones with Neutral Fee Change –		
Decrease in fees	-2.2809	0.9801	4.2098***
	(2.085)	(1.531)	(1.025)
Fee-neutral companies	-0.7687	6.1463*+	3.1922***
	(5.383)	(3.223)	(1.077)
Increase in fees	15.2067*	13.0048**	-0.5658
	(8.618)	(5.739)	(0.972)
Different coefficient?			
Decrease vs increase	Yes**	Yes**	Yes***
Decrease vs neutral	–	–	–
Increase vs neutral	–	–	Yes**+
	– Split by Fee Thresholds –		
cheaper market & total	-4.0663	0.2222	2.9509***
	-(3.589)	-(2.725)	(1.074)
costlier market, cheaper total	-5.1599	-0.9149	4.3953***
	-(4.340)	-(2.176)	(1.021)
costlier market & total	12.8633**	13.8853***	0.5341
	-(6.155)	-(3.966)	(0.927)
Different Coefficient?			
Cheaper all vs total	Yes**+	Yes***	Yes*
Cheaper all vs costlier all	–	–	–
Costlier all vs cheaper total	Yes**+	Yes***	Yes***

Table 6
Panel Regressions for Volume and Transactions

Dependent variables are treatment group value minus control group value for the logarithms of share volume and dollar volume and the number of transactions. Note that an incoming active order can trigger multiple transactions. Specifications for the panel regression and significance levels are as in Table 3.

	volume in shares	dollar volume	trans- actions
full sample	0.1880**+	0.2163**+	61.6111**+
	(0.080)	(0.090)	(24.5)
	– Split into equal sized Zones with Neutral Fee Change –		
Decrease in fees	0.0407	0.0530	43.1540
	(0.094)	(0.101)	(39.3)
Fee-neutral companies	0.2928*	0.3239*	55.8719*+
	(0.174)	(0.178)	(29.4)
Increase in fees	0.2159*	0.2554	83.1504*
	(0.123)	(0.157)	(48.7)
Different coefficient?			
Decrease vs increase	–	–	–
Decrease vs neutral	–	–	–
Increase vs neutral	–	–	–
		– Split by Fee Thresholds –	
cheaper market & total	0.0895	0.0413	115.2805
	(0.169)	(0.168)	(70.4)
costlier market, cheaper total	0.2832**	0.3303**+	55.6612**
	(0.141)	(0.141)	(27.5)
costlier market & total	0.1523	0.1887	51.2545
	(0.112)	(0.134)	(36.6)
Different Coefficient?			
Cheaper all vs total	–	–	–
Cheaper all vs costlier all	–	–	–
Costlier all vs cheaper total	–	–	–

Table 7
Panel Regressions on the Fraction of Intermediated Trades

Dependent variables are treatment group value minus control group value for several ratios of volume for subgroups to total volume. Specifications for the panel regression and significance levels are as in Table 3.

	LPs' % of Passive Volume	LPs' % of Total Volume	% of Volume LP to non-LP	% of Volume non-LP non-LP
full sample	3.8086***	4.7475***	3.2035***	-3.9720***
	(0.880)	(1.173)	(0.874)	(1.033)
	– Split into equal sized Zones with Neutral Fee Change –			
Decrease in fees	4.6457***	5.2075***	4.4782***	-5.1470***
	(1.211)	(1.620)	(1.151)	(1.363)
Fee-neutral companies	2.7407*	2.6556	1.8238	-2.052
	(1.624)	(1.952)	(1.440)	(1.721)
Increase in fees	4.1709**+	6.7025***	3.4786*	-5.0046**+
	(1.757)	(2.283)	(1.942)	(2.118)
Different coefficient?				
Decrease vs increase	–	–	–	–
Decrease vs neutral	–	–	–	–
Increase vs neutral	–	–	–	–
	– Split by Fee Thresholds –			
cheaper market & total	5.7897***	5.5189***	4.6436***	-5.3276***
	(0.640)	(0.977)	(1.227)	(1.005)
costlier market, cheaper total	3.8680***	4.7690***	3.3313***	-4.2793***
	(1.383)	(1.652)	(1.286)	(1.466)
costlier market & total	3.1959**	4.5102**	2.6989*	-3.3505*+
	(1.440)	(1.950)	(1.450)	(1.712)
Different Coefficient?				
Cheaper all vs total	Yes*	–	–	–
Cheaper all vs costlier all	–	–	–	–
Costlier all vs cheaper total	–	–	–	–

Table 8
Panel Regressions on Competition Indicators

Dependent variables are treatment group value minus control group value for the trader level Herfindahl Index (based on inventory or specialist in Column 1 and on LPs identified by behavior in Column 2), the number of liquidity providing brokers and the number of liquidity providing traders that trade on inventory or specialist accounts, and the number of liquidity providers that we have identified by behavior. The Herfindahl Index is defined in (2), the number of brokers is the number of broker IDs that are on the passive side of trades, the number of inventory traders is the number of trader IDs that are on the passive side of trades while using their inventory account. All measures are per stock per day. A decrease in the Herfindahl Index indicates a decrease in market concentration and thus an increase in competition for liquidity provision. Specifications for the panel regression and significance levels are as in Table 3.

	Number of Brokers	Number of LPs	Herfindahl LPs
Full sample	0.7854**	0.8189**+	-0.0579***
	(0.380)	(0.3342)	(0.0168)
	– Split into equal sized Zones with Neutral Fee Change –		
Decrease in fees	-0.5509	0.3871	-0.0341*
	(0.391)	(0.574)	(0.019)
Fee-neutral companies	0.8988	0.6666	-0.0536*
	(0.754)	(0.429)	(0.031)
Increase in fees	1.8397***	1.4522**	-0.0898***
	(0.598)	(0.669)	(0.034)
Different coefficient?			
Decrease vs increase	Yes***	–	–
Decrease vs neutral	Yes*	–	–
Increase vs neutral	–	–	–
	– Split by Fee Thresholds –		
cheaper market & total	-0.4520	1.3917	-0.0601*+
	(0.633)	(0.956)	(0.031)
costlier market, cheaper total	0.5781	0.4106	-0.0423*
	(0.691)	(0.476)	(0.024)
costlier market & total	1.2473**+	0.9760**	-0.0696**+
	(0.513)	(0.498)	(0.027)
Different Coefficient?			
Cheaper all vs total	Yes**	–	–
Cheaper all vs costlier all	–	–	–
Costlier all vs cheaper total	–	–	

Table 9
Panel Regressions for Improvements in the Best Bid and Offer

Dependent variables are treatment group value minus control group value for the total number of improvements at the best bid and offer (BBO) as well as its decomposition into the number of improvements with regards to prices and depth. Specifically, the number of improvements in the BBO is computed, for each stock and day, by counting the number of times that there is an increase in the number of shares available at the bid or offer for a fixed or an improved prices and the number of times that the bid is increased or the offer decreased. Specifications for the panel regression and significance levels are as in Table 3.

	Number of BBO improvements	spread improvements	depth improvements	Number of BBO changes
full sample	138.2***	-46.0***	184.2***	301.9***
	(43.6)	(7.5)	(52.2)	(59.3)
	– Split into equal sized Zones with Neutral Fee Change –			
Decrease in fees	253.3028*+	-99.5156***	352.8184***	526.7796***
	(131.2)	(34.5)	(134.8)	(190.5)
Fee-neutral companies	69.2807	-26.5103**	95.7910**	183.9455*
	(55.4)	(11.6)	(46.0)	(108.5)
Increase in fees	103.9059***	-18.1239***	122.0298***	219.2311***
	(20.7)	(4.4)	(35.4)	(70.9)
Different coefficient?				
Decrease vs increase	–	Yes**	Yes*	–
Decrease vs neutral	–	Yes*	Yes*	–
Increase vs neutral	–	–	–	–
	– Split by Fee Thresholds –			
cheaper market & total	199.6794	-126.0550*	325.7344	331.6561
	(228.7)	(69.9)	(236.4)	(268.5)
costlier market, cheaper total	236.6411**+	-45.7176*	282.3587***	548.1350***
	(96.1)	(25.2)	(83.6)	(179.9)
costlier market & total	58.1426**	-25.0031***	83.1457***	134.7304**
	(27.6)	(5.1)	(30.6)	(65.1)
Different Coefficient?				
Cheaper all vs total	–	–	–	–
Cheaper all vs costlier all	–	–	–	–
Costlier all vs cheaper total	Yes*	–	Yes**+	Yes**

Table 10
Panel Regressions for Net Costs for Retail Traders

Dependent variables are level realizations of average per trader per stock per day net costs (exchange fee adjusted effective spreads minus rebate adjusted 5 minute realized spreads), fraction of passive volume, and net costs scaled by average per stock July net costs. Costs and benefits are measured in basis points of the prevailing midquote, fractions of volume are measured in percent. The underlying regression is outlined in line (5). Specifications for the panel regression and significance levels are as in Table 3.

		Net Costs	% passive volume	July Scaled Net Costs
	Retail	-1.3321	-2.0632**+	-13.5792
		(1.461)	(0.862)	(9.915)
	Non-Retail	-0.531	0.2715	-47.2308
		(0.840)	(0.508)	(40.560)
	Different Coefficients?	–	Yes**	–
	– Split into equal sized Zones with Neutral Fee Change –			
Decrease in fees	Retail	-1.9338*	-1.116	-25.1825**+
		(1.050)	(1.689)	(10.190)
	Non-Retail	-0.6356	0.3668	-31.9033**+
		(0.590)	(0.804)	(12.848)
Fee-neutral companies	Retail	-3.7004	-3.1574***	-26.5210**
		(2.375)	(1.209)	(12.692)
	Non-Retail	-1.1345	0.1738	-118.1442
		(1.359)	(0.694)	(100.518)
Increase in fees	Retail	1.4516	-1.8408	8.9589
		(3.385)	(1.448)	(16.235)
	Non-Retail	0.1411	0.2821	7.3571
		(2.066)	(1.081)	(23.002)
	Different Coefficients?			
	Fee Decrease	–	–	–
	Fee Neutral	–	Yes*+	–
	Fee Increase	–	–	–
	– Split by Fee Thresholds –			
cheaper market & total	Retail	-1.6729	-2.4386	-18.3277
		(1.645)	(2.880)	(13.737)
	Non-Retail	-1.2037	0.9847	-45.5458**
		(0.732)	(1.441)	(19.832)
costlier market, cheaper total	Retail	-4.0983*	-1.1882	-32.7211***
		(2.256)	(1.100)	(11.912)
	Non-retail	0.5	0.039	-108.1935
		(0.594)	(0.516)	(101.049)
costlier market & total	Retail	0.552	-2.5361**	0.1512
		(2.342)	(1.193)	(12.748)
	Non-Retail	-1.0208	0.2332	-8.1922
		(1.560)	(0.827)	(17.481)
	Different Coefficients?			
	cheaper market & total	–	–	–
	costlier market, cheaper total	Yes*+	–	–
	costlier market & total	–	Yes*	–

Figure 3
Spreads and Volatility

The figure plots the time-weighted quoted spreads for the group of NASDAQ/AMEX interlisted securities and the value of the CBOE volatility index VIX. As can be seen, there was a spike in spreads in October 2005 that is partly caused by an increase in volatility. Our analysis controls for volatility, and we add this plot as an illustration.

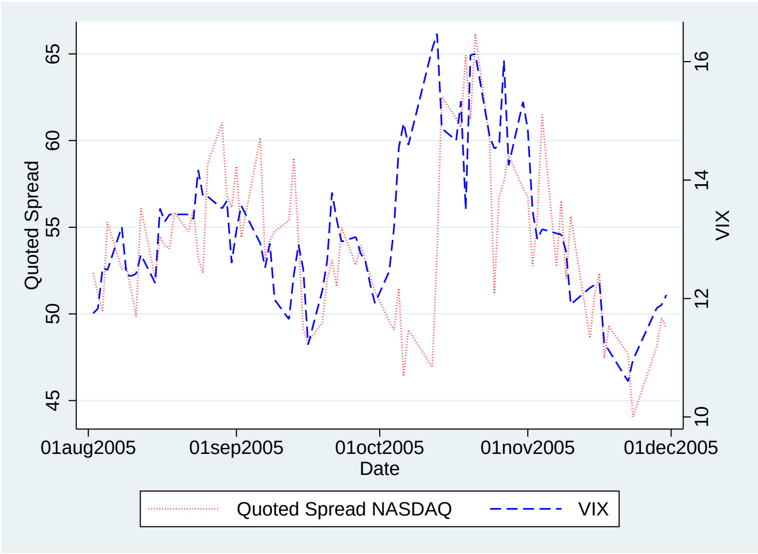

Figure 4
Quoted Liquidity: Spreads and Depth

The top left panel plots the time-weighted quoted spreads for the group of NASDAQ/AMEX interlisted securities and their matches (labelled as “TSX”). The bottom left panel plots depth at the best bid and offer prices. The top and bottom right panels plot the differences of, respectively, quoted spreads and depth for interlisted securities vs. their non-interlisted matches. Spreads are measured in basis points of the midpoint, depth is measured in the logarithm of the average dollar amount available for trading at the best bid and offer prices. The spike in spreads in October 2005 is partly caused by an increase in volatility, which we control for in our analysis; see also Figure 3. All plots contain the levels (thin, light-coloured lines) and ± 15-day moving averages. These averages were formed using an expanded time series to improve the visual appearance.

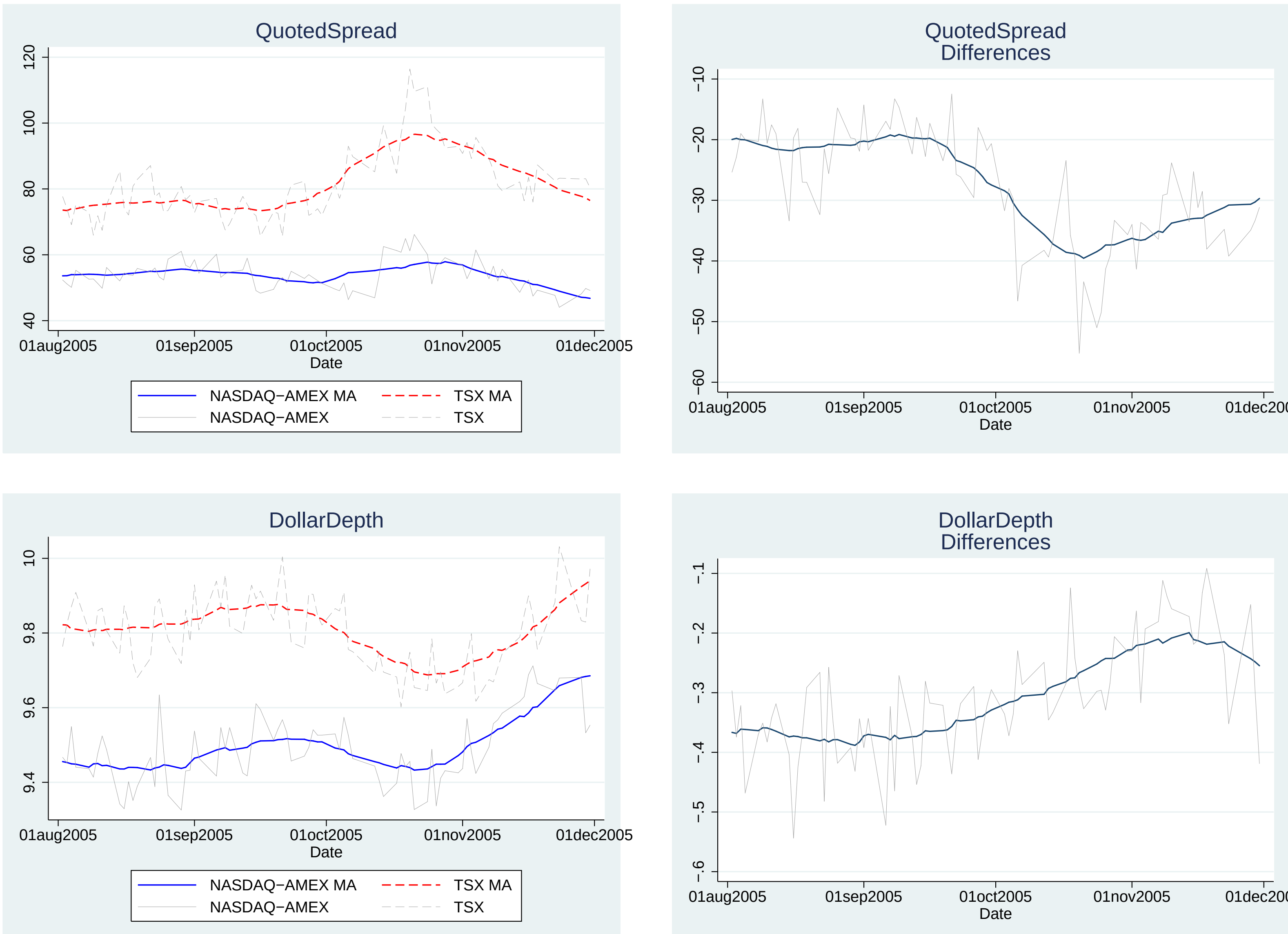

Figure 5
Effective Liquidity: Price Impacts and Effective Spreads

The left panel plots the trade-weighted effective spread for the group of NASDAQ/AMEX interlisted securities and their matches (labelled as "TSX"). The bottom left panel plots the trade-weighted 5-minute price impact. The top and bottom right panels plot the differences of, respectively, effective spreads and price impact for interlisted securities vs. their non-interlisted matches. All plots are ±15-day moving averages. Spreads and price impact are measured in basis points of the midpoint.

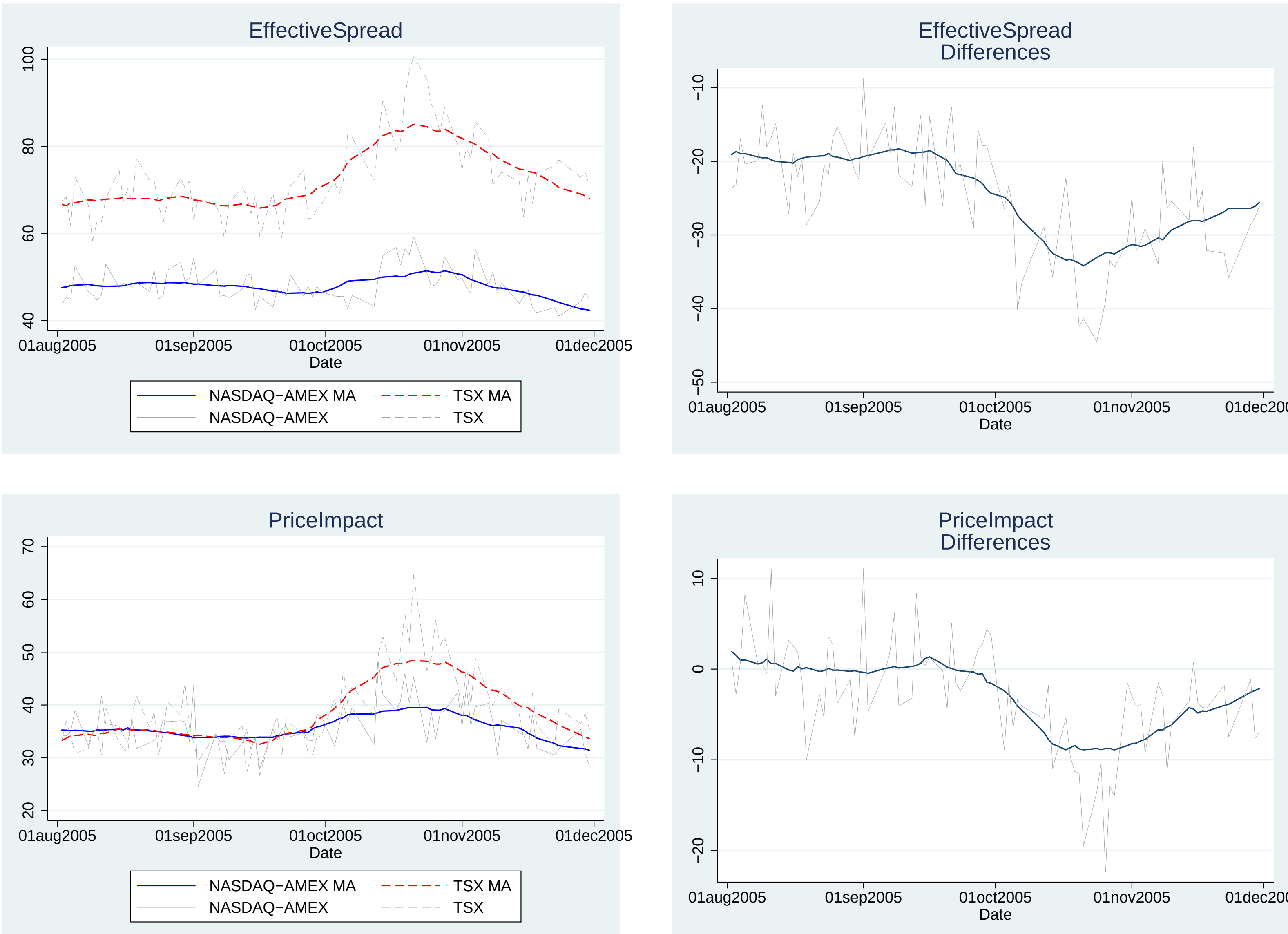

Figure 6

Plots of Trade Execution Costs for Active Orders and Benefits for Passive Orders

The left panel plots the trade-weighted exchange fee adjusted effective spread for the group of NASDAQ/AMEX interlisted securities and their matches (labelled as "TSX"). The bottom left panel plots the trade-weighted 5-minute rebate adjusted realized spread. The top and bottom right panels plot the differences of, respectively, adjusted effective and realized spreads for interlisted securities vs. their non-interlisted matches. All plots are ±15-day moving averages. Spreads are measured in basis points of the midpoint.

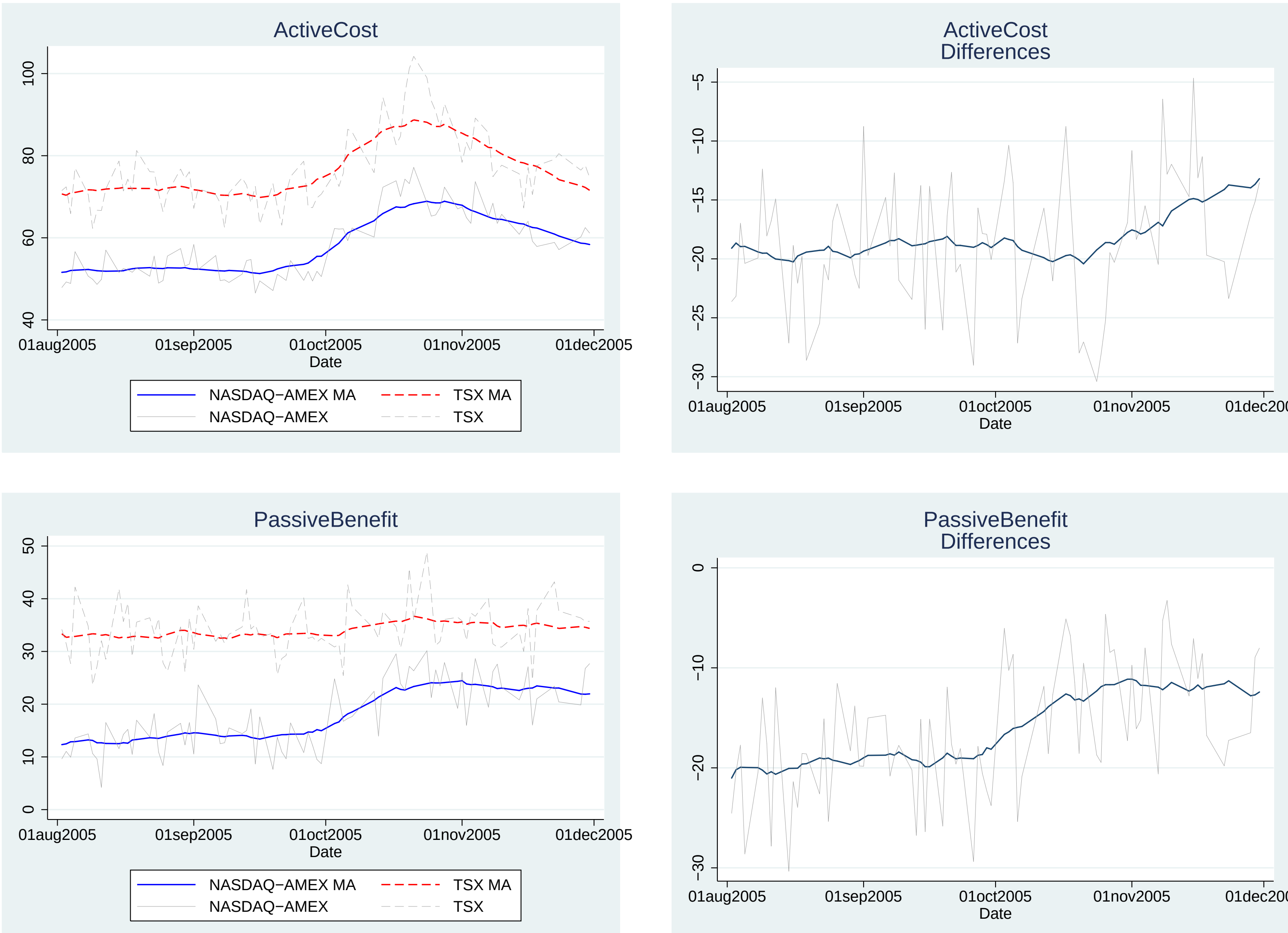

Figure 7
Plots of Dollar Volume

The left panel plots the average daily intra-day dollar volume (all trades against standing orders in the limit order book) for the group of NASDAQ/AMEX interlisted securities and their matches (labelled as "TSX"). The right panel plots the differences of the average dollar volume for interlisted securities vs. their non-interlisted matches. All plots are ±15-day moving averages. Dollar volume is in logarithm.

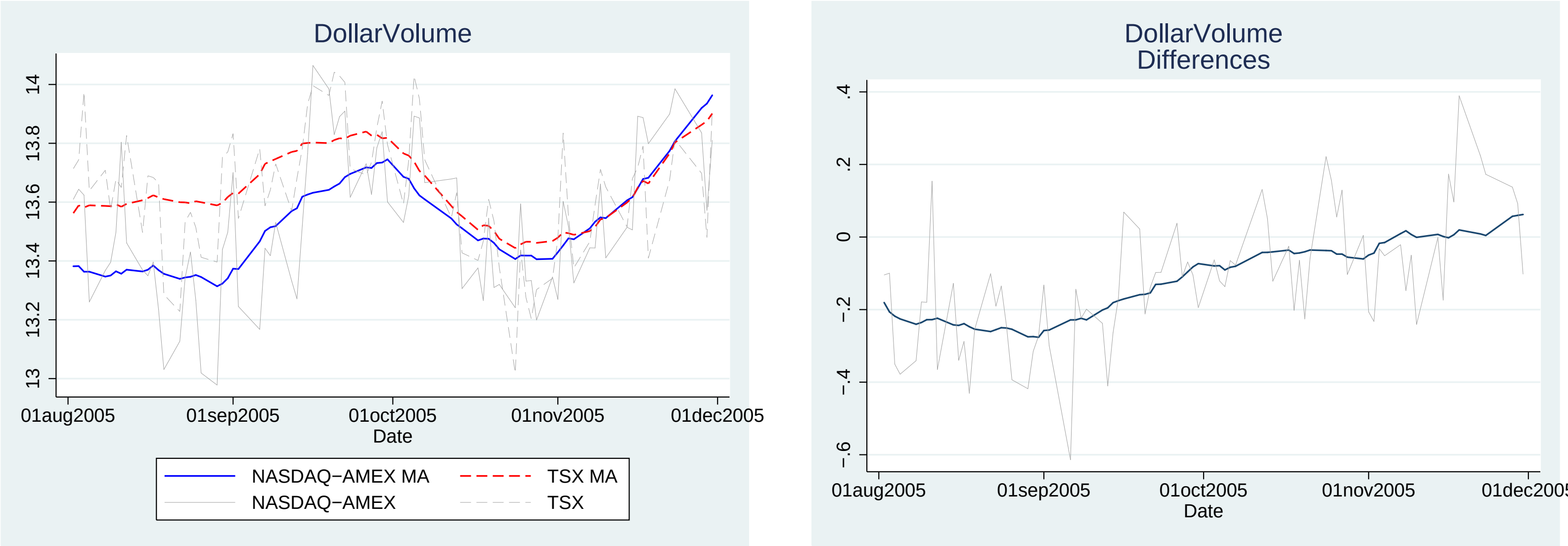

Figure 8
Plots of the Herfindahl Index and the Number of Liquidity Providers

The left panels plots the average of the per day per stock intermediary level Herfindahl Index (see Section 2.4) and number of intermediaries for the group of NASDAQ/AMEX interlisted securities and their matches (labelled as "TSX"). The right panel plots the differences of the intermediary level HHIs and of the number of intermediaries for interlisted securities vs. their non-interlisted matches. All plots are ±15-day moving averages.

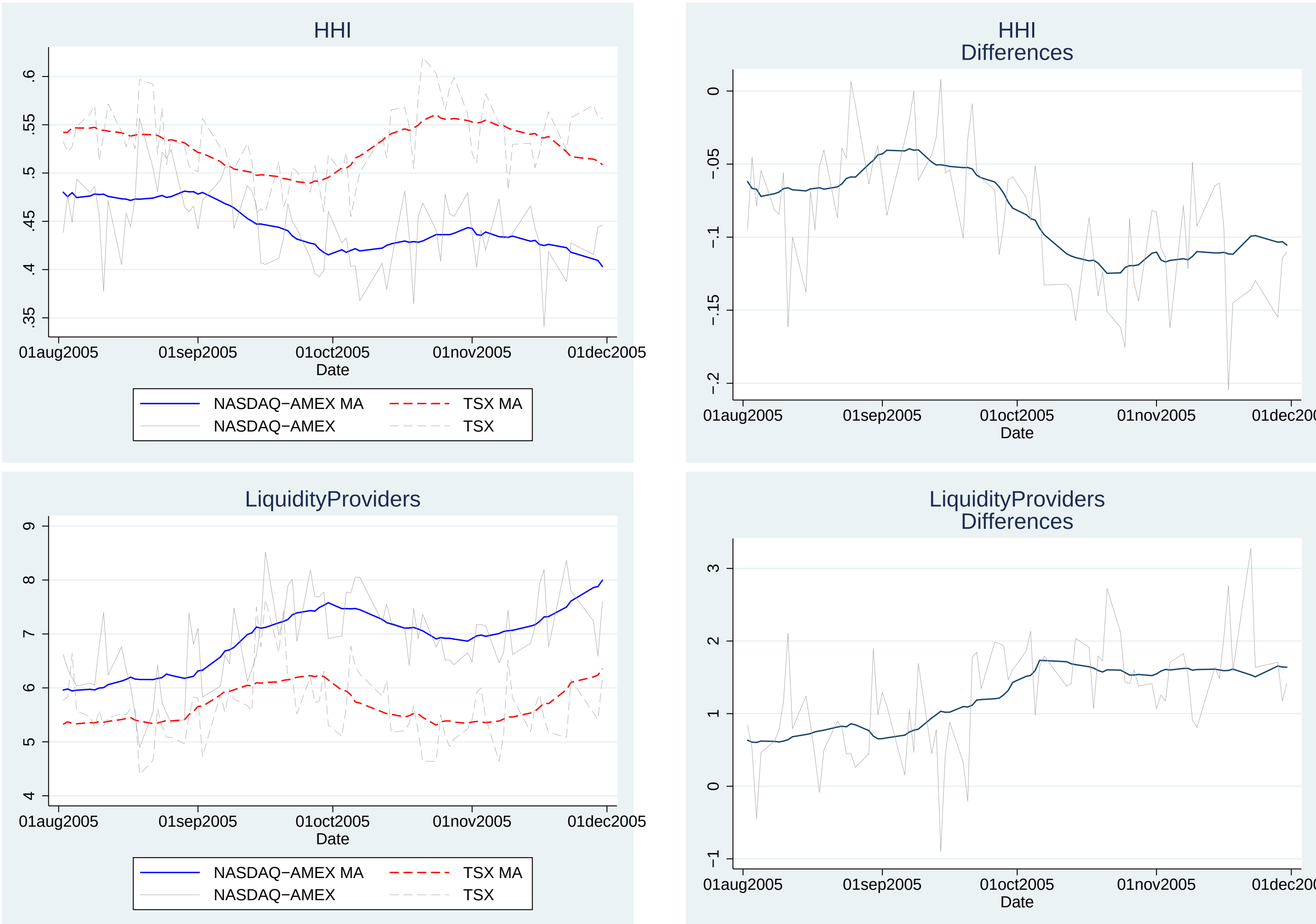

Figure 9
Plots of the Share of Intermediated Volume

The top left panel plots the daily volume between liquidity providers (or, intermediaries) to non-liquidity providers for the group of NASDAQ/AMEX interlisted securities and their matches (labelled as “TSX”) as a share of total volume. The bottom left panel plots the volume between non-liquidity providers, to non-liquidity providers as a share of total volume. The top and bottom right panels plot the differences of, respectively, fractions of liquidity provider to non-liquidity provider and non-liquidity provider to non-liquidity provider for interlisted securities vs. their non-interlisted matches.

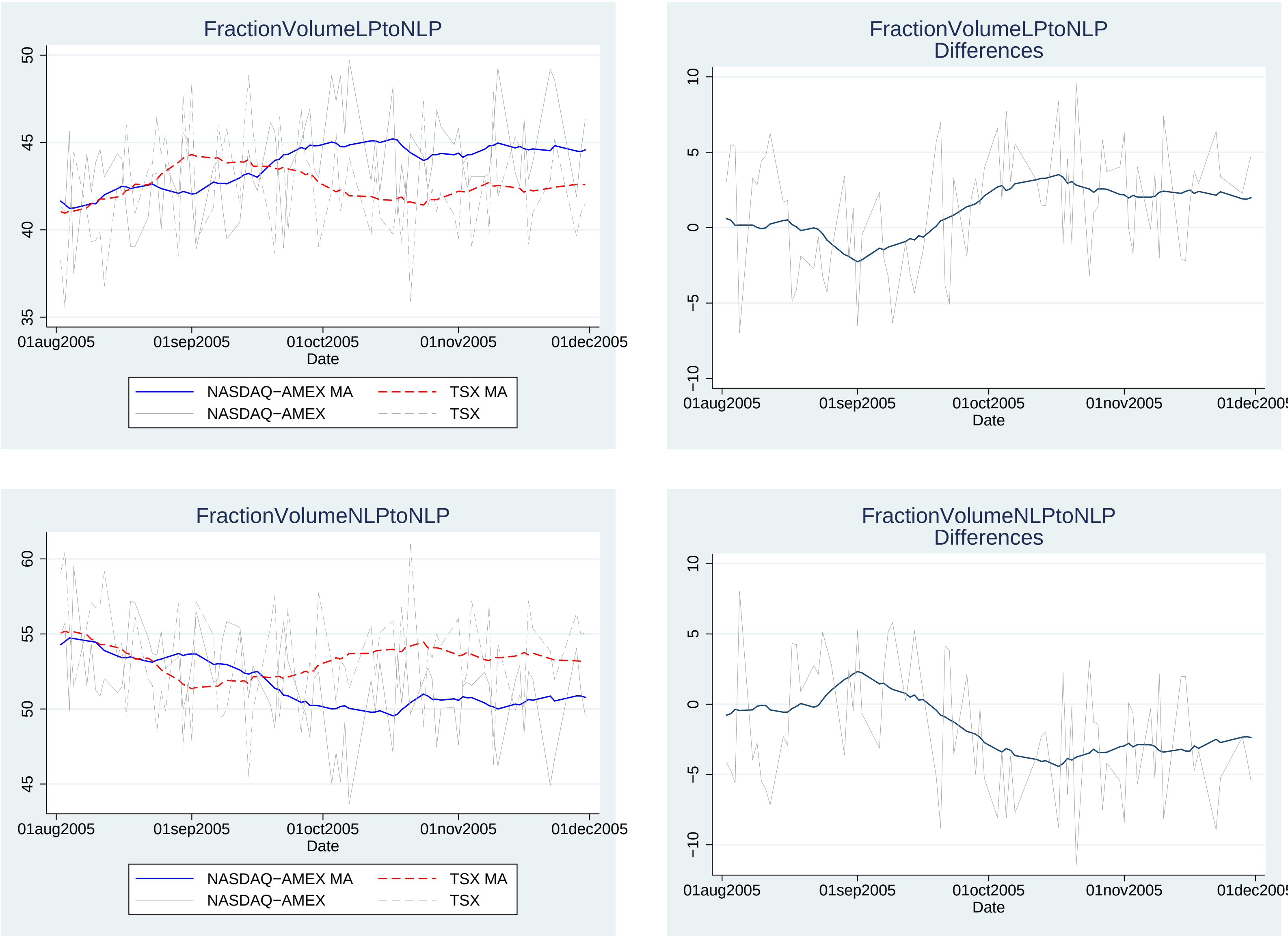

Table 11
List of all interlisted companies and their non-interlisted matches, Part I

Treatment Group: Interlisted with AMEX or NASDAQ		Control group match: non-interlisted	
ABZ	ABER DIAMOND CORPORATION	SBY	SOBEYS INC.
AEZ	AETERNA ZENTARIS INC.	ITX	ITERATION ENERGY LTD. J
ANP	ANGIOTECH PHARMACEUTICALS INC.	AGF.NV	AGF MANAGEMENT LTD. CL 'B' NV
ATY	ATI TECHNOLOGIES INCORPORATED	TA	TRANSALTA CORPORATION
AXP	AXCAN PHARMA INC.	IMN	INMET MINING CORPORATION
BGO	BEMA GOLD CORPORATION J	UTS	UTS ENERGY CORPORATION
BLD	BALLARD POWER SYSTEMS INC.	IUC	INTERNATIONAL URANIUM CORPORATION J
BRA	BIOMIRA INC.	CEK	CASPIAN ENERGY INC. J
CBJ	CAMBIOR INC.	NS	NORSKE SKOG CANADA LIMITED
CEF.NV.A	CENTRAL FUND OF CANADA LTD. CL 'A' NV	SWP	SASKATCHEWAN WHEAT POOL INC.
CLG	CUMBERLAND RESOURCES LTD. J	VTI	VETERAN RESOURCES INC. J
COM	CARDIOME PHARMA CORP.	KEC	KICK ENERGY CORPORATION J
CRY	CRYPTOLOGIC INC.	AAH	AASTRA TECHNOLOGIES LIMITED
CSN	COGNOS INC.	CTR.NV	CANADIAN TIRE CORP. LTD. CL 'A' NV
DAX	DRAXIS HEALTH INC.	IXL	INNOVA EXPLORATION LTD. J
DII.SV	DOREL INDUSTRIES INC. CL 'B' SV	AGA	ALGOMA STEEL INC.
DSG	DESCARTES SYSTEMS GROUP INC. (THE)	GWE	GREY WOLF EXPLORATION INC.
DSM	DESERT SUN MINING CORP. J	ARG	AMERIGO RESOURCES LTD. J
ELD	ELDORADO GOLD CORPORATION	BBD.MV.A	BOMBARDIER INC. CL 'A' MV
EXF.SV	EXFO ELECTRO-OPTICAL ENGINEERING INC. SV	QUA	QUADRA MINING LTD.
FNX	FNX MINING COMPANY INC.	ATA	ATS AUTOMATION TOOLING SYSTEMS INC.
FRG	FRONTEER DEVELOPMENT GROUP INC. J	CSY	CSI WIRELESS INC.
FSV.SV	FIRSTSERVICE CORPORATION SV	CCL.NV.B	CCL INDUSTRIES INC. CL 'B' NV
GAC	GEAC COMPUTER CORPORATION LTD.	HBC	HUDSON'S BAY COMPANY
GAM	GAMMON LAKE RESOURCES INC. J	FAP	ABERDEEN ASIA-PACIFIC INCM INVESTMENT CO LTD.
GSC	GOLDEN STAR RESOURCES LTD.	OIL	OILEXCO INCORPORATED J
HYG	HYDROGENICS CORPORATION	SGF	SHORE GOLD INC. J
IDB	ID BIOMEDICAL CORPORATION	KFS	KINGSWAY FINANCIAL SERVICES INC.
IE	IVANHOE ENERGY INC.	UEX	UEX CORPORATION J
IMG	IAMGOLD CORPORATION	LIM	LIONORE MINING INTERNATIONAL LTD.
IMO	IMPERIAL OIL LTD.	RY	ROYAL BANK OF CANADA

Table 12
List of all interlisted companies and their non-interlisted matches, Part II

Treatment Group: Interlisted with AMEX or NASDAQ		Control group match: non-interlisted	
IMX	IMAX CORPORATION	GND	GENNUM CORPORATION
IOL	INTEROIL CORPORATION J	CCA.SV	COGECO CABLE INC. SV
KRY	CRYSTALLEX INTERNATIONAL CORPORATION J	TBC	TEMBEC INC.
MAE	MIRAMAR MINING CORPORATION	IVW	IVERNIA INC. J
MFL	MINEFINDERS CORPORATION LTD. J	GNY	GENTRY RESOURCES LTD. J
MR	METALLICA RESOURCES INC. J	WPT	WESTPORT INNOVATIONS INC.
MX	METHANEX CORPORATION	MNG	MERIDIAN GOLD INC.
NG	NOVAGOLD RESOURCES INC. J	PTI	PATHEON INC.
NGX	NORTHGATE MINERALS CORPORATION	DY	DYNATEC CORPORATION
NNO	NORTHERN ORION RESOURCES INC. J	TRE	SINO-FOREST CORPORATION
NRM	NEUROCHEM INC.	SWG	SOUTHWESTERN RESOURCES CORP. J
NSU	NEVSUN RESOURCES LTD. J	CDV	COM DEV INTERNATIONAL LTD.
ONC	ONCOLYTICS BIOTECH INC.	CNH	CINCH ENERGY CORP. J
OTC	OPEN TEXT CORPORATION	RUS	RUSSEL METALS INC.
OZN	OREZONE RESOURCES INC. J	ZL	ZARLINK SEMICONDUCTOR INC.
PAA	PAN AMERICAN SILVER CORP.	CRW	CINRAM INTERNATIONAL INC.
PCR	PERU COPPER INC. J	ENE	ENDEV ENERGY INC.
PDL	NORTH AMERICAN PALLADIUM LTD.	IFP.SV.A	INTERNATIONAL FOREST PRODUCTS LTD. CL 'A' SV
QLT	QLT INC.	BVI	BLACKROCK VENTURES INC.
RIM	RESEARCH IN MOTION LIMITED	WN	WESTON LTD. GEORGE
RNG	RIO NARCEA GOLD MINES LTD.	GBU	GABRIEL RESOURCES LTD. J
SNG	CANADIAN SUPERIOR ENERGY INC. J	BGC	BOLIVAR GOLD CORP. J
SOY	SUNOPTA, INC.	SGB	STRATOS GLOBAL CORPORATION
SSO	SILVER STANDARD RESOURCES INC.	RRZ	RIDER RESOURCES LTD.
SVN	724 SOLUTIONS INC.	RVE	ROCKYVIEW ENERGY INC.
SW	SIERRA WIRELESS, INC.	FE	FIND ENERGY LTD.
TEO	TESCO CORPORATION	KCO	KERECO ENERGY LTD.
TGL	TRANSGLOBE ENERGY CORPORATION J	WLE	WESTERN LAKOTA ENERGY SERVICES INC.
TLC	TLC VISION CORPORATION	CGS.SV	CANWEST GLOBAL COMMUNICATIONS CORP. SV
TNX	TAN RANGE EXPLORATION CORPORATION J	BYT	BIOSCRYPT INC.
VAS	VASOGEN INC.	VIA	VIRGINIA GOLD MINES INC. J
WED	WESTAIM CORPORATION (THE)	WTN	WESTERN CANADIAN COAL CORP. J
YRI	YAMANA GOLD INC. J	AGI	ALAMOS GOLD INC. J
ZIC	ZI CORPORATION	COB.SV.A	COOLBRANDS INTERNATIONAL INC. CL 'A' SV

Table 13

Panel Regressions Results for the Comparison of U.S. and Canadian Markets

Dependent variables are the TSX-based realization minus the U.S.based realization for each company and day for some key trading variables. Spreads are measured in basis points of the prevailing midquote; volume and depth are in logarithms; dollar values were adjusted by the noon USD-CAD exchange rate. Each dependent variable is regressed on a dummy variable set equal to one for dates after October 01, 2005 and zero before, daily market volatility as measured by the Montreal Exchange's MVX index, and the following control variables for the security: log(market capitalization) and log(price) at July 31, 2005, and dollar turnover, return volatility, and the share of TSX trading in July 2005. The full sample is 64 securities. Standard errors are in parentheses; * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level. Standard errors are robust to time series and cross-sectional correlation.

	time weighted quoted spreads	trade weighted quoted spreads	trade weighted effective spreads	trade weighted 5-minute realized spreads	share volume	dollar volume	trade weighted share depth	trade weighted dollar depth	transactions
fee change dummy	-2.5132*** (0.942)	0.2279 (0.945)	-2.3443** (1.066)	-2.5279 (1.547)	0.1220*** (0.046)	0.1223*** (0.046)	-0.0166 (0.022)	-0.0161 (0.022)	53.0*** (7.1)
volatility	0.9799*** (0.217)	0.3333** (0.169)	0.6977*** (0.205)	0.0481 (0.251)	-0.0346*** (0.009)	-0.0347*** (0.009)	0.0084*** (0.003)	0.0083*** (0.003)	-4.8 (3.4)
price	-0.7489 (1.640)	2.6209* (1.593)	2.6052 (1.830)	1.1603 (1.115)	0.0537 (0.081)	0.0538 (0.081)	0.2016*** (0.048)	0.2018*** (0.048)	-34.3 (50.3)
marketcap	-1.9674 (1.763)	-2.0818 (1.738)	-5.8612*** (2.255)	-0.6714 (1.126)	-0.0662 (0.066)	-0.0661 (0.066)	-0.1431*** (0.037)	-0.1433*** (0.037)	-174.6 (198.1)
turnover	-143.1554*** (36.365)	-52.5136* (26.864)	-101.8341*** (31.233)	22.2237 (26.581)	-2.0858 (1.285)	-2.0830 (1.286)	-4.2299*** (0.643)	-4.2303*** (0.643)	-2,126.8 (1921.6)
return stdev	493.4208** (212.606)	179.8222 (168.390)	347.3187* (206.714)	-386.4537** (161.933)	13.0545** (5.407)	13.0536** (5.409)	11.0171*** (2.921)	11.0161*** (2.915)	6,703.6 (8911.9)
share of TSX trading	-0.2907*** (0.050)	-0.2563*** (0.050)	-0.1835*** (0.059)	-0.0253 (0.031)	0.0451*** (0.002)	0.0451*** (0.002)	0.0134*** (0.001)	0.0134*** (0.001)	13.2*** (3.3)
constant	48.0426 (35.686)	45.5061 (33.550)	121.3000*** (44.884)	11.6151 (21.923)	-0.8754 (1.267)	-0.8754 (1.267)	1.5840** (0.688)	1.5887** (0.688)	2,832.5 (3902.0)
observations	4,956	4,956	4,956	4,956	4,956	4,956	4,956	4,956	4,956
R-squared	0.333	0.187	0.175	0.011	0.722	0.722	0.417	0.417	0.336