

Fee structure, transaction costs and information content

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Abstract

Examining a recent change in the fee structure of the New Zealand stock exchange (NZX), we study how changes in explicit fees affect transaction costs. Despite the removal of a fixed component to explicit fees reducing transactions costs for smaller trades, we find no evidence for a reduction in average trade size. The increase in transaction costs is found to significantly increase effective and quoted spreads. Price impact also increases significantly, implying more informed on-market trades, consistent with an increase in informed institutional trading. For stocks that experience an increase in relative trading fee, the effective spread and price impact both significantly increase, implying that explicit trading fees are passed on to investors, consistent with the findings of Malinova and Park (2015).

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1. Introduction

Over the last decade, the market structure of most exchanges around the world has changed dramatically, with various maker-take fee schemes being introduced to attract order flow. Trading fees are one of the most controversial and widely-discussed topic in today's equity market. There has been research examining the impact of make-take fee and how markets can be segmented by differing make and take fees (Malinova and Park 2015), and even inverted fee structures (Comerton-Forde et al. 2018). However, it is unclear how a variable rather than fixed explicit trading fees impact overall transaction costs, or if brokers are likely to adjust their trade sizes in an attempt to neutralize the trading fee.

In this study, we utilize an exogenous shock to the fee structure charged by the NZX, changing from a fixed explicit trading fee to a variable fee structure. Because brokers are able to adjust trade sizes, we expect such an event to have differential impact on the information content of different-sized trades. This study provides evidence on how traders and market makers respond to rapid changes in the structure of fees in a modern trading environment which contains smart order routers and HFT participants. This study also contributes to the agency literature (e.g. Battalio, Corwin and Jennings 2016) by providing new evidence on institutional broker trading activity and the ability for brokers to neutralize trading fees.

2. Literature and Hypotheses development

Make take fee

Our research is broadly aligned with the literature on exchange trading fees. Two papers are particularly relevant at this stage. Colliard and Foucault (2012) argue that if the net exchange fee doesn't change, liquidity measures that account for exchange fees will remain unaffected. Malinova and Park (2015) examined the 2005 make-take fee change on TSX (from value-based pricing to volume-based pricing), and found that cum fee effective spread did not change for the 'fee neutral' group. However, as effective spread decreased, retail traders who pay a flat fee increased the use of marketable orders, as their decisions are based on raw effective spreads rather than the "cum fee" spread. Therefore the price impact for market orders decreased.

In the model constructed by Brolley and Malinova (2012), changes to the trading platform's fee structures lead to changes in the marginal valuations that investors require to submit market or limit orders. If maker rebates increase it induces a decrease in bid-ask spread, reducing the cost to cross the spread, increasing the usage of market orders.

Algorithmic trading

The algorithmic trading observed on-market are composed of both proprietary trading activities by high frequency trading firms and buy-side institutions as part of the slicing algorithms (Hendershott, Jones and Menkveld 2011). Almgren (2003) found that the optimal execution strategy for institutions is to slice up orders to minimize cost. These execution

strategies contribute to the wide-spread use of algorithmic trading we observe on-market today.

Hendershott, Jones and Menkveld (2011) used the NYSE quote dissemination as an exogenous instrument to examine the impact of algorithmic trading on liquidity. The measure, AT, captures the variation in limit order submissions and cancellation normalized by trading volume, thereby measuring the amount of algorithmic liquidity supply. Hendershott and Riordan (2013) find that algorithmic liquidity supply represents 64% of total limit order volume in the U.S., with HFT consuming liquidity when spreads are narrow and supplying liquidity when they are wide.

Brogaard, Hendershott and Riordan (2014) examined the role of high frequency trading on price discovery. The HFT activities examined are a subset of the total AT activities, and is differentiated from traditional intermediaries. They find that HFT trade in the direction of permanent price changes and in the opposite direction of transitory pricing errors. Overall, HFTs are found to have a beneficial impact on price discovery.

Hypotheses:

1. The removal of the fixed component of the trading fee is expected to reduce the proportion of block trading and crossings and bring more liquidity on-market, via increased usage of VWAP/TWAP algorithms, which may result in reduced quoted spreads. However, as the majority of the additional on-market volume comes from institutions who are more informed, the price impact component of the bid-ask spread is expected to increase. Also, by adjusting individual trade sizes, brokers can neutralize the fee change. Therefore the transaction cost measures should not be impacted by such fee change. Overall, it is expected that:

H1: Effective spreads will remain the same after the rule takes effect, with smaller trade sizes due to the new fee structure.

2. Because institutions hire brokers who are sensitive to transaction cost, they have the incentive to cut up orders and reduce order size; while retail traders pay a flat fee to brokers and are therefore invariant to the fee change. Therefore, we expect more retail trades to remain large while the size of institutional orders be adjusted to minimise the fee payment under the new fee structure. Overall, we expect on-market trades to have greater information content. If more institutional trades become executed on-market (as opposed to an off-market block or crossing trade), we expect liquidity on market to increase. As the increased liquidity is expected to be driven by institutional rather than retail trading activity, price impact is expected to increase as institutional trading has been found to be informed, and they are frequently used as a proxy for informed trading (e.g. Hendershott, Livdan and Schurhoff 2015).

H2: Price impact increases for on-market trades in NZ after the rule takes effect.

The small trades are defined according to hypothetical fee change (trades that would not have increased fee after the rule).

3. Methodology

Regression framework:

We utilize a panel difference-in-differences regression framework, with the specification detailed below:

$$\text{Metric}_{i,t} = \text{Intercept}_{i,t} + \beta_1 \text{Event} + \beta_2 \text{Event} * \text{Treatment} + \text{controls}_{i,t} + \text{stockFE} + \beta_3 \text{Treatment} + \varepsilon_{i,t}.$$

Experiment setting:

1. Treatment group:
 - S&P/NZ 50 Index (50 stocks)
2. Control group:
 - 1) Cross-listed AU stocks

The following are stocks that are cross-listed on both the ASX and NZX. This leaves the ASX counterpart as a natural control set of stocks, where the only difference in the trading of the two securities is their exchange environment:

'FPH.AX', 'SPK.AX', 'CEN.AX', 'ZEL.AX', 'PPH.AX', 'SKT.AX', 'CNU.AX', 'SKC.AX', 'FBU.AX', 'TME.AX', 'KMD.AX', 'NZM.AX', 'AIA.AX', 'A2M.AX'

- 2) Matched sample (Price, Market cap, Turnover)

We find the best non-NZ cross-listed matched stock by minimizing matching error between the treatment group stocks and each stock in the ASX All Ordinaries index, without replacement. The formula is as follows:

$$\begin{aligned} & \text{Matching error} \\ &= \left| \frac{\text{PRICE(VWAP)}_1 - \text{PRICE(VWAP)}_2}{\text{VWAP}_1 + \text{VWAP}_2} \right| \left| \frac{\text{TURNOVER}_1 - \text{TURNOVER}_2}{\text{TURNOVER}_1 + \text{TURNOVER}_2} \right| \\ &+ \left| \frac{\text{MARKETCAP}_1 - \text{MARKETCAP}_2}{\text{MARKETCAP}_1 + \text{MARKETCAP}_2} \right| \end{aligned}$$

Then the matching error is minimised to find the match for each stock in the NZ All Ords index.

Metrics:

We utilize a group of standard market microstructure metrics including Time-weighted Quoted Spread, Value-weighted Effective Spread, Value-weighted Realized Spread and Value-weighted Price impact. In addition, we utilize the following customized metrics:

1. Order size

Both market order size and limit order size are computed. Order size is inferred from the trade and quote data as there is no qualifier available for orders. Market order size is approximated by aggregating same-direction trades at the bid or ask which occur in the

same millisecond. Limit order size is approximated by the size of changes in depth. When there is no update of best bid or best ask, the limit order size is approximated by the increase in depth. When there is a higher best bid or lower best ask, the limit order size is approximated by the depth first posted at the new best level.

2. % time constrained at tick

This metric measures the percentage of time during a trading day that quoted spread is constrained by the minimum tick size.

Institutional details

We utilise a rule change on October 1st, that changed the fixed component of the trading fee on the NZX, moving to a fully variable fee structure, with the aim of bringing more liquidity on-market.

Old fee: \$1.00 per side per trade plus 0.20 bps of the total trade value, capped at \$75

New fee: 0.45bps of the total on market trade value, capped at \$75

The tick size schedule for NZ and AU are attached:

Exchange	Price range	Price steps
NZX	0.01 - 0.2	0.001
	0.2 - 0.5	0.005
	above 0.5	0.01
ASX	up to 0.1	0.001
	0.1 - 2	0.005
	above 2	0.01

6. Results

The following section contains a number of preliminary results produced for the period of September 2018, one month before and after the introduction of the rule.

Fig.1 is the pre and post event trade size distribution for NZ50 stocks. Contrary to expectations, the trade size did not see much decrease post-event.

<Insert Figure 1 Here>

Fig. 2 shows the pre and post event trade fee distribution for NZ50 stocks. The relative trade fee is the trade fee divided by trade value, expressed in basis points (bps). As we can see, the old fee structure had trades with large relative trade fees, (the chart is capped at 2000 bps on the x-axis). The large relative fees are caused by trades with small sizes which are nevertheless required to pay the fixed upfront fee of \$1 per trade.

Table 2 documents the distribution of trade sizes on of NZ50 pre and post event. This confirms the findings from Fig.1 that trade sizes on average increased on market. The reason

could be the block trades that are originally conducted off-market are now undertaken on-market, increasing the average trade size.

Table 3 contains the distribution of relative trade fees pre and post event. However, after the fee change, the relative trading fee is capped at 45 bps per trade by construction.

Table 4 contains the descriptive statistics produced for a number of metrics including transaction cost measures and trade value measures, for pre-event comparison between NZX and ASX stocks. As we can see, for cross-listed stocks the quoted spread is generally larger on ASX compared with NZX, indicating the quoting activity on the cross-listed stocks is more concentrated on the NZX. However, for the matched sample, the ASX counterpart is usually more liquid with lower quoted spreads and significantly more trading activity. For all three pairs, NZX has significantly larger trade and order sizes, which is consistent with the pre-event impact of the fixed component of explicit fees on the NZX.

Table 5 contains the pre and post event liquidity measures on NZX for NZ50 and cross-listed stocks. For both NZ50 and NZ cross-listed stocks, quoted spreads, effective spreads and price impact measures all increased significantly with the new fee structure, consistent with the results reported in Figure 3.

Table 6 contains the pre and post event liquidity measures for the ASX counterparts of the stocks contains in Table 4. For cross-listed stocks, the quoted spread and effective spread for the AU counterpart stocks increased significantly. This could be attributable to the high volatility present in markets at this time, with a longer time horizon post-event required to determine any causal effect.

Table 7 contains the difference-in-difference regression for stocks cross-listed on both the NZX and ASX. As we can see, the coefficient for the interaction term for treatment (NZ stocks) and event (fee change) on quoted spread, effective spread and price impact are not significant, consistent with the descriptive table where Australian stocks saw an increase in transaction cost measures. This might signal spillover effects of the NZ fee change on Australian trading cost for cross-listed stocks.

Table 8 and table 9 contains the difference-in-differences regressions for matched sample between NZ50 and AXJO index. Consistent with the descriptive statistics table, we observe a significant increase in quoted spreads and price impact. This is consistent with hypothesis 1 and 2 that the increase in trading cost is being passed on to investors in the form of higher spreads. For price impact, it implies that the information content of on-market trades increased, consistent with more institutional trading activities on-market.

For all three groups of regressions, the order sizes measures did not see a significant reduction post-event, contrary to expectations. This could imply the decision of order sizes takes into consideration the relative trading fee in bps rather than absolute trading fee, which would not incentivize brokers to split up trades into smaller sizes.

Table 10 examines the impact of trading fee increase on transaction costs. The fee increase dummy indicates stocks where trading fee increased. As we can see, for stocks where average trading fees increased the most, effective spreads and price impact saw a significant increase.

This is consistent with the increased on-market activity being attributable to more ‘informed’ institutional traders.

7. Conclusion

In this paper, by using an exogenous shock of trading fee structure change on New Zealand, we find evidence that increased trading fees are passed on by market makers, with observed increases in transaction cost measures such as quoted spread and effective spread. Also, the change of trading fee from fixed to variable incentivised institutional brokers to execute a larger proportion of previously off-market trades on-market, increasing the information content of on-market trades in the form of price impact.

These results suggest that whilst the new NZX fee structure has succeeded in moving much of the off-market block-trading on-market, the average increase in overall trade fees has been passed in the form of increased execution costs for participants in the NZ market.

Tables and Charts

Fig 1 NZ50 pre-post trade size distribution

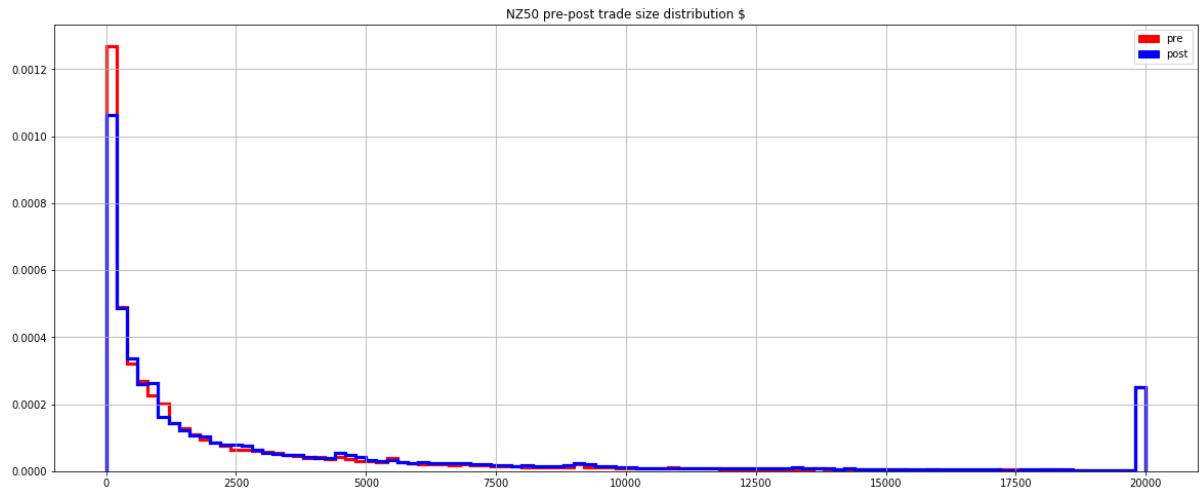


Fig 2 NZ50 pre-post trade fee distribution

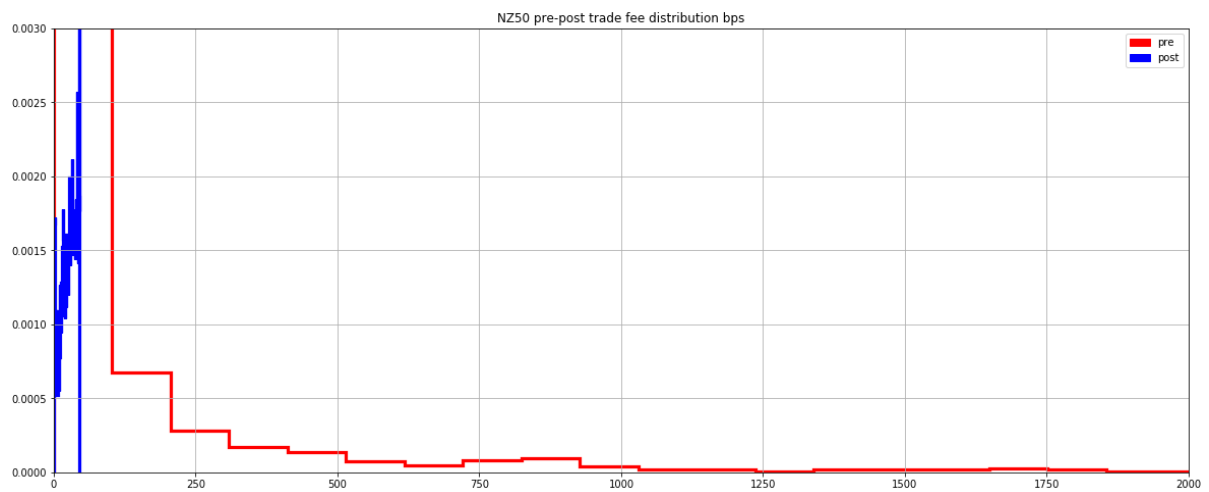


Fig 3 NZ 50 liquidity change over time

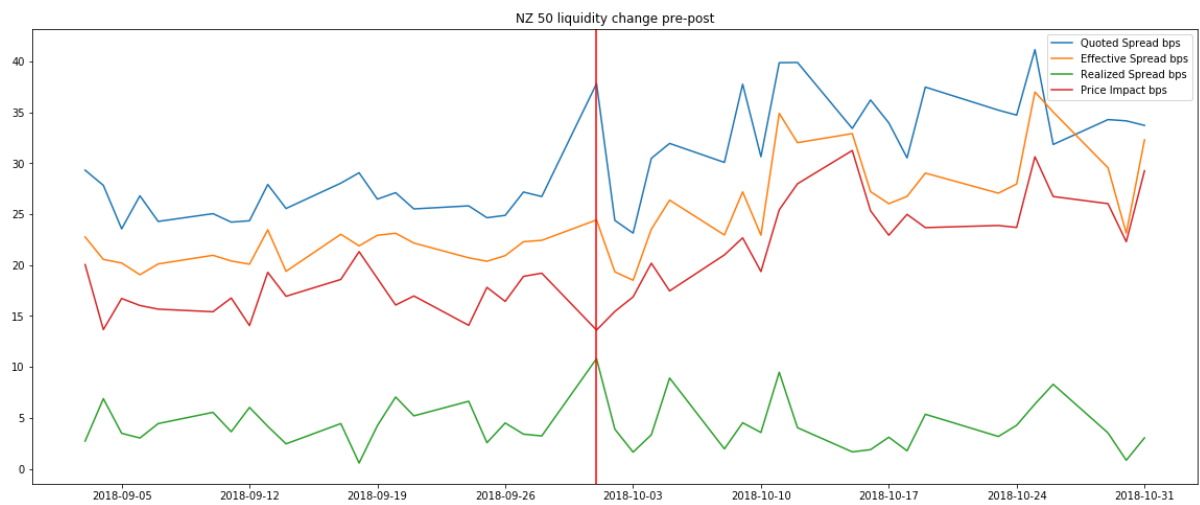


Table 1 Matching quality

	NZ 50			AU match 1			AU match 2		
	VWAP	Turnover	Market Cap	VWAP	Turnover	Market Cap	VWAP	Turnover	Market Cap
mean	5.74	3126677.97	2537688858.44	5.61	3508340.58	1947985896.89	5.44	3127556.61	1104378971.16
std	5.32	7342555.25	2425583293.16	5.10	5950169.81	1873058334.93	4.51	5472910.41	1474487283.57
min	1.05	2508.00	256696998.39	0.90	11288.00	240052853.67	1.01	800.00	121565695.92
0.25	2.15	505006.00	781001756.90	2.19	426694.50	673522390.61	2.19	385275.00	363273052.89
0.50	4.42	1206395.50	1818775196.83	3.87	1293966.50	1136774252.24	3.95	1114271.00	627375317.89
0.75	7.00	2956056.00	3417870065.93	6.23	3808148.50	2571325920.08	6.77	3267644.00	1038863186.56
max	30.17	180546153.00	9417235638.08	23.78	51904102.00	7987245420.41	21.48	67010659.00	8197005304.56

Table 2 NZ Percentile trade size distribution (\$)

Percentile	Pre-event size	Post-event size
1%	4.08	5.75
5%	14.00	21.47
10%	37.06	61.03
15%	72.34	113.54
20%	125.01	182.24
25%	195.30	268.80
50%	931.90	1,099.96
75%	3,537.31	4,329.64
80%	4,765.39	5,554.07
90%	10,375.73	11,260.37

Table 3 NZ Percentile trade fee distribution (bps)

Percentile	relative old fee	relative new fee
1%	9.32	10.25
5%	20.50	37.83
10%	20.96	45.00
15%	21.51	45.00
20%	22.10	45.00
25%	22.83	45.00
50%	30.73	45.00
75%	71.20	45.00
80%	100.00	45.00
90%	289.86	45.00

Table 4 Descriptive statistics (pre-event)

Metric	Cross-listed			Matched 1			Matched 2					
	NZ	AU	Diff	NZ	AU	Diff	NZ	AU	Diff			
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean			
Quoted Spread (bps)	46.84	61.77	14.93	***	43.14	33.24	-9.90	***	43.14	41.67	-1.47	
Effective Spread (bps)	35.45	52.96	17.51	***	34.26	29.80	-4.46	***	34.26	39.03	4.77	**
Realised spread (bps)	12.14	33.21	21.07	***	9.85	18.20	8.35	***	9.85	25.25	15.40	***
Price Impact (bps)	23.31	19.75	-3.56		24.41	11.60	-12.81	***	24.41	13.78	-10.63	***
Daily Value	1733076.49	3838299.34	2105222.85	***	896110.43	2454673.82	1558563.39	***	896110.43	2427507.77	1531397.34	***
Time constrained at tick	0.65	0.45	-0.21	***	0.69	0.60	-0.09	***	0.69	0.52	-0.17	***
Market order value	642.45	612.52	-29.93		1097.78	569.35	-528.43	***	1097.78	656.98	-440.80	***
Bid Order value	2054.45	939.06	-1115.39	***	3399.07	927.01	-2472.06	***	3399.07	964.61	-2434.46	***
Ask Order value	1634.40	1041.67	-592.74	***	3667.30	893.64	-2773.66	***	3667.30	704.94	-2962.36	***
Num. Quote update	3883.10	4264.05	380.95		1654.30	4785.37	3131.07	***	1654.30	5113.10	3458.79	***
Num.Trades	327.79	1257.44	929.65	***	163.42	1582.85	1419.43	***	163.42	1670.70	1507.28	***
Midpoint	5.37	5.37	0.00		5.27	5.19	-0.08		5.27	5.29	0.02	

Table 5 Descriptive statistics (event)

Metric	NZ50				NZ cross-listed			
	Before	After	Diff		Before	After	Diff	
	Mean	Mean	Mean		Mean	Mean	Mean	
Quoted Spread (bps)	43.14	53.97	10.83	***	46.84	65.60	18.76	***
Effective Spread (bps)	34.26	42.90	8.64	***	35.45	44.09	8.64	**
Realised spread (bps)	9.85	10.27	0.42		12.14	10.02	-2.12	
Price Impact (bps)	24.41	32.63	8.22	***	23.31	34.08	10.76	***
Daily Value	896110.43	666072.83	-230037.60	***	1733076.49	1263927.65	-469148.84	***
Time constrained at tick	0.69	0.53	-0.16	***	0.65	0.47	-0.18	***
Market order value	1097.78	1032.88	-64.90	*	642.45	617.09	-25.36	
Bid Order value	3399.07	3363.19	-35.88		2054.45	1886.08	-168.37	
Ask Order value	3667.30	3906.04	238.74		1634.40	1692.36	57.95	
Num. Quote update	1654.30	1267.02	-387.28	***	3883.10	3043.47	-839.63	**
Num. Trades	163.42	120.65	-42.76	***	327.79	239.51	-88.28	***
Midpoint	5.27	5.09	-0.18		5.37	5.07	-0.30	

Table 6 Descriptive statistics (AU event)

Metric	AU cross-listed			AU matched			AU matched 2					
	Before	After	Diff	Before	After	Diff	Before	After	Diff			
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean			
Quoted Spread (bps)	61.77	84.59	22.81	***	33.74	34.48	0.75		23.91	25.98	2.07	**
Effective Spread (bps)	52.96	68.73	15.77	**	30.45	31.93	1.47		21.77	24.33	2.56	***
Realised spread (bps)	33.21	39.20	5.99		20.75	19.20	-1.55		13.91	15.46	1.56	**
Price Impact (bps)	19.75	29.52	9.77		9.71	12.73	3.02	***	7.87	8.87	1.00	
Daily Value	3838299.34	3976188.41	137889.07		3792386.60	3727285.90	-65100.70		3972432.25	4187170.23	214737.98	
Time constrained at tick	0.45	0.40	-0.04	*	0.54	0.48	-0.06	***	0.62	0.57	-0.05	***
Market order value	612.52	544.79	-67.74		730.89	1151.94	421.05	**	642.93	741.81	98.89	**
Bid Order value	939.06	1138.55	199.49	*	1093.44	2185.99	1092.55	*	856.61	974.27	117.66	*
Ask Order value	1041.67	963.93	-77.74		646.75	877.63	230.88	**	790.84	812.69	21.86	
Num. Quote update	4264.05	4297.95	33.90		7523.62	6829.23	-694.39		6984.84	6838.50	-146.34	
Num.Trades	1257.44	1307.71	50.27		2431.72	2178.47	-253.25	*	2293.92	2167.95	-125.97	
Midpoint	5.37	5.06	-0.31		6.13	5.82	-0.31		6.46	6.15	-0.31	

Table 7 difference in differences cross-listed

This table contains the difference-in-difference regression for NZX fee structure change, where $Metric_{i,v,t} = Intercept_{i,v,t} + \beta_1 Event + \beta_2 Event * Treatment + controls_{i,v,t} + stockFE + \beta_3 Treatment + \varepsilon_{i,v,t}$. For stock i and day t . Metric stands for various liquidity metrics including Quoted Spread time weighted in bps, Effective Spread value weighted in bps, Realised Spread value weighted in bps, Price Impact value weighted in bps, Number of quote updates, Number of trades, ask order value, bid order value as defined in Section 3, and market order value. Quoted Spread is calculated as the difference between the venue BO (Best Offer) and venue BB (Best Bid). This metric is time-weighted by the duration of the spread across the day. Effective Spread is calculated as the signed difference between trade Price and the prevailing quote Midpoint of the venue multiply by 2. Realised spread is calculated as the signed difference between the trade Price and the venue Quote Midpoint 1-second after the trade. Price Impact is calculated as the difference between Effective spread and Realised spread. The measures are divided by prevailing midquote to get relative measures. The stocks included are the cross-listed stocks both in AXJO and NZALL indexes, which include 14 stocks.

Controls include Price (Value-weighted Average Price of each day), Value (Daily Trade Volume*Price of each trade), and Volatility (calculated as (Highest Price of the day – Lowest Price of the day)/((Highest Price of the day + Lowest Price of the day)/2)). Event is a dummy variable that equals to 0 before the date of the fee change event on Oct 1 2018, and 1 after the fee change event. Standard errors are in brackets, * $p < .1$, ** $p < .05$, *** $p < .01$

	PIVW bps	ESVW bps	RSVW bps	QS bps	Num quote update	Num trades	Ask order value	Bid order value	Market order value
Intercept	169.84** (2.01)	192.84** (2.46)	23.00 (0.43)	213.11*** (2.62)	23535.64*** (6.24)	9370.46*** (6.44)	2996.45** (2.18)	2711.29*** (2.76)	203.16 (0.32)
Treatment *Event	-6.85 (-1.03)	-11.44 (-1.55)	-4.59 (-0.62)	-10.01 (-1.13)	-679.40*** (-3.30)	-63.14 (-0.95)	792.78*** (3.59)	212.10 (1.05)	134.71** (2.30)
Event	7.04 (1.35)	11.25** (2.26)	4.21 (0.70)	19.18*** (3.47)	-433.17*** (-3.56)	-121.22*** (-2.92)	-419.45** (-1.96)	-135.34 (-0.68)	-61.77 (-1.59)
Treatment	12.77*** (3.03)	-9.85** (-2.02)	-22.62*** (-5.10)	-6.69 (-1.20)	-401.73* (-1.73)	-530.98*** (-5.54)	263.14** (2.49)	646.21*** (5.77)	6.66 (0.10)
Price	-16.48** (-2.01)	-18.73** (-2.40)	-2.25 (-0.41)	-19.84** (-2.41)	-1011.37*** (-3.23)	-422.69*** (-3.66)	-218.83** (-2.01)	-217.83** (-2.57)	107.92** (2.46)
Volatility	1.06 (0.68)	4.76 (1.49)	3.69 (1.05)	4.59 (1.01)	248.62*** (4.44)	40.58** (2.18)	-97.05 (-1.15)	-101.84** (-2.25)	4.63 (0.48)
Value	-0.13 (-1.10)	-0.31 (-1.31)	-0.17 (-1.23)	-0.58 (-1.59)	141.15*** (4.15)	46.36*** (2.77)	8.32** (2.24)	11.90** (2.31)	17.68** (2.44)
N	1166	1166	1166	1167	1167	1167	1165	1164	1167
Adj.R2	0.081494	0.381631	0.223201	0.393612	0.887082	0.850010	0.170590	0.374586	0.364091

Table 8 difference in difference matched 1

This table contains the difference-in-difference regression for NZX fee structure change, where $Metric_{i,v,t} = Intercept_{i,v,t} + \beta_1 Event + \beta_2 Event * Treatment + controls_{i,v,t} + stockFE + \beta_3 Treatment + \varepsilon_{i,v,t}$. For stock i and day t . Metric stands for various liquidity metrics including Quoted Spread time weighted in bps, Effective Spread value weighted in bps, Realised Spread value weighted in bps, Price Impact value weighted in bps, Number of quote updates, Number of trades, ask order value, bid order value as defined in Section 3, and market order value. All metrics are defined the same way as Table 5. The stocks included are the NZ50 stocks and the matched AXJO stocks in matched sample 1.

Controls include Price (Value-weighted Average Price of each day), Value (Daily Trade Volume*Price of each trade), and Volatility (calculated as (Highest Price of the day – Lowest Price of the day)/ ((Highest Price of the day + Lowest Price of the day)/2). Event is a dummy variable that equals to 0 before the date of the fee change event on Oct 1 2018, and 1 after the fee change event. Standard errors are in brackets, * p<.1, ** p<.05, ***p<.01

	PIVW bps	ESVW bps	RSVW bps	QS bps	Num quote update	Num trades	Ask order value	Bid order value	Market order value
Intercept	10.48*** (3.32)	31.00*** (6.57)	20.52*** (3.97)	33.93*** (9.15)	2198.16*** (3.23)	861.39*** (3.60)	1132.58*** (6.92)	925.88** (2.17)	647.20*** (3.63)
Treatment*Event	8.47*** (4.67)	7.08*** (3.20)	-1.39 (-0.53)	7.82*** (4.60)	-161.15* (-1.77)	95.40*** (3.24)	173.78 (0.97)	-506.80 (-1.38)	-45.17 (-0.44)
Treatment	3.20 (1.63)	-3.38* (-1.87)	-6.58*** (-3.14)	4.07* (1.88)	-1072.95*** (-6.50)	-935.90*** (-16.92)	926.81*** (7.54)	1167.34*** (6.08)	-138.85 (-1.20)
Event	-1.98* (-1.84)	-0.26 (-0.13)	1.72 (0.81)	0.79 (0.70)	-195.24*** (-2.76)	-122.58*** (-4.67)	107.99* (1.90)	506.43 (1.39)	-14.03 (-0.13)
Price	-2.14*** (-3.01)	-3.30*** (-3.29)	-1.15 (-1.08)	-2.70*** (-3.09)	265.12 (1.37)	69.04 (1.03)	-32.61 (-0.87)	10.78 (0.14)	-69.32** (-1.98)
Volatility	3.57*** (6.04)	3.46*** (4.98)	-0.11 (-0.13)	4.38*** (7.92)	234.43*** (7.45)	57.11*** (6.16)	-51.89** (-2.02)	27.94 (1.18)	53.64 (1.16)
Value	-0.07 (-1.25)	0.17 (1.44)	0.24* (1.75)	-0.26** (-2.15)	119.61*** (4.37)	34.84*** (3.10)	15.20** (2.33)	11.04** (1.99)	53.98* (1.88)
N	4057	4057	4057	4060	4060	4060	4060	4057	4060
Adj.R2	0.196563	0.271187	0.113839	0.486337	0.906787	0.885130	0.540863	0.256207	0.091391

Table 9 difference in difference matched 2

This table contains the difference-in-difference regression for NZX fee structure change, where $Metric_{i,v,t} = Intercept_{i,v,t} + \beta_1 Event + \beta_2 Event * Treatment + controls_{i,v,t} + stockFE + \beta_3 Treatment + \varepsilon_{i,v,t}$. For stock i and day t . Metric stands for various liquidity metrics including Quoted Spread time weighted in bps, Effective Spread value weighted in bps, Realised Spread value weighted in bps, Price Impact value weighted in bps, Number of quote updates, Number of trades, ask order value, bid order value as defined in Section 3, and market order value. All metrics are defined the same way as Table 5. The stocks included are the NZ50 stocks and the matched AXJO stocks in matched sample 1.

Controls include Price (Value-weighted Average Price of each day), Value (Daily Trade Volume*Price of each trade), and Volatility (calculated as (Highest Price of the day – Lowest Price of the day) / ((Highest Price of the day + Lowest Price of the day)/2)). Event is a dummy variable that equals to 0 before the date of the fee change event on Oct 1 2018, and 1 after the fee change event. Standard errors are in brackets, * p<.1, ** p<.05, ***p<.01

	PIVW bps	ESVW bps	RSVW bps	QS bps	Num quote update	Num trades	Ask order value	Bid order value	Market order value
Intercept	3.34 (1.23)	32.17*** (9.14)	28.83*** (6.72)	37.80*** (17.32)	2033.41*** (8.78)	895.11*** (11.01)	1173.27*** (8.35)	540.75*** (3.76)	77.82 (0.69)
Treatment*Event	6.81*** (3.90)	1.95 (1.30)	-4.86** (-2.39)	4.86*** (2.80)	449.55*** (4.35)	254.60*** (7.87)	59.46 (0.31)	-157.82 (-0.89)	-229.66** (-2.43)
Treatment	-1.25 (-0.37)	-17.80*** (-5.27)	-16.55*** (-4.02)	-10.78*** (-2.78)	-344.46 (-1.34)	-328.27*** (-3.79)	502.40*** (2.82)	665.64*** (3.38)	194.78 (0.97)
Event	-0.08 (-0.08)	5.14*** (4.60)	5.22*** (3.85)	4.21*** (3.62)	-789.87*** (-9.08)	-285.81*** (-9.61)	238.72** (2.33)	212.94 (1.52)	234.51** (2.23)
Price	-0.93 (-1.15)	-2.58*** (-2.86)	-1.66 (-1.64)	-2.23** (-2.44)	363.13*** (3.06)	91.43** (2.46)	-5.47 (-0.11)	103.37 (1.35)	44.89 (0.76)
Volatility	3.68*** (8.58)	2.93*** (7.68)	-0.75 (-1.63)	3.38*** (6.79)	295.80*** (9.79)	92.58*** (7.33)	-61.89** (-2.50)	-54.39** (-2.13)	-36.05* (-1.73)
Value	-0.10* (-1.69)	0.01 (0.15)	0.11 (1.26)	-0.23** (-2.14)	142.16*** (3.74)	39.20*** (2.91)	26.45** (2.17)	19.86 (1.51)	64.03** (2.19)
N	4050	4050	4050	4058	4058	4058	4045	4048	4058
R2	0.24	0.52	0.27	0.58	0.91	0.90	0.52	0.52	0.24
Adj.R2	0.218165	0.509983	0.247245	0.564960	0.904882	0.896465	0.510426	0.504882	0.222184

Table 10 difference in difference fee increase dummy

This table contains the difference-in-difference regression for NZX fee structure change, where $Metric_{i,v,t} = Intercept_{i,v,t} + \beta_1 Event + \beta_2 Event * Treatment + controls_{i,v,t} + stockFE + \beta_3 Treatment + \varepsilon_{i,v,t}$. For stock i and day t . Metric stands for various liquidity metrics including Quoted Spread time weighted in bps, Effective Spread value weighted in bps, Realised Spread value weighted in bps, Price Impact value weighted in bps, Number of quote updates, Number of trades, ask order value, bid order value as defined in Section 3, and market order value. All metrics are defined the same way as Table 5. The stocks included are the NZ50 stocks. Fee increase dummy equals to 1 for stocks which experienced an increase in relative fee while 0 for stocks which did not.

Controls include Price (Value-weighted Average Price of each day), Value (Daily Trade Volume*Price of each trade), and Volatility (calculated as (Highest Price of the day – Lowest Price of the day)/ ((Highest Price of the day + Lowest Price of the day)/2)). Event is a dummy variable that equals to 0 before the date of the fee change event on Oct 1 2018, and 1 after the fee change event. Standard errors are in brackets, * p<.1, ** p<.05, ***p<.01

	PIVW bps	ESVW bps	RSVW bps	QS bps	Num quote update	Num trades	Ask order value	Bid order value	Market order value
Intercept	13.60 (1.30)	42.03*** (3.60)	28.43** (2.14)	31.48*** (2.60)	627.92 (0.72)	-13.51 (-0.18)	2102.49*** (2.92)	2205.39*** (3.72)	1750.81*** (6.03)
Fee increase*Event	46.36** (2.27)	34.66* (1.79)	-11.71 (-0.45)	29.96 (1.54)	424.36*** (6.40)	38.14*** (6.71)	-933.80** (-2.26)	-293.51 (-1.04)	-412.35* (-1.93)
Fee increase	23.26*** (3.95)	30.95*** (5.66)	7.68 (1.13)	50.52*** (7.55)	-1577.12*** (-11.11)	-177.55*** (-10.10)	859.76*** (3.55)	873.79*** (5.23)	493.03*** (3.55)
Event	3.62*** (2.77)	4.88*** (6.72)	1.26 (0.98)	6.80*** (6.00)	-420.36*** (-11.56)	-37.88*** (-11.11)	324.48 (1.59)	-46.42 (-0.31)	-56.92 (-1.54)
Price	-2.11 (-1.48)	-5.29*** (-3.31)	-3.18* (-1.77)	-3.84** (-2.34)	229.06* (1.91)	41.18*** (4.07)	-105.63 (-1.22)	-216.97*** (-3.04)	-116.82*** (-3.13)
Volatility	6.46*** (7.31)	3.18*** (5.26)	-3.28*** (-3.94)	5.38*** (6.16)	238.29*** (5.47)	17.95*** (6.66)	-117.71* (-1.81)	46.53 (0.97)	-6.75 (-0.54)
Value	-0.00 (-0.08)	-0.02 (-0.35)	-0.01 (-0.25)	-0.15 (-1.36)	55.65*** (4.89)	7.39*** (5.63)	14.15* (1.74)	18.03** (2.04)	12.02** (2.21)
N	2010	2010	2010	2012	2012	2012	2012	2011	2012
R2	0.22	0.48	0.13	0.48	0.90	0.84	0.49	0.56	0.31
Adj.R2	0.196157	0.461783	0.102939	0.466261	0.900361	0.837983	0.478999	0.547776	0.290855

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