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RESEARCH ARTICLE

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Broker and institutional investor short selling

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Abstract

Brokers have access to order-flow data, which they can use to enhance their short-selling returns. However, New Zealand brokers also have a fiduciary duty to place their clients' interests before their own. We compare the short-selling returns and trading behaviours of brokers and institutional investors who predominantly focus on profit-making. Our results show no significant return difference between broker and institutional short sales and indicate that broker short sales are apparently to stabilise the market. Short selling is associated with improved market quality, and this improvement is more pronounced when brokers short sell more than institutional investors.

KEYWORDS

Brokers, institutional investor, short selling

JEL CLASSIFICATION

G12;, G24

1 | INTRODUCTION

Brokers have an informational advantage over other investors due to their ability to observe order flow. They may know that one of their clients has a large order to execute or observe repeated trading by another broker and infer that there is more to come. Brokers might look to profit from this information advantage for themselves or pass this opportunity to their valuable clients (e.g., Di Maggio et al., 2019; Fecht et al., 2018).

However, there are reasons that brokers must think carefully before attempting to exploit their information advantage. These include their reputation for providing the best possible service (e.g., execution costs) to their clients and the fiduciary care required by regulators. In New Zealand, brokers are subject to the Advising Duty of Care Regulations in Section 9 of New Zealand Stock Exchange (NZX) Participant Rules. These state that "Each Client Advising

Participant and its Advisers and any Employees: … b) must at all times place the interests of its clients before its interests and in the case of Employees, those of his or her employer, or the person to whom he or she is contracted…. d) shall not place Client Assets at unreasonable risk from that Client Advising Participant's own business activities." In contrast, in the US, stockbroker-dealers are typically not considered as fiduciaries and are "excluded from the definition of investment adviser [who do have a fiduciary duty] insofar as their advice is 'solely incidental' to brokerage services and the broker does not receive 'special compensation' for providing advice" (Laby, 2019, p. 4).

Given the above seemingly conflicting incentives, it is empirically unclear how they affect New Zealand brokers' trading activities. We investigate this question using short-selling transaction data from the NZX. They provide us with a rich dataset that records the type of buyer and seller for every transaction, and whether the transaction involves a short seller. There are five buyer and seller types. "Wholesale" includes professional money managers such as mutual and pension funds. We refer to these investors as "institutional" investors. "Broker" refers to stockbrokers buying on their own account. Although "broker" transactions in our dataset may include the transactions brokers facilitate for other investors, these transactions, which are sometimes referred to as "proprietary trades," are executed mainly for brokers themselves. "Employee" denotes employees of the brokers purchasing or selling for personal reasons. "Market Maker" is for the purchases and sales of market makers. "Retail" indicates the purchases and sales of non-professional investors. We merge this NZX transaction data with quote data from Refinitiv Datascope.

The visibility regarding the buyer and seller category for each transaction that the NZX dataset provides is useful for us to not only examine the shorting behaviour of brokers but also compare and contrast it with the shorting behaviour of institutional investors, another important type of traders in the market. Literature has documented that institutional investors tend to be momentum traders, purchasing stocks when they perform well and shorting stocks with likely negative news (e.g., Griffin et al., 2003; Kelley & Tetlock, 2017). Their trading behaviour purely reflects a profit-driven trading motivation and is not subject to any regulatory requirements for fiduciary duty. The differences in trading motivations between institutional investors and brokers make it important to assess their short-selling behaviours and consequences, especially when we can conduct such an assessment in the same setting.

Specifically, we compare the profits earned by brokers and institutional investors from their short-selling trades and study when or under what market conditions these two groups of traders are more likely to trade. With the NZX unique data, we can also assess the market outcomes following short sales by these traders including price efficiency, liquidity, and volatility.

Addressing these matters is valuable in several aspects. First, with a total stock market capitalisation of approximately USD 40 billion, New Zealand is placed at 48 out of 96 countries included in World Bank data.[1] Conventional market characteristics also indicate that the NZX is representative of global markets. For instance, Fong et al. (2017) find that the average effective spread for NZX companies is 1.7% which is identical to the average effective spread across the 38 countries in their sample. The richness of the available data draws us to the NZX setting, but we believe that the results in this paper are also of interest to regulators, researchers, and market participants in other countries.

Second, our research contributes significantly to the understanding of the role that short sellers play in the stock market, particularly in New Zealand. While market makers are limited to a small number of stocks on the NZX, most stocks are traded in a fully order-driven manner as per most

[1] https://data.worldbank.org/indicator/CM.MKT.LCAP.GD.ZS?most_recent_value_desc=true.

markets around the world.[2] Notably, short selling is common on the NZX, representing 16% of total sales transactions over the 2012–2021 sample period. Short sales account for 8% of the total value of sell trades. These statistics are comparable to other markets. For example, Boehmer et al. (2008) report that short transactions represent 13% of total volume on the New York Stock Exchange (NYSE), while Engelberg et al. (2012) report this number as 20% for a different period. Out of the five market participants identified above, short selling is largely non-existent among broker employees and market makers. Despite retail investors engaging in approximately 34% of all transactions on the NZX, it is difficult for them to borrow stocks to short sell. In addition, naked short selling is not permitted, resulting in almost zero per cent of short selling by retail investors. Taking advantage of stock overvaluation via short selling on the NZX is, therefore, largely the domain of brokers and institutional investors. Institutional and broker short sales represent 16% and 84% of total short sales by number and 41% and 59% of total short sales by trade value, respectively.

Based on the literature (e.g., Boehmer et al., 2008), we expect institutional short sellers to be well-informed and hence short sell before a decline in returns. Our results are indeed consistent with this expectation: stock returns following institutional short sales are significantly lower for up to 2 days. Given the ability to observe information embedded in order flows, brokers should have an information advantage over other traders. Therefore, their short sales are expected to yield higher profits than those made by institutional investors. However, our results show that brokers generally do not earn significantly higher returns from their short-selling activities than institutional investors. Our further analyses show that, unlike institutional investors, brokers short sell less on days when there is negative news and more on days when there is positive news. The opposite short-selling behaviours between brokers and institutional investors are also observed in the order flow data. Specifically, we find that there is more broker short selling on days when buy-sell order imbalance increases whereas more institutional short selling on days with a decrease in this imbalance. These results suggest that brokers short-sell apparently to uphold their fiduciary duty and stabilise the market, whereas profit-making seems to be the main driver for institutional short trades.

Regarding the market outcomes of these short trades, our results indicate that broker short selling is associated with improved market quality. This is evident across all three market quality dimensions: price efficiency, liquidity, and volatility (e.g., Boehmer, Fong, & Wu, 2021). We find that stocks traded on the NZX are, on average, not priced efficiently over 5-, 30-, and 60-min intervals. Positive order imbalance in one interval predicts positive returns in the following interval. Short selling helps make pricing more efficient. Furthermore, the improvement in price efficiency is more pronounced when broker short selling is more than institutional short selling over 5- and 30-min intervals. Broker short-selling also improves market liquidity by reducing bid-ask spreads and volatility.

Overall, our study contributes to several strands of literature. The first is research into brokers and dealers. Several papers document the information advantage of brokers and dealers and what they do with this information (e.g., Di Maggio et al., 2019; Kondor & Pinter, 2022; Li et al., 2021). We contribute to this literature by comparing the profits of broker short selling with those occurring in institutional short selling, and by documenting the impact of broker short selling on market quality. The second contribution is to the literature on short selling. The relative merits of short sales, which date back to the 1600s (e.g., Bris et al., 2007), have been the subject of debate. While there are studies documenting the negative effects of short selling on returns and investments (e.g., Brunnermeier & Oehmke, 2014), many others report the benefits of short selling on price efficiency and managerial decisions on corporate management and investments (e.g., Beber & Pagano, 2013; De Angelis et al., 2017). We contribute to this literature by considering

[2]See https://www.world-exchanges.org/our-work/statistics.

the returns, conditions, and consequences surrounding short-selling activities by those with a unique information advantage. Finally, we contribute to the literature that documents differences between investor types and their trading activities (e.g., Fong et al., 2014; Kelley & Tetlock, 2017). Our research is among few studies that directly compare and contrast the shorting behaviours of brokers and institutional investors (e.g., Boehmer et al., 2008).

The rest of the paper is organised as follows. Section 2 reviews the literature and formalises our hypotheses. Section 3 describes the data. Our methodological approach and results are explained in Section 4. Section 5 concludes.

2 | LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Brokers and dealers play significant roles in stock markets, including supplying liquidity and facilitating trading activities. However, having access to order flow gives brokers an information advantage, and they can use this advantage to trade for their own benefit or pass it along to their best clients. For example, Di Maggio et al. (2019) find that US stockbrokers who are central to broker and institutional investor networks pass on information that they obtain from executing trades to their best clients. Kondor and Pinter (2022) find that UK Government bond dealers pass on information they obtain from their informed clients to their affiliates. Barbon et al. (2019) show that US brokers spread information relating to large portfolio liquidations to their clients. Li et al. (2021) find that US brokers benefit from placing the trades of company insiders and that analysts and mutual fund managers connected with these "inside brokers" benefit from this information advantage. McNally et al. (2017) also find evidence suggestive of some Canadian brokers tipping off their clients about the insider trading of other clients. Fecht et al. (2018) show German banks profit from proprietary trades at the expense of their clients.

However, there is also literature that is suggestive of broker concern for the quality of their trade execution. Ben-Rephael and Israelsen (2018) find that clients who receive lower execution costs offer the reward of increased dollar trading volume. Di Maggio et al. (2022) show that investors are sensitive to both explicit and implicit trading costs. Therefore, brokers may be reluctant to use their information advantage in a manner that could result in inferior performance for their clients. More importantly, brokers may be subject to regulations. Although US brokers are not generally considered to be fiduciaries, the NZX specifies this duty of care to New Zealand brokers under Section 9 of NZX Participant Rules, including brokers' being required to put their client's interests before their own and avoiding placing their clients' assets at unreasonable risk. These regulations may deter NZX brokers from front-running their clients' orders and benefitting themselves via trading from information advantage.

Literature also reports substantial variations in the information content and motivations behind a trade across different traders. Several studies compare the information content between institutional and individual investors and generally find that institutional trades are more informative. For example, Nofsinger and Sias (1999) find, using annual institutional holdings data, that institutional investors engage in more positive feedback trading than individual investors and that herding by institutional investors impacts prices more than herding by individual investors. Griffin et al. (2003) consider intraday trade and quote data and find that top-performing stocks on the previous day are more likely to be purchased by institutions and sold by individuals than stocks in the bottom return decile. Fong et al. (2014) show that there are differences in the informativeness of individual investor trades based on the type of broker they select. Trades via full-service brokers are more informative than trades via discount retail brokers. Kelley and Tetlock (2017) show that short selling by retail investors predicts negative stock returns, especially for small stocks, and this is not subsumed by

institutional investor short selling. Boehmer et al. (2008) find the non-program short sales of institutional investors and brokers are both informative since they are significantly associated with the stocks' negative returns in the future.

The above evidence suggests that both brokers and institutional investors tend to have information advantages. Handling clients' order executions gives brokers a better opportunity to derive quality information embedded in the order flows, which may result in higher trading profits. However, unlike institutional investors, brokers are bound by regulatory fiduciary duty and are concerned about the quality of their brokering service, which may affect their ability and willingness to exploit their superior information advantage to earn higher returns. These apparent conflicts in trading incentives create uncertainty as to whether broker short selling is more profitable than that of institutional investors. Hence, we state our first hypothesis in the null form below:

> **H1.** Profits from short-selling trades do not differ between brokers and institutional investors.

Since profit-making is the main motivation for institutional investors to trade, we conjecture that these investors are likely to implement momentum trading strategies, namely, short selling more (less) on negative (positive) news. However, it is unclear for brokers. If profit-making based on information advantage is the dominant incentive for brokers to trade, we should expect them to follow momentum trading strategies like institutional investors. However, if the regulatory duty of care and concerns about clients' order execution costs prevail over the profit-making incentive, brokers are more likely to implement contrarian trades, that is, short selling more (less) on positive (negative) news. Hence, we state our second hypothesis as follows:

> **H2a.** When information is negative, institutional investors tend to short-sell more, and vice versa.

> **H2b.** When information is negative, brokers may short-sell more or less depending on whether profit-making or the fiduciary care of their clients is their primary focus.

We choose to focus on short selling due to its importance in information discovery and market efficiency. Despite some evidence on the negative effects of short selling, the balance of evidence tilts towards its positive impacts. For example, Allen and Gale (1992) suggest that short sales can be used for stock price manipulation while Brunnermeier and Oehmke (2014) show that financial institutions can be vulnerable to predatory short selling. Given the leverage constraints in these entities, stock price declines induced by aggressive short selling can force the liquidation of investments, which triggers further price declines. Chang et al. (2007) consider the impact of short selling by investigating the outcome following Hong Kong-listed stocks being added to a list where short selling is permitted. They find that the volatility of stocks increases when they can be short-sold. Using Australian data, Ho et al. (2022) show weak evidence that short selling increases stock volatility during normal market conditions whereas Helmes et al. (2017) do not find that short sale bans reduce volatility. Charoenrook and Daouk (2005) use data from 111 countries and measure the impact of short-selling restrictions on stock return volatility and liquidity. They find that volatility is lower, and liquidity is higher when short selling is permitted.

However, Miller (1977) predicts that short-selling restrictions can be expected to result in stocks being overpriced. He suggests that prices will reflect the beliefs of investors with a "bullish" expectation, but investors with a "bearish" expectation who do not own the stock are unable to reflect their views on stock prices. The model by Diamond and Verrecchia (1987)

predicts that short-selling restrictions inhibit informed investors with a negative view of stock prices from having this view reflected in stock prices, and this leads to inefficient pricing. The empirical evidence from other markets is consistent with this model. Saffi and Sigurdsson (2010) use a global dataset of 12,600 stocks spanning 26 countries and find that stocks with fewer short-selling constraints have greater price efficiency. Bris et al. (2007), using data from 46 countries, find that countries allowing short selling have securities that reflect negative information more quickly. Do et al. (2012) show that the short-sale bans over the 2007–2009 period do not affect the law of one price on comparable pairs of stocks. Beber and Pagano (2013) consider 17,000 stocks from 30 countries and find that these bans reduce price discovery, especially in bear markets, hurt liquidity, and do not support prices, except for US financial stocks. In a US study, Boehmer & Wu (2013) find that active short sellers make stock prices more accurate; for instance, post-earnings announcement drift is lower when there is greater shorting flow. Short selling also impacts company management. De Angelis et al. (2017) show that the threat of short selling results in firms re-contracting with managers to avoid underinvestment in firm-specific human capital and/or risky projects. Grullon et al. (2015) find that small firms reduce equity issues and investment following a regulation change that relaxes short-selling constraints. Chang et al. (2019) show that short-selling disciplines managers in merger and acquisition transactions, reducing the number of acquirers engaging in value-destroying takeovers.

The above evidence is mixed on the effects of short selling on market efficiency. However, given the balance of evidence in the literature, we conjecture that short selling, in general, improves market efficiency. In addition, if the fiduciary duty of care imposed on brokers under the NZX Participant Rules prevails over the profit-making incentive, we expect that the positive impact of short selling on market efficiency may be relatively more pronounced for broker trades than institutional trades. Hence, we state our third and fourth hypotheses in their alternative forms as below:

H3. Short selling generally has an impact on market efficiency.

H4. Market efficiency improves following broker short selling relative to institutional short selling.

3 | DATA

We obtain transaction data for all stocks from the NZX for January 2012 to August 2021 and Refinitiv Datascope for the same period. As the results in Table 1 show, the dataset includes 6,012,798 short transactions and 31,277,403 non-short sale transactions. Short sales therefore represent 16% of total sales (short and non-short sales). This is broadly consistent with the US Boehmer et al. (2008) finding that short transactions represent 13% of total volume on the NYSE, while this number in Engelberg et al. (2012) is 20% in a different period. Most short transactions relate to either broker or institutional investors. Of the 6,012,798 short transactions in our dataset just 847 transactions are executed by either retail investors, market makers, or broker employees.[3]

As noted in the NZX Participant Rule Procedures,[4] all trades entered into the NZX Trading System must include a flag in the "Account" field which indicates whether an order relates to a Retail Client (R), Wholesale Client (W) (we refer to these as institutional investors), Employee

[3]The results in Appendix 1 indicate retail investors are the most active of these three investors in general. Retail investors represent 34% of all sell transactions on the NZX and 18% of the value of sell transactions. Both employee and market maker trades comprise less than 1% of the number and value of trades on the NZX.

[4]https://www.nzx.com/regulation/nzx-rules-guidance/participant-guidance.

TABLE 1 Descriptive statistics.

		Broker	Institution	Other	Total
Panel A: Number of trades					
Short trades		950,146	5,061,805	847	6,012,798
Buy trades		2,506,112	21,980,048	12,804,041	37,290,201
Sell trades		2,963,623	17,748,853	10,564,927	31,277,403
Short trades as % of short + sell trades		24%	22%	0%	16%
% of total short trades		16%	84%	0%	100%
% of total sell trades		9%	57%	34%	100%
Panel B: Value of trades (000s)					
Short trades		8,277,393	11,969,896	5546	20,252,835
Buy trades		53,472,739	164,961,023	42,350,406	260,784,168
Sell trades		42,717,894	153,739,052	44,074,386	240,531,333
Short trades as % of short + sell trades		16%	7%	0%	8%
% of Total short trades		41%	59%	0%	100%
% of Total sell trades		18%	64%	18%	100%
Panel C: Trade sizes and value					
Trade size short trades	Mean	2460	473	2243	787
	Median	62	69	181	68
Trade size other trades	Mean	4424	2445	2390	2614
	Median	144	85	106	96
Trade value short trades	Mean	8712	2365	6548	3368
	Median	299	517	840	498
Trade value other trades	Mean	14,414	8662	4172	7690
	Median	581	581	328	505

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The "Other" category includes transactions from retail investors, broker employees, and market makers.

or Prescribed Person (E), the Trading Participant "Broker" Acting as a Principal (P), or a Market Maker (M). There is also a "Short Sale" field in the system that must be checked for all short trades. So, while brokers place orders on behalf of other investors, transactions assigned as being "Broker" pertain to trades on their behalf.[5]

Brokers account for 16% of total short trades while institutional investors account for 84% of those trades. Broker short trades are larger on average, representing 41% of the total short transaction value, with institutional investors comprising the remaining 59%. Short sales represent 24% of total broker sales. The corresponding percentage is 22% for institutional investors. Since these trades tend to be smaller than other transactions, they constitute 16% and 7% of total broker and institutional sales by value, respectively.

The mean short-sale trade size for brokers is materially higher than the equivalent number for institutional investors. However, the median short trade size of brokers is lower than that of institutional investors. This indicates that there are some particularly large broker short sale transactions in the sample.

[5]We find transactions that are flagged as "*m*" (standing for multiple orders) in the CSN field. However, these represent less than 0.02% of more than 37 million transactions over the 10-year sample period. Excluding these observations do not alter our results. We thank a referee for bringing this point to our attention.

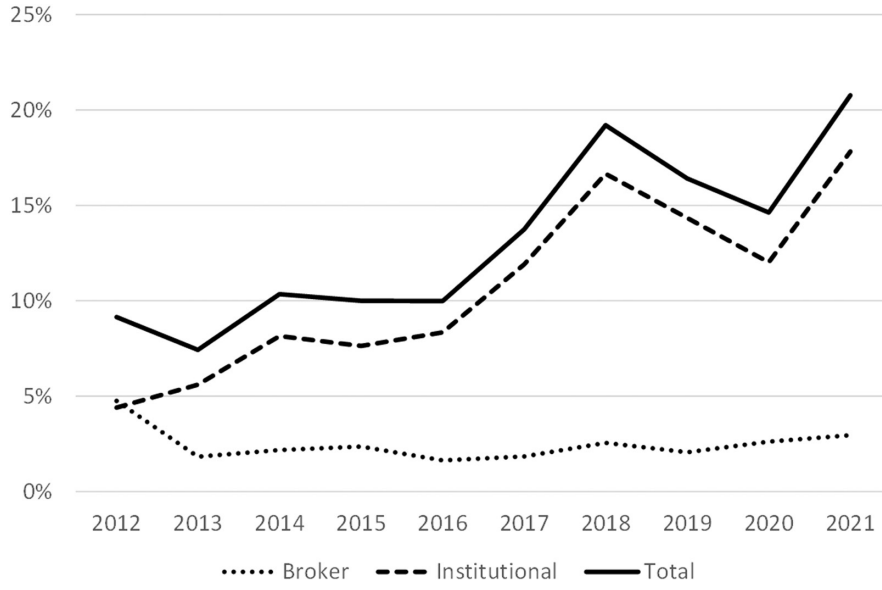

FIGURE 1 Short selling trades as a percentage of all sale transactions. These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The "Other" category includes transactions from retail investors, broker employees, and market makers.

Appendix 2 shows the trading patterns throughout a trading day. The number of short-sale transactions increases throughout the trading day. It is four times larger in the last trading hour of the day (4–5 pm NZT) than it is in the first trading hour (10–11 am NZT). This contrasts with the pattern evident in sales that are not short sales, which exhibit a "U" shape, with more trading activity in the first and last hour of the day than at other intervals. There is a major difference between the intraday short-selling activity of brokers and institutional investors. Brokers trade half as many shares in the last hour of the day as they do in the first hour of the day, while institutional investors trade over 17 times more shares in the last hour of the day compared to the first hour. Appendix 2 results indicate that broker short sales comprise 80% of all short sales in the first hour of the day, then decline throughout the day to 41% of total short sales in the second hour and just 10% in the last hour of the day. While in value terms, brokers trade more in the last hour of the day than the first hour of the day, this increase (around two-fold) is small compared to the increase in short selling by institutional investors who trade 21 times the value in the last hour compared to the first hour of the day.

This pattern in institutional short selling is related to the opening hours of the Australian Stock Exchange (ASX). The NZX is the first market to open each day and the ASX, which is a larger market, is the second market to open. The ASX typically commences trading 2 h after the NZX. However, when there is a misalignment of daylight savings times, the difference in opening time is 3 h. The results in Appendix 3 show that institutional investors delay more of their daily trading during these periods. In Appendix 4, we find that both broker and institutional short selling are more than 15% lower on Mondays than on other weekdays, but this is broadly consistent with the degree to which overall trading activity is lower on Mondays.

As Figure 1 shows, there has been an increase in short-selling activity on the NZX over time. In 2012, it represented 9% of total stock sales, but by 2021, this has increased to 21%. This increase can be attributed to increased short-selling by institutional investors. The proportion of institutional short selling to total selling by all investors has increased from 4% in 2012 to

TABLE 2 Returns following short selling.

	5-min		30-min		60-min		1-day		2-day	
Constant	−0.030***	−0.003	−0.044***	−0.018**	−0.046***	−0.024***	−0.030***	−0.024	−0.046***	−0.062***
	(−41.705)	(−0.449)	(−27.385)	(−1.978)	(−18.922)	(−2.613)	(−21.471)	(−1.344)	(−15.690)	(−4.493)
Broker	−0.003	0.004	−0.012	0.015	−0.025	0.009	0.055	0.077**	0.043	0.073
	(−0.674)	(0.821)	(−0.893)	(1.511)	(−1.366)	(0.786)	(1.447)	(2.312)	(0.712)	(1.417)
Trade Size		−0.002***		−0.002**		−0.001		0.000		0.004
		(−3.978)		(−2.049)		(−0.844)		(−0.034)		(0.729)
Spread		−0.058***		−0.029		−0.039		−0.001		−0.012
		(−3.538)		(−0.957)		(−1.427)		(−0.016)		(−0.146)
Pre ASX Open		−0.01		−0.087***		−0.115***		−0.083		−0.117**
		(−1.266)		(−3.310)		(−3.466)		(−1.547)		(−1.973)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.031	0.034	0.078	0.080	0.077	0.079	0.265	0.265	0.299	0.299
Observations	5,974,378	5,974,378	5,940,933	5,940,933	5,900,762	5,900,762	5,963,058	5,963,058	5,958,537	5,958,537

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. Returns are based on quote midpoints at trade time t and h interval ($h = 5$ min, 30 min, 60 min, 1 day, or 2 days) after a trade. *Broker* is a dummy variable that equals one if the return is following a short sale by a broker and zero otherwise. *Trade Size* is the natural logarithm of short trade value. *Spread* is the short trade's effective spread. *Pre ASX Open* is a dummy variable that equals one if a short sale occurs in the period before the opening of the Australian Stock Exchange (ASX) and zero otherwise. Standard errors are adjusted for clustering by firm and day. t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

18% in 2021. The equivalent percentage for broker short selling was 5% in 2012 and has been 2% or 3% since then.

In Appendix 5 we document the number and value of short trades across stocks that are grouped by market capitalisation, book-to-market ratio, return volatility, and liquidity, respectively. In each instance, we form sub-samples based on firms that are above and below the median of each characteristic. The results show that both broker and institutional investors' short trades exhibit a larger proportion of the total trades of large firms compared to small firms. They are also more likely to short-sell growth stocks and more liquid stocks. The liquidity characteristic is particularly important to institutional investors. While brokers tend to short-sell low-volatility stocks, institutional investors focus relatively more on stocks with high volatility as short targets.

4 | RESULTS

Our analysis starts with testing the first hypothesis by determining the returns following short selling by brokers and institutional investors. Short sellers can make a profit when they can buy back shares at a lower price than the selling price. However, we do not have data related to individual short sellers, so we do not know when a particular short seller buys shares back. We, therefore, use the returns following short selling as a proxy for the potential profits that short sellers can make.

We use the following regression to compare short-selling profits between brokers and institutional investors:

$$Return_{i,t+h} = \alpha + \beta_1 Broker_t + \beta_2 Trade\ Size_t + \beta_3 Spread_t + \beta_4 Pre\ ASX\ Open_t + \varepsilon_{i,t} \quad (1)$$

where $Return_{i,t+h}$ is the stock return based on quote midpoints at trade time t and h minutes after the trade. We measure returns for 5-min, 30-min, 60-min, 1-day, and 2-day intervals following each short sale transaction. $Broker_t$ is a dummy variable that equals one if the return is following a short sale by a broker and zero otherwise. $Trade\ Size_t$ is the natural logarithm of short trade value. $Spread_t$ is the short trade's effective spread, measured as $100 \times 2 \times |lnprc - lnmid|$ where *lnprc* and *lnmid* denote the natural logarithm of the traded price and the quote midpoint, respectively. $Pre\ ASX\ Open_t$ is a dummy variable that equals one if a short sale occurs in the period before the opening of the ASX and zero otherwise. The regression is run with firm and day fixed effects and, following Petersen (2009), standard errors are adjusted for clustering by firm and day.

The results presented in Table 2 show that the intercept, which reflects the profits of institutional short sellers, is consistently negative and statistically significant, except for columns (2) and (8) of the 5-min and 1-day intervals. The broker dummy variable is not statistically significant for the intraday intervals, which indicates that there is no difference in the returns following broker and institutional investor short selling. Although care must be taken when interpreting the results for longer intervals, the results for the 1- and 2-day intervals appear to suggest return reversals following broker short selling. When we focus on the returns following broker short selling (i.e., the combined value of the regression constant and the broker dummy coefficient), we find that after controlling for trade characteristics these returns are not statistically significantly different from zero. This finding suggests that NZX brokers may engage in short selling for reasons different from profit-making.

For other variables, there is some evidence that short-selling profits are larger when trade sizes and spreads are smaller. Profits are also larger when short sales occur before the opening of the ASX. There is likely more information asymmetry at this time which provides an environment in which short sellers can earn larger returns.

Under the NZX Participant Rules, brokers in New Zealand have a fiduciary duty towards their clients, which requires them to place their client's interests before their own. The fact that brokers, on average, do not seem to profit from their short sales after trade characteristics are considered may be consistent with their duty of care. For instance, it is possible that their short selling is conducted in such a way that it stabilises the market and allows opportunities for better execution of client orders. We, therefore, devote the remaining part of this section to exploring our Hypothesis 2 regarding the timing of trades between brokers and institutional investors.

We commence our investigation into this by considering if there is a relation between company news and short selling. We obtain all companies' news in our sample from the NZX Company Research database. There are 158,798 in total. We then follow Engelberg et al. (2012) and assign each news item as "positive" ("negative") if the stock return on the day of the announcement is positive (negative). As these authors note, this approach captures the impact of the news on market pricing, whereas other approaches, such as measuring the sentiment of words in the announcement, do not. It is possible that an announcement with many positive words would still lead to price declines if the prior expectations were more positive than the tone in the announcement. Considering days with news allows us to investigate the impact of information-based short selling, rather than short selling that may be based on noise-driven returns.

We calculate the short sale ratio for each type of trader j per stock i on day t as:

$$Short_{i,j,t} = Short\ Trade\ Value_{i,j,t} / Total\ Trade\ Value_{i,j,t}. \tag{2}$$

In Appendix 6, we present further summary statistics. We also calculate the percentage of short trades as the number of short trades across all stocks/(the number of short and non-short trades across all stocks) daily. The mean and median broker short percentages are 11.3% and 8.9% respectively, while the mean and median institutional investor short percentages are 8.3% and 8.0% respectively.

We then run the following regressions:

$$Short_{i,t+k} = \alpha + \beta_1 Neg\_News_{i,t} + \beta_2 Ret_{i,t+k-1} + \beta_3 Ret_{i,t+k-2} + \varepsilon_{i,t+k}, \tag{3a}$$

$$Short_{i,t+k} = \alpha + \beta_1 Pos\_News_{i,t} + \beta_2 Ret_{i,t+k-1} + \beta_3 Ret_{i,t+k-2} + \varepsilon_{i,t+k}. \tag{3b}$$

Our objective is to determine the level of short selling on the kth day relative to the news event day where $k \in [-2, 2]$. The one- and two-day lagged returns are relative to the short selling day. We include firm and day fixed effects and adjust standard errors for clustering by firm and day.

The results in Table 3 indicate that brokers take a contrarian approach and trade against the return direction induced by the news, while institutional investors adopt a momentum approach and trade in the same direction as the news. On positive news days, when prices increase there is a sharp increase in broker short selling.[6] The coefficient is 1.047, which indicates an increase of 105%. This is statistically significant at the 1% level. The equivalent coefficient for the institutional investor regression is −0.189 and statistically significant at the 1% level, which suggests that institutional investors reduce their short selling by 19% on days when there is a positive news story. A similar pattern is evident on negative news days when prices decline. Brokers reduce their short selling by 41% (coefficient −0.407, t-statistic −2.409),

[6]Our results are similar when we divide each party's total daily short value by total trade value across parties for a stock in a day.

TABLE 3 Short selling and news.

	$t-2$	$t-1$	$t=0$	$t+1$	$t+2$
Panel A: Positive news					
	Broker short selling				
POS_News	−0.117	−0.220***	1.047***	0.337***	0.076
	(−1.566)	(−2.675)	(5.809)	(3.245)	(0.776)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.094	0.095	0.096	0.095	0.095
Observations	313,345	313,619	313,893	313,893	313,893
	Institutional short selling				
POS_News	−0.019	−0.005	−0.189***	0.000	0.010
	(−0.476)	(−0.136)	(−2.875)	(−0.000)	(0.237)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.115	0.115	0.115	0.115	0.115
Observations	313,345	313,619	313,893	313,893	313,893
Panel B: Negative news					
	Broker short selling				
NEG_News	0.001	0.269***	−0.407**	−0.163	0.024
	(0.009)	(3.188)	(−2.409)	(−1.368)	(0.256)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.094	0.095	0.095	0.095	0.095
Observations	313,345	313,619	313,893	313,893	313,893
	Institutional short selling				
NEG_News	0.196***	0.193***	0.419***	0.219***	0.195***
	(4.736)	(4.467)	(5.468)	(4.522)	(4.173)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.115	0.115	0.115	0.115	0.115
Observations	313,345	313,619	313,893	313,893	313,893

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. Company news is obtained from the NZX Company Research database. We assign each news item as *POS_News* (*NEG_News*) if the stock return on the day of the announcement is positive (negative). The analysis involves regressing the daily number of short to total trades on day $t+k$ ($k \in [-2, 2]$) on positive or negative news dummy (defined at day t). We control for the one- and two-day lagged returns relative to the day of short activity. Standard errors are clustered by firm and day. t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

while institutional investors increase their short selling by 42% (coefficient 0.419, t-statistic 5.468). Institutional investors appear to be adept at anticipating negative news. Their short selling is higher than normal on each of the 2 days before the news, and this continues in the 2 days following the news. These results are consistent with brokers' market stabilisation motivation.

We next consider whether broker and institutional investor short selling are influenced by order imbalance. We assign transactions as buyer-initiated or seller-initiated using the Lee and Ready (1991) algorithm.[7] If a trade occurs at the ask price or closer to the ask price than the bid price, the trade is assigned as being a buyer-initiated trade. If a trade takes place at the bid price or closer to the bid price than the ask price, the trade is designated as a seller-initiated trade. We apply the tick rules for trades at the midpoint. We run the following regression:

$$\begin{aligned} Short_{i,t} &= \alpha + \beta_1 OIB_{i,t} + \beta_2 OIB_{i,[t-5,t-1]} + \beta_3 Spread_{i,t} \\ &+ \beta_4 Std\ Dev_{i,t} + \beta_5 Std\ Dev_{i,[t-5,t-1]} + \beta_6 Turnover_{i,[t-5,t-1]} + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

where $OIB_{i,t}$ is order imbalance, calculated as the difference between buyer-initiated and seller-initiated volume divided by the total traded volume for stock i on day t; and $OIB_{i,[t\text{-}5,t\text{-}1]}$ is the average of order imbalance over the previous 5 days. $Spread_{i,t}$ is the daily value-weighted average of effective spreads, and $Std\ Dev_{i,t}$ is the daily standard deviation for stock i, which is measured as the difference between maximum and minimum prices divided by the maximum price on day t. $Std\ Dev_{i,[t\text{-}5,t\text{-}1]}$ is the average standard deviation over the previous 5 days. $Turnover_{i,[t\text{-}5,t\text{-}1]}$ is the average turnover over the previous 5 days where turnover is daily traded volume divided by total shares outstanding. Fixed effects are included and standard are adjusted for clustering errors like Equation (3).

The results in Table 4 provide more evidence of brokers taking a contrarian approach in their short selling and of institutional investors taking a momentum approach. The positive coefficient of 0.656 for the OIB_t variable for broker short sales suggests that brokers short sell 6.6% more on stock days when there is a 10% increase in buying pressure relative to selling pressure. The equivalent coefficient for institutional short selling is −0.395, which indicates 4.0% less short selling by institutional investors on stock days when order imbalance increases by 10%. Regarding control variables, the results show that both brokers and institutional investors short-sell more on days when volatility is higher and on days following a period of heightened volatility. Institutional investors short-sell less following a period of higher trading volume. Overall, the results in Tables 3 and 4 support Hypothesis 2A. They are also consistent with the findings in Table 2 to suggest that NZX brokers may consider their fiduciary duty towards their clients more important than earning profits.

We now turn our attention to addressing whether short selling in general and by brokers and institutional investors respectively is associated with changes in market quality. As stated in Hypothesis 4, we expect that broker short-selling activities tend to improve market quality compared to institutional short sales. As Boehmer, Fong, and Wu (2021) note, there are three dimensions to market quality, and its improvement is characterised by an increase in price efficiency and liquidity and a decline in volatility.

We first consider price efficiency and examine whether there is a discrepancy in the effects of short selling by brokers and institutional investors on subsequent price efficiency. We follow Chordia et al. (2005) and measure price efficiency by the extent to which order imbalance in one interval can be used to forecast returns in subsequent intervals. If prices are weak-form efficient then past trading information should not be able to predict future prices (e.g., Fama, 1970).

We measure order imbalance as the difference between buyer-initiated and seller-initiated volume scaled by total traded volume over an h-minute interval and run the following regressions:

$$Return_{i,h} = \alpha + \beta_1 OIB_{i,h-1} + \beta_2 OIB_{i,h-1} {}^{*} Short_{i,h-1} + \varepsilon_{i,h} \tag{5a}$$

[7]While data from the NZX have flags to distinguish buyers and sellers, there are no other indicators that could help us identify who initiates a trade.

TABLE 4 Short selling and market conditions.

	Broker		Institution	
OIB_t	0.660***	0.656***	−0.257***	−0.395***
	(8.968)	(7.645)	(−4.786)	(−4.991)
$OIB_{[t\text{-}5,t\text{-}1]}$	0.118**	0.242***	−0.126***	−0.175***
	(2.223)	(3.663)	(−4.106)	(−3.915)
$Spread_t$		−0.020		−0.007
		(−1.390)		(−0.691)
$Std\ Dev_t$		2.468*		1.643***
		(1.804)		(2.950)
$Std\ Dev_{[t\text{-}5,t\text{-}1]}$		8.119**		4.931***
		(2.603)		(2.697)
$Turnover_{[t\text{-}5,t\text{-}1]}$		0.000		−0.000*
		(1.570)		(−1.883)
Firm fixed effects	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.095	0.084	0.118	0.116
Observations	314,581	216,292	314,581	216,292

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The analysis involves regressing the daily number of short to total trades on order imbalance and the control variables of spread, standard deviation, and volume. OIB_t is order imbalance, calculated as the difference between buyer-initiated and seller-initiated volume divided by the total traded volume for a stock on day t; and $OIB_{[t\text{-}5,t\text{-}1]}$ is the average of order imbalance over the previous 5 days. $Spread_t$ is the daily average of value-weighted effective spread, $Std\ Dev_t$ is the daily standard deviation for a stock, which is measured as the difference between maximum and minimum prices divided by the maximum price on day t. $Std\ Dev_{[t\text{-}5,t\text{-}1]}$ is the average standard deviation over the previous 5 days. $Turnover_{[t\text{-}5,t\text{-}1]}$ is the average turnover over the previous 5 days where turnover is daily traded volume divided by total shares outstanding. Standard errors are clustered by firm and day. t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

$$Return_{i,h} = \alpha + \beta_1 OIB_{i,h-1} + \beta_2 OIB_{i,h-1}{}^{*} BmI\_Short_{i,h-1} + \varepsilon_{i,h} \quad (5b)$$

where $Return_{i,h}$ is the interval midpoint return, where h is either a 5-, 30-, or 60-min interval. *Short* is a dummy variable that equals one if there is short selling in interval h-1 and zero otherwise, and *BmI_Short* is a variable that equals one when the net of broker minus institutional short selling in interval h-1 is positive and zero otherwise. We use two alternative specifications for the *BmI_Short*, one being based on the number of shares traded, denoted as *BmI_ShortTrade*, while the other on the value of shares traded, *BmI_ShortValue*.

The results in Table 5 indicate that there is a positive relation between order imbalance in each of the three intervals and returns in the following interval. This indicates that NZX stocks on average are not efficiently priced over 5-, 30-, and 60-min intervals with respect to order imbalance. However, in intervals when there is short selling this inefficiency is reduced. Moreover, the inefficiency is reduced further in the 5- and 30-min intervals when broker short selling is higher than institutional short selling. This indicates that short selling is associated with improved market efficiency, and the improvement is more pronounced for broker short selling.

We next consider whether short selling in general or short selling by brokers relative to institutional investors influences liquidity. As Diamond and Verrecchia's (1987) model suggests, short selling affects the participation of informed traders and hence the revelation of information to the market. It influences the price discovery process and the quality of the information

TABLE 5 Price efficiency following short selling.

	5-min			30-min			60-min		
OIB	0.019***	0.030***	0.029***	0.033***	0.038***	0.036***	0.043***	0.041***	0.041***
	(14.299)	(11.617)	(11.565)	(12.484)	(9.347)	(9.596)	(10.287)	(6.567)	(6.752)
*OIB*Short*	−0.003**			−0.009***			−0.012***		
	(−2.301)			(−4.495)			(−3.287)		
*OIB*BmI_ShortTrade*		−0.015***			−0.011**			−0.004	
		(−6.224)			(−2.570)			(−0.419)	
*OIB*BmI_ShortValue*			−0.015***			−0.012***			−0.007
			(−6.283)			(−2.950)			(−0.926)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.006	0.009	0.009	0.018	0.014	0.015	0.031	0.025	0.026
Observations	1,901,386	387,509	408,957	625,695	164,199	182,763	376,429	115,224	130,312

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The dependent variable is midpoint returns in an *h*-minute interval ($h = 5$, 30, or 60). *OIB* is an order imbalance, calculated as the difference between buyer-initiated and seller-initiated trades divided by the total trades for a stock within an interval. *Short* is a dummy variable that equals one if there is short selling in interval *h*-1 and zero otherwise, and *BmI_Short* is a variable that equals one when the net or broker minus institutional short selling in interval *h*-1 is positive and zero otherwise. We test two alternative specifications. The first is based on the difference in the number of shares traded, *BmI_ShortTrade*, while the second is based on the difference in the value of shares traded, *BmI_ShortValue*. Standard errors are clustered by firm and day. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 6 Liquidity following short selling.

	5-min			30-min			60-min		
ShortTrade	0.000			−0.002			0.001		
	(0.208)			(−0.924)			(0.229)		
BmI_ShortTrade		−0.008***			−0.009***			−0.015***	
		(−3.549)			(−3.454)			(−4.080)	
BmI_ShortValue			−0.008***			−0.008***			−0.013***
			(−3.540)			(−3.229)			(−4.058)
Lag Liquidity	0.647***	0.655***	0.655***	0.567***	0.561***	0.561***	0.503***	0.521***	0.491***
	(30.669)	(18.350)	(18.874)	(13.265)	(6.678)	(6.810)	(11.735)	(7.437)	(6.606)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.670	0.750	0.748	0.695	0.766	0.762	0.674	0.723	0.714
Observations	1,155,079	196,343	211,155	563,310	140,147	158,257	356,791	98,773	114,388

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The dependent variable is the average quoted spread on each stock in an *h*-minute interval ($h = 5$, 30, or 60). *Short* is a dummy variable that equals one if there is short selling in interval *h*-1 and zero otherwise, and *BmI_Short* is a variable that equals one when the net or broker minus institutional short selling in interval *h*-1 is positive and zero otherwise. We test two alternative specifications. The first is based on the difference in the number of shares traded, *BmI_ShortTrade*, while the second is based on the difference in the value of shares traded, *BmI_ShortValue*. Standard errors are clustered by firm and day. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 7 Volatility following short selling.

	5-min			30-min			60-min		
ShortTrade	−0.000***			−0.000***			−0.001***		
	(−8.717)			(−3.557)			(−3.252)		
BmI_ShortTrade		−0.000***			−0.001***			−0.001***	
		(−9.522)			(−7.135)			(−5.430)	
BmI_ShortValue			−0.000***			−0.001***			−0.001***
			(−10.767)			(−6.844)			(−5.960)
Lag Volatility	0.072***	0.034**	0.051**	0.244***	0.299***	0.292***	0.350***	0.405***	0.377***
	(7.035)	(2.275)	(2.573)	(5.340)	(4.442)	(4.515)	(5.382)	(5.952)	(5.421)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.025	0.017	0.018	0.116	0.147	0.142	0.199	0.241	0.222
Observations	1,921,534	395,129	416,842	637,933	168,698	187,608	379,782	108,496	124,407

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The dependent variable is volatility measured as the difference between max and min prices scaled by the max price in an h-minute interval ($h = 5$, 30, or 60). *Short* is a dummy variable that equals one if there is short selling in interval h-1 and zero otherwise, and *BmI_Short* is a variable that equals one when the net or broker minus institutional short selling in interval h-1 is positive and zero otherwise. We test two alternative specifications. The first is based on the difference in the number of shares traded, *BmI_ShortTrade*, while the second is based on the difference in the value of shares traded, *BmI_ShortValue*. Standard errors are clustered by firm and day. t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

environment about company fundamentals. As a result, short selling impacts the level of stock liquidity.

We measure liquidity as the average quoted spread on each stock in 5-, 30-, and 60-min intervals and regress it on the short variables in the lagged interval. The regression results are reported in Table 6. The insignificant coefficient for the *Short* dummy indicates that short selling in general has no impact on liquidity. However, the coefficients of *BmI_ShortTrade* and *BmI_ShortValue*, as defined in Equation (5b), are negative and statistically significant, indicating that when broker short selling is higher than institutional investor short selling, spreads decrease, and liquidity improves. This is evident in all three intervals.

Finally, we assess broker and institutional short-selling activities on stock return volatility. Although there is mixed evidence on the impact between short selling and volatility (e.g., Boehmer et al., 2013; Chang et al., 2007), given possible differences in their motivations for short selling, we expect that volatility is reduced following broker short sales compared to institutional short sales. We regress stock price volatility, which is measured as the difference between max and min prices scaled by the max price in the 5-, 30-, or 60-min intervals, on the short variables. The results in Table 7 show consistent evidence that short selling leads to a reduction in volatility. Importantly, the coefficients of *BmI_ShortTrade* and *BmI_ShortValue* are consistently negative and statistically significant. This suggests that the volatility decrease is larger when broker short selling is larger than institutional investor short selling. Overall, the results in Tables 5–7 show that short selling generally improves market quality and that, relative to institutional short selling, broker short selling improves market quality following their trades, supporting Hypotheses H3 and H4.

5 | CONCLUSIONS

Brokers have access to order flow data which gives them an informational advantage over other investors. However, NZX brokers are required to uphold their fiduciary responsibility stated in the NZX Participant Rules. We consider whether the profit-making incentive or the required duty of care prevails in their proprietary short-selling activity. We also compare broker short selling with institutional short selling given that the main objective of institutional investors, including mutual and sovereign wealth funds from the NZX, is expected to be profit-making and not bound by any regulatory fiduciary duty.

Our results show that institutional investors profit from their short-selling activity. Brokers do not seem to earn significantly higher returns than institutional investors on their short-selling trades. Our further analysis shows that on negative news days, brokers short sell less while institutional investors increase their short selling. The opposite pattern is observed on positive news days where there is an increase (decrease) in broker (institutional) short-selling activities. These trading behaviours are also evident in the relation between buy-sell order imbalance and short selling. Brokers short-sell more when the buy-sell order imbalance increases while institutional investors conduct more short-selling trades this imbalance decreases. The findings on returns and trading behaviours indicate that while institutional investors tend to pursue a momentum trading strategy to maximise their short-selling profits, brokers employ a contrarian trading approach to fulfil their fiduciary responsibility, that is, stabilising the market when necessary to possibly provide their clients with better order execution prices.

Broker short selling is associated with improved market quality. We show that NZX stocks are not priced efficiently with respect to order imbalance over 60-min intervals. Rather, a positive order imbalance in one interval predicts positive returns in the following interval. However, short selling helps make pricing more efficient. Moreover, this improvement is greater when broker short selling is larger than that of institutional investors. Relative to institutional short

selling, broker short selling also improves market liquidity by reducing bid-ask spreads and volatility.

International evidence shows that brokers use order flow information for their benefit. The results we document in this paper may, therefore, be attributable to NZX regulation. The actions of NZX brokers may be due to their determining that it is in their better business interests to adhere to the regulation and prioritise client order execution to obtain more or maintain their current market share in the competitive broking business rather than pursuing short selling profits and damaging their reputation.

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DATA AVAILABILITY STATEMENT

Some data is proprietary to NZX and other data is used under license and cannot be shared.

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APPENDIX 1

Retail, employee, and market maker descriptive statistics

	Retail	Employee	Market maker	Total
Panel A: Number of trades				
Short trades	335	499	13	6,012,798
Buy trades	11,265,587	32,856	25,638	37,290,201
Sell trades	10,484,288	46,272	34,367	31,277,403
Short trades as % of short + sell trades	0%	1%	0%	16%
% of total short trades	0%	0%	0%	100%
% of total sell trades	34%	0%	0%	100%
Panel B: Value of trades (000s)				
Short trades	2325	3102	119	20,252,835
Buy trades	37,331,450	146,518	941,454	260,784,168
Sell trades	43,013,293	187,068	874,025	240,531,333
Short trades as % of short + sell trades	0%	2%	0%	8%
% of total short trades	0%	0%	0%	100%
% of total sell trades	18%	0%	0%	100%

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The last column shows the total number of trades or trade values across all participants, including brokers and Institutional investors.

APPENDIX 2

Average short sales by time of the day

Short trades					As % of (short + sell) trades				As % of total short trades		
Hour	Broker	Institution	Other	Short total	Broker	Institution	Other	Short total	Broker	Institution	Other
Panel A: Number of short trades											
10–11	259,165	66,090	94	325,349	25.7%	6.0%	0.0%	6.0%	79.7%	20.3%	0.0%
11–12	111,529	160,167	122	271,818	26.7%	12.3%	0.0%	9.1%	41.0%	58.9%	0.0%
12–1	127,898	898,417	89	1,026,404	25.0%	26.0%	0.0%	19.4%	12.5%	87.5%	0.0%
1–2	109,346	854,601	145	964,092	23.4%	25.0%	0.0%	19.2%	11.3%	88.6%	0.0%
2–3	108,381	910,292	191	1,018,864	23.9%	24.0%	0.0%	18.9%	10.6%	89.3%	0.0%
3–4	107,023	998,366	135	1,105,524	22.5%	23.4%	0.0%	18.7%	9.7%	90.3%	0.0%
4–5	126,523	1,173,172	71	1,299,766	21.7%	21.4%	0.0%	18.0%	9.7%	90.3%	0.0%
Panel B: Value of short trades											
10–11	932,561	168,216	581	1,101,357	18.3%	1.4%	0.0%	4.4%	84.7%	15.3%	0.1%
11–12	820,273	325,222	886	1,146,381	17.5%	2.5%	0.0%	4.9%	71.6%	28.4%	0.1%
12–1	1,208,623	2,067,320	583	3,276,527	15.8%	8.2%	0.0%	8.3%	36.9%	63.1%	0.0%
1–2	1,104,633	1,802,168	639	2,907,439	14.7%	7.5%	0.0%	7.9%	38.0%	62.0%	0.0%
2–3	1,148,379	1,888,126	805	3,037,311	15.6%	7.8%	0.0%	8.1%	37.8%	62.2%	0.0%
3–4	1,231,231	2,086,683	1158	3,319,071	15.4%	8.1%	0.0%	8.3%	37.1%	62.9%	0.0%
4–5	1,820,608	3,611,392	895	5,432,895	17.1%	8.7%	0.0%	9.3%	33.5%	66.5%	0.0%

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The "Other" category includes transactions from retail investors, broker employees, and market makers.

APPENDIX 3

Average number of short sales by time of the day – daylight savings

Short trades					As % of (short + sell) trades				As % of total short trades		
Hour	Broker	Institution	Other	Short total	Broker	Institution	Other	Short total	Broker	Institution	Other
Panel A: 2-h time difference between New Zealand and Australia											
10–11	255,623	65,637	91	321,351	25.8%	6.0%	0.0%	6.0%	79.5%	20.4%	0.0%
11–12	110,312	158,415	122	268,849	26.8%	12.3%	0.0%	9.1%	41.0%	58.9%	0.0%
12–1	125,934	894,335	88	1,020,357	25.0%	26.0%	0.0%	19.4%	12.3%	87.6%	0.0%
1–2	107,277	833,502	145	940,924	23.4%	24.9%	0.0%	19.1%	11.4%	88.6%	0.0%
2–3	106,851	894,555	191	1,001,597	23.9%	23.9%	0.0%	18.9%	10.7%	89.3%	0.0%
3–4	105,468	983,310	135	1,088,913	22.5%	23.4%	0.0%	18.7%	9.7%	90.3%	0.0%
4–5	124,515	1,155,005	70	1,279,590	21.8%	21.4%	0.0%	18.0%	9.7%	90.3%	0.0%
Panel B: 3-h time difference between New Zealand and Australia											
10–11	3542	453	3	3998	22.1%	3.6%	0.0%	5.4%	88.6%	11.3%	0.1%
11–12	1217	1752	0	2969	22.4%	13.3%	0.0%	8.4%	41.0%	59.0%	0.0%
12–1	1964	4082	1	6047	28.1%	16.9%	0.0%	12.9%	32.5%	67.5%	0.0%
1–2	2069	21,099	0	23,168	24.7%	34.8%	0.0%	26.8%	8.9%	91.1%	0.0%
2–3	1530	15,737	0	17,267	21.0%	28.2%	0.0%	21.5%	8.9%	91.1%	0.0%
3–4	1555	15,056	0	16,611	21.1%	24.8%	0.0%	19.6%	9.4%	90.6%	0.0%
4–5	2008	18,167	1	20,176	19.8%	22.4%	0.0%	18.6%	10.0%	90.0%	0.0%

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The "Other" category includes transactions from retail investors, broker employees, and market makers. Due to daylight saving adjustments, the time difference between New Zealand and Australia can increase to 3 h.

APPENDIX 4

Average short sales by weekday

Short trades					As % of (short + sell) trades				As % of total short trades		
Weekday	Broker	Institution	Other	Short total	Broker	Institution	Other	Short total	Broker	Institution	Other
Panel A: Number of short trades											
Monday	166,578	795,549	178	962,305	23.0%	22.1%	0.0%	14.8%	17.3%	82.7%	0.0%
Tuesday	194,034	1,074,347	136	1,268,517	24.1%	21.5%	0.0%	15.8%	15.3%	84.7%	0.0%
Wednesday	208,969	1,124,171	135	1,333,275	25.3%	22.4%	0.0%	16.7%	15.7%	84.3%	0.0%
Thursday	205,245	1,043,267	128	1,248,640	25.1%	22.4%	0.0%	16.6%	16.4%	83.6%	0.0%
Friday	175,320	1,024,471	270	1,200,061	23.7%	22.5%	0.0%	16.5%	14.6%	85.4%	0.0%
Panel B: Number of short value											
Monday	1,296,178	1,849,113	1239	3,146,531	16.7%	7.6%	0.0%	7.8%	41.2%	58.8%	0.0%
Tuesday	1,765,998	2,406,011	518	4172,527	16.9%	7.2%	0.0%	7.9%	42.3%	57.7%	0.0%
Wednesday	1,912,991	2,598,194	1273	4,512,458	16.6%	7.1%	0.0%	7.8%	42.4%	57.6%	0.0%
Thursday	1,739,093	2,516,510	1304	4,256,907	16.0%	7.0%	0.0%	7.6%	40.9%	59.1%	0.0%
Friday	1,563,132	2,600,069	1211	4,164,413	15.1%	7.4%	0.0%	7.7%	37.5%	62.4%	0.0%

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The "Other" category includes transactions from retail investors, broker employees, and market makers.

APPENDIX 5

Short sales by stock characteristics

	Broker			Institution		
	Short (1)	Sell (2)	(1)/[(1) + (2)]	Short (3)	Sell (4)	(3)/[(3) + (4)]
Panel A: Number of trades						
Small	22,646	95,875	19.1%	44,331	406,753	9.8%
Large	597,410	1,772,094	25.2%	4,877,125	16,554,112	22.8%
Value	208,769	666,024	23.9%	1,377,655	5,016,771	21.5%
Growth	393,890	1,133,422	25.8%	3,461,158	11,682,163	22.9%
Low Volatility	656,494	2,200,808	23.0%	1,849,542	8,847,388	17.3%
High Volatility	293,650	762,814	27.8%	3,212,263	8,901,454	26.5%
Low Liquidity	43,247	180,380	19.3%	41,602	487,256	7.9%
High Liquidity	906,899	2,783,243	24.6%	5,020,203	17,261,597	22.5%
Panel B: Value of trades						
Small	85,080	689,560	11.0%	44,541	2,992,885	1.5%
Large	7,202,921	34,881,645	17.1%	11,397,810	136,407,961	7.7%
Value	2,223,665	11,531,392	16.2%	3,149,184	45,680,949	6.4%
Growth	4,810,109	22,647,798	17.5%	8,121,270	89,875,824	8.3%
Low Volatility	5,688,417	32,221,223	15.0%	5,415,090	99,920,884	5.1%
High Volatility	2,588,964	10,496,668	19.8%	6,554,806	53,818,120	10.9%
Low Liquidity	113,265	839,148	11.9%	69,879	3,939,260	1.7%
High Liquidity	8,164,127	41,878,747	16.3%	11,900,017	149,799,793	7.4%

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. In each instance, we form sub-samples based on firms that are above and below the median of each characteristic. *Small* and *Large* refer to low and high-market capitalisation stocks, respectively. *Value* and *Growth* refer to low and high book-to-market ratio stocks, respectively. *Low Volatility* and *High Volatility* refer to stocks with low and high return volatility, respectively. Finally, *Low Liquidity* and *High Liquidity* refer to stocks with low and high liquidity, respectively.

APPENDIX 6

Daily short selling summary statistics

	Broker	Institution	Other	Total
Panel A: Proportion of daily trades that are shorts				
Minimum	0.0	0.0	0.0	0.0
Median	8.9	8.0	0.0	11.8
Mean	11.3	8.3	0.0	12.6
Maximum	48.3	48.6	1.2	48.2
Std Dev	8.6	5.4	0.0	7.0
Panel B: Proportion of daily traded value that are shorts				
Minimum	0.0	0.0	0.0	0.0
Median	7.5	2.3	0.0	6.6
Mean	8.7	3.0	0.0	7.5
Maximum	46.8	29.7	0.9	45.5
Std Dev	5.9	2.8	0.1	4.5

Note: These results are based on transaction data from the New Zealand Exchange and quote data from Refinitiv Datascope for all New Zealand stocks for the January 2012 to August 2021 period. The "Other" category includes transactions from retail investors, broker employees, and market makers.