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Short-selling, margin-trading, and stock liquidity: Evidence from the Chinese stock markets☆

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ABSTRACT

This paper examines the impacts of two forms of leveraged trading—margin trading and short selling—on the trading liquidity of individual stocks in China. We find that trading liquidity for relevant stocks generally improves after restrictions on leveraged trading are removed. However, margin trading and short selling have opposite impacts on liquidity. During ordinary periods, margin trading benefits liquidity, whereas short selling damages liquidity; however, during market downturns, their roles are reversed. We also provide evidence suggesting that short sellers are informed traders in China and that short selling reduces stock liquidity because of the increased risk of adverse selection faced by uninformed traders.

1. Introduction

The impacts of trader leverage on stock liquidity have gained significant interest in recent literature. A number of empirical studies provide evidence that traders' financing constraints have negative impacts on stock market liquidity (Comerton-Forde et al., 2010; Hameed et al., 2010; Jensen and Moorman, 2010). However, as stated by Kahraman and Tookes (2017), many of these studies suffer from the identification issue—that is, certain economic forces may simultaneously reduce stock market liquidity and traders' funding ability. Thus, it is difficult to determine the causal effect from traders' funding constraints on stock liquidity. Given that traders' ability to take positions with greater leverage on a firm's stock is influenced by both funding constraints and regulatory margin requirements, a few studies (e.g., Alexander et al., 2004; Kahraman and Tookes, 2017) eliminate the issue of identification through analyzing the change of stock liquidity when the relevant stocks change from the status of margin ban to the status of margin eligible. However, these studies nevertheless reach different conclusions. Alexander et al. (2004) find that market liquidity of stocks, as measured by spreads and depths, is unchanged when they become margin eligible. In contrast, using data from the Indian equity market, Kahraman and Tookes (2017) suggest that traders' ability to borrow could increase stock liquidity.

Similarly, another strand of the literature investigates the influence of short sale constraints (which forbid traders from using leverage in the form of short selling) on market liquidity, using data from a period of financial crisis when short sale bans were imposed in various countries (e.g., Autore et al., 2011; Beber and Pagano, 2013; Boehmer et al., 2013; Boulton and Braga-Alves, 2010; Kolasinski et al., 2013; Marsh and Payne, 2012). Most of these studies find short sale ban damage liquidity, suggesting that allowing traders to employ leverage through short selling should improve liquidity. This finding is contrary to the regulators' intention of banning short selling to avoid potential negative impacts on market conditions. Hence, the effectiveness of such a policy is questionable. Unfortunately, similar to some of the aforementioned studies regarding capital constraints' impact on liquidity, these studies are also subject to the endogeneity issue, as short selling was banned exactly when the market crashed and liquidity deteriorated. Further, the analysis through a numerical model with market microstructure and heterogeneous agents in Lensberg et al. (2015) suggests that transaction costs (e.g., bid–ask spread) may only increase temporarily when short selling is unexpectedly banned, while the equilibrium effect may be different.

In this study, we use the regulatory reform on margin trading and short selling in the Chinese stock market as a natural experiment to investigate the impacts of trader leverage on stock liquidity. Margin trading and short selling were banned in China until March 2010, when a list of 90 stocks was selected as pilot stocks to lift the leverage ban. Since then, during our sample period, the list of eligible stocks has been extended five times to around 950 stocks. Thus, relevant stocks experienced a positive shock in the level of leverage that their traders may employ. Similar to the setting in Kahraman and Tookes (2017), such a

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positive shock of trader leverage in relevant Chinese stocks is independent of changes in stock liquidity, which allows us to better address the endogeneity issue. In this paper, we seek to examine the implications of such positive shocks of leverage on stock liquidity. In particular, we compare the liquidity of the leverage eligible stocks with their matched counterparties with no leverage in the framework of multivariate regressions, both before and after the lift of the leverage ban. The empirical results suggest that lifting the leverage ban is generally beneficial to stock liquidity.

Given that the constraints on margin trading and short selling were lifted simultaneously, it is difficult to know which of these two types of leveraged trading activities may have contributed to the improved liquidity. Thus, we next focus on a subsample that includes only leverage eligible stocks to analyze the marginal impacts of margin trading and short selling activities on stock liquidity. We find that greater margin trading activities benefit stock liquidity, whereas greater short selling activities damage stock liquidity. Through further analysis, we seek to understand the opposite influence on liquidity of margin trading and short selling.

First, we explore the trading strategies of margin traders and short sellers to determine whether their improved access to capital has been transformed to trading behaviors that improve liquidity. We find that both margin traders and short sellers are short-term contrarian traders who naturally provide liquidity to relevant stocks, and also act as voluntary liquidity providers when there is significant buying/selling pressure in these stocks. Consistent with Diether et al. (2008), we also find that short sellers in our sample act as opportunistic risk-bearers during periods of elevated uncertainty. We conclude that the trading strategies of margin traders are mostly consistent with their liquidity improving function, whereas the trading strategies of short sellers cannot explain why short selling activities are detrimental to liquidity.

Second, we investigate whether margin traders and short sellers are informed traders. Our evidence suggests that short sellers, but not margin traders, can predict future short-term stock returns in our sample. This suggests that short selling activities may reduce stock liquidity, as they increase the risk of adverse selection that other traders face (Boehmer et al., 2013; Cai et al., 2019). This mechanism is supported by further evidence that the detrimental impacts of short selling activities on stock liquidity are only significantly different from zero among stocks with greater information asymmetry.

Finally, we investigate whether the impacts of margin trading and short selling on stock liquidity differ during market downturns than during ordinary periods. Although the asymmetrical impact of margin trading on liquidity is studied in Kahraman and Tookes (2017), the potential asymmetry in short selling's influence has seldom been investigated. Literature on the effect of short sale bans naturally only examines periods of financial crisis, while we are able to study whether short selling has different impacts on stock liquidity in different market conditions as the regulatory reform in China was not conditioned on the market environment. Our results suggest that, during market downturns, the impacts of margin trading and short selling are very different from those in ordinary market conditions. Consistent with Kahraman and Tookes (2017), our evidence indicates that, despite being more liquid in ordinary periods, leverage eligible stocks actually have lower liquidity than matched ineligible stocks during market downturns. In addition, among the eligible stocks, there is some evidence that greater margin trading activities are associated with lower liquidity during market downturns. However, we also find that greater short selling activities are associated with higher stock liquidity during market downturns—that is, although short selling activities are generally detrimental to stock liquidity, their impacts actually become positive during harsh market conditions.

Our paper adds to the strand of literature investigating the relationship between traders' funding constraints and stock liquidity (e.g., Comerton-Forde et al., 2010; Hameed et al., 2010; Jensen and Moorman, 2010). In spirit, our paper is closest to those by Alexander et al. (2004) and Kahraman and Tookes (2017), who also employ the change of regulation on margin systems to examine the causal effect of margin trading on stock liquidity. Our results are consistent with Kahraman and Tookes (2017), who find that margin trading activities are beneficial to stock liquidity. However, because of the different requirements for short selling,[1] Kahraman and Tookes (2017) are unable to analyze the causal effect of short selling on liquidity. In this paper, we extend the analysis to include both margin trading and short selling. Our results on short selling reveal that, as a different form of leveraged trading, the influence of short selling can be very different to that of margin trading.

Our paper is also related to the studies examining the role of short selling in financial markets (e.g., Boehmer and Wu, 2012; Deng and Gao, 2018; Geraci et al., 2018; Massa et al., 2015). Compared with many prior studies, our data on short selling activities (e.g., short interests and short selling turnover) are of higher frequency (i.e., daily) and cover close to seven years. These rich and higher frequency data allow us to better analyze the influence from the short sellers' short-term trading strategies. In addition, to the best of our knowledge, our paper is one of the very few studies to investigate the asymmetric influence of short selling under different market conditions. The detrimental impacts of short selling on stock liquidity during ordinary periods that we discover is consistent with policymakers' negative impression of shorting activities. However, our finding that short selling's impacts on liquidity actually become positive during market downturns is consistent with Diamond and Verrecchia (1987), who argue that short selling constraints' impact in reducing liquidity is stronger in cases of bad news. This finding is also consistent with previous academic findings that banning short selling during market crashes actually harms stock liquidity. This suggests that, to reconcile the debate on the role of short selling, it may be necessary to consider influences from the market conditions.

Finally, a group of papers is also interested in understanding the impacts on market quality of China's regulatory reform regarding leveraged trading. For instance, previous work finds that this reform improves price efficiency (Chang et al., 2014; Chen et al., 2016) and reduces stock market volatility (Chang et al., 2014). Our paper adds additional empirical evidence to this body of work by demonstrating the implications of this reform for the trading liquidity of individual stocks. We reach similar conclusions to Ma et al. (2018), who use aggregated data on margin trading and short selling data and find that an increased margin trading volume is associated with reduced market-wide bid–ask spread, while increased short selling volume is associated with increased market-wide bid–ask spread. However, our analysis is undertaken at individual stock level, rather than market level. In addition, we also provide evidence about the mechanism through which such impacts may occur. Our analysis provides important evidence to help policymakers in China understand and evaluate the effectiveness of this regulatory reform for leverage trading.

This paper is organized as follows. Section 2 provides information on the institutional background of China's leverage trading reform, while Section 3 discusses sources of data and descriptions of key variables. Sections 4 and 5 investigate the impacts of leverage trading status (i.e., leverage eligible or leverage ineligible), margin trading turnover, and short selling turnover on stock liquidity. Section 6 conducts further analysis to understand the results discovered in Sections 4 and 5. Section 7 focuses on the asymmetrical impacts of leveraged trading in

[1] For example, shorting was allowed four years later, after the start of the margin system in India. It was also restricted to a much smaller group of stocks. Moreover, shorting does not free up capital in the Indian equity market, as investors need to post cash collateral equal to 100% of the value of the borrowed securities. Hence, short selling cannot represent a form of leveraged trading with sufficient impacts during the sample period of Kahraman and Tookes (2017).

different market conditions, while Section 8 concludes this paper.

2. Institutional setting

On March 31, 2010, the Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) launched a trial program for margin trading and short selling. Restrictions on leveraged trading were lifted for 90 pilot stocks, including the 50 stocks in the SSE50 index and the 40 component stocks in the Shenzhen component index. The trial program lasted for 21 months and, in December 2011, the China Securities Regulatory Commission (CSRC) announced the successful completion of the trial program. As such, the SHSE extended the eligibility of leveraged trading to another 130 stocks in the SSE180 index, and the SZSE extended the list to another 58 stocks. In January 2013, the list of stocks eligible for margin trading and short selling ("eligible stock" hereafter) was extended again to reach 500 stocks in the two markets. At this stage, the SHSE and SZSE reached some consensus on the selection criteria—that is, both exchanges selected stocks that ranked highly on an indicator a weighted average of the relative market capitalization and relative trading volume of the stock.[2] In addition, the eligible stocks needed to have been listed for at least three months, and have a sufficient number of shares outstanding and shareholders. The eligible stocks also needed to meet a minimum requirement on volatility, turnover, and trading volume. Based on the selection criteria, the smallest, most illiquid, and most volatile stocks were not eligible. The number of eligible stocks increased to 700 in September 2013, and to 900 in September 2014. On December 12, 2016, the list of eligible stocks was extended to include another 50 stocks. Table 1 tabulates the number of stocks included in the eligible list for both the SHSE and SZSE. The SHSE and SZSE also specified that a stock will be excluded from the eligible list if it receives a "special treatment" tag; therefore, the actual number of eligible stocks each day will be slightly less than that reported in Table 1.

Similar to the margin requirements in many countries, investors are allowed by the stock exchanges to borrow up to 50% of the trading value of the stocks. Both cash and securities can be used as collaterals. Depending on the level of risk for collateral securities, stock exchanges have imposed different conversion rates (e.g., 0.7 for component stocks in SSE180, 0.65 for other stocks, 0 for stocks with a "special treatment" tag, and 0.95 for corporate bonds) when valuing these security collaterals. The maintenance collateral coverage ratio—which is defined as the value of the collateral in the investor's margin account divided by the sum of borrowed loans, value of borrowed stocks, and interests and fees—is set at 130%. Margin calls will be issued when the maintenance collateral coverage ratio falls below 130%. Naked shorts are prohibited in China. Furthermore, similar to the "uptick rule" in the U.S., all short sale transactions must be entered at a higher price than the previous trade. The maximum horizon for margin trading and short selling is six months. The interest rates for margin trading and short selling—which are usually linked to the benchmark interests published by the People's Bank of China (PBoC)—are determined by individual securities houses. Some securities houses have imposed equal borrowing rates for margin trading and short selling, while others require greater rates for short selling.

Based on the principle of prudence, the CSRC requires that only investors with sufficient experience in security investment can participate in leveraged trading (i.e., margin trading and short selling). This imposes some limitations on individual investors who wish to participate. The securities houses are responsible for screening these individual investors. The guidance from the CSRC in the early period of the leverage trading reform was that, for an individual investor to open a margin account with a broker, he or she must have been the client with the broker for more than 18 months and have at least RMB500,000 worth of securities in his or her accounts. The CSRC also specified that leveraged trading should not be opened to investors who lack risk-bearing capacity or have records for fraud. However, the investor qualification in leverage trading was relaxed when the CSRC announced in April 2013 that securities companies could themselves decide the thresholds of leveraged investors. By the end of 2014, most brokers only required investors to have six months of trading activities before they could open a leveraged trading account, and the requirement on financial assets possession also declined significantly. This declined standard for leveraged traders alerted the CSRC, who in 2015 re-emphasized the importance of prudence. As a result, securities companies re-increased the requirements for leveraged investors.

Table 1
Number of leverage eligible stocks in SHSE and SZSE, 2010–2016.

Events of eligible stocks expansion	Announcement date	Effective date	No. of leverage eligible stocks		
			SHSE	SZSE	Total
Event 1	Feb 22, 2010	Mar 31, 2010	50	40	90
Event 2	Nov 25, 2011	Dec 5, 2011	180	98	278
Event 3	Jan 25, 2013	Jan 31, 2013	300	200	500
Event 4	Sep 6, 2013	Sep 16, 2013	400	300	700
Event 5	Sep 12, 2014	Sep 22, 2014	500	400	900
Event 6	Dec 2, 2016	Dec 12, 2016	525	425	950

3. Data

We obtain the daily value of the following variables from the China Stock Market & Accounting Research database: market capitalization, stock price, stock return, trading volume, number of issued shares, short volume (in shares), finance volume (in RMB), short position outstanding (in shares), and margin position outstanding (in RMB). In addition, the same dataset provides quarterly data on ownership concentration, institutional ownership, and monthly analyst coverage (i.e., number of analyst reports), which are used in this study. Finally, we obtain the intraday transaction data—such as bid price, ask price, and transaction price at minute level—from the WIND dataset, which we use to calculate the daily effective spread. WIND also provides the other daily data we use in the empirical analysis, including buyer-initiated and seller-initiated orders.

We use the list of A shares in the SHSE and SZSE that became eligible for margin trading and short selling to form our treatment sample. The sample period begins in March 2010, when the first cohort of 90 stocks was selected as the pilot stocks for the institutional reform, and ends in December 2016. As the first step of the empirical analysis, we investigate the impact on stock liquidity of the leveraged trading by comparing the liquidity of the eligible stocks with those ineligible stocks with similar firm characteristics, except the possibility of margin trading and short selling. To this end, on each day, we match each eligible stock with one ineligible stock in the same industry that is closest in terms of market capitalization, stock price, and trading volume. Similar to the matching method used by Huang and Stoll (1996), Bacidore and Sofianos (2002), and Sharif et al. (2014), we calculate the sum of squared relative differences for the three characteristics between the eligible stock and each ineligible stock in the same industry, and select the one ineligible stock that minimizes the relative difference as the matching stock that forms our control sample for this analysis. To be specific, the following is the equation for calculating the squared relative differences:

[2] The market value (trading volume) is scaled by the average market value (trading volume) of A shares in the exchange in which the stock is listed.

Total Relative Difference

$$= \left(\frac{price_e - price_i}{(price_e + price_i)/2}\right)^2 + \left(\frac{market\ value_e - market\ value_i}{(market\ value_e + market\ value_i)/2}\right)^2 + \left(\frac{volume_e - volume_i}{(volume_e + volume_i)/2}\right)^2$$

where subscript e and i represent eligible and ineligible stocks, respectively. The matching process is undertaken without replacement.[3]

Our matching process provides close yet inexact matching between the eligible and ineligible stocks. As shown in Panel A of Table 2, the average market capitalization for the eligible stocks is more than two times larger than that for the ineligible stocks. The exact matching for firm size is very difficult in our specific sample, as market capitalization is one of the key criteria in determining whether a stock is likely to be added to the eligible list. Panel A in Table 2 also shows that the eligible stocks tend to have greater trading volume than the ineligible stocks. However, our matching process provides a close match in terms of stock price. To control the remaining difference between the eligible and ineligible stocks, we include several firm and stock characteristics as control variables in our regression analysis.

For the eligible stocks, we also report the summary statistics for the margin trading and short selling activities in Panel B of Table 2. We can see that the average margin position for the eligible stocks achieved RMB 727 million in our sample period. On an average day, the margin investors contribute RMB 63 million of trading, which represents 17.23% of the total trading volume. The statistics for short selling, which are calculated in terms of number of shares, reveal that the short selling activities are much less intense than the margin trading. Short sellers contribute only 0.63% to the total trading volume on an average day. A typical stock has a short balance of 223,000 shares at the end of day. The average daily short selling volume is 267,000 shares, which is even larger than the short balance. This indicates that some short sellers actually close their position before the end of day, and the holding period for their shorted stocks is quite short. In addition, even for the eligible stocks, more than 25% of the observations have no short selling activities in a day. This is because the supply of stocks for short selling was very limited for our sample stocks, especially during the early period of the regulatory reform.

Fig. 1 displays the movements of the HS300 stock price index and average margin interest for the eligible stocks between 2010 and 2016. There are four clear cliff falls in the average margin positions during our sample period, each of which is caused by the expansion of the eligible list, which immediately increases the denominator in the calculation of average margin interest, but not necessarily the numerator—the actual leveraged trading. This suggests that, when the trading restriction is lifted for a particular stock, it takes a while for the margin trading activities to build. Apart from the five falls, the average margin positions for the eligible stocks rise steadily over time. The booming stock prices in the first half of 2015 encouraged margin trading activities, which caused the margin position to skyrocket. By June 2015, it more than doubled its value from the beginning of the 2015. However, when the stock market crashed between July and August of 2015, the margin trading activities also crashed. It is apparent from the graph that the margin trading activities move up and down alongside the stock index during the remaining days in our sample period.

The short selling activities do not enjoy the same level of growth as the margin trading activities, as shown in Fig. 2, which displays the movements of average short positions in terms of shares and the HS300 index during our sample period. Although the short position of the eligible stocks rises between 2011 and 2012, there is only a gradual declining trend for the rest of the sample period. The co-movements between the short position and stock market index are also less apparent in Fig. 2 than in Fig. 1.

In Fig. 3, we plot the average margin interest and short interest for the first 90 stocks that were selected as the pilot for the leverage trading reform.[4] We can see that the movements of margin interest and short interests for these stocks are mostly consistent with their performance in Figs. 1 and 2.

The effective spread (*Espread*) is adopted to capture the liquidity of individual stocks on each day. We calculate the percentage effective spread for every minute of the trading time using the following formula:

$$Effective\ Spread_k = 2 \cdot |ln(P_k) - ln(M_k)|$$

where P_k and M_k are the trading price and midpoint of bid and ask price for the trade at the end of the k^{th} minute, respectively. For every minute interval, we also calculate the total trading volumes occurring within the minute, and use this as weight to calculate the daily value of the effective spread. In Fig. 4, we display the average daily effective spread for the eligible stocks and the differential spread between the ineligible and eligible stocks during our sample period. Clearly, the differential spread is positive on most days, suggesting a lower liquidity for the ineligible stocks. In addition, as expected, the movement of effective spread for the eligible stocks is negatively correlated with the variation in the stock market index HS300. The effective spread tends to increase when the stock index decreases.

For the purpose of robustness checks, in most empirical analyses, we also report the results with an alternative measure of liquidity: Amihud's (2002) price impact measure. We calculate the daily price impact measure (*Pimpact*) through dividing the daily absolute return by the daily trading volume in RMB.

To further eliminate the impacts on liquidity of different firm characteristics between the eligible and ineligible stocks, we control several stock-related explanatory variables at day t, including firm size (*Size*), volatility in the recent 20 trading days (*Volatility*20), trading volume (*Volume*), stock price (*Price*), stock return (*Return*), and ownership concentration (*OwnCon*), in our regression analyses. Trading volume is the amount of traded stocks in RMB. *Volatility*20 is the standard deviation of daily stock returns during the past 20 trading days. Ownership concentration is the percentage of ownership held by the largest 10 shareholders. In addition, we include two dummy variables (*HS*300 and *PL*) which indicate whether a stock is a component stock for the HS300 index and whether a stock reaches the price limit at day t, respectively, as explanatory variables. A component stock is likely to have greater liquidity than other stocks, as it may attract trading from the various equity index funds. In addition, once a stock reaches the price limit in China, its liquidity usually declines, as the price limit prevents the stock prices from moving further up or down.

4. Impacts of leverage trading status on stock liquidity

To understand the impacts of leverage trading on stock liquidity, we first compare the liquidity between eligible and ineligible stocks using the following specification:

$$Liquidity_{it} = \alpha + \beta \times Eligible_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (1)$$

Eligible is a dummy variable that equals 1 if the stock is an eligible stock, and 0 otherwise. Coefficient β captures the relative difference between the liquidity of the eligible and ineligible stocks. X is the group of control variables discussed in Section 3. In addition, to control for first-order autocorrelation in liquidity, we include the lagged value of the

[3] The financial industry is excluded from the analysis when using the without-replacement approach because of the insufficient number of ineligible stocks in this industry. We also repeat all of our analyses using a replacement approach, in which case all industries are included, and obtain qualitatively similar conclusions.

[4] We focus on the 90 stocks in Fig. 3 to observe the movements of margin and short positions for a stable sample over time to avoid the influence from the changing composition of the sample of leverage eligible stocks.

Table 2
Summary statistics of firm characteristics, margin trading, and short selling activities for sample stocks.

Panel A: firm characteristics for eligible and matched ineligible stocks

	Mean	Stdev	Min	P25	P50	P75	Max
Market capitalization (in million RMBs)							
Eligible stocks	25,034	12,277	12,380	16,073	20,466	32,007	55,457
Ineligible stocks	9241	5952	3565	4945	6970	11,317	24,962
Difference in means	15,792*** (46.88)						
Trading volume (in million RMBs)							
Eligible stocks	298	202	63	154	226	377	1157
Ineligible stocks	191	127	44	97	151	252	755
Difference in means	106.12*** (18.04)						
Price							
Eligible stocks	16.33	3.53	10.16	13.98	15.36	18.77	30.08
Ineligible stocks	16.41	3.66	10.05	13.84	15.50	18.87	30.81
Difference in means	-0.07 (0.57)						

Panel B: Short selling and margin trading activities for eligible stocks

	Mean	Stdev	Min	P25	P50	P75	Max
Margin balance (in million RMBs)	727	837	0	244	506	915	19,456
Margin volume (in million RMBs)	63	118	0	10	27	68	5557
Margin turnover (%)	17.23	7.80	0	11.87	17.62	22.86	30.96
Short balance (in 000 shares)	223	537	0	6	44	200	26,671
Short volume (in 000 shares)	267	2037	0	0	11	107	218,618
Short turnover (%)	0.63	1.04	0	0	0.11	0.78	3.92

Notes: Panel A reports the summary statistics for the daily value of the matching variables—namely, market capitalization, trading volume, and stock price—for the eligible and matched ineligible stocks between March 2010 and December 2016. Panel B reports the summary statistics of the daily short selling and margin trading activities for eligible stocks during the sample period. Margin volume is the value of the shares purchased through margin trading on each day. Margin balance is the margin position in terms of million RMBs at the end of each day. Margin turnover is the ratio of margin trading volume to total trading volume on each day. Short balance is the short position in terms of number of shares at the end of each day. Short volume is the number of shares sold short on each day. Short turnover is the ratio of the short volume (in shares) to total trading volume (in shares) on each day. *t*-statistics are in parentheses. *** Indicates significance at the 1% level.

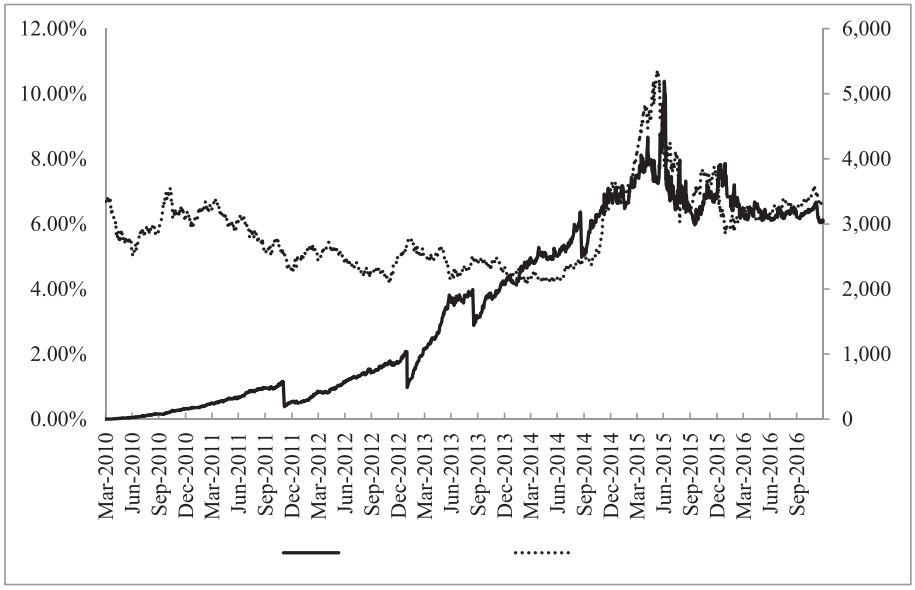

Fig. 1. HS300 index and average margin interest for eligible stocks, March 2010 to December 2016.

liquidity in *X*. Both firm and day fixed effects are included in (1) to control the influence on stock liquidity of other stock characteristics and take into account the changes in the market conditions that may commonly affect stock liquidity. We also cluster the standard errors by both firm and date (Thompson, 2011). To diminish the influence of outliers, all variables are winsorized at the top and bottom 1%. In addition, aside from *Return*, which might be negative, and the dummy variables, we log transform the other variables in the regression

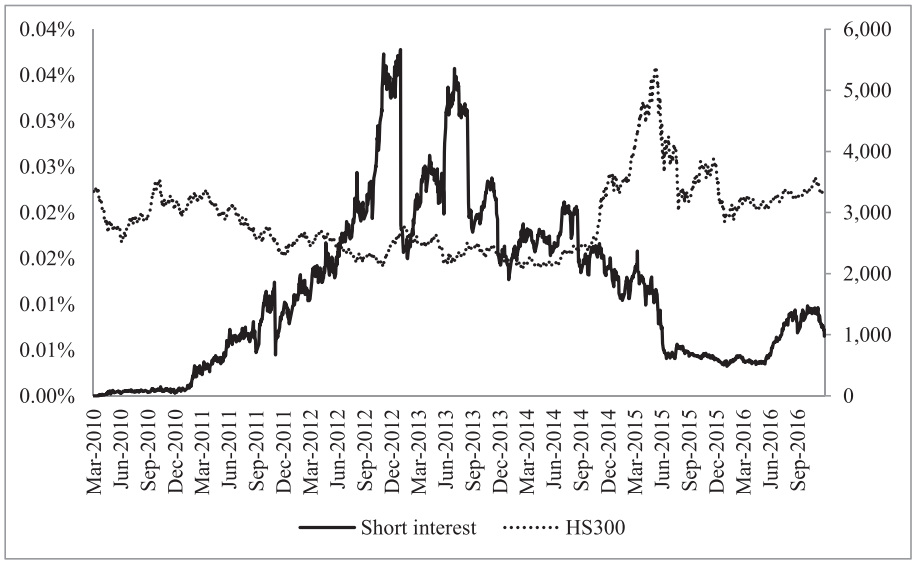

Fig. 2. HS300 index and average short interest for eligible stocks, March 2010 to December 2016.

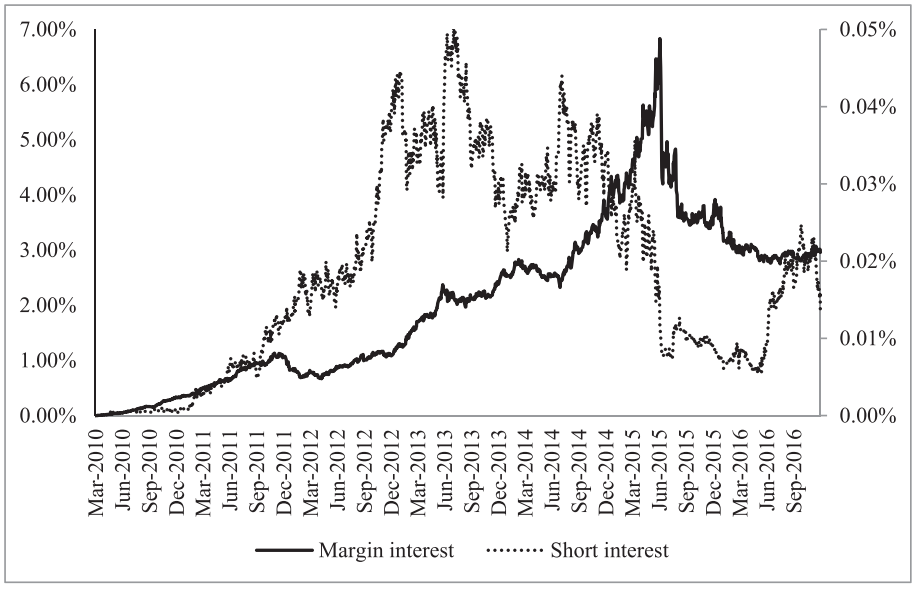

Fig. 3. Average margin interest and short interest for the 90 stocks that became leverage eligible on the March 31, 2010.

because of their high degree of skewness.

The regression results for Eq. (1), which are reported in Table 3, suggest that the eligible stocks are more liquid than the ineligible stocks. Columns 1 and 2 of Table 3 present the results for effective spread. In both columns, the coefficients of *Eligible* are significantly negative at the 1% level, and the magnitudes suggest that the effective spread is between 1.5% and 3.4% lower for eligible stocks, depending on whether we control the various influential stock-related characteristics. The coefficients on the control variables are also mostly consistent with our expectation. For instance, the index component stocks and stocks with larger market capitalization, greater trading volumes, or higher prices are more liquid, whereas the stocks with greater daily returns, larger volatilities, or concentrated ownership are less liquid. Stocks that reach the daily price limit also have lower liquidity. In Columns 3 and 4, we report the regression results using the daily value of Amihud's (2002) price impact measure of liquidity as the dependent variable. The results indicate that our conclusion that the eligible stocks have greater liquidity than the matched ineligible stocks still holds when we use a different measure of liquidity.

One may argue that liquid stocks are more likely to be included in the list of eligible stocks than the less liquid ones, and the negative coefficients on *Eligible* simply reflect this tendency. Indeed, although the criteria for selecting leverage eligible stocks are not directly based on liquidity, several stock characteristics included in the criteria set may be correlated with liquidity. To eliminate this possibility, we investigate whether the stocks that were newly added to the eligible list at the time when the list expanded experienced increased liquidity relative to the matched ineligible stocks. To this end, for each list expansion event, we use the stocks newly added to the eligible list as our treatment sample, and match the stock characteristics of the treatment stocks with ineligible stocks to form our control sample. We then run ordinary least squares regression of Eq. (1) on each day for the 360 days (i.e., event window is [-180, +180]) around the event dates.[5] Our purpose is to

[5] We do not include the expansion of eligible list on December 12, 2016 in Table 4's analysis, as our sample ends on December 31, 2016—19 days after this expansion. In addition, we drop the days between the announcement dates and

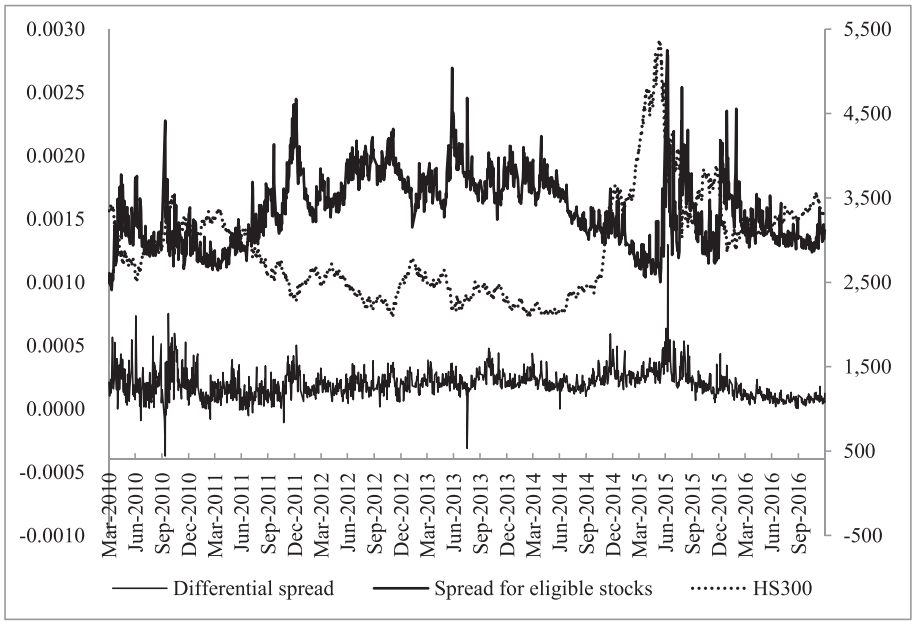

Fig. 4. HS300 index, effective spread for eligible stocks and differential spread between eligible and ineligible stocks, March 2010 to December 2016.

examine how the coefficient of *Eligible* changes from the pre-event to post-event period. A decreased coefficient suggests that the relative liquidity between the eligible stocks and matched ineligible stocks increased after the ban of leverage was lifted. To ensure a consistent sample before and after the lifting events, we use the average market capitalization, trading volume, and stock price in pre-event days to match ineligible stocks in the same industry, and keep the same ineligible stocks for days in the post-event period. In addition, we demean all the variables before running the regression to control the impact from time variation.

Table 4 reports the change of the *Eligible* coefficient for 180 days before and after every event. The *Eligible* coefficient reflects the marginal difference between the liquidity of stocks in the treatment and control groups after several stock characteristics are controlled. For example, Column 1 of Panel A in Table 4 shows that the characteristic-adjusted effective spread for stocks in the treatment group is 0.43% higher than that in the control group in the 180 days before February 22, 2010 (i.e., the announcement date for Event 1), but 1.22% higher in the 180 days after March 31, 2010 (i.e., the effective date for Event 1). In the first event, the *Eligible* coefficient increases by 0.79% when the restrictions for margin trading and short selling are removed. This is consistent with Sharif et al. (2014), who find that, for their sample including only the first 90 pilot stocks in the first expansion event, their liquidity relative to matched ineligible stocks and cross-listed H stocks decreases after the event. For the second list expansion event on December 5, 2011, the coefficient on *Eligible* is 5.07% lower than that in the control group before the lifting of constraints, yet only 3.30% lower after the event, which represents a 1.77% increase relative to the pre-event days. Both the coefficients on *Eligible* increase for Events 1 and 2, suggesting that liquidity for stocks in the treatment group actually declines compared with the control group after the events. This may be because the margin trading and short selling activities were not adequately established in the eligible stocks during the early period of the reform. Alternatively, it may be because of market participators' prudence in trading stocks affected by the new policy changes.

As suggested by Columns 3, 4, and 5 of Panel A in Table 4, the other three events that occurred later and involved a larger number of stocks display opposite patterns. Stocks in the treatment group enjoy increased liquidity relative to the control group after the margin trading and short selling activities are allowed. Column 6 indicates that, overall, being eligible for margin trading and short selling has positive impacts on a stock's liquidity. In the 180 days after being added to the eligible list, the coefficient on *Eligible* decreases by 0.92% and the difference is statistically significantly different from zero at 1% level. In Panel B of Table 4, we repeat the same analysis using *Pimpact* as the liquidity measure, and the results are qualitatively similar. Column 6 of Panel B in Table 4 shows that the coefficient on *Eligible* is 1.58% lower after the list expansion events. Overall, the results in Table 4 suggest that being able to use leverage in trading has positive impacts on stock liquidity.[6]

5. Marginal impacts on stock liquidity of margin trading and short selling activities

Given that eligible stocks have both margin trading and short selling activities, the results in Section 4 cannot indicate which of the two leverage trading activities contributes to the improved stock liquidity. Thus, in this section, we seek to identify the marginal effects of both margin trading and short selling, and investigate whether their impacts are similar. To do this, we regress the effective spread on the turnover of margin trading and short selling, as well as the control variables for the sample of eligible stocks with the following specification:

$$Liquidity_{it} = \alpha + \beta_1 \times Mturnover_{it} + \beta_2 \times Sturnover_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (2)$$

Mturnover and *Sturnover* represent the percentage of margin trading turnover and short selling turnover, respectively. *X* represents the control variables. As in previous analyses, we control the firm and time

(*footnote continued*)
effective dates to avoid any impacts from the market reactions to the announcements themselves.

[6] This result is consistent with Li, Lin, Zhang, and Chen (2018), who use a regression analysis to determine that the relative liquidity for 700 eligible stocks in earlier events increases relative to the matched ineligible stocks after the event dates. However, Li, Lin, et al. (2018) attributes the increased liquidity in the eligible stocks to the lifting of short selling restrictions only. In contrast, we believe that the change of liquidity is caused by the lifting of leverage bans (i.e., both margin trading and short selling) in general. Thus, we perform further analyses in the following sections to determine the marginal impacts from margin trading and short selling activities.

Table 3
Impacts of leverage trading eligibility on stock liquidity.

	Espread		Pimpact	
	(1)	(2)	(3)	(4)
Constant	-3.685***	-1.057***	-18.383***	-2.424***
	(-95.30)	(-8.64)	(-186.87)	(-8.70)
Eligible	-0.034***	-0.015***	-0.083***	-0.018**
	(-5.82)	(-3.56)	(-4.80)	(-2.26)
Lag Espread	0.433***	0.342***		
	(72.96)	(72.49)		
Lag Pimpact			0.199***	0.040***
			(46.32)	(15.61)
Size		-0.089***		-0.377***
		(-14.90)		(-26.36)
Volatility20		0.040***		0.212***
		(13.15)		(18.61)
Volume		-0.028***		-0.525***
		(-14.24)		(-60.90)
Price		-0.186***		-0.111***
		(-24.47)		(-11.46)
Return		0.001***		0.038***
		(3.04)		(8.07)
OwnCon		0.048***		0.152***
		(15.51)		(23.96)
HS300		-0.044***		-0.004
		(-7.88)		(-0.34)
PL		0.134***		0.812***
		(15.31)		(26.81)
Observations	1,395,468	1,395,468	1,395,468	1,395,468
Adj_R^2	0.610	0.636	0.461	0.543

Notes: This table reports the results for the impacts on stock liquidity of *Eligible*, which equals 1 if the stock is an eligible stock and 0 otherwise. *Espread* is the daily value of effective spread for a stock. *Pimpact* is the ratio of daily absolute return to the daily trading volume in RMBs. *Size* is the market capitalization for a stock at day *t*. *Volatility*20 is the standard deviation of daily stock returns in the previous 20 trading days. *Price* is the closing stock price at day *t*. *Return* is the percentage of daily stock return at day *t*. *Volume* is the trading volume in RMBs. *OwnCon* is the percentage of ownership held by the largest 10 shareholders. *HS*300 and *PL* are dummy variables that indicate whether a stock is a component stock for the HS300 Index and whether a stock reaches price limit at day *t*, respectively. All variables except *Return*, *HS*300, *PL*, and *Eligible* are in the form of natural logarithm. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firm and date. * Indicates significance at the 10% level. *t*-statistics are in parentheses. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

fixed effects, and calculate t-values with the standard errors clustered by both firm and date (Thompson, 2011). In Columns 1 and 2 of Table 5, we regress *Espread* and *Pimpact* against the contemporaneous turnover of margin trading and short selling activities. Column 1 of Table 5 shows that margin trading and short selling activities actually have opposite impacts on the effective spread. For example, the coefficient on margin trading turnover (*Mturnover*) is -0.001 and significantly negative at 1% level. A 10% increase in an eligible stock's margin trading turnover can decrease the effective spread by 1%. The marginal impact of short selling turnover (*Sturnover*) on liquidity is economically stronger than that of the margin trading. The coefficient on short turnover is 0.002 at 10% significance level. A 10% increase in an eligible stock's short selling turnover can increase the effective spread by 2%. When using the price impact illiquidity measure, the results are qualitatively similar, except that the impact of short selling turnover is statistically more significantly different from zero.

In Columns 3 and 4, we also obtain similar conclusions when regressing the liquidity measures against the lagged value of margin trading and short selling turnover. Overall, we find that margin trading activities tend to increase stock liquidity, whereas short selling activities tend to reduce stock liquidity. In addition, the reduction of liquidity caused by the short selling turnover is more than the increase of liquidity caused by the same amount of margin trading turnover. From Panel B of Table 2, we see that the turnover of margin trading is around 27 times that of short selling. Therefore, the impacts of margin trading dominate that of short selling, causing the liquidity of eligible stocks to improve. This is consistent with our results in Section 4.

6. Impacts of margin trading and short selling on liquidity: mechanisms

In this section, we aim to investigate why the margin trading and short selling activities may impact stock liquidity differently. Logically, when traders can use leverage through either margin trading or short selling, they have greater ability to provide liquidity to the stock market, which may increase the competition in liquidity provision and hence cause trading activity to improve (e.g., Alexander et al., 2004; Brunnermeier and Pedersen, 2009; Lensberg et al., 2015). Nevertheless, with an increased ability to provide liquidity, leveraged investors' trading strategies are also crucial in deciding whether they act as liquidity providers or liquidity demanders. For example, Kahraman and Tookes (2017) discover that, except in crisis periods or when stock returns become very negative, margin traders in Indian equity markets are, on average, contrarian traders who buy (sell) when stock prices decline (increase). This explains their contribution to stock liquidity during ordinary periods.

The impact of short selling on liquidity is more ambiguous than the impacts of margin trading on liquidity. Diamond and Verrecchia (1987) argue that short sellers are more likely to be informed, as they will never initiate a short sale for liquidity reasons. As a consequence, short sale constraints, by preventing informed traders from trading on negative information, reduce the speed of price discovery and the informativeness of stock prices. This subsequently increases the risk of investing in the stock for uninformed liquidity providers, and hence increases the bid–ask spread (Diamond and Verrecchia, 1987). According to this argument, allowing short selling activities could increase liquidity by reducing the bid–ask spread for the shortable stocks. However, from another perspective, if short sellers are indeed more informed than other investors, short selling activities will also increase the risk of adverse selection that liquidity providers may face in shortable stocks, which will increase their bid–ask spread (Boehmer et al., 2013). Similarly, when extending the one asset sequential trading model in Diamond and Verrecchia (1987) to a multiple-asset setting, Cai et al., 2019 argue that, when shortable and non-shortable stocks coexist in a market, uninformed traders may switch their investments to non-shortable stocks to avoid trading against informed traders in shortable stocks, thereby causing a higher spread for the shortable stocks. In summary, the various offsetting mechanisms at work may cause the overall impact of short selling activities to be positive, negative, or insignificant.

To understand the opposite effects of margin trading and short selling discovered in our sample, we perform some analyses to address the following questions: (1) What are the trading strategies of margin traders and short sellers in our sample? (2) Are short sellers and margin traders informed investors in our sample? (3) Are the impacts of short selling activities on liquidity similar across firms with varying degrees of information asymmetry?

6.1. Trading strategies of margin traders and short sellers

We investigate the trading strategies for margin traders and short sellers to examine whether their access to leverage has been transformed to trading behaviors that have implications for stock liquidity. In the spirit of Diether et al. (2008), we seek to understand margin traders' and short sellers' response to short-term stock returns, price pressures, and stock price uncertainty. In particular, we seek to determine whether margin traders and short sellers are momentum traders or contrarian traders, whether they voluntarily provide liquidity

Table 4
Change of *Eligible* coefficient before and after list expansion events.

	(1)	(2)	(3)	(4)	(5)	(6)
	1st expansion Mar 31, 2010	2nd expansion Dec 5, 2011	3rd expansion Jan 31, 2013	4th expansion Sep 16, 2013	5th expansion Sep 22, 2014	All expansion events
No. of newly added stocks	90	188	222	200	200	900
Panel A: *Espread* as the measure of liquidity						
Days (-180, -1)	0.0043	-0.0507***	-0.0125***	0.0054*	-0.0250***	-0.0158***
	(0.66)	(-17.65)	(-5.55)	(1.82)	(-7.98)	(-9.48)
Days (+1, +180)	0.0122**	-0.0330***	-0.0293***	-0.0309***	-0.0439***	-0.0250***
	(2.35)	(-12.29)	(-14.17)	(-10.52)	(-12.57)	(-16.55)
Diff	0.0079	0.0177***	-0.0168***	-0.0364***	-0.0189***	-0.0092***
	(0.94)	(4.49)	(-5.49)	(-8.69)	(-4.04)	(-4.09)
Panel B: *Pimpact* as the measure of liquidity						
Days (-180, -1)	-0.0498***	-0.0299***	-0.0910***	-0.0383***	-0.0701***	-0.0559***
	(-3.58)	(-3.47)	(-10.99)	(-4.20)	(-7.85)	(-12.25)
Days (+1, +180)	-0.0405***	-0.0043	-0.1296***	-0.1141***	-0.0708***	-0.0717***
	(-3.03)	(-0.53)	(-15.87)	(-12.86)	(-7.38)	(-15.36)
Diff	0.0093	0.0255***	-0.0386***	-0.0757***	-0.0007	-0.0158**
	(0.48)	(2.16)	(-3.32)	(-5.95)	(-0.05)	(-2.42)

Notes: This table reports the change of *Eligible* coefficient for OLS regression in Eq. (1) in both the 180 days before and 180 days after the leverage trading eligibility expansion events. Panel A reports the results when liquidity is measured with effective spread, and Panel B reports the results when liquidity is captured with Amihud's (2002) price impact measure. All variables are demeaned in running the regressions. *t*-statistics are in parentheses. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

when stock prices are under buying (selling) pressure, and what their trading behaviors are during periods of elevated uncertainty.

To this end, in Table 6, we regress the daily turnover of margin trading or short selling against the stock's contemporaneous return, price pressure, and intraday volatility with the following specifications:

$$Mturnover_{it} = \alpha + \beta_1 \times Return_{it} + \beta_2 \times Spressure_{it} + \beta_3 \times HL_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (3)$$

$$Sturnover_{it} = \alpha + \beta_1 \times Return_{it} + \beta_2 \times Bpressure_{it} + \beta_3 \times HL_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (4)$$

The daily price pressure (*Ppressure*) is captured by the difference between the percentage buyer-initiated orders and percentage seller-initiated orders. The percentage buyer (seller)–initiated orders are defined as the RMB value of limit buyer (seller) orders with quote prices greater (lower) than or equal to the lowest (highest) ask (bid) price, divided by the stock's market capitalization. In Columns 1 to 3, when examining the margin investors' trading strategies, we include a variable (*Spressure*) that equals the absolute value of price pressure if it is negative, and 0 otherwise. This variable captures the degree of selling pressure (i.e., sell–order imbalance) and we wish to know whether margin investors increase their activities under such pressure of declining prices. Alternatively, in Columns 4 to 6, we include a measure (*Bpressure*) of buying pressure (i.e., buy–order imbalance) that equals the price pressure if it is positive, and 0 otherwise, when the dependent variable is the short seller's activities. The intraday volatility (*HL*) for each stock on each day is calculated as the difference between daily high price and daily low price, divided by the daily low price. *X* represents a range of control variables that we will explain later. The panel regressions in Table 6 also include firm and day fixed effects. In addition, we estimate standard errors that cluster by both stock and date (Thompson, 2011).

In Column 1 of Table 6, we report the result of Eq. (3) with no control variables. The negative coefficient on *Return* indicates that, consistent with the findings in Kahraman and Tookes (2017), margin investors tend to be contrarian traders, as they reduce their activities when stock price increases. The coefficient implies that a return of 10% results in a decrease of margin trading turnover of 0.5% for stocks in our sample. In addition to providing liquidity as contrarian traders, the significantly positive coefficient on *Spressure* suggests that margin investors also step in as voluntary liquidity providers when the selling pressure is high. Possibly, they increase their trading when the sell–order imbalance is high, expecting to benefit from the price recovery that they anticipate will occur in the near future.[7] Finally, the negative coefficient on *HL* shows that, in stocks with elevated uncertainty, margin trading activities decreases.

Margin trading activities and stock return may both be autocorrelated. To account for this, following Diether et al. (2008), in Column 2 of Table 6, we add lagged margin trading turnover (*Mturnover_t5_t1*), lagged total turnover (*Turnover_t5_t1*), and lagged returns (*Return_t5_t1*) over the past five days on the right-hand side. We also include lagged selling pressure (*Spressure_t5_t1*) and lagged measure of uncertainty (*HL_t5_t1*) during the past five days in the regression. In Column 3, we add the set of stock characteristic variables used in previous analysis as additional control variables. None of these additions change the signs or significance levels for the coefficients on *Return*, *Spressure*, or *HL* in Column 1. Margin traders remain contrarian traders who voluntarily provide liquidity when selling pressure is high. In general, the behavior of margin traders is consistent with the results in Section 4, where we find that margin trading improves stock liquidity.

The short sellers' trading strategies can be seen from Columns 4 to 6 of Table 6. Similar to the margin traders, the short sellers in our sample are also contrarian traders. This result is consistent with the trading behavior of short sellers found in several previous studies (e.g., Boehmer and Wu, 2012; Dechow et al., 2001; Diether et al., 2008). The significantly positive coefficients on *Return* in Columns 4 to 6 show that they increase their short selling activities when stock prices increase, and decrease their short selling activities when stock prices decrease.[8] Thus, similar to margin traders, this trading strategy of short sellers

[7] Given that the coefficient on contemporaneous return is significantly negative, we need not worry about the impacts from the reversed relation, as greater margin trading positively influences the stock prices.

[8] Given that the coefficient on contemporaneous return is significantly positive, we need not worry about the impacts from the reversed relation, as greater short selling negatively influences the stock prices.

Table 5
Impact of margin trading and short selling turnover on stock liquidity.

	Espread	Pimpact	Espread	Pimpact
	(1)	(2)	(3)	(4)
Constant	-1.424***	-2.934***	-1.454***	-3.198***
	(-7.41)	(-5.56)	(-7.56)	(-6.09)
Mturnover	-0.001***	-0.005***		
	(-7.44)	(-11.38)		
Sturnover	0.002*	0.032***		
	(1.66)	(6.66)		
Lag Mturnover			-0.001***	-0.002***
			(-3.29)	(-3.94)
Lag Sturnover			0.003**	0.100**
			(2.46)	(2.44)
Lag Espread	0.332***		0.332***	
	(45.24)		(45.17)	
Lag Pimpact		0.042***		0.043***
		(12.20)		(12.58)
Size	-0.073***	-0.387***	-0.072***	-0.375***
	(-7.79)	(-14.44)	(-7.71)	(-14.10)
Volatility20	0.052***	0.189***	0.052***	0.194***
	-13.15	(13.36)	(13.23)	(13.66)
Volume	-0.020***	-0.476***	-0.020***	-0.476***
	(-7.63)	(-46.16)	(-7.58)	(-46.02)
Price	-0.252***	-0.183***	-0.252***	-0.183***
	(-19.24)	(-9.61)	(-19.19)	(-9.66)
Return	0.001**	0.027***	0.001***	0.029***
	(2.17)	(5.08)	(2.74)	(5.36)
OwnCon	0.038***	0.172***	0.038***	0.168***
	(8.04)	(15.47)	(7.99)	(15.14)
HS300	-0.044***	-0.034**	-0.044***	-0.019
	(-6.58)	(-2.38)	(-6.67)	(-1.31)
PL	0.125***	0.803***	0.125***	0.801***
	(12.58)	(22.03)	(12.57)	(22.06)
Observations	751,415	751,415	750,810	750,810
Adjusted R^2	0.698	0.579	0.698	0.578

Notes: This table reports the results for the impacts of margin trading turnover and short selling turnover on stock liquidity for the sample of leverage trading eligible stocks. *Mturnover* and *Sturnover* represent the percentage of margin trading turnover and short selling turnover, respectively. *Espread* is the daily value of effective spread for a stock. *Pimpact* is the ratio of daily absolute return to the daily trading volume in RMBs. *Size* is the market capitalization for a stock at day *t*. *Volatility*20 is the standard deviation of daily stock returns in the previous 20 trading days. *Price* is the closing stock price at day *t*. *Return* is the percentage of daily stock return at day *t*. *Volume* is the trading volume in RMBs. *OwnCon* is the percentage of ownership held by the largest 10 shareholders. *HS*300 and *PL* are dummy variables that indicate whether a stock is a component stock for the HS300 Index and whether a stock reaches price limit during day *t*, respectively. All variables except *Return*, *HS*300, *PL*, *Mturnover*, and *Sturnover* are in the form of natural logarithm. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firm and date. *t*-statistics are in parentheses. * Indicates significance at the 10% level. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

provides liquidity, instead of demand liquidity. In addition, coefficients on *Bpressure* show that short sellers also increase their activities when the buy–order imbalance is high. Thus, they also provide liquidity when the immediacy of trading is needed. Unlike margin traders, who reduce activities in times of elevated uncertainty, short sellers step in as opportunistic risk-bearers and increase their trading on such days. Overall, the trading strategies of short sellers revealed in Columns 4 to 6 of Table 6 suggest that their trading behavior tends to provide liquidity, instead of demand liquidity. This is inconsistent with the empirical evidence reported in Section 4; thus, the trading strategies of short sellers cannot explain why the short selling turnover reduces stock liquidity.[9]

[9] Using the 278 eligible stocks that had leveraged trading constraints lifted between 2010 and 2011, Chang et al. (2014) also investigate the trading strategies for margin traders and short sellers in Chinese markets. Our results are generally consistent with those in Chang et al., except that Chang et al. do not find that short sellers increase their activities when sell–order imbalance is high. This difference is possibly caused by the different (i.e., increased) sample of eligible stocks in our study.

6.2. Return predictive power of margin trading and short selling activities

A number of articles have found that short sellers are informed investors who can predict future stock returns (e.g., Anderson et al., 2012; Boehmer et al., 2008; Desai et al., 2002; Lynch et al., 2014). In the Chinese stock market, Chang et al. (2014) and Li et al. (2018b) suggest that short sellers in China are likely to be informative investors. Chen et al. (2016) find that margin trading is associated with an improved information environment on days around good news, and short selling is associated with an improved information environment on days around bad news.

To determine whether the margin traders and short sellers are informed traders in our sample, we regress the stock return against the change of margin (*Chmargin*) and short interest (*Chshort*) to examine whether leveraged traders can foresee stock price movements. To avoid the impact of short-term reversals, we skip day $t + 1$, and regress returns on day $t + 2$ against the change of margin and short positions on day t with the following specification:

$$Return_{it+2} = \alpha + \beta_1 \times Chmargin_{it} + \beta_2 \times Chshort_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (5)$$

The results are reported in Table 7. In Column 1, we report the regression results without any other explanatory variables. We can see that the coefficient of the change of short interests is significantly negative, whereas that of the change of margin interest is not, thereby suggesting that only short sellers can predict the movements of future returns. In Section 6.1, we discover that both margin traders and short sellers are voluntary liquidity providers, who improve their position at the time when buying or selling pressure appears. Given that stock returns may return to their long-term level when the liquidity demand shock caused by the pricing pressure subsides, we control price pressure (*Ppressure*) in Column 2 of Table 7 to eliminate the possibility that the association between short selling and return is due to traders' voluntary liquidity providing. In addition, short sellers increase their activities in periods of heightened uncertainty. When the reasons behind the increased uncertainty ease, stock price is likely to recover and cause association between short selling activity and future return. As such, we also control (*HL*) in Column 2. In addition, in the same specification, we add past returns (*Return*_t5_t1) and past turnover (*Turnover*_t5_t1) to control the impact from weekly return reversal and the relation between turnover and return. In Column 3, we include other firm characteristics as the explanatory variables. The coefficients on *Chshort* remain significantly negative and those on *Chmargin* remain insignificant in both columns. The coefficient on *Chshort* is -1.967 in Column 3, suggesting that a 1% increase in the short interest could predict a close to 2% decline in stock return two days hence.

Finally, we also investigate whether short sellers' predictive power on future return still exists when the investment horizon extends from one day to one week. In Column 4, we regress the average daily return for days between $t + 2$ and $t + 6$ against the change of short and margin positions. We can see that, although both economic significance and statistical significance decline for the coefficient of *Chshort* in Column 4, the short sellers still predict returns for the next week. Overall, the results in Table 7 indicate that the short sellers in our sample seem to be able to detect when the stock price exceeds the fundamental value, whereas margin traders cannot. These results are consistent with many studies in both emerging and developed markets that find that short sellers are informed traders (e.g., Anderson et al.,

Table 6
Trading strategies of margin traders and short sellers.

	Mturnover			Sturnover		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	17.850***	6.139***	17.174***	0.622***	0.051***	-0.881***
	(356.41)	(62.23)	(11.12)	(50.61)	(6.88)	(-4.70)
Return	-0.050***	-0.059***	-0.056***	0.016***	0.018***	0.019***
	(-5.30)	(-6.99)	(-6.48)	(8.19)	(12.46)	(11.83)
Spressure	0.030***	0.027***	0.027***			
	(13.47)	(15.26)	(14.66)			
Bpressure				0.009***	0.008***	0.008***
				(14.70)	(19.22)	(19.00)
HL	-0.229***	-0.224***	-0.206***	0.013***	0.013***	0.017***
	(-16.79)	(-25.18)	(-21.06)	(4.13)	(8.82)	(10.62)
Return_t_5_t_1		0.097***	0.100***		-0.040***	-0.039***
		(7.34)	(7.43)		(-16.99)	(-16.21)
HL_t_5_t_1		0.083***	0.092***		-0.002	-0.003
		(6.72)	(6.91)		(-1.10)	(-1.13)
Spressure_t_5_t_1		-0.033***	-0.036***			
		(-14.20)	(-15.32)			
Bpressure_t_5_t_1					-0.006***	-0.006***
					(-14.20)	(-13.83)
Turnover_t_5_t_1		0.049***	0.067***		0.004***	0.007***
		(5.21)	(6.42)		(4.39)	(6.16)
Mturnover_t_5_t_1		0.673***	0.671***			
		(142.46)	(139.03)			
Sturnover_t_5_t_1					0.853***	0.840***
					(146.81)	(132.92)
Size			-0.366***			0.060***
			(-5.23)			(6.60)
Volatility20			0.096**			0.014**
			(2.27)			(2.19)
Volume			-0.104***			-0.025***
			(-3.21)			(-5.69)
Price			-0.038			-0.003
			(-0.53)			(-0.36)
OwnCon			0.154***			-0.018***
			(3.86)			(-4.04)
HS300			0.024			0.116***
			(0.42)			(15.01)
PL			-0.129			-0.080***
			(-1.60)			(-3.96)
Observations	768,630	768,630	768,630	768,630	768,630	768,630
Adjusted R^2	0.615	0.703	0.703	0.538	0.762	0.762

Notes: This table displays the regression results for Eqs. (3) and (4) for the sample of eligible stocks. *Mturnover* and *Sturnover* represent the percentage of margin trading turnover and short selling turnover, respectively. *Spressure* is the absolute value of the difference between percentage buyer-initiated orders and percentage seller-initiated orders when the difference is negative at day *t*, and 0 otherwise. *Bpressure* is the difference between percentage buyer-initiated orders and percentage seller-initiated orders when the difference is positive at day *t*, and 0 otherwise. *HL* is percentage form of the daily high price minus daily low price divided by the daily low price at day *t*. *Return* is the percentage of daily stock return at day *t*. *Turnover* is the percentage form of turnover of the stock at day *t*. Variables with t_5_t_1 are the average values of relevant variables during day $t-5$ to day $t-1$. *Size* is the market capitalization for a stock at day *t*. *Volatility*20 is the standard deviation of daily stock returns in the previous 20 trading days. *Price* is the closing stock price at day *t*. *Volume* is the trading volume in RMBs. *OwnCon* is the percentage of ownership held by the largest 10 shareholders. *HS*300 and *PL* are dummy variables that indicate whether a stock is a component stock for the HS300 Index and whether a stock reaches price limit during day *t*, respectively. Variables *Size*, *Volatility*20, *Price*, *OwnCon*, and *Volume* are in the form of natural logarithm. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firm and date. *t*-statistics are in parentheses. * Indicates significance at the 10% level. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

2012; Boehmer et al., 2008; Chang et al., 2014; Deng and Gao, 2018; Desai et al., 2002; Li et al., 2018b) and with Chang et al.'s (2014) finding that margin traders cannot predict future returns in China.

6.3. Cross-firm analysis on impacts of margin trading and short selling activities on stock liquidity

The evidence that short sellers are informed traders supports the evidence that short selling activities are associated with reduced stock liquidity. It is possible that the liquidity providers for the shortable stocks demand a higher bid–ask spread because of the risk of adverse selection. The result is also consistent with the theoretical prediction in Cai et al. (2019), whereby uninformed traders for shortable stocks shift their investment to non-shortable stocks to avoid trading against informed short sellers, which has a detrimental effect on the liquidity of shortable stocks. However, these results are not consistent with Diamond and Verrecchia (1987), who argue that, because of increasing the speed of price adjustment, short selling activities should reduce bid–ask spread. This is possibly because the mechanism argued in Diamond and Verrecchia (1987) is only strong enough to offset the negative impacts of short selling with regard to negative information. We will return to this issue in Section 7.

In this section, we aim to provide further evidence to support the conjecture that short selling activities reduce liquidity in our sample mainly because short sellers are informed traders. If this is true, we expect to find that the detrimental impact of short selling activities on stock liquidity is strongest among firms with greater information asymmetry. In such firms, non-informed traders face greater disadvantages in terms of trading against informed traders; thus, they demand a higher bid–ask spread to compensate for this risk. To test this

Table 7
Predictability of margin position and short position on stock return.

	(1)	(2)	(3)	(4)
Constant	0.091***	0.078**	8.121***	7.621***
	(218.49)	(2.22)	(11.14)	(13.91)
Chmargin	0.062	0.047	0.046	0.032
	(1.29)	(0.94)	(0.90)	(1.36)
Chshort	-2.897***	-1.876*	-1.967**	-0.863*
	(-2.78)	(-1.84)	(-1.96)	(-1.70)
Ppressure		-0.349***	-0.300***	-0.085***
		(-6.31)	(-5.21)	(-2.65)
HL		1.171	2.361**	1.301***
		(1.46)	(2.52)	(2.72)
Return_t_5_t_1		-0.021	-0.015	-0.004
		(-1.19)	(-0.84)	(-0.43)
Turnover_t_5_t_1		-2.092***	-0.988	-1.447***
		(-2.70)	(-1.06)	(-3.09)
Size			-0.281***	-0.284***
			(-7.45)	(-10.38)
Volatility20			0.063*	0.023
			(1.74)	(1.30)
Volume			-0.046*	-0.025*
			(-1.87)	(-1.88)
Price			-0.132***	-0.123***
			(-4.64)	(-6.00)
OwnCon			0.081***	0.079***
			(5.37)	(6.29)
HS300			-0.053**	-0.045**
			(-2.03)	(-2.56)
PL			0.004	-0.030
			(0.03)	(-0.51)
Observations	765,500	765,500	765,500	743,045
Adjusted R^2	0.472	0.472	0.473	0.497

Notes: This table reports the regression results for Eq. (5). In columns (1), (2), and (3), the dependent variable is the stock return at day $t + 2$. In column (4), the dependent variable is the average daily stock return between day $t + 2$ and $t + 6$. *Chmargin* and *Chshort* are the percentage change of margin interest and short interest at day *t*. *Ppressure* is the difference between percentage buyer-initiated orders and percentage seller-initiated orders at day *t*. *HL* is the percentage of daily high price minus daily low price divided by the daily low price at day *t*. *Turnover* is the percentage form of turnover of the stock at day *t*. Variables with t_5_t_1 are the average values of relevant variables during day $t - 5$ to day $t - 1$. *Size* is the market capitalization for a stock at day *t*. *Volatility*20 is the standard deviation of daily stock returns in the previous 20 trading days. *Price* is the closing stock price at day *t*. *Volume* is the trading volume in RMBs. *OwnCon* is the percentage of ownership held by the largest 10 shareholders. *HS*300 and *PL* are dummy variables that indicate whether a stock is a component stock for the HS300 Index and whether a stock reaches price limit during day *t*, respectively. Variables *Size*, *Volatility*20, *Price*, *OwnCon*, and *Volume* are in the form of natural logarithm. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firms and dates. *t*-statistics are in parentheses. * Indicates significance at the 10% level. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

hypothesis, we divide our sample of eligible stocks into three groups (Groups 1, 2, and 3) with different levels of information asymmetry, and examine the marginal impacts of short selling across different groups of stocks. We use firm size, institutional ownership, and analyst coverage to proxy for the level of information asymmetry, with the assumption that stocks with smaller size, lower institutional ownership, or fewer analyst reports have greater problems with information asymmetry. To estimate whether the impacts of leveraged trading on effective spread differ across firms with varying degrees of information asymmetry, we estimate the following specification:

$$\begin{aligned} Espread_{it} &= \alpha + \beta_1 \times Mturnover_{it} + \beta_2 \times Group2_{it} \times Mturnover_{it} \\ &\quad + \beta_3 \times Group3_{it} \times Mturnover_{it} \\ &\quad + \theta_1 \times Sturnover_{it} + \theta_2 \times Group2_{it} \times Sturnover_{it} \\ &\quad + \theta_3 \times Group3_{it} \times Sturnover_{it} + \gamma \times X_{it} + \varepsilon_{it} \end{aligned} \quad (6)$$

In Eq. (6), *Group* 2 and *Group* 3 equal 1 if the stock belongs to Groups 2 or 3, and 0 otherwise. X represents the set of firm characteristics, including size, return, price, volume, volatility, ownership concentration, HS300 dummy, price limit dummy, and lagged value of effective spread. In Eq. (6), the coefficients β_1 and θ_1 represent the impacts of margin trading and short selling activities on stock liquidity in Group 1 stocks, while β_2, β_3, θ_2, and θ_3 represent the differential impacts in Group 2 or 3 stocks. Our focus in this regression is not only β_1 and θ_1, but also $\beta_1 + \beta_2$ (marginal effect of margin trading turnover on liquidity in Group 2 stocks), $\beta_1 + \beta_3$ (marginal effect of margin trading turnover on liquidity in Group 3 stocks), $\theta_1 + \theta_2$ (marginal effect of short selling turnover on liquidity in Group 2 stocks), and $\theta_1 + \theta_3$ (marginal effect of short selling turnover on liquidity in Group 3 stocks). Similar to previous regression analysis, we include firm and time fixed effects and calculate standard errors clustered by firm and date.[10]

In Table 8, we report these important coefficients in the relevant regressions. For brevity, we do not report the coefficients for other control variables. In Column 1 of Table 8, stocks are divided into three groups (Groups 1, 2, and 3) based on the market capitalization of the stock at day *t*. Group 1 includes one-third of the stocks with the smallest market capitalization, and Group 3 includes one-third of the stocks with the largest market capitalization. The negative coefficient of β_1 and positive coefficient of θ_1 in Column 1 indicate that, for Group 1 stocks, margin trading turnover increases liquidity and short selling turnover decreases liquidity. Both impacts are statistically significantly different from zero at 1% level. However, for Group 2 and 3 stocks, as indicated by coefficients $\beta_1 + \beta_2$ and $\beta_1 + \beta_3$, the impacts of margin trading turnover on stock liquidity are still significantly different from zero at 1%. However, coefficients $\theta_1 + \theta_2$ and $\theta_1 + \theta_3$ show that short selling turnover's impact on stock liquidity is not statistically significantly different from zero in Group 2 and 3 stocks. Therefore, short selling activities only reduce stock liquidity in the smallest stocks that suffer from greater information asymmetry.

In Column 2, we divide stocks into three groups with different levels of institutional ownership, with the assumption that firms held by fewer institutional investors have greater information asymmetry. In general, we find similar evidence to Column 1—that is, the impacts of short selling on stock liquidity mainly concentrate in stocks with lower institutional ownership, and hence greater information asymmetry. In Column 3, we merge the monthly data on the number of released reports by analysts with the daily trading data, and allocate stocks with no released analyst report at day *t* to Group 1. We then divide the remaining stocks equally into two groups, with Group 2 containing stocks with fewer analyst reports and Group 3 containing stocks with more reports. We find that short selling activities reduce stock liquidity only in the group of stocks with no analyst reports revealing firm-specific information. In other stocks for which more information is available, short selling's impacts are not statistically significantly different from zero. Overall, Table 8's results are consistent with the hypothesis that short sellers reduce stock liquidity because they are informed traders, and bid–ask spread increases for shortable stocks because of the greater risk of adverse selection that uninformed investors may face.

[10] We do not include *Group* 2 or *Group* 3 dummy variables in Eq. (6), as we have included firm fixed effect.

Table 8
Impacts of margin trading and short selling activities on stock liquidity in firms with different levels of information asymmetry.

	Firm size	Institutional ownership	No. analyst reports
	(1)	(2)	(3)
β_1	-0.093***	0.033	-0.054***
	(-3.90)	(1.41)	(-2.68)
θ_1	0.594***	0.444**	0.424***
	(2.59)	(2.25)	(2.78)
β_2	-0.119***	-0.108***	-0.132***
	(-3.36)	(-3.32)	(-5.21)
β_3	-0.036	-0.361***	-0.258***
	(-0.93)	(-10.23)	(-7.92)
θ_2	-0.354	-0.402	-0.457***
	(-1.15)	(-1.57)	(-2.74)
θ_3	-0.608**	-0.479	-0.269
	(-2.05)	(-1.56)	(-1.21)
$\beta_1 + \beta_2$	-0.212***	-0.076***	-0.186***
	(-7.36)	(-2.92)	(-7.02)
$\beta_1 + \beta_3$	-0.129***	-0.328***	-0.312***
	(-4.16)	(-11.68)	(-10.29)
$\theta_1 + \theta_2$	0.240	0.042	0.033
	(1.11)	(0.22)	(0.18)
$\theta_1 + \theta_3$	-0.014	-0.035	0.155
	(-0.08)	(-0.14)	(0.74)
Observations	789,126	789,126	789,126
Adjusted R^2	0.720	0.716	0.724

Notes: This table reports the important regression coefficients from Eq. (6). In column (1), Group 1 in Eq. (6) includes one-third of the stocks with the smallest market capitalization, and Group 3 includes one-third of the stocks with the largest market capitalization. In column (2), Group 1 includes one-third of the stocks with the lowest level of institutional ownership, and Group 3 includes one-third of the stocks with the highest level of institutional ownership. In column (3), Group 1 includes stocks with zero analyst reports, Group 2 includes stocks with a lower number of analyst reports, and Group 3 includes stocks with a greater number of analyst reports. The coefficients β_1 and θ_1 represent the impacts of margin trading and short selling activities on stock liquidity in Group 1 stocks, while β_2, β_3, θ_2, and θ_3 represent the differential impacts in Group 2 or Group 3 stocks than in Group 1 stocks. $\beta_1 + \beta_2$ represents the marginal effect of margin trading turnover on liquidity in Group 2 stocks, $\beta_1 + \beta_3$ represents the marginal effect of margin trading turnover on liquidity in Group 3 stocks, $\theta_1 + \theta_2$ represents the marginal effect of short selling turnover on liquidity in Group 2 stocks, and $\theta_1 + \theta_3$ represents the marginal effect of short selling turnover on liquidity in Group 3 stocks. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firms and dates. *t*-statistics are in parentheses.* Indicates significance at the 10% level. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

7. Impacts of leveraged trading under different market conditions

In this section, we examine the asymmetric impacts of leveraged trading on stock liquidity in different market conditions. The theoretical model established in Brunnermeier and Pedersen (2009) suggests that funding constraints on traders have great implications for stock liquidity during severe market downturns when deleverage occurs. Empirically, Kahraman and Tookes (2017) confirm the asymmetric impacts of margin trading on liquidity. During crises, instead of increasing stock liquidity, margin trading activities actually reduce liquidity because of forced deleverage. However, the asymmetric impact of short selling on liquidity under different market conditions has not been tested. According to Diamond and Verrecchia (1987), by reducing the speed of stock price adjusting to information and converging to fundamental value, short sale constraints increase the bid–ask spread. In addition, Diamond and Verrecchia (1987) suggest that such impacts should be more pronounced in the case of bad news than good news. In Section 5, we discover that short selling activities actually reduce stock liquidity, thereby suggesting that the positive impact of short selling on liquidity argued by Diamond and Verrecchia (1987) is insufficient to offset the negative impacts caused by the increased risk of informed trading. However, because the mechanism suggested by Diamond and Verrecchia (1987) should be stronger in negative market conditions when bad news dominates, the overall impact of short selling on stock liquidity may differ during downturns than during ordinary market conditions.

We begin our analysis of the asymmetric impact of leveraged trading by examining whether eligible stocks have greater or less liquidity than ineligible stocks during market downturns. To Eq. (1), we add a dummy variable, *Downturn*, which stands for the negative market conditions, as well as the interaction term, *Eligible* × *Downturn*, to capture the differential impact of eligible status on stock liquidity during downturn markets:

$$Liquidity_{it} = \alpha + \beta_1 \times Eligible_{it} + \beta_2 \times Eligible \times Downturn_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (7)$$

We use two methods to define *Downturn*. In the first method, the dummy variable *Downturn* equals 1 if the market returns at day *t* are lower than the 20th percentile market returns over our sample period, and 0 otherwise. In the second method, *Downturn* equals 1 if the market return at day *t* is less than -5%, and 0 otherwise. *X* is the set of stock characteristics described in Section 3 and includes the lagged value of liquidity. Again, we include firm and time fixed effects in the regression and calculate the standard errors clustered by firm and date.[11] In Eq. (7), β_1 represents the impact of *Eligible* on liquidity in ordinary periods, β_2 captures how much the liquidity for eligible stocks differs in down markets than ordinary periods, and $\beta_1 + \beta_2$ represents the overall impact of *Eligible* on liquidity during market downturns.

In Table 9, we report the key coefficients in which we are interested. The coefficients on *Eligible*, β_1, are all significantly negative in all four columns, suggesting that eligible stocks have higher liquidity than ineligible stocks in ordinary periods. In addition, the coefficients on the interaction term, β_2, in all four columns are significantly positive at 1% level, suggesting that eligible stocks have much lower liquidity in market downturns than in ordinary market conditions. In Table 9, we also report the coefficients $\beta_1 + \beta_2$, which represent the marginal impacts of *Eligible* on stock liquidity when market returns are particularly low. We can see that, in Columns 2, 3, and 4, liquidity for eligible stocks is actually lower than that for ineligible stocks in these periods. This is consistent with the empirical results in Kahraman and Tookes (2017) and the theoretical prediction of Brunnermeier and Pedersen (2009).

In Table 10, we focus on the subsample of eligible stocks and investigate whether the impacts of margin trading and short selling activities differ in downturn markets, using the following specification:

$$Liquidity_{it} = \alpha + \beta_1 \times Mturnover_{it} + \beta_2 \times Mturnover \times Downturn_{it} + \theta_1 \times Sturnover_{it} + \theta_2 \times Sturnover \times Downturn_{it} + \gamma \times X_{it} + \varepsilon_{it} \quad (8)$$

Our results show that, during market downturns, the impacts of margin trading and short selling on liquidity significantly differ from their impacts during ordinary periods. For example, we can see that the coefficients β_2 and θ_2 are significantly different from zero in all four columns. In particular, the significantly positive β_2 suggests that margin trading's role in improving liquidity is actually much weaker during market downturns than during ordinary periods. Similarly, the significantly negative θ_2 suggests that short selling's role in reducing liquidity is much weaker in down markets. In Table 10, we also report the margin impacts of short selling activity (i.e., $\theta_1 + \theta_2$) on liquidity during severe market downturns. We can see that, as expected, $\theta_1 + \theta_2$ are significantly negative in all four columns. This suggests that, instead

[11] Given that we include time fixed effect in the specification, we do not include *Downturn* in the specification because of the multicollinearity problem.

Table 9
Impact of leverage eligible status on liquidity during different market conditions.

	Downturn = 1 if market return < 20th percentile		Downturn = 1 if market return < -5%	
	Espread	Pimpact	Espread	Pimpact
	(1)	(2)	(3)	(4)
β_1	-0.017***	-0.045***	-0.016***	-0.023***
	(-3.95)	(-5.78)	(-3.88)	(-2.91)
β_2	0.010***	0.090***	0.038***	0.141***
	(3.49)	(11.60)	(6.92)	(14.75)
$\beta_1 + \beta_2$	-0.007	0.045***	0.022***	0.118***
	(-1.47)	(5.15)	(3.12)	(10.47)
Observations	1,395,468	1,395,468	1,395,468	1,395,468
Adjusted R^2	0.638	0.586	0.638	0.551

Notes: This table reports the important regression coefficients from Eq. (7). In columns (1) and (2), *Downturn* in Eq. (7) equals 1 if the market returns at day *t* are lower than the 20th percentile market returns over our sample period, and 0 otherwise. In columns (3) and (4), *Downturn* equals 1 if the market return at day *t* is less than -5%, and 0 otherwise. *Eligible* equals 1 if the stock is an eligible stock and 0 otherwise. *Espread* is the daily value of effective spread for a stock. *Pimpact* is the ratio of daily absolute return to the daily trading volume in RMBs. β_1 represents the impact of *Eligible* in ordinary periods, β_2 captures how much the liquidity for eligible stocks differs in down markets than in ordinary periods, and $\beta_1 + \beta_2$ represents the overall impact of *Eligible* on liquidity during market downturns. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firm and date. *t*-statistics are in parentheses. * Indicates significance at the 10% level. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

of reducing liquidity, short selling activity actually improves stock liquidity when the market is dominated with negative news. This is consistent with Diamond and Verrecchia's (1987) prediction that short sale constraints' negative impacts in decreasing liquidity are the greatest in the case of bad news. Hence, the short selling activities' positive impact in improving liquidity is the greatest at such moments. This result is also consistent with Charoenrook and Daouk (2009), who find that short selling's role in improving market-wide stock liquidity is stronger in down markets. The marginal impacts of margin trading during market downturn ($\beta_1 + \beta_2$) show mixed results. When we measure liquidity using *Pimpact*, greater margin trading turnover is associated with lower stock liquidity in down markets. However, when we measure liquidity using effective spread, the results are not significantly different from zero.

8. Conclusions

In this paper, we seek to understand the impacts of leverage trading on stock liquidity in Chinese equity markets. We find that stock liquidity increased when the restriction of leverage trading was lifted in China between 2010 and 2016. However, the two forms of leveraged trading—margin trading and short selling—have opposite influences on liquidity in our sample. During ordinary market conditions, margin trading activities benefit stock liquidity, while short selling activities harm stock liquidity. However, both of their roles reverse when market conditions are bad. Our results highlight the importance of taking market conditions into consideration when discussing the role of leveraged trading.

In this paper, we also investigate the mechanism through which leveraged trading might influence stock liquidity. In this process, we examine leverage traders' trading strategies and find that both margin traders and short sellers are contrarian traders and voluntary liquidity providers in the situation of pricing pressure. In addition, short sellers are opportunistic risk-bearers, while margin traders are not. We also find that, in our sample, short sellers tend to be informed traders, but

Table 10
Impacts of margin trading and short selling activities on stock liquidity under different market conditions.

	Downturn = 1 if market return < 20th percentile		Downturn = 1 if market return < -5%	
	Espread	Pimpact	Espread	Pimpact
	(1)	(2)	(3)	(4)
β_1	-0.179***	-0.855***	-0.152***	-0.596***
	(-9.39)	(-17.45)	(-8.05)	(-12.65)
θ_1	0.421***	5.179***	0.287**	3.386***
	(2.87)	(10.18)	(1.97)	(6.93)
β_2	0.194***	1.801***	0.308***	2.401***
	(5.96)	(13.62)	(2.98)	(6.80)
θ_2	-0.948***	-10.233***	-3.065***	-11.509***
	(-5.32)	(-11.89)	(-5.57)	(-4.01)
$\beta_1 + \beta_2$	0.016	0.946***	0.157	1.805***
	(0.44)	(7.63)	(1.48)	(5.17)
$\theta_1 + \theta_2$	-0.526**	-5.054***	-2.779***	-8.123***
	(-2.49)	(-6.09)	(-5.00)	(-2.84)
Observations	751,415	751,415	751,415	751,415
Adjusted R^2	0.698	0.581	0.698	0.579

Notes: This table reports the important regression coefficients from Eq. (8). In columns (1) and (2), *Downturn* in Eq. (8) equals 1 if the market returns at day *t* are lower than the 20th percentile market returns over our sample period, and 0 otherwise. In columns (3) and (4), *Downturn* equals 1 if the market return at day *t* is less than -5%, and 0 otherwise. *Mturnover* and *Sturnover* represent the percentage of margin trading turnover and short selling turnover, respectively. *Espread* is the daily value of effective spread for a stock. *Pimpact* is the ratio of daily absolute return to the daily trading volume in RMBs. β_1 represents the impact of *Mturnover* in ordinary periods, β_2 indicates the additional impacts of *Mturnover* in market downturns than in ordinary periods, and $\beta_1 + \beta_2$ represents the overall impact of *Mturnover* on liquidity during market downturns. θ_1 represents the impact of *Sturnover* in ordinary periods, θ_2 indicates the additional impacts of *Sturnover* in market downturns than in ordinary periods, and $\theta_1 + \theta_2$ represents the overall impact of *Sturnover* on liquidity during market downturns. Both firm and day fixed effects are included in the regressions, and *t*-values are calculated with standard errors clustered by both firms and dates. *t*-statistics are in parentheses. * Indicates significance at the 10% level. ** Indicates significance at the 5% level. *** Indicates significance at the 1% level.

margin traders do not. We conclude that short selling activities reduce stock liquidity because of the increased risk of adverse selection for other uninformed traders. This conclusion is supported by our finding that short sellers' role in reducing liquidity only appears in stocks with large information asymmetry.

Overall, our paper improves understandings of the role of leveraged trading in stock markets. It also provides evidence that enables policymakers in China to better evaluate the impacts on market quality of China's recent regulatory reform for leveraged trading.

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