Decoding Leveraged Trading*

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Abstract

We examine the informational role of leveraged trading. Using a unique Chinese sample of stock-level margin buying and short selling over the period from July 2010 to June 2015, we document that short selling predicts cross-sectional stock returns while margin buying has no cross-sectional prediction power. The time-series return prediction of margin buying is mechanically driven by the future increase in margin buying, which is not sustainable during the June 2015 Chinese stock market crash. Further evidence shows that margin buying activities are more likely to co-move across stocks, the intensity of margin buying is positively associated with contemporaneous investor sentiment, and the return predictability of margin buying is stronger during high-sentiment periods. Overall, the findings suggest that leverage is not a sufficient condition for informed trading.

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1 Introduction

Leveraged investors borrow money or stocks from brokers as the leverage of portfolio investments. Their trading activities play an important role in the standard asset pricing equilibrium, where the information environment is assumed to be perfect. When information is asymmetric across investors, the question of how leveraged trading is related to the stock price becomes theoretically challenging. On the empirical side, the informational role of leveraged investors in capital markets is established by short selling. This attempt is limited by the fact that leveraged trading includes both margin buying and short selling. To understand the relation between leverage and informativeness, we examine the return prediction of margin buying and short selling.

As one of the leveraged twins, short sellers is considered the most informed investors,[1] and its informativeness can be explained by two features of short sellers: a leveraged position and a pessimistic view. One one hand, leverage serves as an obstacle to naive investors. That is, the risky nature of leverage may deter inexperienced and unskill investors to take leveraged investments, and hence investors who take leveraged positions should be sophisticated traders. Given leveraged positions of margin buyers and short sellers, we expect both margin buying and short selling to predict future stock returns. We call this statement *the informed leverage hypothesis*.

On the other hand, trading informativess is driven by investor pessimism. When investors are pessimistic about a firm, they are more likely to suppress their animal emotions to make rational decisions. Similarly, Yu and Yuan (2011) argue that inexperienced traders

[1]The informativeness of short selling has been shown in three collections of evidence. First, increases in short interest predict lower future stock returns (e.g., Dechow et al., 2001; Christophe, Ferri, and Angel, 2004; Asquith, Pathak, and Ritter, 2005; Cohen, Diether, and Malloy, 2007; Boehmer, Jones, and Zhang, 2008; Diether, Lee, and Werner, 2009; Rapach, Riggenbach, and Zhou, 2015). Second, as one type of whistleblowers, short sellers can effectively detect the misconduct of managers (Dyck, Morse, and Zingales, 2010; Karpoff and Lou, 2010; Hirshleifer, Teoh, and Yu, 2011; Mass, Zhang, and Zhang, 2015). Third, short sellers have sophisticated skills in analyzing both private and public available information (Engelberg, Reed, and Ringgenberg, 2012; Khan and Lu, 2013).

exert greater influence during optimistic (high-sentiment) periods than during pessimistic (low-sentiment) periods, due to their reluctance to sell stocks when they have pessimistic views. Their argument is also consistent evidence that noisy investors participate and trade more aggressively in optimistic (high-sentiment) periods (e.g., Karlsson, Loewenstein, and Seppi, 2005). Thus, leveraged trading is not a sufficient condition for trading informativeness, and only short selling can predict future stock returns (margin buying does not predict future returns). We refer to this view as *the uninformed leverage hypothesis*.

To test the two hypotheses, we exploit a unique dataset of Chinese margin trading that contains data on both margin buying and short selling of individual stocks. We propose a margin buying measure and a short selling measure to capture margin investors' directional trades that might reflect their informational advantage. We define the margin buying measure MB as the net purchase amount of a stock on margin (total margin buying minus total margin repayment) in a week divided by the average RMB trading volume over the previous 52 weeks. Similarly, the short selling measure SS is defined as the net short selling shares of a stock in a week divided by the average shares traded over the previous 52 weeks. A change in MB or SS suggests that margin traders could have informative advantage on stocks' mispricing and thus predict stocks' future returns.

We find that the proposed margin buying and short selling measures are indeed associated with underlying stocks' future returns. However, margin buying and short selling contribute to the return prediction in different dimensions. Consistent with previous empirical findings[2], short selling predicts stocks' returns in the cross section, i.e., stocks with more short selling earn lower returns in the future. On the other hand, the return predictability of margin buying is in the time series: a given stock earns higher future returns when its current margin buying is larger. A long-short portfolio that exploits the time series predictability of

[2]Papers that study the relation between short selling and stock returns include Boehmer, Jones, and Zhang (2008); Diether, Lee, and Werner (2009); Boehmer, Huszar, and Jordan (2010); Christophe, Ferri, and Hsieh (2010); Engelberg, Reed, and Ringgenberg (2012); and among others.

margin buying and cross sectional predictability of short selling earns positive and significant raw return and risk-adjusted alpha. Furthermore, the market-wide margin buying activities positively predict the market returns, complementing the finding in Rapach, Ringgenberg, and Zhou (2015) that short interest predicts the aggregate stock returns in the U.S.. To the best of our knowledge, our paper is the first that distinguishes the cross sectional and time series predictive effects of stocks' margin buying and short selling activities.

We next investigate what explains the distinct dimensions of return predictability for margin buying and short selling. First, we find that compared to short selling, stocks' margin buying activities are more likely to comove together, suggesting that margin buying may not reflect investors' specific private information on individual stocks as such information tends to arrive randomly across companies. Second, the intensity of margin buying is positively affected by contemporaneous investors' sentiment, and the return predictability of margin buying is stronger during high-sentiment periods. Therefore, margin buying seems to affect future returns through the channel of price pressure caused by retail investors' margin flows. Third, stocks with larger margin buying balance experienced deeper price drop during the 2015 June China stock market crash, which was triggered by regulator's strict ban on margin trading. In contrast, stocks with large short selling volume did not exhibit lower post-rule-change returns. Overall, evidence suggests that while short selling is possibly conducted by informed investors, margin buying is likely to be driven by unsophisticated investors' margin borrowing activities. The source of return prediction for short selling and margin buying is different in nature.

The remainder of the paper is organized as follows. In Section **??** we describe the institutional background of margin trading in China and construction of variables. Section **??** presents our main findings. Section **??** investigates the possible sources of return predictions of margin buying and short selling. We conclude in Section **??**. Details on the data and variable construction can be found in Appendices **??** and **??**.

2 Institutional background and variable construction

2.1 Institutional background of margin trading in China stock market

Margin-trading was first introduced in Chinese stock market in March, 2010. On March 31, 2010, the Shanghai stock exchange and Shenzhen stock exchange started a pilot program that included 90 stocks to be qualified for margin-trading, including buying stocks on margin and short selling. The first 90 stocks are constituent stocks for the Shanghai Stock Exchange (SSE) 50 Index and Shenzhen Stock Exchange (SZSE) 40 Component Index. Several requirements are imposed on stocks to be marginable, such as listed for at least three months after the IPO, the number of shares greater than 100/200 millions and market capitalization greater than 500 million RMB (around 80 million USD)/800 million RMB (around 125 million USD) for margin buying/short selling stocks, at least 4000 shareholders, and so forth. In general, those requirements restrict qualifiers to be those large, liquid, and well-established stocks.

The China Securities Regulatory Commission (CSRC) also imposes restrictions on market participants for margin-trading. For example, CSRC requires investors to have a stock account for at least six months before they can open a margin-trading account. In addition, CSRC recommends that brokerages should only setup margin-trading account for investors with net asset value (NAV) in the stock account greater than 500,000 RMB (around 80,000 USD).[3] According to China Securities Depository and Clearing Corporation (CSDC), as of October, 2014, 94% of stock accounts have NAV less than 500,000 RMB. However, some brokers especially those smaller ones have loose NAV requirement to attract low-NAV retail investors to open margin account. Because we do not have account level trading

[3]The NAV requirement was relaxed in March, 2013 but was reemphasised in January, 2015.

and holding data for those margin accounts, a couple of possibilities exist regarding the margin trading and future stock returns. On one hand, the relative strict participation restriction suggests that margin-trading could be conducted by experienced retail investors or sophisticated institutional investors. Those investors might have superior information that results in return predictability. On the other hand, naive retail investors might follow other investors and use leverage to take more positions. Their trades could still predict stock prices in a different way: instead of driven by informed trading, prices might be affected by extra liquidity from margin traders. We examine these two possibilities in the later section of the paper.

After the first introduction of the qualified list of margin trading, several revisions have been made over our sample period. In 2010 after the qualification of the first 90 stocks, another 6 stocks were added to the list. On December 5, 2011, additional 185 stocks were included while 21 stocks were removed from the list. Then in 2013, two groups of 461 stocks were qualified for margin-trading with 18 dropped. Finally on September 22, 2014, 200 stocks were added to the list. Overall, 942 stocks have ever been included in the margin-trading list for at least once from 2010 to 2014. The detailed history of marginable stocks can be found in Table **??**. Because margin-trading of a qualified stock trends up slowly over the first several months after its introduction, we drop a stock's margin-trading data for the first three months. On June 13, The CSRC banned illicit share financing and caused liquidity spiral in the A-Share market. The regulatory rule change resulted in tremendous change in margin traders' behavior and thus we do not include data after the regulatory change. Our final sample is from July 1, 2010 to June 12, 2015.

2.2 Data and variable construction

The margin trading, stock return, and firm financial statements data are obtained from China Stock Market Trading Research (CSMAR) database of GuoTaiAn (GTA) Company. We keep common stocks and exclude marginable ETFs. The macroeconomic variables, including Treasury bond and bill yields, SHIBOR, and inflation rate are obtained from RESSET database. The closed-end fund discount, equity issues and long-term debt issues, number of investors, and number of active investors, are obtained from WIND.

We propose a margin buying measure and a short selling measure to capture the informational content of margin traders on the opposite directions. Specifically, the margin buying measure for stock i in week t, $MB_{i,t}$, is defined as the ratio of weekly net margin buying amount to the average RMB trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks, where the net margin buying amount is equal to the total margin buying amount minus the margin repayment amount. The short selling measure for stock i in week t, $SS_{i,t}$, is defined as the ratio of weekly net short selling shares to the the average weekly shares traded over the previous 52 weeks with a minimum required number of observations of 40 weeks, where the net short selling shares are equal to the total short selling shares minus the number of shares repaid. Note that short selling is quoted in number of shares instead of RMB amount in the database. While previous research focuses on the cross sectional predictive power of short selling, the availability of both short selling and margin buying data allows us to investigate whether and how margin buying and short selling could predict stocks' future returns simultaneously.

We present the summary statistics of stock level variables in Table **??**. Panel A reports the summary statistics of the proposed margin buying measure MB and short selling measure SS. There are 82,643 stock-week observations in total. Several observations are worth discussing. First, the average margin buying ratio MB is 1.697%, suggesting that net margin

buying accounts for 1.7% of total trading volume on average. Second, compared to margin buying, the number of short selling shares is much smaller (0.004% of weekly shares traded on average). The small amount of short selling is probably due to the shortage of lendable shares in the Chinese stock market. Overall, the margin buying seems to be more important than short selling. Third, large cross sectional and time series variations exist for both MB and SS, suggesting that informed investors, if they exploit their information advantage through margin trading, might dynamically allocate their long/short positions across stocks over time. Therefore, the predictability of margin buying and short selling could come from both time series dimension and cross sectional dimension. The source of return predictability could be more subtle when we take both margin buying and short selling into consideration.

Panel B of Table **??** reports the summary statistics of weekly excess returns (in percentage) of marginable stocks. The risk-free rate is proxied by Shanghai Interbank Offered Rate (Shibor). Panel C of Table **??** reports the summary statistics of stock level control variables that have been found to have predictive power for future returns. Those variables include logarithm of market capitalization, book-to-market ratio, idiosyncratic volatility w.r.t. the Fama-French three-factor model, the Amihud illiquidity measure, the turnover, the past one-month return, the past 12 to past 1 month cumulative return, and the beta loadings on the Fama-French three factors. Details of variable construction are in Appendix **??**.

2.3 Relation between margin buying and short selling

The main variables of our analyses are MB and SS, which capture the magnitude of individual stocks' net margin buying and net short selling after controlling for stocks' normal trading volume. Informed investors might purchase shares on margin or short sell shares when mispricing exists. They may find some stocks more attractive or easier to conduct margin trading, or sometimes margin buying (short selling) is easier to implement. As a

result, it is possible that margin buying trades and short selling trades are related both cross-sectionally or in the time series.

We report correlation between MB and SS in Table **??**. In Panel A, for each year, we present the weekly average of cross sectional Pearson and Spearman correlation coefficients between MB_i and SS_i. Average cross sectional Pearson correlation coefficients are negative for all years with a magnitude ranging from -0.006 (t-statistics = -0.65) to -0.116 (t-statistics = -5.33). The negative correlation suggests that stocks with large net margin buying tend to have small net short selling in the same week. The results for Spearman correlation coefficients are quite similar. In Panel B, for each year, we present the average of time series Pearson (Spearman) correlation coefficients between MB_t and SS_t across all stocks. For years before 2014, the average time series correlations are negative, suggesting that for a given stock the weekly net margin buying and short selling move in the opposite directions. For years 2014 and 2015, the average time series correlations become positive. Overall, there is no clear time series relation between margining buying and short selling (-0.001, t-statistics = -0.22).

3 The predictability of margin buying and short selling on stock returns

Both margin buying and short selling could predict future stock returns. In the cross section, margin traders (both margin buyers and short sellers) may have information advantage and therefore pick those stocks with potentially better future performance. In the time series, margin traders could also be able to anticipate stocks' future price movements due to either fundamental change or liquidity flow. In this section, we investigate whether margin buying and shorting selling predict future stocks' returns and how they predict the returns.

3.1 Results of panel regressions

Informed investors with positive information of a stock could purchase shares on margin as leveraged margin trading can enhance their profits. Similarly, informed investors with negative information could short sell shares of a stock if they do not own the stock per se. Therefore, the proposed margin trading measures MB and SS are likely to reflect investors' private information and predict subsequent returns. We investigate this relation between margin trading and future stock returns in a pooled regression. As the predictability could be attributed to either cross sectional variation or time series variation, we specify the margin trading-return relation with fixed effects in the time or stock dimension following Pastor, Stambaugh, and Taylor (2015):

$$
\begin{aligned}
R_{i,t+1} &= a^{mb}_{t+1} + b^{mb} MB_{i,t} + c^{mb} X_{i,t} + \epsilon_{i,t+1} && (1)\\
R_{i,t+1} &= a^{ss}_{t+1} + b^{ss} SS_{i,t} + c^{ss} X_{i,t} + \epsilon_{i,t+1} && (2)\\
R_{i,t+1} &= a^{ss}_{t+1} + b^{mb} MB_{i,t} + b^{ss} SS_{i,t} + c^{ss} X_{i,t} + \epsilon_{i,t+1} && (3)\\
R_{i,t+1} &= a^{mb}_{i} + b^{mb} MB_{i,t} + c^{mb} X_{i,t} + \epsilon_{i,t+1} && (4)\\
R_{i,t+1} &= a^{ss}_{i} + b^{ss} SS_{i,t} + c^{ss} X_{i,t} + \epsilon_{i,t+1} && (5)\\
R_{i,t+1} &= a^{ss}_{i} + b^{mb} MB_{i,t} + b^{ss} SS_{i,t} + c^{ss} X_{i,t} + \epsilon_{i,t+1} && (6)
\end{aligned}
$$

Note that a_{t+1} and a_i are time fixed effect and stock fixed effect, respectively. By imposing the time fixed effect a^{mb}_{t+1} (a^{ss}_{t+1}), the estimated $\hat{b^{mb}}$ ($\hat{b^{ss}}$) in Equations **??** to **??** capture purely the cross sectional effect of MB (SS) on $R_{i,t+1}$. On the other hand, by controlling for the stock fixed effect a_i (Equations **??** to **??**), the estimated $\hat{b^{mb}}$ ($\hat{b^{ss}}$) reflect purely the time series relation between margin trading and future returns for a given stock.

In addition to the main variables of interest MB and SS, we also include a vector of

control variables X that are known to have predictability on future returns. There control variables include size, book-to-market ratio, idiosyncratic volatility, the Amihud illiquidity measure, turnover, past one-month return, past 12 to 1 month return, and beta loadings on the Fama-French three factors. Details of variable construction are in Appendix **??**.

Table **??** reports the results of panel regressions with dependent variables to be one-week cumulative returns. We present the estimation results with time fixed effect in the first three columns. The regression coefficients for MB and SS are reported in bold. When time fixed effect is included, SS negatively predict next week returns while MB does not. The negative and significant coefficients on SS are found when SS along (-0.275, t-statistics = -2.26) or when both SS and MB are present in the specification (-0.266, t-statistics = -2.17). This finding is consistent with previous researchers' findings: in the cross section, short sellers are likely to hold information advantage on negative news and high short selling predicts lower future returns. On the other hand, our results indicate that margin buyers do not seem to have positive information advantage on those stocks they purchase on margin.

Columns four to six of Table **??** report the results of regressions with stock fixed effect. When stock fixed effect is included, contrast to the case with time fixed effect, MB positively predict next week returns while SS does not. The positive coefficients of MB are 0.032 (t-statistics = 3.61) and 0.032 (t-statistics = 3.55) when only MB or both MB and SS are included in the panel regressions. SS negatively predicts next week return in the time series but without statistic significance. The time series predictability of MB on future returns indicates that for a given stock, when its current net margin buying is large, its next week return is also high.

Overall, results of panel regressions with time fixed effect or stock fixed effect suggest that the source of return predictability of margin buying and short selling is different: while SS might reflect investors' information advantage across stocks, the channel that MB affects future returns could be more subtle. We provide more evidence to understand the

predictability of MB and SS in later sections.

3.2 Time series predictability

In this section, we examine the time series return prediction of MB and SS on the aggregate stock market. If margin trading contains information of the market or macroeconomic condition, MB and SS are expected to predict future market returns. Rapach, Ringgenberg, and Zhou (2015) find that short interest predicts aggregate market returns through its prediction on the aggregate cash flow. Our data on both margin buying and short selling allow us to examine their predictability on the aggregate market simultaneously.

Table **??** presents the results of time series predictive regressions using MB and SS. The main variables of interest, aggregate margin buying and short selling, are defined as the cross sectional average of individual stocks' MB and SS. Following Rapach, Ringgenberg, and Zhou (2015), control variables include market excess return volatility, the aggregate book-to-market ratio, the risk-free rate, the 10-year Treasury bond yield, the term spread between 10-year Treasury bond yield and 3-month Treasury bill yield, and the inflation rate. The sample has 255 weeks in total. The first two columns report the results for the equal-weighted portfolio of all marginable stocks and the last two columns report the results for the value-weighted portfolio of all marginable stocks. First, the aggregate MB positively and significantly predict future aggregate market returns. The coefficients are very similar (0.372) for equal-weighted (t-statistics = 3.13) and value-weighted (t-statistics = 3.33) market portfolios. Even we include all control variables, the coefficients are still 0.197 (t-statistics = 1.70) and 0.283 (t-statistics = 2.10). Second, the aggregate SS does not have predictive power for future market returns, which is in contrast to Rapach, Ringgenberg, and Zhou (2015) who find that short interest is a strong predictor in the U.S. market. Third, the time series R^2s are 4.9% (equal-weighted aggregate return) and 6.7% (value-weighted

aggregate return) when MB and SS are the predictors, and R^2s only increase to 8.6% and 8.1% when all control variables are included. This finding suggests that MB and SS are likely to be important return predictors for the aggregate market.

3.3 A trading strategy based on margin buying and short selling

We next employ bivariate portfolio analyses to further examine the time series predictability of MB and cross sectional predictability of SS. A two-by-two independent portfolio sorting is conducted on MB and SS. In the time series, a stock is classified as high-MB (low-MB) if its week t MB is larger (smaller) than its average MB over week t-8 to t-1. Note that instead of usual cross-sectional sorting on stock characteristics, here whether a stock is assigned to the high-MB or low-MB group depends on its current week MB value compared to the previous 8 weeks' moving average. In the cross section, each week all stocks are assigned into a high-SS group and a low-SS group according to their SS value. The sorting procedure by MB exploits the time series return predictability of MB and the sorting procedure by SS exploits the cross sectional return predictability of SS. P1 refers to the portfolio of stocks with high-MB and low-SS, P2 refers to the portfolio of stocks with high-MB and high-SS, P3 refers to the portfolio of stocks with low-MB and high-SS, and P4 refers to the portfolio of stocks with low-MB and high-SS. P1-P4 is the long-short portfolio with long-leg to be P1 and short-leg to be P4. Because MB positively predict returns in the time series and SS negatively predicts returns in the cross section, we expect P1 has the largest return and P4 has the smallest return.

Table **??** presents the raw excess returns and Fama-French three-factor adjusted alphas for four portfolios and the P4-P1 portfolio. We require each portfolio to have at least 20 stocks and thus the sample starts from May 4, 2012. Panel A reports the results for equal-

weighted portfolios. The average weekly excess returns of P1 and P4 are 0.504% (t-statistics = 1.70) and 0.370% ($t$statistics = 1.19), respectively. The alphas of these two portfolios are -0.092 (t-statistics = -1.40) and -0.229 (t-statistics = -2.70). The long-short portfolio P4-P1 has a weekly raw excess return of 0.135% (t-statistics = 1.98) and a weekly alpha of 0.137 (t-statistics = 1.72). The annualized risk-adjusted alpha of P4-P1 is at an economic significant magnitude of 6% and cannot be explained by the Fama-French three factors. The significant raw and risk adjusted returns of P1-P4 are consistent with our previous finding that high MB predicts high future returns in the time series and high SS predicts low future returns in the cross section.

In Panel B of Table **??**, we report results of deviation-weighted portfolios following Moskowitz, Ooi, and Pedersen (2012) who study time series momentum effect. Specifically, a stock's weight in a portfolio is inversely related to its past 52 weeks' return variance. Similar to the results of equal-weighted portfolios, P1 still delivers the highest average weekly excess return (0.532%, t-statistics = 1.82) and P4 earns the lowest average weekly excess return (0.387, t-statistics = 1.27). The long-short portfolio P4-P1 has statistically and economically significant raw return (0.145%, t-statistics = 2.24) and risk adjusted alpha (0.159%, t-statistics = 2.13).[4] Overall, our results of double-sorted portfolios provide consistent evidence with panel regressions on the return predictability of MB and SS.

4 Understanding the return prediction of margin buying and short selling

Why do margin buying and short selling predict future returns in different ways? While short selling predicts returns in the cross section that is consistent with previous findings,

[4]Results of value-weighted portfolios are similar and available upon request.

our results suggest that margin buying predicts returns in the time series dimension: a given stock earns high return in the future if its current net margin buying is large. As purchasing a stock on margin essentially provides more liquidity and thus price pressure on that stock, it is possible that different from the informed trading explanation of short sellers' role on return prediction, margin buyers' synchronous trades results in return prediction. In other words, margin buying may not reflect informed investors' information advantage but only affects stock returns through crowd purchase/repayment on margin. In this section, we provide several pieces of evidence to understand why margin buying and short selling predict future returns.

4.1 Properties of margin buying and short selling

If trades of margin investors on a stock only reveals specific private information of that stock, margin buying (short selling) activities should not move together across stocks. Alternatively, if margin trades, either margin buying or short selling, reflect uninformed naive investors' crowd purchase/sale of stocks, they are more likely to move together. We evaluate these two possibilities by examining to what extent individual stocks' MB (SS) can be explained by the market-wide MB (SS). Specifically, for each stock, we run time series regression of MB (SS) on the average or principal components across all stocks' MB (SS). If the R^2s of those regressions are large, it suggests that the intensities of individual stocks' margin trades move together over time. In other words, simultaneous increase or decrease in margin buying (short selling) activities across a wide range of stocks is unlikely to be driven by informed investors. Instead, it is more likely that naive investors conduct margin trades together and such behavior moves stock prices.

Table **??** reports the summary statistics of adjusted R^2s for time series regressions of MB and SS on their average or principal components. In Panel A, the explanatory

variables are cross sectional average of MB or SS. The average adjusted R^2 is 14.44% for MB and less than 4% for SS, and such difference in R^2 is significant with a t-statistics of 25.02. The difference in R^2 suggests that stocks' net margin buying has higher comovement than their net short selling. In addition, large R^2s of MB indicates that on average the mean margin buying can explain more than 14% time series variations for individual stocks' margin buying. In Panels B to D, the explanatory variables are the the first, the first two, and the first three principal components of stocks' MB (SS) measures. Similarly, we find that MB has stronger factor structure than SS, and the mean adjusted R^2s are 13.37%, 17.26%, and 19.31% for MB regressions compared to the numbers of 1.20%, 3.91%, and 5.23% for SS regressions. Taken together, our findings suggest that stocks margin buying tend to move simultaneously in the same direction over time and such comovement seems not to reconcile with an informed trading explanation of MB's predictability. Instead, evidence supports the hypothesis that MB predicts future returns through retail margin investors' crowd trades.

Furthermore, if the return predictability comes from flows of unsophisticated margin investors', i.e., they use leverage to purchase or sell stocks at the same which drives prices, margin trading is likely to depend on past margin trading. For example, margin buyers' inflow into a stock could push up its price, and such increase in price attracts other trend following margin traders to borrow more to buy this stock, which would possibly cause more net margin buying next period. Therefore, persistency in MB or SS could be an indicator of trend following margin trading behavior of unsophisticated retail investors.

In Table **??**, we present the estimation coefficients for regressions of MB and SS on their lagged values. Columns (1) and (2) report the results of panel regressions with time fixed effect. Lagged MBs have strong predictive power on MB, the coefficients are 0.132, 0.063, 0.038, and 0.026 for MB_{t-1}, MB_{t-2}, MB_{t-3}, and MB_{t-4}. All four coefficients are significant. Lagged SSs also have positive and significant predictive power on MB, while

the economic magnitude is much smaller as net short selling is less than 1/200 of net margin buying at stock level. In contrast, SS is negatively affected by lagged MBs and lagged SSs, suggesting that the lack of persistency for net short selling. Columns (3) and (4) give results of panel regressions with stock fixed effect. Again, while SS does not show persistency MB is indeed positively affected by past MB and SS. In the last two columns of (5) and (6), we present the results of vector auto-regressions of aggregate MB and SS. We find that only past one week MB positively predicts current week MB and there is no predictive relation between past MB/SS and current SS. Overall, margin buying is more persistent than short selling and such persistency seems to be caused by retail margin buyers' simultaneous trades in the same direction.

4.2 The role of investor sentiment

If investors' net margin buying is not driven by informed investors but instead by those uninformed retail margin users, we would expect that the proposed MB variable should be affected by investor sentiment. When the market sentiment is high, retail investors are more likely to purchase stocks on margin even if the fundamental of those stocks does not change. For short selling, the role of sentiment would be weaker as short selling is mostly conducted by informed sophisticated investors. We assess whether sentiment affects investors' margin buying and short selling by regressing cross-sectional average of MB and SS on market-wide investor sentiment. Two sentiment proxies are used: the Baker and Wurgler (2006) sentiment index and the market's active account percentage, where the latter is the ratio of the number of stock accounts that have trades in a week to the total number of accounts with stock holdings by the end of the same week. High active account percentage implies that investors trade more and therefore investors' sentiment tend to be high.

Table **??** presents the results. Columns (1) to (4) give the results when the dependent

variable is MB and columns (5) to (8) give the results when the dependent variable is SS. In addition to sentiment proxies, we also include other control variables that could also affect margin trading, including the Fama-French three factors, the momentum factor, the risk-free rate proxied by SHIBOR, volatility of market excess return, book-to-market value ratio of the market, 10-year Treasury bond yield, the term premium calculated as the yield spread between a 10-year Treasury bond and a 3-month Treasury bill, and inflation rate. Several findings are worth emphasizing. First, the average net margin buying positively and significantly depends on the contemporaneous market sentiment. The coefficients on Baker and Wurgler sentiment index are 1.016 (t-statistics = 9.22) and 0.819 (t-statistics = 3.90) for time series regressions without and with controls, while the numbers are 0.958 (t-statistics = 6.43) and 1.036 (t-statistics = 5.43) when active account sentiment proxy is used. Second, sentiment is a strong explanatory variable for the average market-wide MB, the R^2 is 51.3% when only the Baker and Wurgler index is used and R^2 increases to 57.7% after all controls are included. Similar R^2s are found for active account sentiment proxy. Third, investors' sentiment does not explain net short selling: the coefficients are not significant and the regression R^2s are close to zero. All the findings support the conjecture that while short selling reflects informed trades, margin buying is more likely to coincide with retail investors' naive crowd trades.

We further confirm our argument with panel regressions conditional on investors' sentiment levels. Specifically, we divide the sample into a low-sentiment subsample and a high-sentiment susample, and repeat the exercise in Table **??**. Panel A of Table **??** present the results of panel regressions conditional on Baker and Wurgler sentiment index levels. During low-sentiment weeks, large net short selling still strongly predicts low future returns in the cross section, similar as the results of full sample. However, net margin buying no longer positively predicts future returns in the time series, instead it negatively and significantly predicts next week returns. On the other hand, during high-sentiment weeks, the time series

predictability of net margin buying is positive and significant and net short selling does not predict cross sectional return difference. When investor sentiment is low, short selling, potentially conducted by sophisticated informed investors, is more effective in predicting cross sectional returns. When investor sentiment is high, margin buying, potentially conducted by native retail investors, is more likely to drive a stock's future return in the time series. In Panel B, we report the results when active account sentiment proxy is used. The results are similar except that during high-sentiment period measured by active account, net margin buying have positive and significant cross sectional return prediction with small economic magnitude. The loss of predictability for MB during low sentiment period and for SS during high sentiment period provides supportive evidence that net margin buying predicts returns through investors' flow channel and net short selling predicts returns through the information channel.

4.3 The 2015 June Chinese stock market crash

On June 12, 2015, China Securities Regulatory Commission (CSRC) announced regulatory rule change on leveraged trading, including capping a brokerage firm's margin trading and short selling, restricting illicit loan for share purchase, and banning several largest brokerage firms from opening new margin trading accounts for three months. All the changes aim to control potential risks associated with highly-leveraged stock market. Thereafter, China stock market encountered crash in both price and liquidity: thousands of stocks hit the price limit without any trading volume and such liquidity dries-up furthered investors' sell-off. In this section, we try to understand how pre-rule-change margin trading has a post-rule-change impact on marginable stocks' returns. If margin buying results in positive future returns due to borrowed loan, we would see those stocks with high margin purchase amount to have deeper price drop after June 12, 2015. In contrast, highly short sold stocks should not exhibit the opposite if short selling is information-based.

We formally test our conjecture. We calculate the margin buying balance ratio ($MBRATIO$) and short selling balance ratio ($SSRATIO$) of marginable stocks, where $MBRATIO$ ($SSRATIO$) is defined as the ratio of a stock's remaining margin buying (short selling) balance on June 12, 2015. We examine whether margin trading balance right before the regulatory rule change predicts cumulative returns over the next 5, 10, and 20 trading days post the rule change, after controlling for other cross sectional return determinants. Because many stocks suspended trading during the 2015 June market crash, we drop those stocks that have the number of trading suspended days five or more than the market trading days. Table **??** presents the results. The five-day cumulative characteristic-adjusted return post the rule change date is negatively predicted by $MBRATIO$ in the cross section with a coefficient of -0.275 and t-statistics of -2.02. The cross sectional regression coefficients are -0.526 (t-statistics = -2.88) and -0.563 (t-statistics = -2.68) for the 10- and 20-day scenarios. However, stocks with various $SSRATIO$ levels do not exhibit clear monotonic pattern for post-rule-change returns. To sum up, stocks with large margin buying balance experience more price drop during the market crash, which is consistent with our conjecture that margin buyers do not have information advantage and MB affects future returns through price pressure due to margin-driven flows.

Table **??** presents the post-rule-change performance of portfolios double sorted by $MBRATIO$ and $SSRATIO$. P1 refers to the portfolio of stocks with high-$MBRATIO$ and low-$SSRATIO$, P2 refers to the portfolio of stocks with high-$MBRATIO$ and high-$SSRATIO$, P3 refers to the portfolio of stocks with low-$MBRATIO$ and high-$SSRATIO$, and P4 refers to the portfolio of stocks with low-$MBRATIO$ and high-$SSRATIO$. P1-P4 is the long-short portfolio between P1 and P4. P1 (P4) has the smallest (largest) cumulative characteristic-adjusted returns post the rule change, which is exactly opposite to the performance of portfolios sorted by MB and SS before the rule change (Table **??**). The characteristic-adjusted cumulative 5-day, 10-day, and 20-day returns of P1-P4 are -3.57%

(t-statistics = -4.58), -4.37% (t-statistics = -3.50), and -5.75% (t-statistics = -3.85), respectively. The significant and negative P1-P4 returns also suggest that stocks with high margin buying tend to underperform those with low margin buying, and thus while short selling seems to be conducted by informed traders margin buying is exercised by unsophisticated retail investors. Therefore, stocks heavily held by margin buyers encountered deeper price depreciation in the 2015 June crash after the regulator set stricter restrictions on margin trading.

5 Conclusion

We study the informational role of leveraged trading by constructing two hypothesis. Under *the informed leverage hypothesis*, leverage serves as an obstacle to naive investors, and we expect both margin buying and short selling to predict future stock returns. Under *the uninformed leverage hypothesis*, trading informativess also depends on investor pessimism, and only short selling can predict future stock returns (margin buying does not predict future returns).

Using a unique Chinese sample of stock-level margin buying and short selling over the period from July 2010 to June 2015, we consistent evidence to *the uninformed leverage hypothesis*. Short selling predicts cross-sectional stock returns while margin buying has no cross-sectional prediction power . The time-series return prediction of margin buying is mechanically driven by the future increase in margin buying, which is not sustainable during the June 2015 Chinese stock market crash. Further evidence shows that margin buying activities are more likely to co-move across stocks, the intensity of margin buying is positively associated with contemporaneous investor sentiment, and the return predictability of margin buying is stronger during high-sentiment periods. Overall, the findings suggest that leverage is not a sufficient condition for informed trading.

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Table 1: Summary statistics

This table presents summary statistics. Panel A reports the summary statistics for the margin buying (MB) and short selling (SS) variables. MB (SS) is constructed as the ratio of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Panel B reports the summary statistics for the weekly return of marginable stocks. Panel C reports the summary statistics for control variables, including stock size (logarithm of market value), book-to-market ratio, idiosyncratic volatility calculated over the previous 52 weeks, the Amihud illiquidity ($\times 10^8$) measure calculated over the previous 52 weeks, turnover calculated over the previous 52 weeks, past one month return Ret_{-1}, past one year excluding past one month return $\text{Ret}_{-12,-2}$, and the Fama-French three-factor model loadings. The sample period is between July 1, 2010 and June 12, 2015.

Variable	N	Mean	STD	10%	25%	Median	75%	90%
Panel A: Margin buying and short selling variables								
MB	82,643	1.697	5.682	-3.333	-1.146	0.452	3.257	8.239
SS	82,643	0.004	0.180	-0.149	-0.038	0.000	0.041	0.160
Panel B: Cumulative weekly returns								
Ret^{1w}	82,643	0.704	5.305	-5.373	-2.603	0.299	3.296	7.099
Panel C: Control variables								
$Size$	82,643	23.592	1.082	22.304	22.802	23.476	24.199	25.037
BM	82,643	0.561	0.379	0.173	0.285	0.466	0.734	1.091
$IVOL$	82,643	3.956	1.477	2.229	2.925	3.777	4.763	5.876
$Amihud$	82,643	0.933	0.764	0.212	0.395	0.742	1.223	1.852
$Turnover$	82,643	0.059	0.045	0.015	0.027	0.046	0.079	0.121
Ret_{-1}	82,643	2.799	11.370	-9.763	-4.521	1.288	8.270	16.971
$Ret_{-12,-2}$	82,643	10.884	31.769	-21.354	-10.790	3.679	24.774	52.177
β_{mkt}	82,643	1.132	0.380	0.638	0.866	1.125	1.385	1.626
β_{smb}	82,643	0.133	0.700	-0.739	-0.328	0.107	0.569	1.036
β_{hml}	82,643	-0.175	1.003	-1.531	-0.795	-0.076	0.504	0.990

Table 2: Correlation between margin buying and short selling

This table presents the correlation coefficients between margin buying (MB) and short selling (SS). MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Panel A (Panel B) presents average Pearson and Spearman cross-sectional (time series) correlation coefficients. The cross-sectional correlation is averaged across weeks and the time series correlation is averaged across stocks. Newey-West adjusted t-statistics are reported in parentheses. The sample period is between July 1, 2010 and June 12, 2015.

Year	2010	2011	2012	2013	2014	2015	All
Panel A: Cross-sectional correlation							
$\rho^{Pearson}$	-0.077	-0.116	-0.111	-0.049	-0.006	-0.011	-0.065
	(-1.76)	(-5.33)	(-6.73)	(-3.62)	(-0.65)	(-0.74)	(-7.72)
$\rho^{Spearman}$	-0.059	-0.108	-0.115	-0.063	-0.013	0.006	-0.065
	(-1.65)	(-5.88)	(-8.80)	(-4.97)	(-1.53)	(0.52)	(-9.05)
Panel B: Time-series correlation							
$\rho^{Pearson}$	-0.173	-0.116	-0.119	-0.040	0.018	0.031	-0.001
	(-4.18)	(-5.86)	(-9.83)	(-4.19)	(2.50)	(3.38)	(-0.22)
$\rho^{Spearman}$	-0.151	-0.107	-0.113	-0.036	0.005	0.037	-0.008
	(-4.09)	(-5.95)	(-10.34)	(-3.99)	(0.69)	(4.05)	(-1.46)

Table 3: Panel regressions

This table presents the results of panel regressions when either time fixed effect or stock fixed effect is included. The dependent variables are stocks' weekly returns. MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Control variables include stock size (logarithm of market value), book-to-market ratio, idiosyncratic volatility calculated over the previous 52 weeks, the Amihud illiquidity ($\times 10^8$) measure calculated over the previous 52 weeks, turnover calculated over the previous 52 weeks, past one month return Ret_{-1}, past one year excluding past one month return $\text{Ret}_{-12,-2}$, and the Fama-French three-factor model loadings. Columns (1) to (3) report the results for regressions with time fixed effect and columns (4) to (6) report the results for regressions with stock fixed effect. Coefficients are reported with heteroskedasticity-robust t-statistics clustered by industry and week in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%. The sample period is between July 1, 2010 and June 12, 2015.

	Cross-Sectional Prediction			Time-Series Prediction		
	(1)	(2)	(3)	(4)	(5)	(6)
MB	**0.007**		**0.007**	**0.032*** **		**0.032*** **
	(1.38)		**(1.29)**	**(3.61)**		**(3.55)**
SS		**-0.275** **	**-0.266** **		**-0.284**	**-0.245**
		(-2.26)	**(-2.17)**		**(-1.39)**	**(-1.20)**
$Size$	-0.116**	-0.116**	-0.116**	0.382	0.422	0.382
	(-2.28)	(-2.29)	(-2.28)	(0.90)	(0.99)	(0.90)
BM	0.247**	0.247**	0.246**	1.679***	1.719***	1.678***
	(2.52)	(2.52)	(2.51)	(3.31)	(3.39)	(3.31)
β_{mkt}	0.037	0.035	0.036	-0.570***	-0.591***	-0.570***
	(0.45)	(0.42)	(0.44)	(-3.05)	(-3.14)	(-3.05)
β_{smb}	0.253***	0.253***	0.253***	-0.003	-0.012	-0.003
	(3.87)	(3.87)	(3.86)	(-0.03)	(-0.12)	(-0.03)
β_{hml}	-0.004	-0.004	-0.004	0.380***	0.387***	0.380***
	(-0.08)	(-0.09)	(-0.08)	(4.37)	(4.41)	(4.37)
$IVOL$	0.014	0.013	0.014	-0.382***	-0.389***	-0.383***
	(0.55)	(0.50)	(0.53)	(-4.70)	(-4.78)	(-4.72)
$Amihud$	-0.075*	-0.073*	-0.075*	-0.477***	-0.470***	-0.475***
	(-1.86)	(-1.82)	(-1.86)	(-3.31)	(-3.26)	(-3.31)
$Turnover$	-1.745*	-1.785**	-1.744*	23.808***	23.439***	23.802***
	(-1.92)	(-1.97)	(-1.92)	(4.19)	(4.11)	(4.18)
Ret_{-1}	-0.007	-0.006	-0.007	-0.002	0.004	-0.001
	(-1.23)	(-0.95)	(-1.15)	(-0.21)	(0.44)	(-0.18)
$Ret_{-12,-2}$	-0.004*	-0.004*	-0.004*	0.003	0.003	0.003
	(-1.82)	(-1.80)	(-1.83)	(0.85)	(0.97)	(0.84)
Time FE	Yes	Yes	Yes	No	No	No
Stock FE	No	No	No	Yes	Yes	Yes
Obs	82,643	82,643	82,643	82,643	82,643	82,643
R^2	0.3%	0.3%	0.3%	2.0%	1.9%	2.0%

Table 4: Predictive regressions of aggregate stock returns

This table presents the results of time-series predictive regressions of aggregate stock returns using margin buying (MB) and short selling (SS). MB (SS) is the cross-sectional average of stocks' margin buying (short selling) in week t. Dependent variables are equal-weighted and value-weighted excess return of marginable stocks in week $t+1$. Control variables include market excess return volatility calculated over the previous 52 weeks ($RVOL$), the book-to-market ratio of the market (BM_{MKT}), the risk-free rate proxied by SHIBOR (R_F), 10-year Treasury bond yield (LTY), the term spread ($TERM$) calculated as the yield spread between a 10-year Treasury bond and a 3-month Treasury bill, and inflation rate ($INFL$). Heteroskedasticity-robust t-statistics are reported in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%. The sample period is between July 1, 2010 and June 12, 2015.

	Equal-weighted return		Value-weighted return	
	(1)	(2)	(3)	(4)
MB	**0.372*** **	**0.197***	**0.372*** **	**0.283****
	(3.13)	**(1.70)**	**(3.33)**	**(2.10)**
SS	**1.661**	**2.286**	**1.382**	**1.368**
	(0.34)	**(0.43)**	**(0.32)**	**(0.30)**
$RVOL$		0.089		-0.236
		(0.09)		(-0.27)
BM_{MKT}		-2.151		-1.018
		(-0.79)		(-0.47)
R_F		15.588		0.723
		(0.81)		(0.04)
LTY		-0.775		-0.553
		(-1.20)		(-1.06)
$TERM$		0.316		0.087
		(0.49)		(0.20)
$INFL$		-0.614***		-0.240
		(-2.75)		(-1.24)
Obs	255	255	255	255
R^2	4.9%	8.6%	6.7%	8.1%

Table 5: Margin buying and short selling sorted portfolios

This table presents the weekly returns of portfolios double sorted by margin buying (MB) and short selling (SS). MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. In the time series, each stock is classified as high-MB (low-MB) if the stock's week t MB is larger (smaller) than its average week $t-8$ to week $t-1$ value. In the cross section, all stocks are divided into a high-SS group and a low-SS group according to SS. P1 refers to the portfolio of stocks with high-MB and low-SS, P2 refers to the portfolio of stocks with high-MB and high-SS, P3 refers to the portfolio of stocks with low-MB and high-SS, and P4 refers to the portfolio of stocks with low-MB and high-SS. Each portfolio is required to have at least 20 stocks for a given week. P1-P4 is constructed by longing the stocks belonging to high-MB and low-SS group while short selling the stocks belonging to low-MB and high-SS group. Panel A reports the results of equal-weighted portfolios and Panel B reports the results of deviation-weighted portfolios (the weight of stock is inversely proportional to its return deviation during the previous 52 weeks). Weekly excess returns and risk adjusted alphas are presented in percentage. Newey-West three-lag adjusted t-statistics are reported in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%. The sample period is between May 4, 2012 and June 12, 2015.

Panel A: Equal-weighted portfolio returns

	P1-P4		P1		P2		P3		P4	
α	**0.135****	**0.137***	**0.504***	**-0.092**	**0.397**	**-0.179****	**0.440**	**-0.173****	**0.370**	**-0.229*****
	(1.98)	**(1.72)**	**(1.70)**	**(-1.40)**	**(1.24)**	**(-2.31)**	**(1.56)**	**(-2.46)**	**(1.19)**	**(-2.70)**
β_{mkt}		-0.012		1.067***		1.092***		1.050***		1.079***
		(-0.39)		(32.85)		(39.63)		(34.92)		(37.96)
β_{smb}		0.011		0.218***		0.144*		0.270***		0.207***
		(0.24)		(3.33)		(1.83)		(3.44)		(3.28)
β_{hml}		0.055		-0.076		-0.157**		-0.079		-0.131*
		(0.78)		(-1.07)		(-2.13)		(-1.34)		(-1.91)
Obs	157	157	157	157	157	157	157	157	157	157
R^2	0.0%	0.8%	0.0%	93.3%	0.0%	93.3%	0.0%	93.4%	0.0%	93.1%

Panel B: Deviation-weighted portfolio returns

	P1-P4		P1		P2		P3		P4	
α	**0.145****	**0.159****	**0.532***	**-0.044**	**0.415**	**-0.142***	**0.478***	**-0.111***	**0.387**	**-0.202****
	(2.24)	**(2.13)**	**(1.82)**	**(-0.67)**	**(1.32)**	**(-1.83)**	**(1.73)**	**(-1.66)**	**(1.27)**	**(-2.45)**
β_{mkt}		-0.015		1.037***		1.063***		1.012***		1.052***
		(-0.48)		(32.06)		(41.49)		(36.86)		(40.34)
β_{smb}		-0.011		0.206***		0.135		0.260***		0.217***
		(-0.25)		(2.93)		(1.62)		(3.64)		(3.50)
β_{hml}		0.059		-0.031		-0.099		-0.043		-0.090
		(0.89)		(-0.45)		(-1.38)		(-0.79)		(-1.27)
Obs	157	157	157	157	157	157	157	157	157	157
R^2	0.0%	1.8%	0.0%	92.7%	0.0%	93.0%	0.0%	93.4%	0.0%	93.0%

Table 6: Explanation of margin buying and short selling

This table presents the adjusted R^2 of regressing individual stocks' margin buying (MB) and short selling (SS) on their cross-sectional averages and principal components. MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Panel A reports the distribution of time series regression adjusted R^2s in percentage of MB_i (SS_i) on the cross sectional average $\bar{MB}$ ($\bar{SS}$). Panels B to D report the distribution of time series regression adjusted R^2s in percentage of MB_i (SS_i) on the first, the first two, and the first three principal component of MB_i (SS_i).

	N	Mean	STD	P10	P25	Median	P75	P90
Panel A: The cross-sectional average of MB (SS)								
$R^2_{adj,MB}$	812	14.444	10.283	1.858	6.536	13.337	20.948	28.090
$R^2_{adj,SS}$	812	3.978	7.033	-1.492	-0.642	1.946	6.632	11.676
Difference		10.466						
t-stat		25.02						
Panel B: The first principal component								
$R^2_{adj,MB}$	812	13.369	11.572	0.205	3.722	11.179	20.671	30.251
$R^2_{adj,SS}$	812	1.195	5.838	-1.656	-0.934	-0.436	0.738	4.805
Difference		12.174						
t-stat		26.19						
Panel C: The first two principal components								
$R^2_{adj,MB}$	812	17.261	12.580	2.296	7.869	16.196	24.849	34.773
$R^2_{adj,SS}$	812	3.911	8.207	-2.482	-0.992	1.567	6.324	13.825
Difference		13.350						
t-stat		27.34						
Panel D: The first three principal components								
$R^2_{adj,MB}$	812	19.320	13.562	3.043	9.293	18.101	27.809	38.077
$R^2_{adj,SS}$	812	5.231	9.505	-2.809	-0.674	2.863	8.595	17.031
Difference		14.089						
t-stat		25.73						

Table 7: Predictive regressions of margin buying and short selling

This table presents the results of predictive regression of margin buying (MB) and short selling (SS) on lagged margin buying and short selling. MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Columns (1) to (4) present the results of the panel regressions of stock level MB and SS on lagged MB and SS. Heteroskedasticity-robust t-statistics clustered by industry and week are reported in parentheses. Columns (5) and (6) present the results of a vector auto-regression (VAR) of the aggregate MB and SS on lagged MB and SS. Newey-West three-lag adjusted t-statistics are reported in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%. The sample period is between July 1, 2010 and June 12, 2015.

	MB_t	SS_t	MB_t	SS_t	MB_t	SS_t
	(1)	(2)	(3)	(4)	(5)	(6)
MB_{t-1}	0.132	-0.001	0.169	-0.001	0.501***	-0.003
	(16.06)***	(-3.38)***	(14.85)***	(-4.31)***	(4.17)	(-1.44)
MB_{t-2}	0.063	-0.000	0.074	-0.000	0.099	-0.002
	(8.45)***	(-0.79)	(6.74)***	(-2.10)**	(1.30)	(-1.19)
MB_{t-3}	0.038	-0.000	0.050	-0.000	0.069	0.003
	(5.27)***	(-1.06)	(4.71)***	(-0.29)	(0.75)	(1.46)
MB_{t-4}	0.026	-0.000	0.042	-0.001	0.149	-0.002
	(4.08)***	(-3.32)***	(4.39)***	(-3.62)***	(1.47)	(-0.86)
SS_{t-1}	1.109	-0.281	1.350	-0.271	3.228	-0.068
	(8.13)***	(-30.41)***	(7.79)***	(-25.14)***	(1.32)	(-0.78)
SS_{t-2}	1.179	-0.163	1.194	-0.158	0.989	-0.063
	(8.12)***	(-17.21)***	(6.33)***	(-14.75)***	(0.51)	(-0.84)
SS_{t-3}	0.665	-0.084	0.464	-0.078	-1.219	0.040
	(4.96)***	(-9.43)***	(2.69)***	(-8.12)***	(-0.60)	(0.53)
SS_{t-4}	0.505	-0.060	0.392	-0.058	0.656	-0.040
	(4.05)***	(-7.57)***	(2.09)**	(-6.16)***	(0.26)	(-0.46)
Time FE	Yes	Yes	No	No	No	No
Stock FE	No	No	Yes	Yes	No	No
Obs	71,812	71,812	71,812	71,812	251	251
R^2	17.8%	12.3%	8.2%	7.8%	47.7%	4.8%

Table 8: The effects of sentiment on margin buying and short selling

This table presents the results of contemporaneous regressions of margin buying (MB) and short selling (SS) on sentiment proxies. The dependent variables are the cross-sectional average of MB and SS. MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. The sentiment proxies include $BW2006$ which is the sentiment index calculated following Baker and Wurgler (2006), and *Active* which is the ratio of the number of stock accounts that have trades in week t to the total number of accounts with stock holdings by the end of week t. Control variables include Fama-French three factors, the momentum factor (UMD), the risk-free rate proxied by SHIBOR (R_F), volatility of market excess return ($RVOL$), book-to-market value ratio of the market (BM_{MKT}), 10-year Treasury bond yield (LTY), the term premium ($TERM$) calculated as the yield spread between a 10-year Treasury bond and a 3-month Treasury bill, and inflation rate ($INFL$). Newey-West three-lag adjusted t-statistics are reported in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%. The sample period is between July 1, 2010 and June 12, 2015.

	Margin Buying				Short Selling			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BW2006$	**1.016*** **	**0.819*** **			**-0.002**	**-0.005**		
	(9.22)	**(3.90)**			**(-1.51)**	**(-0.93)**		
$ACTIVE$			**0.958*** **	**1.036*** **			**-0.005*** **	**-0.002**
			(6.43)	**(5.43)**			**(-2.94)**	**(-0.64)**
$MKTRF$		0.065**		0.087***		0.003***		0.003***
		(2.22)		(3.06)		(3.56)		(3.41)
SMB		0.124**		0.103*		0.001		0.001
		(2.13)		(1.84)		(0.75)		(0.75)
HML		0.087		0.096		0.003		0.003
		(1.18)		(1.41)		(1.45)		(1.41)
UMD		-0.042		-0.027		0.000		0.000
		(-1.41)		(-0.93)		(0.04)		(0.01)
R_F		-21.496*		-31.970***		-0.246		-0.238
		(-1.92)		(-2.96)		(-1.11)		(-1.09)
$RVOL$		-1.381***		-2.220***		-0.016		-0.009
		(-3.09)		(-5.48)		(-0.92)		(-0.61)
BM_{MKT}		-2.673		1.440		0.038		0.045
		(-1.64)		(0.81)		(1.22)		(1.26)
LTY		-0.163		-0.073		-0.012*		-0.013*
		(-0.58)		(-0.25)		(-1.84)		(-1.95)
$TERM$		-0.171		-0.476***		-0.001		-0.000
		(-1.09)		(-2.64)		(-0.21)		(-0.05)
$INFL$		0.067		0.101		0.003		0.005**
		(0.29)		(0.60)		(0.76)		(2.25)
Obs	254	254	254	254	254	254	254	254
R^2	51.3%	57.6%	35.3%	62.1%	0.5%	12.3%	2.2%	12.0%

Table 9: Panel regressions conditional on sentiment level

This table presents the results of panel regressions conditional on sentiment level. The dependent variables are stocks' weekly returns. MB (SS) is constructed as the ratio (in percentage) of weekly net margin buying amount (net short selling amount) to average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Control variables include stock size (logarithm of market value), book-to-market ratio, idiosyncratic volatility calculated over the previous 52 weeks, the Amihud illiquidity ($\times 10^8$) measure calculated over the previous 52 weeks, turnover calculated over the previous 52 weeks, past one month return Ret_{-1}, past one year excluding past one month return $\text{Ret}_{-12,-2}$, and the Fama-French three-factor model loadings. The sample is equally divided into a low-sentiment period and a high-sentiment period according to $BW2006$ (Panel A) and $Active$ (Panel B) sentiment proxies. Columns (1) to (6) report the results of regressions during low-sentiment period and columns (7) to (12) report the results of regressions during high-sentiment period. Coefficients are reported with heteroskedasticity-robust t-statistics clustered by industry and week in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%. The sample period is between July 1, 2010 and June 12, 2015.

	Low Sentiment						High Sentiment					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: BW2006												
MB	**-0.028***		**-0.032****	**-0.093*****		**-0.097*****	**0.008**		**0.008**	**0.029*****		**0.029*****
	(-1.82)		**(-2.14)**	**(-3.34)**		**(-3.58)**	**(1.47)**		**(1.41)**	**(3.19)**		**(3.15)**
SS		**-0.427*****	**-0.459*****		**-0.302**	**-0.404**		**-0.235**	**-0.224**		**-0.243**	**-0.207**
		(-2.68)	**(-2.91)**		**(-1.03)**	**(-1.41)**		**(-1.51)**	**(-1.44)**		**(-0.96)**	**(-0.81)**
Time FE	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
Stock FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	16,291	16,291	16,291	16,291	16,291	16,291	65,730	65,730	65,730	65,730	65,730	65,730
R^2	0.2%	0.3%	0.3%	2.2%	2.0%	2.2%	0.4%	0.4%	0.4%	2.2%	2.1%	2.2%
Panel B: Active												
MB	**-0.026*****		**-0.028*****	**-0.058*****		**-0.058*****	**0.014****		**0.014****	**0.042*****		**0.041*****
	(-3.51)		**(-3.69)**	**(-3.58)**		**(-3.60)**	**(2.35)**		**(2.31)**	**(4.01)**		**(3.95)**
SS		**-0.343*****	**-0.375*****		**-0.054**	**-0.113**		**-0.230**	**-0.210**		**-0.634***	**-0.576***
		(-2.62)	**(-2.84)**		**(-0.23)**	**(-0.48)**		**(-1.00)**	**(-0.91)**		**(-1.81)**	**(-1.65)**
Time FE	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
Stock FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	38,327	38,327	38,327	38,327	38,327	38,327	43,694	43,694	43,694	43,694	43,694	43,694
R^2	0.4%	0.3%	0.4%	1.1%	0.9%	1.1%	0.6%	0.6%	0.6%	3.5%	3.3%	3.5%

Table 10: The effects of margin trading balance on stock returns during market crash

This table presents the results of cross-sectional regressions of stocks' returns during 2015 market crash on stocks pre-crash margin trading balance. The following regression of cumulative abnormal returns on margin buying and short selling balance ratio is implemented:

$$CAR_i = a + bMBRATIO_i + cSSRATIO_i + dControl_i + \epsilon_i$$

CAR_i is the cumulative characteristic adjusted return of marginable stock i over 5/10/20 trading days after June 12, 2015. We follow the DGTW (1997) method to adjust stocks' raw returns according to the 27 ($3 \times 3 \times 3$) benchmark portfolios sorted by size, book-to-market, and momentum. $MBRATIO_i$ ($SSRATIO_i$) is the ratio ($\times 10^6$) of a stock's margin buying (short selling) balance to its market capitalization on June 12, 2015. Control variables include stock size (logarithm of market value), book-to-market ratio, idiosyncratic volatility calculated over the previous 52 weeks, the Amihud illiquidity ($\times 10^8$) measure calculated over the previous 52 weeks, turnover calculated over the previous 52 weeks, past one month return Ret_{-1}, past one year excluding past one month return $\text{Ret}_{-12,-2}$, and the Fama-French three-factor model loadings. The sample begins from June 15, 2015 and ends in 5, 10, and 20 trading days afterwards.

	t=5	t=10	t=20
$MBRATIO$	**-0.275****	**-0.526*****	**-0.563*****
	(-2.02)	**(-2.88)**	**(-2.68)**
$SSRATIO$	**0.037**	**0.034**	**0.049**
	(1.55)	**(0.87)**	**(1.30)**
$Size$	-0.016***	-0.023***	-0.002
	(-2.88)	(-2.77)	(-0.15)
BM	-0.002	-0.001	-0.000
	(-1.32)	(-0.22)	(-0.03)
β_{mkt}	0.017	0.015	-0.012
	(1.36)	(0.99)	(-0.58)
β_{smb}	-0.037***	-0.069***	-0.030*
	(-3.11)	(-4.31)	(-1.84)
β_{hml}	0.024***	0.042***	-0.003
	(4.39)	(5.19)	(-0.30)
$Illiq$	0.464	0.736*	0.950
	(1.43)	(1.94)	(1.11)
$Turnover$	0.044	0.211**	0.015
	(0.59)	(2.04)	(0.12)
$Ivol$	0.034	-0.023	-1.191**
	(0.12)	(-0.06)	(-2.49)
Ret_{-1}	-0.029	-0.050	-0.093**
	(-1.18)	(-1.58)	(-2.27)
$Ret_{-12,-2}$	-0.022**	-0.040***	-0.012
	(-2.40)	(-3.37)	(-0.91)
$Constant$	0.299***	0.416***	0.094
	(2.98)	(2.88)	(0.52)
Obs	709	688	600
R^2	10.0%	13.3%	10.5%

Table 11: Returns of $MBRatio$ and $SSRatio$ sorted portfolios during market crash

This table shows the characteristic adjusted returns of portfolios double sorted by margin buying ratio ($MBRATIO_i$) and short selling ratio ($STRATIO_i$) during 2015 market crash. Raw returns are adjusted following the DGTW (1997) method according to the 27 ($3 \times 3 \times 3$) benchmark portfolios sorted by size, book-to-market, and momentum. $MBRATIO_i$ ($SSRATIO_i$) is the ratio ($\times 10^6$) of a stock's margin buying (short selling) balance to its market capitalization on June 12, 2015. P1 refers to the portfolio of stocks with high-$MBRATIO$ and low-$SSRATIO$, P2 refers to the portfolio of stocks with high-$MBRATIO$ and high-$SSRATIO$, P3 refers to the portfolio of stocks with low-$MBRATIO$ and high-$SSRATIO$, and P4 refers to the portfolio of stocks with low-$MBRATIO$ and high-$SSRATIO$. P1-P4 is constructed by longing the stocks belonging to high-$MBRATIO$ and low-$SSRATIO$ group while short selling the stocks belonging to low-$MBRATIO$ and high-$SSRATIO$ group. Cumulative returns of four portfolios and the P1-P4 portfolio over the 5/10/20 trading days after June 12, 2015 are reported in percentage. The t-statistics of the return difference P1-P4 are reported in parentheses.

Days	P1-P4	P1	P2	P3	P4
5	-3.57	-3.34	-0.69	-1.31	0.22
	(-4.58)				
10	-4.37	-5.90	-3.73	-5.28	-1.53
	(-3.50)				
20	-5.75	-11.23	-7.37	-8.52	-5.54
	(-3.85)				

Appendix

A History of marginable stocks

Table A.1: History of marginable stocks

This table lists the dates when a group of stocks were classified as qualified marginable stocks. Date is the time when some stocks were included into the marginable group. N^{added} is the number of stocks that were qualified for margin buying and short selling on a specific day. $N^{deleted}$ is the number of stocks that were removed from the list.

Date	N^{added}	$N^{deleted}$
March 31, 2010	90	6
July 1, 2010	5	0
July 29, 2010	1	0
December 5, 2011	185	21
January 31, 2013	275	13
September 16, 2013	186	5
September 22,2014	200	0
Total	942	45

B Details of variable construction

Margin buying (MB): the ratio of weekly net margin buying amount to the average weekly trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks. Net margin buying in week t is defined as the total margin buying minus the total margin repayment, and RMB trading volume of stock i in week w is denoted $VOLD^i_w$.

$$MB^i_t = \frac{MarginBuy^i_t - MarginRep^i_t}{\frac{1}{52}\sum_{w=t-52}^{t-1} VOLD^i_w}$$

Short selling (SS): the ratio of weekly net short selling shares to the average weekly trading shares over the previous 52 weeks with a minimum required number of observations of 40 weeks. Net short selling in week t is defined as the total short selling minus the repayment of short selling, and number of shares traded for stock i in week w is denoted $VOLS_w^i$.

$$SS_t^i = \frac{ShortSell_t^i - ShortRep_t^i}{\frac{1}{52}\sum_{w=t-52}^{t-1} VOLS_w^i}$$

Margin buying balance ratio ($MBRATIO$): the ratio of RMB margin balance to the market capitalization (stock price multiplied by the number of shares outstanding) on June 12, 2015.

Short selling balance ratio ($SSRATIO$): the ratio (multiplied by 1,000,000) of short selling balance (shares) to the the number of shares outstanding on June 12, 2015.

Size: Firm size is measured as the natural logarithm of the market capitalization (stock price multiplied by the number of shares outstanding in ¥) at the end of the week for each stock.

Book-to-market ratio (BM): Following Fama and French (1992), the book value is measured as the common equity plus balance-sheet deferred taxes for the firm's latest fiscal year ending in the previous calendar year, the market value is measured at the end of December of the previous calendar year.

Illiquidity (*Amihud*): Following Amihud (2002), we measure stocks' illiquidity in week t as the time series average of the ratio (multiplied by 100,000,000) of the absolute weekly stock return to the weekly RMB trading volume over the previous 52 weeks with a minimum required number of observations of 40 weeks: $Amihud_t^i = \frac{1}{52}\sum_{w=t-51}^{w=t} \frac{|r_w^i|}{VOLD_w^i}$, where r_w^i denotes the return and $VOLD_w^i$ denotes the RMB trading volume.

Turnover ratio ($Turnover$): we measure stocks' turnover ratio in week t as the time series average of the ratio of the weekly shares traded to the number of shares outstanding in a 52-week rolling window with a minimum required number of observations of of 40 weeks: $Turnover_t^i = \frac{1}{52}\sum_{w=t-51}^{w=t} \frac{VOLS_w^i}{SHROUT_w^i}$, where $VOLS_w^i$ denotes the shares traded and $SHROUT_w^i$ denotes the number of shares outstanding.

Idiosyncratic volatility ($Ivol$): Following Ang et al. (2006), we measure idiosyncratic volatility as the standard deviation of residuals in the Fama-French three-factor model over the previous 52 weeks with a minimum required number of observations of 40 weeks.

$BETA$ (β_{mkt}^i, β_{smb}^i, β_{hml}^i): The factor loadings of stock i in week t are estimated with the Fama-French three-factor model using the sample over the previous 52 weeks with a minimum required number of observations of 40 weeks.

Short-term reversal (Ret_{-1}): Following Da, Liu, and Schaumburg (2014), we define a stock's week t past short-term reversal return as the cumulative return from week $t-4$ to week $t-1$.

Momentum ($Ret_{-12,-2}$): Following Jegadeesh and Titman (1993), we define a stock's week t past momentum return as the cumulative return from week $t-52$ to week $t-5$.

Excess return volatility ($RVOL$): We measure excess return volatility as the standard deviation of weekly excess market return over risk-free rate over the previous 52 weeks.

Market book-to-market ratio (BM_{MKT}): the ratio of book value to market value for the aggregate China A-Share market. Following Rapach, Ringgenberg, and Zhou (2015), the market-wide book value is aggregated over all listed A-Share stocks as the common equity plus balance-sheet deferred taxes for the latest fiscal year ending in the previous calendar year, and the aggregate market value is measured at the end of each week.

Long-term yield (LTY): 10-year Treasury bond yield.

Term spread ($TERM$): the yield spread between a 10-year Treasury bond and a 3-month Treasury bill.

Inflation rate ($INFL$): the inflation rate calculated from monthly consumer price index (CPI) published by National Bureau of Statistics of the People's Republic of China.

Baker and Wurgler sentiment index ($BW2006$): Following Baker and Wurgler (2006), the sentiment index is defined as the first principal component of the correlation matrix of five variables: the closed-end fund discount ($CEFD$), share turnover of China A-Share market ($TURNOVER$), the average first-day IPO return ($RIPO$), the summation of equity issues and long-term debt issues ($Share$), and the natural logarithm of the number of new investors ($NINV$). We replace the number of IPOs in their paper by the number of new investors because of IPO restriction set by China Securities Regulation Commission. We define first-day IPO return as the cumulative return from IPO date to the first day when the price limit is not hit. All the five series have been standardized and the first principal component explains 33.3% of the sample variance. The sentiment index is calculated from January 2006 to June 2015.

Active account ratio ($Active$): the ratio of the number of active investors who trade in week t to the number of investors who hold stocks at the end of week t.