Extreme Returns and Expected Returns

——Evidence from Chinese A-Share Market

ABSTRACT

This paper mainly explores the relationship between stock return and maximum daily return in Chinese A-share market, and analyze the maximum effect, skewness effect and idiosyncratic skewness effect in different levels of investor sentiment and market volatility. The paper verifies that there is a significant maximum effect in Chinese A-share market, and that the maximum effect does not weaken the idiosyncratic volatility effect. In addition, when investors are extremely pessimistic about stock market, the significant negative correlations between stock return and monthly maximum daily return and skewness disappear. In the period of high market volatility, the maximum effect still exists steadily, but the skewness effect and idiosyncratic skewness effect disappear.

KEY WORDS: extreme return, skewness, idiosyncratic volatility, investor sentiment, market volatility

1.Introduction

The relationship between the asymmetry of stock return distribution and the expected stock return has been discussed by many researchers since the end of the last century. There are several variables that can be used to characterize the asymmetry of stock returns, including stock extreme returns and skewness of return distribution. Extreme returns and skewness are correlated. The larger daily stock return is, the return distribution is more likely to present the right-biased feature, and the skewness is consequently larger. However, since the skewness is a third central moment variable, its complex calculation can affect the stability of its relationship with expected return.

In recent years, some researchers have conducted in-depth research on the relationship between stock extreme returns and expected returns. For example, Bali, Cakici, and Whitelaw (2011) showed there is a significant negative correlation between stock expected return and maximum daily return they proposed, controlling size, book-to-market ratio, momentum, reversal, illiquidity and skewness. The maximum daily return also reversed idiosyncratic volatility effect proposed by Ang, Hodrick, Xing, and Zhang (2006, 2009). Afterwards, Nartea, Kong and Wu (2017) used Chinese A-share market as their sample and found the same significantly negative correlations. Unlike the study in the US market, the maximum daily return does not eliminate the market's idiosyncratic volatility effect.

Compared with extreme returns, more researchers have explored the relationship between stock expected returns and skewness. Skewness including total skewness, systematic skewness, and idiosyncratic skewness, are calculated in a variety of ways. Harvey and Siddique (2000) used a method to calculate the conditional skewness over time and found its correlation with stock returns. Boyer, Mitton and Vorkink (2009) tested theory proposed in Mitton and Vorkink (2007) by constructing a model of expected skewness and verified the negative correlation between future returns and expected idiosyncratic skewness. Conrad, Dittmar and Ghysels (2013) used option prices to estimate the moments of distribution of stock returns under the risk-neutral measure, and then found that the stock returns had a significant correlation with the variance, skewness and kurtosis under the measure. Specifically, there is a negative correlation between expected return and variance, skewness, and a positive correlation with kurtosis. Ghysels (2016) explored both developing and developed countries' stock markets and found that stock returns in developing countries are more positively biased. The empirical result suggested that investors can allocate more assets in developing making use of the stock characteristics. This research encourages more researchers to explore the asymmetry of returns in developing countries' stock markets.

Why is there a negative correlation between stock expected return and maximum daily return or skewness? To solve this question, most researchers built a theoretical model based on behavioral finance theory for explanation.

Mitton and Vorkink (2007) pointed out that investors preferred more positively biased return distribution of their portfolio and thus gave up some diversification when allocating assets, leading to a worse future return. Barberis and Huang (2008) proposed a cumulative prospect theory to construct a stock pricing model with skewness as a factor. Brunnermeier, Gollier and Parker (2007) showed individual investors tended to overestimate the possibility of obtaining higher returns, thus overestimating the price of positive stocks.

It is interesting to note that the negative correlation between expected return and variable that characterizes the asymmetry of stock return distribution may be weakened in periods when investors have different sentiments. Stambaugh, Yu, and Yuan (2012, 2015) found that stock abnormal return values were higher during periods of high investor sentiment, because wrong estimates of stock prices were more likely to occur when investor was very optimistic. Jiang, Wu, Zhou and Zhu (2019) divided the sample into different periods of investor sentiment according to the Baker and Wurgler (2006) sentiment index and found that there was a significant positive correlation between stock return and skewness variables in US stock market in low-sentiment periods. Thus, the skewness effect doesn't persistently exist in the market.

Chinese A-share market has developed rapidly since its establishment in 1990. At the end of 1997, there were 720 stocks with a total market value of 1,752.9 billion yuan. At the end of 2017, there were more than 3,000 A-shares with a total market capitalization of about 50.62 trillion. Although there are regulations such as the daily limit system and short-selling restrictions that affect market efficiency, the market with such a large value is worth studying. I believe that it is important to explore the factors that create excess returns in China's A-share market, and we need to understand how these factors drive stock price dynamics.

Therefore, inspired by the above research and the rapid development of stock market, the paper is trying to verify the relationship between stock returns and extreme returns in A-share market. Firstly, this paper adopts the traditional method of asset pricing empirical research, performs univariate and bivariate sorting and grouping according to our interested variables, and reports the average return of portfolio in the next month and the FF-3 ALPHA return. The paper also explores the relationship between stock returns and extreme returns on level of individual stocks using weighted FAMA-MACBETH regression for both univariate and multivariate regression. In order for further analysis, I extend the holding period from one month to six months.

In addition, this paper also explores whether investor sentiment will affect the result we find for extreme returns and expected returns. Therefore, I divide the sample according to investor sentiment index in China and apply the same method under different circumstances. Similarly, this paper also explores whether market volatility matters for our results.

The second following part introduces data source, data cleaning methods and definition of relevant variables.

The third part mainly shows the empirical results for different holding periods and subsamples. The fourth part is the conclusion, summarizing all the findings of this paper.

2.Data

The stock data and risk-free return data are from CSMAR database. The sample includes all A-share stocks from January 1997 to December 2017. The FAMA three-factor data come from China Asset Management Research Center. The investor confidence index from April 2008 to December 2017 is from WIND macroeconomic database, which is the China Securities Market Investor Confidence Index issued by China Securities Investor Protection Fund Co., Ltd.

The sample includes 2,832 stocks within 252 months from January 1997 to December 2017. Since some stocks were not listed until time between 1997 and 2017, there is an average of 1508 stocks per month. When cleaning daily data, data with missing daily return is deleted first. Then, IPO returns are deleted. At the same time, according to the regulation of limit of the price daily change, this paper deletes outliers of daily return. When cleaning monthly data, the missing and IPO month return are also deleted.

The variables used in this paper are defined as follows.

The maximum daily stock return is the maximum of excess daily return of a stock in each month. According to Nartea, Kong and Wu (2017), the actual daily return of a stock can be estimated by accumulating the stock return in following days if it hits price limits of Chinese A-share market. It should be noted that a stock's maximum daily stock return used for portfolio sorting and regression analysis at current month is calculated from its previous month returns. MAX in this paper refers to the maximum daily stock return.

The definition and calculation of skewness and idiosyncratic skewness are as follows. If a stock has no less than 20 trading days in previous three months, skewness is generated from these days' excess return distribution. Otherwise the skewness should be a missing value. Idiosyncratic characteristics are calculated using this regression $R_{i,t,d} = \alpha_{i,t,d} + \beta_{MKT,i,t}MKT_{t,d} + \beta_{SMB,i,t}SMB_{t,d} + \beta_{HML,i,t}HML_{t,d} + \varepsilon_{i,t,d}$. Using previous three months individual stock return and Fama-French three factors, we obtain the residuals. Idiosyncratic skewness and volatility are just the skewness and stand deviation of the residuals.

Size is the log of market capitalization in the previous month. Book-to-market ratio is the reciprocal of the P/B ratio obtained from most recent June. Momentum for a stock at time t is the excess cumulative return from month t-12 to t-2. Reversal for a stock at time t is the excess return at month t-1. Closing price is just the closing price of the last trading day in the previous month. Illiquidity is stock return divided by turnover in the previous month. BETA is obtained by regressing daily excess return to daily Fama-French three factors monthly, and it's the average of values we get from previous twelve months' regression. The investor confidence index variable

has range from 0 to 100. When the index is greater than 50, it says investors are generally optimistic. Index less than 50 indicates investors are pessimistic. This variable will serve as an important criterion for segmenting the sample.

3.Portfolio Return Results

3.1Portfolio returns by univariate sorting

At the beginning of each month, stocks are sorted by their and divided into 5 groups. The five groups are the LOWMAX, 2, 3, 4, HIGHMAX. We calculate the average return of both equal-weighted and value-weighted portfolios. Also, FF-3 Alpha are generated by regressing portfolio returns on FAMA three factors. Longing HIGHMAX and shorting LOWMAX, we obtain return of HIGH-LOW. The Newey-West t stats are reported below. The result is shown in Table 1.

Table 1 Excess return for equal-weighted and value-weighted portfolio constructed by univariate sorting on MAX. FF-3 Alpha are also reported.

	Equal-weighted		Value-weighted	
	Average Return（%）	FF-3 Alpha（%）	Average Return（%）	FF-3 Alpha（%）
LOW MAX	1.54	0.23	1.39	0.76
	（2.24）	（1.97）	（2.22）	（2.84）
2	1.67	0.29	1.88	1.07
	（2.39）	（3.07）	（2.72）	（6.22）
3	1.54	0.15	2.01	1.34
	（2.18）	（1.82）	（3.02）	（7.29）
4	1.06	-0.31	1.61	0.96
	（1.53）	（-4.01）	（2.32）	（5.54）
High MAX	0.51	-0.84	1.62	0.87
	（0.72）	（-6.78）	（2.16）	（3.48）
HIGH-LOW	-1.02	-1.07	0.24	0.11
	（-5.38）	（-5.74）	（0.65）	（0.28）

3.2Portfolio returns by bivariate sorting

At the beginning of each month, the stocks are ordered and divided into three groups according to other characteristics such as SIZE, BM and MOM, etc., and then the stocks in each group are sorted by MAX and divided into five groups. Then we report the average return of portfolios with same level of MAX but different

values of other factors to keep portfolio L,2,3,4 and H neutral to the other factor. The Newey West t test results are reported below the rate of return. The results are shown in Table 2.

Table 2 Excess return for equal-weighted and value-weighted portfolio constructed by dependent bivariate sorting on size, book-to-market ratio, momentum, reversal, close price, skewness, idiosyncratic skewness, idiosyncratic volatility, illiquidity, market beta and MAX.

Equal-weighted						Value-weighted					
L	2	3	4	H	H-L	L	2	3	4	H	H-L
A. SIZE and MAX											
1.58	1.62	1.46	1.09	0.57	-1.02	1.38	1.83	1.84	1.69	1.67	0.29
					-6.09						-0.82
B. BM and MAX											
1.60	1.63	1.49	1.10	0.49	-1.10	1.51	1.91	1.95	1.65	1.5	-0.01
					-6.47						-0.04
C. MOM and MAX											
1.55	1.63	1.52	1.09	0.54	-1.01	1.33	2.03	1.82	1.70	1.71	0.38
					-5.76						-1.06
D. REV and MAX											
1.53	1.46	1.43	1.14	0.76	-0.77	1.5	1.8	1.95	1.66	1.63	0.13
					-4.65						0.41
E. CP and MAX											
1.57	1.64	1.46	1.12	0.54	-1.02	1.43	1.92	1.79	1.75	1.60	0.18
					-6.59						0.52
F. SKEW and MAX											
1.50	1.56	1.42	1.12	0.65	-0.85	1.32	1.72	1.81	1.89	1.64	0.31
					-4.77						0.98
G. ISKEW and MAX											
1.53	1.64	1.48	1.07	0.54	-0.99	1.34	1.82	1.93	1.60	1.78	0.45
					-5.13						1.18
H. IVOL and MAX											
1.29	1.33	1.34	1.22	1.14	-0.15	1.32	1.87	1.96	1.83	1.62	0.30
					-0.91						0.93
I. ILLIQUIDITY and MAX											
1.57	1.59	1.52	1.07	0.58	-0.99	1.46	1.91	1.92	1.65	1.65	0.20

					-5.48						0.54
					J. BETA and MAX						
1.49	1.57	1.51	0.99	0.56	-0.93	1.28	1.91	1.95	1.48	1.64	0.37
					-4.72						1.05

4.Regression analysis

We also use univariate regression and multivariate regression to analyze the relationship between the extreme returns and future returns from the level of individual stocks. The weighted Fama-Macbeth regression is used here. In each month, we regress monthly return of stocks on lagged explanatory variables. The final coefficient for each explanatory variable is the weighted average of coefficients we obtain from regression in each month. This method reasonably considers number of observations.

One example of the regression equation:

$$R_t=\beta_{0,t}+\beta_{1,t}MAX_{t-1}+\beta_{2,t}SIZE_{t-1}+\beta_{3,t}BM_{t-6}+\beta_{4,t}MOM_{t-1}+\beta_{5,t}REV_{t-1}+\beta_{6,t}CP_{t-1}+\beta_{7,t}SKEW_{t-1}$$
$$+\beta_{8,t}ISKEW_{t-1}+\beta_{9,t}IVOL_{t-1}+\beta_{10,t}ILLIQUIDITY_{t-1}+\beta_{11,t}BETA_{t-1}+\varepsilon_t \quad (1)$$

The regression results are shown in Table 3 and Table 4.

Table 3 Univariate regression result by Fama-Macbeth method.

Independent Variable	Coefficient	t-stats
MAX	-0.083***	（-4.592）
SIZE	-0.007***	（-4.634）
BM	-0.006	（-0.985）
MOM	0.001	（0.301）
REV	-0.041***	（-4.440）
CP	-0.000	（-1.539）
SKEW	-0.005***	（-3.893）
ISKEW	-0.000	（-0.672）
IVOL	-0.852***	（-9.640）
ILLIQUIDITY	9.508***	(3.636)
BETA	-0.002	（-0.687）

Table 4 Bivariate and multivariate regression results by Fama-Macbeth method.

MAX	SIZE	BM	MOM	REV	CP	SKEW	ISKEW	IVOL	ILLIQUIDITY	BETA	
-0.086***	-0.005***										（1）
-5.17	-3.29										
-0.086***		0.007									（2）
-5.12		1.32									
-0.081***			0.002								（3）
-4.879			0.49								
-0.057**				-0.029**							（4）
-2.57				-2.45							
-0.084***					0.000						（5）
-5.04					-0.86						
-0.068***						-0.004					（6）
-3.52						-2.54					
-0.080***							0.000				（7）
-4.30							0.18				
0.046**								-1.050***			（8）
2.44								-10.43			

Note: t-stats are reported under the coefficient, *, ** and *** indicates that p value is less than 10%,5% and 1% respectively.

Table 4 (part 2) Bivariate and multivariate regression results by Fama-Macbeth method.

MAX	SIZE	BM	MOM	REV	CP	SKEW	ISKEW	IVOL	ILLIQUIDITY	BETA	
-0.089***									59.625***		（9）
-4.70									4.53		
-0.083***										0.000	（10）
-4.50										0.13	
	-0.004***	0.012***	0.002	-0.055***	0.000				17.937***	-0.000	（11）
	-3.41	3.02	0.77	-6.88	0.80				2.88	-0.02	
-0.040**	-0.003**	0.013***	0.003	-0.051***	0.000				56.579***	0.002	（12）
-2.14	-2.39	3.40	1.16	-5.14	1.38				5.27	0.70	
0.105***	-0.004***	0.010**	0.006**	-0.044***	0.000	-0.001	-0.002**	-1.065***	60.564***	0.001	（13）
6.02	-2.95	2.56	2.33	-4.40	1.44	-0.60	-2.00	-11.90	4.98	0.50	

Note: t-stats are reported under the coefficient, *, ** and *** indicates that p value is less than 10%,5% and 1% respectively.

4.Extending the holding period

The paper also extends the holding period from one month to six months to further check whether MAX matters for future return. We apply the same method above. We just calculate each portfolio and stock cumulative return in future six months. And the results are shown in the following tables.

Table 5 Excess return for equal-weighted and value-weighted portfolio with an extended holding period of 6 months constructed by univariate sorting on MAX. FF-3 Alpha are also reported.

	Equal-weighted		Value-weighted	
	Average Return（%）	FF-3 Alpha（%）	Average Return（%）	FF-3 Alpha（%）
LOW MAX	9.80	1.45	7.33	3.00
	（2.44）	（1.93）	（2.00）	（2.69）
2	10.11	1.50	8.75	3.71
	（2.42）	（1.78）	（2.19）	（4.30）
3	9.49	1.12	7.36	3.21
	（2.29）	（1.28）	（1.89）	（3.29）
4	8.37	0.49	6.45	2.64
	（2.02）	（0.50）	（1.70）	（2.72）
High MAX	6.39	-1.71	4.80	-0.07
	（1.58）	（-1.82）	（1.27）	（-0.09）
HIGH-LOW	-3.40	-3.16	-2.53	-3.06
	（-5.45）	（-5.53）	（-2.33）	（-2.32）

Table 6 Excess return for equal-weighted and value-weighted portfolio with an extended holding period of 6 months constructed by dependent bivariate sorting on size, book-to-market ratio, momentum, reversal, close price, skewness, idiosyncratic skewness, idiosyncratic volatility, illiquidity, market beta and MAX.

Equal-weighted						Value-weighted					
L	2	3	4	H	H-L	L	2	3	4	H	H-L
A. SIZE and MAX											
9.89	9.62	9.45	8.47	6.72	-3.17	7.12	8.25	7.25	6.50	4.92	-2.20
					-5.89						-2.14
B. BM and MAX											
9.55	9.83	9.33	8.60	6.61	-2.94	7.29	8.28	7.31	6.73	5.05	-2.25

					-5.51						-2.12
					C. MOM and MAX						
9.93	9.69	9.33	8.47	6.72	-3.21	7.17	8.42	7.43	6.33	5.08	-2.09
					-6.19						-2.07
					D. REV and MAX						
9.83	9.59	9.40	8.67	6.67	-3.16	7.12	7.68	7.80	6.46	4.93	-2.19
					-5.54						-2.35
					E. CP and MAX						
9.59	9.57	9.57	8.68	6.75	-2.84	7.11	8.10	7.28	6.58	5.02	-2.09
					-5.53						-2.01

Table 6 (part 2) Excess return for equal-weighted and value-weighted portfolio with an extended holding period of 6 months constructed by dependent bivariate sorting on size, book-to-market ratio, momentum, reversal, close price, skewness, idiosyncratic skewness, idiosyncratic volatility, illiquidity, market beta and MAX.

Equal-weighted						Value-weighted					
L	2	3	4	H	H-L	L	2	3	4	H	H-L
					F. SKEW and MAX						
9.64	9.56	9.30	8.36	6.73	-2.91	7.41	7.73	6.99	6.53	4.95	-2.47
					-4.98						-2.31
					G. ISKEW and MAX						
9.49	9.97	9.35	8.57	6.20	-3.29	7.02	8.54	7.21	6.94	4.65	-2.37
					-5.25						-2.25
					H. IVOL and MAX						
9.35	9.67	8.81	8.52	7.81	-1.54	6.72	8.29	7.24	6.77	5.38	-1.34
					-2.88						-1.38
					I. ILLIQUIDITY and MAX						
9.74	10.03	9.43	8.37	6.58	-3.15	7.17	8.72	7.68	6.17	4.80	-2.37
					-4.59						-2.18
					J. BETA and MAX						
9.98	9.79	9.59	8.53	7.08	-2.89	7.02	8.21	7.82	5.76	5.10	-1.91

	-4.38	-1.91

Table 7 Univariate regression result by Fama-Macbeth method. Stock returns with an extended holding period of 6 months are used on the LHS of regression.

Independent Variable	Coefficient	t-stats
MAX	-0.331***	（-7.545）
SIZE	-0.032***	（-7.328）
BM	0.019	1.599
MOM	-0.000	（-0.078）
REV	-0.072***	（-3.541）
CP	-0.002***	（-3.728）
SKEW	-0.016***	（-4.823）
ISKEW	-0.000	（-0.209）
IVOL	-2.012***	（-9.128）
ILLIQUIDITY	21.880***	（2.782）
BETA	-0.002	（-0.687）

Table 8 Bivariate and multivariate regression results by Fama-Macbeth method. Stock returns with an extended holding period of 6 months are used on the LHS of regression.

MAX	SIZE	BM	MOM	REV	CP	SKEW	ISKEW	IVOL	ILLIQUIDITY	BETA	MAX
-0.308***	-0.025***										（1）
-7.574	-5.992										
-0.292***		0.069									（2）
-7.442		5.824									
-0.298***			0.004								（3）
-7.117			0.420								
-0.373***				0.030							（4）
-7.860				1.213							
-0.292***					-0.001**						（5）
-7.001					-2.326						
-0.317***						-0.009***					（6）
-6.923						-2.706					
-0.341***							-0.000				（7）
-7.486							-0.220				
-0.089*								-1.796***			（8）
-1.724								-6.343			

Note: t-stats are reported under the coefficient, *, ** and *** indicates that p value is less than 10%,5% and 1% respectively.

Table 8 (part 2) Bivariate and multivariate regression results by Fama-Macbeth method. Stock returns with an extended holding period of 6 months are used on the LHS of regression.

MAX	SIZE	BM	MOM	REV	CP	SKEW	ISKEW	IVOL	ILLIQUIDITY	BETA	
-0.359***									250.321***		（9）
-8.736									6.829		
-0.304***										-0.004	（10）
-6.265										-0.535	
	-0.027***	0.085***	0.010	-0.053***	0.000				41.393***	-0.010*	（11）
	-7.502	7.295	1.061	-3.038	0.972				4.995	-1.673	
-0.269***	-0.024***	0.080***	0.012	-0.009	0.000				199.139***	-0.005	（12）
-6.127	-6.701	6.682	1.144	-0.397	-0.291				7.974	-0.774	
-0.054	-0.025***	0.075***	0.017*	0.006	0.000			-1.820***	187.827***	-0.006	（13）
-0.694	-7.007	6.137	1.680	0.265	-0.247			-5.236	7.506	-0.812	
-0.255***	-0.023***	0.079***	0.011	-0.008	0.000	-0.001	-0.004		213.252***	-0.006	14
-6.213	-6.673	6.788	1.045	-0.331	-0.255	-0.352	-1.302		8.051	-0.763	
-0.022	-0.025***	0.075***	0.016	0.005	0.000	0.002	-0.005*	-1.839***	200.728***	-0.006	15
-0.255	-6.994	6.200	1.598	0.211	-0.261	0.480	-1.676	-4.710	7.601	-0.820	

Note: t-stats are reported under the coefficient, *, ** and *** indicates that p value is less than 10%,5% and 1% respectively.

5.Sentiment and MAX

We also try to explore whether the characteristics regarding asymmetric return distribution still matter or not for future return under different levels of investor sentiment. This paper uses investor confidence index as sentiment index issued by China Securities Investor Protection Fund Company. However, due to the late release of the index, we only explore the time period from April 2008 to December 2017.

We firstly standardize the investor confidence index, and the calculation formula is as follows

$$sentiment\ index_{standardized} = \frac{sentiment\ index - average\ of\ sentiment\ index}{std\ of\ sentiment\ index} \quad (2)$$

The standardized sentiment index has range from -2.5 to 2.5 with mean value of 0.00 and the standard deviation of 1.00. So, we use 0.00 as a criterion to make our subsamples.

In each subsample corresponding to different levels of investors' sentiment, stocks are divided into 5 groups at the beginning of each month in order of MAX, SKEW and ISKEW. The equal-weighted portfolio return is reported in Table 9. We are also interested particularly in the subsample when investors are pessimistic, so we divide our subsample again into two time periods when investors are extreme pessimistic and not that pessimistic. The equal-weighted portfolio return is reported in Table 10.

Table 9 Excess return for equal-weighted portfolio constructed by univariate sorting in subsamples with different investor sentiments.

Panel A	Constructed by MAX		
Investor Sentiment Index	（−∞，0）	（0，＋∞）	（−∞，＋∞）
LOW MAX	-0.0145	0.0435	0.0143
2	-0.0114	0.0454	0.0168
3	-0.0136	0.0423	0.0141
4	-0.0171	0.0365	0.0095
HIGH MAX	-0.0232	0.0300	0.0031
HIGH-LOW	-0.0087**	-0.0136***	-0.0111***
	（-2.48）	（-3.79）	（-4.26）
Panel B	Constructed by SKEW		
Investor Sentiment Index	（−∞，0）	（0，＋∞）	（−∞，＋∞）
LOW SKEW	-0.0143	0.0479	0.0166
2	-0.0149	0.0424	0.0135
3	-0.0158	0.0407	0.0122
4	-0.0169	0.0372	0.0100

HIGH SKEW	-0.0194	0.0335	0.0068
HIGH-LOW	-0.0051*	-0.0144***	-0.0097***
	（-1.91）	（-4.58）	（-4.00）
Panel C	Constructed by ISKEW		
Investor Sentiment Index	（−∞，0）	（0，＋∞）	（−∞，＋∞）
LOW ISKEW	-0.0154	0.0394	0.0118
2	-0.0159	0.0407	0.0122
3	-0.0164	0.0407	0.0119
4	-0.0162	0.0400	0.0116
HIGH ISKEW	-0.0173	0.0410	0.0116
HIGH-LOW	-0.0019	0.0016	-0.0002
	-1.00	0.67	-0.10

Table 10 Excess return for equal-weighted portfolio constructed by univariate sorting in subsamples under the circumstance that investors are pessimistic.

Panel A	Constructed by MAX	
Investor Sentiment Index	（−∞，－1)	（-1，0）
LOW MAX	-0.0959	0.0212
2	-0.0961	0.0258
3	-0.0971	0.0230
4	-0.0977	0.0183
HIGH MAX	-0.1041	0.0123
HIGH-LOW	-0.0082	-0.0090**
	（-0.81）	（-2.13）
Panel B	Constructed by SKEW	
Investor Sentiment Index	（−∞，－1）	（-1，0）
LOW SKEW	-0.0977	0.0224
2	-0.0979	0.0215
3	-0.0979	0.0203
4	-0.0981	0.0188
HIGH SKEW	-0.1003	0.0161

HIGH-LOW	-0.0026	-0.0062**
	（-0.49）	（-2.55）

6.Market volatility and MAX

Applying the same method as Sentiment and MAX, we also explore whether market volatility affects our maximum effect. Here we use a value-weighted cross-section market volatility and standardize it by using the formula below.

$$\text{Market volatility}_{\text{standardized}} = \frac{\text{Market volatility} - \overline{\text{Market volatility}}}{\text{std of Market volatility}}。 \quad （3）$$

The standardized market volatility has mean value of -0.1056 and the standard deviation of 1.01. So, we use -0.1056 as a criterion to make our subsamples.

Table 11 Excess return for equal-weighted portfolio constructed by univariate sorting in subsamples with different market volatility.

Panel A	Constructed by MAX		
Market Volatility	（$-\infty$，-0.1056）	（-0.1056，$+\infty$）	（$-\infty$，$+\infty$）
LOW MAX	0.0047	0.0354	0.0154
2	0.0069	0.0350	0.0167
3	0.0046	0.0353	0.0106
4	0.0005	0.0295	0.0106
HIGH MAX	-0.0052	0.0244	0.0051
HIGH-LOW	-0.0099***	-0.0109***	-0.0102***
	（-5.53）	（-3.23）	（-5.38）
Panel B	Constructed by SKEW		
Market Volatility	（$-\infty$，-0.1056）	（-0.1056，$+\infty$）	（$-\infty$，$+\infty$）
LOW SKEW	0.0082	0.0361	0.0179
2	0.0057	0.0342	0.0157
3	0.0038	0.0338	0.0143
4	0.0014	0.0323	0.0122
HIGH SKEW	-0.0011	0.0327	0.0107

HIGH-LOW	-0.0093***	-0.0034	-0.0073***
	（-5.84）	（-0.98）	（-4.28）
Panel C	Constructed by ISKEW		
Market Volatility	（−∞，−0.1056）	（−0.1056，+∞）	（−∞，+∞）
LOW ISKEW	0.0066	0.0339	0.0162
2	0.0051	0.0325	0.0146
3	0.0033	0.0332	0.0137
4	0.0025	0.0337	0.0134
HIGH ISKEW	0.0005	0.0356	0.0128
HIGH-LOW	-0.0061***	0.0016	-0.0034**
	（-5.74）	（0.58）	（-2.46）

7. Conclusion

We adopt several classic methods in empirical research of asset pricing and explore the maximum effect in Chinese A-share market in this paper. Also, we examine some correlated effects like skewness effect, idiosyncratic skewness effect and idiosyncratic volatility effect.

With a single month as the holding period of the portfolio and the stock, the results of univariate sorting and bivariate sorting all show that there is a significant negative correlation between stock's future return and its maximum daily return, and the relationship cannot be explained by Fama-French three factor. The result of bivariate sorting shows that idiosyncratic volatility can fully explain the maximum effect. The result of regression analysis shows that there exists maximum effect, skewness effect and idiosyncratic volatility effect in the short-term, but maximum can explain the skewness effect. In addition, we also find that reversal can greatly weaken the maximum effect.

With six months as the holding period of the portfolio and stock, the results of univariate sorting and bivariate sorting show that there is still a significant negative correlation between stock's future return and its maximum daily return in the long run. The relationship cannot be explained by the Fama-French three factors. The result of bivariate sorting shows that idiosyncratic volatility can partially explain the maximum effect. The result of regression analysis shows that there exists maximum effect, skewness effect and idiosyncratic volatility effect in the long run, and the negative correlation between stock return and maximum daily return, idiosyncratic volatility can exist simultaneously. It's also found that in the long term, maximum daily return can fully explain

the negative correlation between return and skewness.

When taking investor sentiment into account, the results show that when investors are extremely pessimistic, there will be no significant negative correlation between stock return and extreme return. The stability of the relationship between extreme returns and future returns is also affected by market volatility. We divide the sample into a period of high market volatility and low market volatility. The results show that the negative correlation between stock return and extreme return is relatively stable, compared with skewness and idiosyncratic skewness. High skewness doesn't result in low stock return when the market is volatile. Therefore, when applying trading strategies constructed by characteristics regarding return asymmetry, we need to take care of investor sentiment and market volatility, otherwise such strategies will fail.

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