Lottery-like stocks and expected returns

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ABSTRACT: This paper examines the market inefficiency and the corresponding investment strategies related to prospect factor, mainly focusing on lottery-like characteristics of stocks. With analysis using data of the Chinese stock market, we verified that investors' preference on stocks as lotteries indicates a negative and significant relation between lagged maximum daily return and expected stock returns. These results remain robust and cannot be fully explained by other factors such as size. Based on the previous investigation, an investment strategy related to lottery factor is recommended at last.

Keywords: extreme positive return; expected return; alpha strategy; Chinese market

1. Introduction

Finance research has a long history of investigating the pricing errors of stock markets and speculative behavior on some investors, especially individual investors, has motivated multiple researching models. Risk aversion is one of the significant assumptions of CAPM asset pricing model, but many papers have put forward opinions on lack of diversification in the portfolio of individual investors. Odean(1999), Mitton and Vorkink(2007) and Kumar(2008) all presented relevant evidence based on the portfolios of a large sample of U.S. individual investors while Calvet, Campbell, and Sodini(2007) presented evidence on the under-diversification of Swedish households. Van Nieuwerburgh and Veldkamp(2010) thought returns to specialization in information acquisition might be one possible explanation. However, after paying more attention to the distribution of the individual stock's return, researchers found some investors' preference for lottery-like assets. As for lotto investors, stocks having exhibited extreme high returns are supposed to perform well continuously in the future so that these irrational investors are willing to pay high prices, for a chance of hitting an investment "home run", sacrificing decentralization of portfolios. The deeper reason may be that individuals place a high value on stocks with positive idiosyncratic skewness. Turan G. Bali, Nusret Cakici and Robert F. Whitelaw(2011) did specific research on stocks as lotteries and brought up the MAX factor (maximum daily return) . They then drew on the conclusion that there is a statistically and economically significant relation between lagged extreme positive returns and this result is robust. So fund managers can sell lottery-like stocks and buy those who performed severely to earn a premium.

Most of the researches mentioned above did empirical analysis using American stock market data. To investigate whether MAX strategy makes sense in the Chinese market, we examine

the lottery strategy using A-share stock data. We sort stocks on the value of maximum daily return over a month, trying to find how average monthly return changes when MAX gets higher. Then we do a regression analysis to estimate the explanatory power of MAX. However, MAX behaves contrarily in China compared to results of American research to some extent. We then construct a new investment strategy which seems to act better in Chinese market most of the time.

2. Research Data

Data used in this report is from the A-shares market and include the information of 3631 stocks from Jan 2005 to July 2018.

Table1 shows the primary statistical result about all the data we used in this report. Primarily, for one stock, MAX is identified as the max daily yield in each month.

Table1:Descriptive statistics

	Mean	Median	Var	Std	Skew	Kurt
MAX	0.056	0.048	0.002	0.049	113.249	21150.220
Mon_BM	0.338	0.280	0.051	0.225	1.227	1.315
Mon_Illiq	0.439	0.031	8134.023	90.189	319.063	102208.720
Mon_IVol	0.018	0.016	0.000	0.013	54.834	8016.421
Mon_SizeAll	1742193.484	775905.337	345120752327 40.500	5874697.884	19.678	534.059
Mon_SizeFlt	1302110.942	568878.617	194491051295 39.100	4410113.959	18.721	497.019
Mon_Turnover	54.674	35.284	3427.888	58.548	3.131	17.105
Mon_Yield	0.005	0.000	0.025	0.158	2.791	49.630
Mon_Yield_1	0.012	0.000	0.027	0.163	3.841	79.013

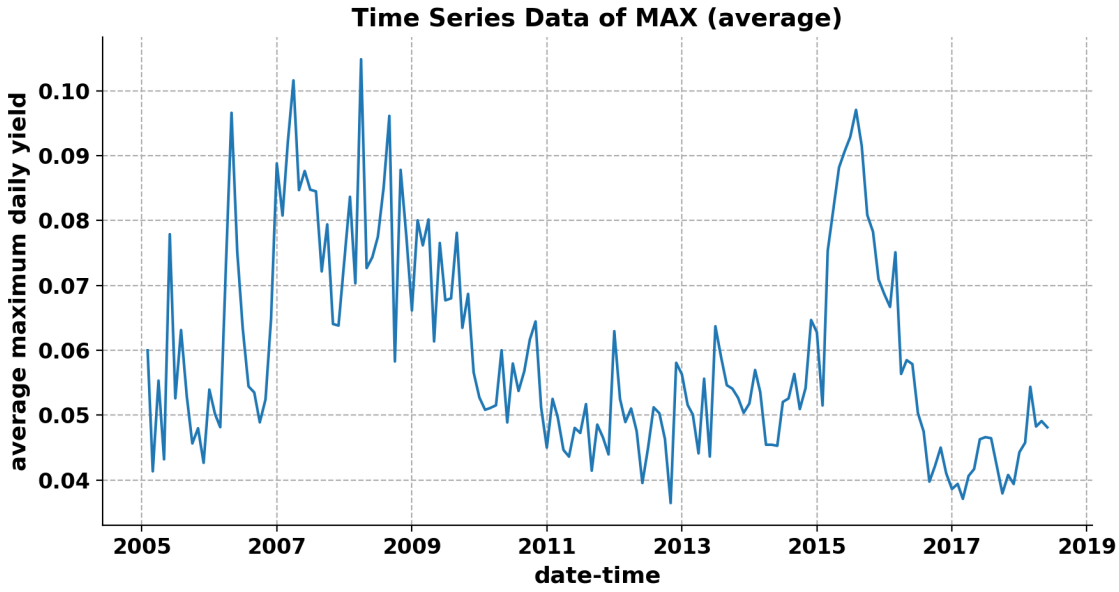

Chart1 Time-Series Data of MAX

Chart1 depicts the time-series data of max(average). It indicates that the volatility of MAX is obviously in a high leve in time series.

3. Lottery-like Stocks and expected returns

3.1 Univariate portfolio-level analysis

In this part, we do empirical analysis by sorting simply on extreme positive returns. We used daily stock returns to get maximum daily stock returns for each firm in each month. Then portfolios divided into ten deciles are constructed every month from January 2005 to June 2018 by sorting stocks based on the maximum (MAX) daily returns over last one month. Group 1 is the portfolio formed by stocks with the lowest maximum daily returns over the past month while group 10 formed by highest ones. We reported equal-weighted returns (calculated by the format: yields*size_all/ sum of size_all) and value-weighted returns as well as some other variables such as price earnings ratio, book-to-market ratio, liquidity, idiosyncratic volatility, size, turnover rates over month perspective. Table 2 shows the specific results.

Table2: Summary statistics for decile portfolios of stocks sorted by MAX.

	MAX	Mon_Yield	Rt_VW	Mon_EP	Mon_BM	Mon_Illiq	Mon_IVol	Mon_SizeAll (10^5)	Mon_Turnover
1	2.58%	-4.30%	-0.014%	0.0158	0.48	1.31	0.0158	30.73	30.25
2	3.49%	-2.20%	-0.011%	0.0136	0.46	0.69	0.0171	14.86	37.30

3	4.04%	-1.75%	0.001%	0.0143	0.43	0.57	0.0179	12.27	41.73
4	4.55%	-0.89%	0.003%	0.0135	0.41	1.15	0.0184	12.35	44.56
5	5.10%	0.23%	0.002%	0.0120	0.39	0.46	0.0193	11.03	48.60
6	5.73%	1.51%	0.016%	0.0110	0.38	0.34	0.0197	11.38	51.87
7	6.45%	3.23%	0.029%	0.0089	0.35	0.30	0.0206	11.85	55.99
8	7.36%	5.13%	0.046%	0.0119	0.35	0.25	0.0209	11.54	61.98
9	8.70%	8.12%	0.049%	0.0119	0.34	0.30	0.0216	10.28	73.37
10	11.35%	13.32%	0.056%	0.0053	0.35	0.44	0.0206	8.47	92.72
10-1	8.77%	17.62%	0.071%	-0.0105	-12.66%	-0.87	0.0048	-22.26	62.47

From the results exhibited above, as we move from the low MAX decile to high MAX decile, the average return over months of equal-weighted increase from -4.30% to 13.32% with an average premium return of 17.62% and from value-weighted perspective stock return increases from -0.014% to 0.056%. This result provides evidence that lotto investors' behaviors have few influences on Chinese stock returns. Buying stocks which performed poorly while selling shares having lagged extreme positive returns may not lead to premium, but opposite investment strategy does.

We also investigate other characters of lottery-like stocks. In Mon_size volume, higher MAX signifies lower firm size and frequenter turnover rate which is consistent with the fact that extreme positive returns more likely caused by small firms and individuals prefer to make trades related to lottery-like stocks.

Though the strategy recommended by American researchers seems to fail in the Chinese market, it is supposed to indicate the low efficiency of the Chinese market. Firms, especially those whose sizes are small, get extensive attention of much more investors suddenly after extreme positive return one time. Because of the inefficiency of the market caused by imperfect competition and lack of adequate information, investors focus on these firms excessively, and once individuals invest more on these firms, the price will get higher as the booming of stock demands. Though people are irrational, MAX can't lead to premium returns as stocks' lagged remarkable performance do repeat high yield in the future.

3.2 Bivariate portfolio-level analysis

Table3:Control Idiosyncratic volatility , double sorting construct portfolio

	Group1	Group2	Group3	Group4	Group5	Group6	Group7	Group8	Group9	Group10	Diff
Control： Idiosyncratic volatility										Diff:group10-1	
small	-0.0409	-0.0101	-0.0012	0.0035	0.0109	0.0257	0.0389	0.0682	0.0957	0.2490	0.2899
2	-0.0319	-0.0136	-0.0079	0.0032	0.0097	0.0225	0.0380	0.0523	0.0790	0.1164	0.1483
3	-0.0348	-0.0177	-0.0093	0.0010	0.0091	0.0205	0.0399	0.0545	0.0816	0.1185	0.1533
4	-0.0391	-0.0189	-0.0128	-0.0051	0.0104	0.0224	0.0387	0.0561	0.0833	0.1170	0.1561
5	-0.0453	-0.0193	-0.0106	-0.0047	0.0048	0.0203	0.0387	0.0535	0.0783	0.1205	0.1658
6	-0.0445	-0.0224	-0.0156	-0.0050	0.0043	0.0205	0.0346	0.0568	0.0835	0.1181	0.1626
7	-0.0514	-0.0310	-0.0190	-0.0097	0.0027	0.0133	0.0376	0.0553	0.0800	0.1213	0.1727
8	-0.0553	-0.0375	-0.0251	-0.0140	-0.0008	0.0197	0.0299	0.0540	0.0802	0.1179	0.1732
9	-0.0626	-0.0435	-0.0310	-0.0197	-0.0035	0.0116	0.0250	0.0573	0.0802	0.1200	0.1827
big	-0.0727	-0.0566	-0.0422	-0.0324	-0.0105	0.0030	0.0249	0.0522	0.0778	0.1097	0.1824
aver	-0.0478	-0.0271	-0.0175	-0.0083	0.0037	0.0180	0.0346	0.0560	0.0820	0.1309	0.1787

Table3 shows the results of returns when we construct portfolios according to MAX and idiosyncratic volatility. Stocks are divided into ten groups with the standard of idiosyncratic volatility, then, within each group portfolios are divided into ten groups again according to the MAX. Comparing with the increasing trend of the returns of portfolios merely grouped by MAX when the level of MAX increases, using idiosyncratic volatility and constructing double sorting portfolios also make returns to show remarkable increasing trends in each group. The phenomenon indicates that in the regression model MAX factor are generally performing independent interpretability with idiosyncratic volatility.

Table4: average returns of different controlling variables

group	Size	Illiq	BM	EP	IVol
1	-0.0411	-0.0323	-0.0435	-0.0417	-0.0478
2	-0.0229	-0.0174	-0.0241	-0.0246	-0.0271
3	-0.0156	-0.0096	-0.0144	-0.0148	-0.0175

4	-0.0066	-0.0012	-0.0038	-0.0059	-0.0083
5	0.0033	0.0076	0.0068	0.0050	0.0037
6	0.0165	0.0170	0.0180	0.0185	0.0180
7	0.0323	0.0298	0.0319	0.0323	0.0346
8	0.0498	0.0470	0.0485	0.0513	0.0560
9	0.0775	0.0726	0.0756	0.0772	0.0820
10	0.1303	0.1134	0.1285	0.1264	0.1309

In Table4, other variables, such as BookToMarket and EarningsToPrice also show similar results as idiosyncratic volatility. These results indicate that the independence of MAX as an explanatory variable always exist with these controlling variablesMoreover, one common in these results is that the differences between group 10 and group 1 in any level of controlling variables are still positive, which is consistent with the increasing trend of MAX.

3.3 Alpha strategy considering MAX factor

CAPM is one of the most critical asset pricing models in the financial field. However, as the assumptions can't be strictly satisfied, there are often pricing errors, and the fund managers are eager to maximize α which means the difference between real asset real return and that required by CAPM of their portfolios. After sorting stocks on MAX in the way introduced in Table2, we calculated alphas separately of each decile with equal-weighted returns. Table 5 shows the specific performance of MAX strategy.

Table5: CAPM alpha and beta

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	0.2691	-0.7259	-0.6599	0.8222	0.7539	1.6326*	2.3348	1.6554*	3.1872***	6.7096***
	(0.374)	(-0.889)	(-0.916)	(0.927)	(0.929)	(1.735)	(1.385)	(1.658)	(2.859)	(3.996)
Mkt beta	248.75***	257.39***	247.58***	255.29***	232.87***	231.22***	227.83***	252.00***	221.48***	245.08***
	(25.88)	(23.58)	(25.70)	(21.54)	(21.46)	(18.38)	(10.11)	(18.88)	(14.86)	(10.92)

This chart represents the premium returns compared with returns calculated using the CAPM model. We can find that group 10 which has the highest MAX has the most Alpha and both of the results of Alpha and market beta is significant. So the conclusion can be made that buying stocks performed well cause possible high returns.

4. Fama-Macbeth Regressions

To further assess the pricing effect of MAX factor, we conducted cross-sectional regressions in the method introduced by Fama and MacBeth(1973). We regard yields of month t as explained variables and examine the explanation effects of different explanatory variables of last month t-1. We then run the following regression for each month:

$$Mon\_yield_{p,t} = \beta_{0,t} + \beta_{1,t} MAX_{t-1} + \gamma_{t-1} Z_{p,t-1} + \varepsilon_{p,t}$$

where the definitions of Mon_yield, MAX is consistent with those mentioned above and p represents the number of a portfolio. Z_(p,t-1) represents the t-1 month value of other firm characteristic factors such as EP ratio, book-to-market ratio, size and so on whose definition is consistent with those mentioned above. We then calculated time series averages of coefficients and Table 6 shows the results. For each volume, factors included are different.

Table 6: Fama-Macbeth regressions

	Constant	MAX	Mon_BM	Mon_ Illiq	Mon_IVol	Mon_SizeAll	Mon_SizeFlt	Mon_Turnover	Mon_Yield_1
(1)	0.0168**	0.0750***							
	(2.15)	(5.11)							
(2)	0.0232***		-0.0049						
	(2.76)		(-1.39)						
(3)	0.0218***			-0.0003					
	(2.73)			(-0.24)					
(4)	0.0211***				0.0258				
	(2.62)				(0.68)				
(5)	0.0218***					0.0000*			
	(2.70)					(-1.70)			

(6)	0.0218***						0.0000		
	(2.70)						(-0.10)		
(7)	0.0195**							0.0000**	
	(2.47)							(2.56)	
(8)	0.0214***								-0.0432***
	(2.71)								(-4.13)
(9)	0.0189**	0.0618***	-0.0035						
	(2.28)	(5.88)	(-1.04)						
(10)	0.0175**	0.0686***		-0.0006					
	(2.24)	(4.63)		(-0.37)					
(11)	0.0172**	0.0745***			-0.0157				
	(2.18)	(5.20)			(-0.43)				
(12)	0.0173**	0.0710***				(0.0000)			
	(2.20)	(5.09)				(-1.56)			
(13)	0.0174**	0.0695***					0.0000		
	(2.21)	(5.08)					(-0.06)		
(14)	0.0167**	0.0560***						0.0000	
	(2.15)	(4.59)						(1.51)	
(15)	0.0168**	0.0735***							-0.0436***
	(2.18)	(5.04)							(-4.18)
(16)	0.0203**	0.0358***	-0.0037	-0.0005	-0.0520*	0.0000	0.0000	0.0000	-0.0441***
	(2.48)	(3.64)	(-1.19)	(-0.32)	(-1.75)	(-0.88)	(0.80)	(1.63)	(-4.29)

This chart provides evidence of strong explanation power of MAX. MAX appears to have a positive correlation with monthly return no matter what factor combination we use to run the regression and the results are significant, supporting the basic conclusion we made before. When the equation includes more variables, the value of correlation coefficient decrease. One reasonable explanation is that other dependent variables separate power of MAX. Lagged monthly yield can help to forecast expected returns as well but we observe a negative correlation which means the existence of reversal effects in the Chinese market. However, some

regular variables such as size and turnover are considered to have no relationships with expected returns which implies that these factors are inefficiency and related strategies may not bring high returns as for Chinese stock market.

5. Recommended Investment strategies

5.1 Strategy performances

According to the factor of MAX, two opposite trading strategies could be set:

Strategy 1 *Buying stocks with the largest MAX and selling stocks with the least MAX.*

Strategy 2 *Buying stocks with the least MAX and selling stocks with the largest MAX.*

The performances of the two strategies in different trade ratio are illustrated as the following curves.

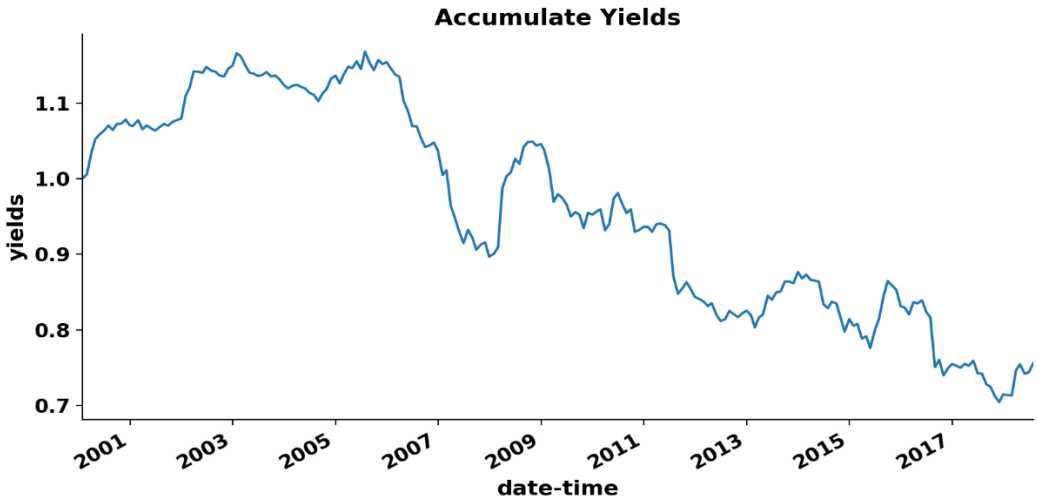

Chart 2. strategy 1, trade ratio=0.01

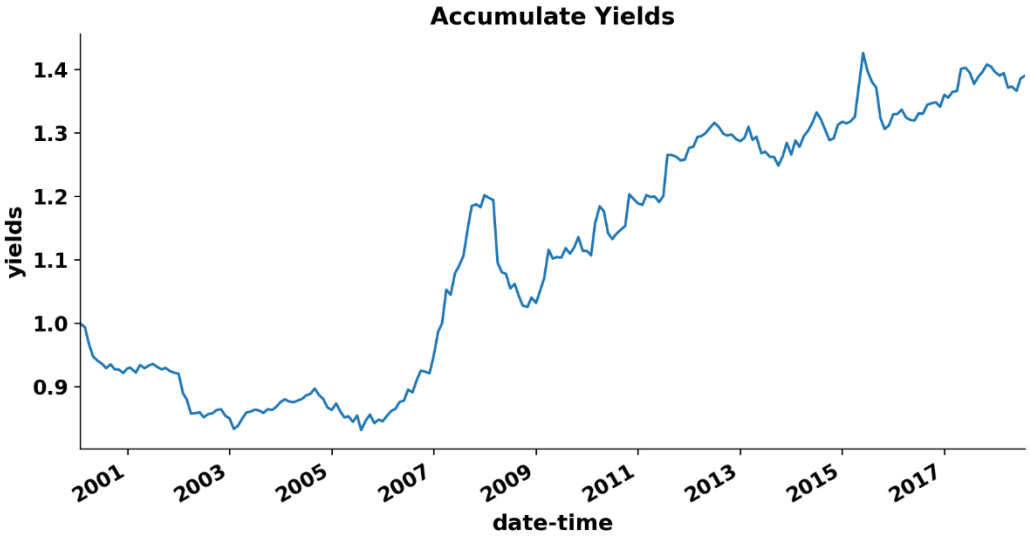

Chart 3. Strategy 2, trade ratio=0.01

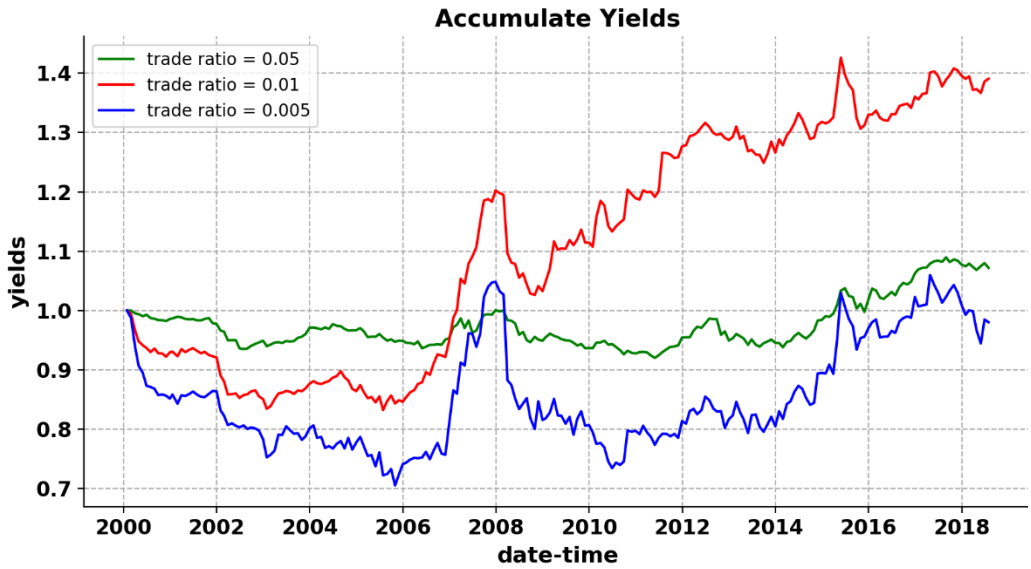

Chart 4. Strategy 2, trade ratio=0.05, 0.01, 0.005

5.2 Discussion

It is showed in these curves that strategy 1 and 2 generally produce opposite results in accumulate yields which is consistent with the operations. In addition, strategy 2, which is similar with the Barra's method using prospect factor, give better performance. Although from 2000 to 2006 strategy 2 does not provide a positive return, in result years this strategy could provide positive yields. Especially, from chart 4, it could be concluded that strategy 2 with higher trade ratio (range from 0.01 to 0.005) will perform better. One possible explanation for the phenomenon may be that the stocks with extremely high or low MAX always represent

firms performing not very well in the A-shares market. Moreover, as the trade ratio increase to 0.01, the performance of this strategy worsen, and it loses effectiveness, which may mean that some useless stocks are included in portfolios.

The sharp ratio of the strategy 2 with trade ratio equaling to 0.01 is 0.0593 and the annualized yield is 0.438, which means that this strategy possesses use value for investors. Considering the increasing trend in resent years on accumulate yields, it even may be more meaningful in A-shares market.

6. Conclusions

We identified a statistically significant relation between lagged extreme positive returns and future return based on Chinese A-Stock market data. Motivated by the literature Maxing out: Stocks as lotteries and the cross-section of expected returns(Turan G. Bali a,1, Nusret Cakici b,2 and Robert F. Whitelaw c,d,n, 2010), we examine the extreme positive returns using the maximum daily return of the past one month (MAX) and the expected returns.

According to the univariate portfolio-level analysis, there is a significant positive correlation between extreme positive returns and the expected yields. As shown in the bivariate portfolio-level analysis and Fama-Macbeth regressions, the result is robust with control of other risk factors including size, earning to price, illiquidity, idiosyncratic volatility and short-term momentum. In particular, MAX shows excellent explanatory power in the firm-level regression of expected return. This positive relationship is extremely significant before 2010, while there are a slow transformation and reversion after 2015.

This finding is somehow in the opposite of Bali's analysis of extreme positive return's influence in American Stock Market, and it also counterpart with Barberis, N., Huang, M.(2008)'s result. We interpret this difference mainly due to the different development stage in the U.S capital market and the Chinese stock market. With the tight IPO restriction and immature institutional investors, Chinese stock market before 2010 is significantly chaotic with the close relationship of government policies. Extreme positive return is not only a reflection of the lottery-like characteristic in stocks but also an indicator of the positive policy influence. In other words, this factor contains both the prospect information from individual investors and the market information. The extreme positive return is a much stronger indicator of the expected returns than other traditional factors, such as size and momentum. According to the back-test result, longing stocks with higher positive extreme returns can generate a rather robust positive return before 2010.

This positive relationship gradually reversed after 2010, especially after 2015. An intuitive

interpretation is that the Chinese Market's development invalidates MAX's reflection of the market information. With the maturity of other financial derivatives, investors have more choices to diverse away the risks. The high extreme returns stock is more likely to be the preference for the lottery-like payoff, which is associated with the under-diversification. That's the reason why the different trading strategy has an astonishingly good performance after 2015.

According to our analysis, as Chinses Market grew more mature than before, the relationship between extreme positive returns and the expected returns in Chines stock market will be much similar to the link in the U.S. market. This effect won't be traded away in the short-term because of the lack of large institutional investors in the Chinese market and the unwillingness of many individual investors engaging in short-selling. However, the investors have to pay attention to the outlier companies that rank within 0.5% in the MAX, since that extreme phenomenon still carry more market information compares to the influence of investors' prospects.

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