Overreaction, Investor Anxiety, and Anomalies in the A-share Disposition Effect

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***Abstract*—This paper empirically investigates the disposition effect anomalies in the A-share market using publicly available data on companies listed in the Chinese A-share market from January 2010 to January 2022 and finds a new empirical fact that, contrary to existing studies, capital gains are negatively correlated in cross-sectional stock expected returns, stocks with higher capital gains have lower expected returns and going long a portfolio of low capital gain stocks while going short a portfolio of high capital A long portfolio of low capital gain stocks and a short portfolio of high capital gain stocks can yield an average monthly excess return of 2.70%. Further research finds that investor overreaction and mispricing due to excessive attention to floating stocks are the sources of the disposition effect anomaly, with overreaction leading to a stronger negative effect of capital gains on expected returns for stocks with higher stock price overvaluation and higher investor attention. The research in this paper not only contributes to a better understanding of the disposition effect anomaly in the Chinese stock market but also has practical implications for improving market effectiveness and reducing the impact of the anomaly.**

***Keywords*—capital gains, disposition effect, mispricing, overreaction, investor concerns**

I. Introduction

The disposition effect refers to the behavioral phenomenon that investors tend to sell immediately when faced with a stock profit and tend to hold when faced with a stock loss (Shefrin and Statman, 1985). The disposition effect is widespread in capital markets and exists to some extent for both individual and institutional investors (Locke and Mann, 2002; Shapira & Venezia, 2000; Zhou *et al.*, 2011; Wu *et al.*, 2020).

The average cost of ownership for investors weighted by weekly volume is estimated by Grinblatta and Han (2005) using a Capital Gain Overhang (CGO) proxy. According to their empirical findings, capital gains explain the expected return on stocks and have a strong positive cross-sectional relationship with future returns. Being long the top 10% quartile of capital gains stocks can result in a monthly return of about 0.96% or an annual return of 12.5%. The empirical results of Frazzini (2006) also show that when investors face capital losses, the stock price underreacts to bad news, and when facing capital gains, it underreacts to good news, leading to the predictability of the expected return of capital gains on stocks. Ingersoll and Jin (2013) construct an investor value function based on the disposition effect, and their theoretical model goes on to obtain that the disposition effect leads to higher expected returns for stocks with capital gains and stocks with capital losses have lower expected returns.

Contrary to existing studies, this paper finds that capital gains in the Chinese stock market are negatively correlated with the expected returns of stocks, stocks with higher capital gains have lower expected returns, while a portfolio of long low capital gains stocks and short high capital gains stocks can earn an average monthly excess return of 2.70% (0.96% in the U.S. market). Specifically, this paper follows Grinblatta and Han (2005) in the empirical measurement of capital gains (CGO) and then sorts all Chinese A-share stocks into ten portfolios according to their smallest to largest CGO. If the portfolios are constructed according to the US disposition effect premium: long high capital gains and short low capital gains in the Chinese A-share stock market the average monthly return of the portfolio strategy is −2.707%.

In this paper, based on univariate ranking analysis, independent bivariate ranking analysis, and time series regressions combining the CAPM model, FF three-factor model, and FF five-factor model, all found that going long a portfolio of low capital gain stocks while shorting a portfolio of high capital gain stocks can capture robust excess return ability, and finally controlling for other variables such as size, book-to-market ratio (Fama and French, 1993), momentum (Jegadeesh and Titman, 2001), short-term reversal (Jegadeesh, 1990), and profitability (Fama and French, 2015), etc., the FM regression reveals that there is a significant negative correlation between capital gains and expected stock returns, a finding that further demonstrates the existence of the A-share market unlike the U.S. and European markets This finding further demonstrates that the A-share market has a different disposition effect anomaly from the US and European markets. Further, this paper attempts to explain the disposition effect anomaly in the Chinese A-share market for two possible reasons.

First, the disposition effect, which is absent in stocks with floating profits, predisposes investors to hold stocks with floating losses, causing them to overreact to historically fundamentally unfavorable news and to unanticipated bearishness already priced into the company. To test this hypothesis, we construct a mispricing variable due to investors' overreaction. The results of the bivariate analysis show that the CGO of the most overvalued stocks due to overreaction has a significant negative effect on stock expected returns. After introducing the overreaction mispricing variable into the model as a moderating variable, the negative relationship between individual stock capital gains and expected returns disappears, indicating that capital gains have a significantly different effect on expected returns across portfolios of overreaction mispriced stocks, with overreaction The stronger the negative impact of capital

gains on expected return for stocks with more overvalued stock prices, the negative correlation between capital gains and expected return in the A-share market is mainly due to investors' overreaction mispricing.

Second, we contend that stocks with floating profits typically attract too much investor attention whereas stocks with floating losses attract even less. This is because investors have limited attention spans. Mispricing due to investor attention may also lead to the anomaly of a negative correlation between capital gains and expected returns in the Chinese stock market. We construct a limited attention mispricing variable, and the results of the bivariate analysis show that capital gains are more significantly negatively correlated with expected returns for stocks with high investor attention, while capital gains are not significantly predictive of returns for stocks with low investor attention. Introducing the limited attention mispricing variable as a moderating variable regression also reveals that there is a significant difference in the impact of capital gains on expected returns across portfolios of stocks with different investor attention mispricing, the increase in investor attention exacerbates the negative relationship between capital gains and expected stock returns.

In addition, we exclude the effect of excluding the liquidity risk compensation aspect. The presence of the disposition effect significantly affects the liquidity of stocks, as stocks facing floating losses tend to be held by investors and will be traded more and more sluggishly, while stocks facing floating gains tend to be sold and will be traded more actively, low CGO stocks tend to have lower liquidity, which strengthens the liquidity premium of this segment of stocks. However, our study in this paper draws on Amihud *et al.* (2002) and Jiang *et al.* (2018) on liquidity measures to find that the source of the negative correlation between capital gains and expected returns of individual stocks is not the higher liquidity risk taken, and thus the use of liquidity risk compensation does not explain for the disposition effect anomaly that exists in the Chinese market.

The contribution of this paper is that, first, the empirical results of this paper provide empirical data to support the disposition effect anomaly in the Chinese stock market and find a negative relationship between capital gains and expected stock returns in the Chinese stock market; second, this paper explains the reasons for the negative relationship between capital gains and expected stock returns in the Chinese stock market from the mispricing perspective, which helps to deepen people's understanding of the impact of investor Second, this paper explains the reasons for the negative relationship between capital gains and expected stock returns in the Chinese stock market from the perspective of mispricing, which helps to improve the understanding of the impact of investor behavior on asset pricing.

The rest of the paper is organized as follows: the second part describes the new fact of the disposition effect anomaly in the Chinese stock market, capital gains are negatively related to expected stock returns; the third part discusses the mispricing explanation and excludes the effect of liquidity risk compensation; the fourth part is a robustness test and the fifth part is the conclusion.

II. The Mystery of the Disposition Effect in Chinese Stock Market: A New Empirical Fact

In this section, we present a new empirical finding on the existence of a significant negative correlation between CGO and stock expected returns. We first define the key variables in the empirical analysis and then report statistical results such as univariate analysis, bivariate analysis, and FM regression analysis after controlling for other characteristic variables that affect stock price expected returns.

A. Key Variable Definitions and Sample Data

The data in this paper mainly comes from Wind Financial Terminal, and the sample data comes from all common stocks listed in China's A-share market including Shanghai Stock Exchange and Shenzhen Stock Exchange, and the sample period is from January 2010 to January 2022, the starting point of choosing 2010 as the sample period is that the Chinese A-share market started a series of institutional improvements in 2010, such as accounting approval system, financing and financing system, and the opening of the stock index futures market. The starting point of 2010 is that the Chinese A-share market started a series of institutional improvements, such as the accounting approval system, financing and financing system, and the opening of the stock index futures market, so that the Chinese A-share market after 2010 has a more market-oriented trading mechanism and credit approval mechanism. In this paper, the screening rules for the sample are as follows: (1) exclude the sample data of stocks that have been listed for less than six months to prevent short-term price fluctuations caused by the listing of new stocks; (2) exclude the sample data of stocks that have been out of trading (suspended) for more than three months to prevent short-term price fluctuations after the resumption of trading; (3) exclude the sample data of ST, ST* and PT with risk warning to prevent the impact of different trading systems on price formation; 4) exclude the sample data of stocks with market capitalization caused by the different trading regimes; (4) excluding the sample data of the latter 30% of market capitalization size, drawing on Liu *et al.* (2019) to prevent the effect of small market capitalization price overvaluation caused by shell premium; (5) tailoring the variable values in the 0.5% and 99.5% quartiles to reduce the effect of extreme values on the empirical results.

To measure the capital gains, we used the method of Grinblatt & Han (2005) to calculate the reference cost and based on the method of Frazzini (2006) to calculate the unrealized gain/loss ratio, so that the reference cost of the stock is shown in Eq. (1).

$$RP_t = \frac{1}{k}\sum_{n=1}^{J}(V_{t-n}\prod_{s=1}^{n-1}(1-V_{t-n+s}))P_{t-n} \quad (1)$$

where Vt-n denotes the turnover rate for the past n periods, T is 52 trading weeks, Pt-n denotes the stock price for the past n periods, and k is the weight normalization factor. The weekly turnover rate is calculated by dividing the weekly volume by the number of shares outstanding. According to the theoretical definition of the disposition effect, investors form a reference price when evaluating the utility of a stock's return, and this price is related to its acquisition cost, but as the market as a whole rather than a particular investor, the average transaction price of a certain period can be used as a

measure of the reference price, so the CGO of week t is defined as Eq. (2), which represents the average profit of investors when CGO is greater than 0, and the average loss of investors when CGO is less than 0.

$$CGO_t = \frac{P_t - RP_t}{RP_t} \quad (2)$$

To control for the effects of other firm characteristic variables on expected returns, based on the Fama & French three-factor model (Fama& French, 1993) and the Carhart four-factor model (Carhart, 1997) controlling for individual stock market risk exposure (β), Book-to-Market ratio (BM), log of market capitalization (LogME), the medium-term momentum returns (R-12, −2) as well as firm earnings quality (ROE) (Fama & French, 2015) and firm turnover rate (Turnover).

This paper measures liquidity risk as an illiquidity indicator proposed by Amihud (2002) and also uses abnormal volume to measure the level of unanticipated liquidity, liquidity shocks, of a stock (Liu *et al.*, 2019). Where ILLIQit denotes the liquidity measure of the ith stock in period t, Dit is the trading day in period t; Ritd is the return in day d and VOLDitd is the total amount traded in day d. The smaller the value is, the smaller the impact of unit turnover on the return and the better the liquidity.

$$ILLIQ_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{|R_{itd}|}{VOLD_{itd}} \quad (3)$$

Measuring investor overreaction to historical information This paper also selects three alternative indicators, namely Ang *et al.*'s (2006) characteristic volatility (IVOL), Jegadeesh's (1990) short-term momentum (R-1), and Asness *et al.*'s (2020) MAX anomaly (Max), also based on Stambaugh *et al.*'s (2015) construction of stock overreaction mispricing through anomaly variables, using a combination of the three variables to measure stock mispricing due to investor overreaction. The stocks are ranked and scored using the 3 anomaly variables and each stock will receive 3 scores finally averaged to be the valuation anomaly level Over the individual stock as in Eq. (4).

$$Over = Z[Z(IVOL) + Z(R_{-1}) + Z(Max)] \quad (4)$$

To construct the mispricing variables due to limited attention, three proxies are also chosen in this paper, which is abnormal Volume (AVOL) from Barber and Odean (2008), Analyst Coverage (AC) from Hirshleifer *et al.* (2013) and Institutional Investor Shareholding (IS) from Drake *et al.* (2014), again based on Stambaugh *et al.*'s (2015) construction of stock overreaction mispricing through anomaly variables, since investor attention proxy variables are negatively correlated with expected returns, smaller attention values indicate greater undervaluation, and a combination of three variables is used to measure the mispricing variable attention of stocks due to investor attention.

B. Univariate Ranking Analysis

Fig. 1 plots the returns of each portfolio after CGO sorting grouping in the U.S. stock market and the Chinese stock market calculated according to the previous variable settings. Each week, all stocks listed in the U.S. NYSE and stocks listed on the Chinese Shanghai and Shenzhen exchanges calculate their capital gains CGO and divide them into ten groups (P1: lowest group, P10: highest group), then calculate their next weekly returns and compute each group's average expected the average expected return of each group is calculated. The sampling period for U.S. stocks is from January 2000 to December 2021 and for Chinese stocks is from January 2010 to December 2021.

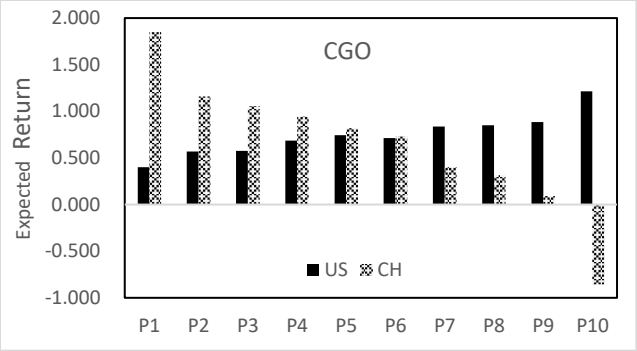

Fig. 1. U.S.-China CGO and expected returns.

Table 1 reports summary statistics of the risk-adjusted portfolio excess returns for the CAPM, Fama-French three-factor model, and Fama-French five-factor model for the univariate ranking of CGO. The results show that the portfolios with the minimum 10% and maximum 10% of CGO factors have significant risk-adjusted excess returns, which are significantly different from 0 for both the CAPM model and the Fama-French three-factor and five-factor models risk-adjusted. In FF3, for example, the minimum 10% portfolio has a monthly return of 1.136% with a t-statistic of 4.32, and the maximum 10% portfolio excess monthly return is −1.507% with a t-statistic of −5.25, and the long-short portfolio excess monthly return is 2.642% with a t-statistic of 5.55.

This finding is dramatically different from the results obtained by Grinblatt & Han (2005) and Frazzini (2006) in their empirical studies of the U.S. stock market, namely, that in the Chinese stock market stock, CGO is negatively correlated with expected returns.

Table 1. CGO univariate sorted grouped monthly returns (%)

Channels	CAPM-α	FF3-α	FF5-α
P1	1.697***	1.136***	1.184***
	(3.53)	(4.32)	(4.56)
P2	1.038**	0.463**	0.492**
	(2.44)	(2.32)	(2.53)
P3	0.966**	0.359**	0.391**
	(2.39)	(2.14)	(2.43)
P4	0.841**	0.262*	0.276**
	(2.19)	(1.87)	(2.05)
P5	0.742**	0.149	0.153
	(1.97)	(1.09)	(1.18)
P6	0.667*	0.056	0.062
	(1.81)	(0.41)	(0.48)
P7	0.362	−0.254*	−0.266**
	(1.01)	(−1.86)	(−2.03)
P8	0.286	−0.332**	−0.354**
	(0.82)	(−2.15)	(−2.29)
P9	−0.000	−0.558***	−0.575***
	(−0.00)	(−3.00)	(−3.10)
P10	−0.099***	−1.507***	−1.524***
	(−2.59)	(−5.25)	(−5.27)
P1–P10	2.683***	2.642***	2.708***
	(5.32)	(5.55)	(5.69)

C. Independent Double Ranking Analysis

To further analyze the different firm characteristics possessed by different CGO stock portfolios, we use a bivariate ranking analysis of the size and book-to-market ratio. First, we ranked the market capitalization size and book-to-market ratio into five groups from smallest to largest, and then crossed them with the five groups of CGO factors respectively, each forming 25 stock portfolios with equal weighting allocation of stocks within each portfolio, bivariate analysis under the independent dual ranking method.

Panel A from Table 2 shows that there is a certain connection between CGO and scale effect, and the abnormal return of each CGO portfolio gradually increases as the scale decreases. From the long-short portfolio, it can be seen that the abnormal return of the largest CGO long-short portfolio is 0.84% per month with a t-value of 1.84; as the scale decreases the abnormal return of the smallest CGO long-short portfolio is 3.40% per month with a t-value of Panel B results show that there is no significant correlation between CGO and book-to-market ratio, regardless of the book-to-market ratio, the abnormal return of disposal effect long-short portfolio is around 2%, and all of them are significantly greater than 0 at 1% significance level. Further, it can be found that the return of each portfolio decreases as the book-to-market ratio increases, except for the portfolio with the largest CGO, showing that stocks with low book-to-market ratios can obtain higher returns than those with high book-to-market ratios, and all in all still exhibit stable excess return ability after controlling for the effect of the book-to-market ratio variable.

In the Carhart four-factor model, the momentum factor plays a role in stock pricing, and it is found through empirical research that there is also a degree of momentum effect in the Chinese stock market in the short term. We obtain Panel C by bivariate sorting analysis of the momentum variable and CGO, and the results show that the expected returns of individual stocks are U-shaped through the medium-term momentum and CGO bivariate grouping, and in the capital In the portfolio of stocks with higher capital gains, larger CGO values, the expected return of the portfolio of stocks with large historical returns is higher, such as the first group with the maximum CGO value, the expected return of stocks with high historical returns is 0.74% higher than the portfolio of stocks with low historical returns. However, in stock portfolios with lower capital gains, and smaller CGO values, the expected return is lower for stock portfolios with large historical returns, such as the fifth group with the lowest CGO value, where stocks with high historical returns have a 0.71% lower expected return than stock portfolios with low historical returns. However, in all momentum groupings, the expected returns of the low CGO stock portfolios are higher than the expected returns of the high CGO stock portfolios, and the low CGO stock portfolios still exhibit stable excess returnability after controlling for the effect of medium-term momentum variables.

Table 2. CGO size and book-to-market ratio

Panel A		**CGO Grouping**						
		Low CGO	2	3	4	High CGO	Low-Hig	T-Value
	Small	0.0340	0.0248	0.0192	0.0140	0.0000	0.0340***	8.09
	2	0.0220	0.0144	0.0092	0.0068	−0.0012	0.0208***	5.85
Size	3	0.0164	0.0100	0.0080	0.0032	−0.0024	0.0188***	5.06
Grouping	4	0.0140	0.0076	0.0048	0.0032	0.0012	0.0128***	3.29
	Large	0.0108	0.0044	0.0032	0.0052	0.0032	0.0084*	1.84
Panel B		**CGO Grouping**						
		Low CGO	2	3	4	High CGO	Low-Hig	T-Value
	Small	0.0156	0.0132	0.0100	0.0076	−0.0012	0.0168***	4.68
	2	0.0184	0.0136	0.0104	0.0072	−0.0008	0.0192***	5.12
BM	3	0.0208	0.0140	0.0108	0.0076	0.0016	0.0192***	4.90
Grouping	4	0.0216	0.0148	0.0100	0.0068	0.0008	0.0208***	5.12
	Large	0.0216	0.0080	0.0068	0.0048	0.0000	0.0216***	4.69
Panel C		**CGO Grouping**						
		Low CGO	2	3	4	High CGO	Low-High	T-Value
	Small	0.0213	0.0133	0.0074	0.0020	−0.0065	0.0278**	4.44
	2	0.0182	0.0127	0.0093	0.0045	−0.0047	0.0229***	4.02
	3	0.0161	0.0140	0.0100	0.0076	−0.0016	0.0177***	3.65
Momentum Grouping	4	0.0156	0.0120	0.0098	0.0077	0.0014	0.0142***	2.69
	Large	0.0142	0.0091	0.0072	0.0037	0.0009	0.0133***	2.27

D. FM Regression

According to the bivariate ranking study, capital gains are inversely associated with expected stock market returns in China. However, this study cannot account for all variables that could affect the outcomes, such as historical returns and stock turnover for CGO stocks. To control for the drivers of influences other than capital gains and losses faced by investors, this paper uses Fama-Macbeth regression to determine the impact of unrealized earnings on stock returns, to determine whether there is a significant factor premium. The explained variable is the return of individual stocks for the t+1 period, the control variables are individual stock market risk exposure, book-to-market ratio, log market capitalization, and historical momentum returns, and the regression model is based on Newey-West adjusted statistics, as in Eq. (5).

$$R = \alpha + \beta_1 CGO + \beta_2\beta_M\beta_3 BM + \beta_4 LogME + \beta_5 R_{-12,-2} + \beta_6 ROE + \beta_7 Tumover + \varepsilon \quad (5)$$

where R represents the stock's return at week t+1, CGO represents the stock's capital gain per week t according to Frazzini (2006), BM represents the stock's book-to-market ratio at week t, LogME represents the stock's log market capitalization at week t, R-12, −2 represents the medium-term momentum, which is the historical cumulative return for the past 12 months excluding the last two months, and ROE represents the stock's return on the net worth at

week t.

Specifically, model 3 controls market risk as a base model and then gradually inserts control variables into the cross-sectional regression model to evaluate capital gains and predicted returns for individual stocks. In model 2, the book-to-market ratio (BM) and the logarithmic market value (Log ME) are added. The historical momentum (R-12, −2) is controlled in the model (3). In model (4), the profitability (ROE), as well as the turnover rate (Turnover), is controlled.

Table 3. Stock cross-sectional characteristics based on FM regression

Regression model	*(1)*	*(2)*	*(3)*	*(4)*
CGO	−0.0106** (−2.62)	−0.0124*** (−3.26)	−0.0129*** (−3.43)	−0.0080*** (−2.56)
β	−0.0004 (−0.37)	−0.0000 (−0.09)	0.0000 (−0.01)	0.0017* (1.65)
BM		0.0005* (1.80)	0.0005** (2.02)	0.0003 (1.14)
LogME		−0.0008** (−2.30)	−0.0008** (−2.30)	−0.0014*** (−4.07)
$R_{-12,-2}$			−0.0001 (−0.01)	0.0016** (2.38)
ROE				0.0008 (1.64)
Turnover				−0.0008*** (−9.07)

When the FM regression is conducted using the characteristic value of the individual stock cross section as the risk exposure variable, the CGO regression coefficient is significantly negative after controlling the risk exposure of the individual stock market, book-to-market ratio, logarithmic scale, historical momentum, profitability, and turnover rate. There is a significant correlation between capital gains and expected stock returns from Table 3. The average regression coefficient ranges from −0.0080 to −0.0129, and the t statistic ranges from −2.56 to −3.43, indicating a significant negative correlation between capital gains and expected stock returns. This conclusion further proves that the A-share market exhibits different disposal effect anomalies from the United States and European markets. This conclusion is similar to previous research results. For example, the empirical results of Grinbatt & Han (2005) show that the CGO coefficient is significantly positive, and the higher the capital gain, the higher the expected return rate of the stock. The authors argue that investors are prone to sell floating-earning stocks, which results in the undervaluation of stocks with high capital gains. This argument is further supported by Li *et al*.'s (2018) research.

In conclusion, the results of portfolio univariate analysis, bivariate ranking analysis, and Fama-Macbetch regression analysis all indicate that capital gains from Chinese stocks negatively correlate with expected returns. This differs dramatically from the theoretical inference and the empirical results of the US market. In the following section, we will discuss several potential impact mechanisms identified in the empirical study.

III. Analysis of the Influence Mechanism

A. Compensating for Liquidity Risks

According to Amihud and Mendelson (1986), liquidity risk premiums contribute to the negative relationship between liquidity and expected stock returns. Low-liquidity stocks are likely to be exposed to greater liquidity risk, necessitating a larger risk premium. This indicates that the expected return on a stock increases as the liquidity variable risk exposure rises. Disposition effects substantially affect the liquidity of stocks, as investors tend to hold stocks with floating losses and trade them more slowly. In contrast, stocks with floating gains tend to be sold and traded more actively. In other words, low CGO stocks tend to have inferior liquidity, which contributes to their higher liquidity premium.

By controlling for bivariate ranking analysis and interactions between individual stocks' liquidity proxy (ILLIQ) and capital gains, we employ Fama-Macbeth regressions to study thoroughly how liquidity influences the link between capital gains and projected returns. Through a bivariate ranking analysis, we can see the relationship between individual stock liquidity and capital gains. For example, in the portfolio with the highest level of illiquidity, going long low CGO investment and shorting high CGO investment can obtain a monthly return of 2.04%, with a t statistic of 6.69. As illiquidity increases, both the portfolio's return rate and the return disparity between the low-high CGO portfolio will rise. When illiquidity is considered, the bivariate ranking analysis reveals that aberrant CGO returns persist.

Table 4. Rank-based bivariate analysis of illiquidity and CGO

		CGO Grouping						
		Low CGO	2	3	4	High CGO	Low – High	t-value
ILLIQ grouping	Min	0.0092	0.0080	−0.0004	−0.0032	−0.0024	0.0116**	2.28
	2	0.0136	0.0064	0.0036	0.002	−0.004	0.0176***	4.02
	3	0.0160	0.0112	0.0080	0.004	−0.0032	0.0192***	4.69
	4	0.0184	0.0176	0.0124	0.0108	−0.0012	0.0196***	5.89
	Max	0.0244	0.0232	0.0184	0.0140	0.0040	0.0204***	6.69

For further consideration of whether the illiquidity of the stock influences the CGO anomaly return, we conduct an FM cross-section regression to control the liquidity effect and investigate whether the relationship between the capital gain and the expected return has been affected. Based on model (6), the model incorporates the illiquidity index ILLIQ for the t-period of individual equities and its interaction with CGO variables.

$$R = \alpha + \beta_1 CGO + \beta_2 ILLIQ + \beta_3 CGO \times ILLIQ + \lambda \sum Control + \varepsilon \quad (6)$$

Table 5's results show that similar to what Song *et al.* (2017) found, there is a significant positive correlation between the expected return of individual stocks and the illiquidity in the A-share market. The expected return grows as individual stock illiquidity increases. Individual stocks with a high level of illiquidity are likely to have a higher liquidity risk. This is consistent with the risk compensation theory, which holds that the expected return on given stocks is positively related to their liquidity risk. The coefficients of the CGO variable of capital gains still vary between −0.012 and −0.015, and the t-statistics still range from −2.92 to 3.88 despite the addition of the illiquidity variable and its interaction term with capital gains. The correlation between capital gains and expected returns of individual stocks is still

significant, and the regression coefficients of interaction terms are ineffective, suggesting that illiquidity hasn't been a regulatory factor. The negative correlation between capital gains and expected returns is not due to higher liquidity risk. Therefore, the liquidity risk compensation theory cannot account for the disposition effect anomaly in the Chinese market.

Table 5. FM regressions for illiquidity

Regression model	(1)	(2)	(3)	(4)
CGO	−0.0127*** (−2.92)	−0.0147*** (−3.65)	−0.0155*** (−3.88)	−0.0120*** (−3.01)
ILLIQ	0.0183*** (4.92)	0.0168*** (5.05)	0.0169*** (5.14)	0.0119*** (3.79)
CGO×ILLIQ	−0.0105 (−1.41)	−0.0100 (−1.45)	−0.0098 (−1.44)	−0.0098 (−1.44)
β	0.0008 (0.80)	0.0013 (1.36)	0.0014 (1.50)	0.0027*** (2.90)
BM		0.0005 (1.55)	0.0005* (1.82)	0.0002 (0.93)
LogME		−0.0005 (−1.19)	−0.0004 (−1.19)	−0.0011*** (−2.99)
R-12, −2			0.0002 (0.27)	0.0018*** (2.56)
ROE				0.0007 (1.51)
Turnover				−0.0087*** (−9.36)
Avg-R2	0.0510	0.0786	0.0849	0.0978

B. Mispricing Caused by Overreaction

The predictability of capital gains on stock returns is not a result of risk compensation, we further find that capital gains are associated with unanticipated earnings disposals, which suggests that the negative correlation between capital gains and expected stock returns may be attributed to mispricing resulting from irrational investor behavior. Frazzini (2006) concludes that investors don't react enough to new information because of the disposition effect, which produces a positive correlation between expected returns and capital gains. It's speculated that the lower the capital gains of stocks on the Chinese stock market, the greater the overreaction of investors. Due to this phenomenon, equity prices are undervalued, and expected returns are higher. As a result, we construct a mispricing variable based on investors' overreaction to verify the hypothesis.

Based on the above, this paper selected three alternative indicators to measure investors' overreaction to historical information: Ang *et al.*'s (2006) characteristic volatility (IVOL), Jegadeesh's (1990) short-term momentum (R-1), and Asness *et al.*'s (2020) MAX anomaly (Max). Similarly, based on Stambaugh *et al.*'s (2015) construction of stock overreaction mispricing through heterogeneous variables, a smaller value of over indicates greater underestimation since overreaction proxy variables are negatively correlated with expected returns, and therefore a combination of three variables is used to measure the mispricing variable over of stocks due to investor overreaction.

Table 6. The arrangement of channels

		CGO Grouping						
		Low CGO	2	3	4	High CGO	Low-High	t-value
Over Grouping	Most Underestimated	0.0106	0.0105	0.0124	0.0135	0.0126	−0.0020	−0.4926
	2	0.0103	0.0117	0.0120	0.0131	0.0140	−0.0037	−0.6891
	3	0.0129	0.0129	0.0107	0.0106	0.0104	0.0025	0.4668
	4	0.0123	0.0095	0.0095	0.0047	0.0057	0.0066	1.3488
	Maximum Estimate	0.0095	0.0016	−0.0017	−0.0035	−0.0086	0.0181***	3.3458

From Table 6 shows that the portfolio of overreacting mispriced most undervalued stocks, as CGO increases stock expected returns also keep increasing, but the long-short return of −0.02% is not statistically significant, indicating that overreacting leads to a negative correlation between unrealized earnings and stock expected returns in undervalued stocks is not significant. Among the most overvalued stocks due to overreaction low CGO stocks have higher expected returns of 0.95%, while high CGO stocks have negative expected returns of −0.86% with a long-short return difference of 1.81%. The results of the bivariate analysis indicate a significant negative effect of CGO on stock expected returns in the most overvalued stocks due to overreaction, but the effect of CGO on stock expected returns in undervalued stocks is offset by valuation anomalies, but manifested in a negative correlation between unrealized earnings and expected returns in the cross-section of stocks.

Further, we introduce overreaction leading to mispricing variables into model 7, the explanatory variable is the stock's return in period t+1, the explanatory variables are capital gains in period t, overreaction mispricing, and the interaction term between the two, and the control variables are as described in the previous section, and the results are obtained by FM regression in Table 7.

$$R = \alpha + \beta_1 CGO + \beta_2 Over + \beta_3 CGO \times Over + \gamma \sum Control + \varepsilon \quad (7)$$

The results in Table 7 show that the negative relationship between individual stocks' capital gains and expected returns disappears after the introduction of the overreaction mispricing variable, while the overreaction mispricing variable has its regression coefficient between −0.0406 and −0.0743 in four regression models with t-statistics between −5.23 and −8.97, indicating that overreaction leads to higher expected returns for more undervalued stocks, in line with Asness *et al.* (2020) findings. While the interaction term regression coefficients range from −0.0725 to −0.2171 and regression coefficients range from −1.85 to −4.45, indicating that there is a significant difference in the effect of capital gains on expected return in different portfolios of overreacting mispriced stocks, and the stronger the negative effect of capital gains on expected return for stocks whose overreaction leads to more overvalued stock prices, the A-share market capital gains and expected return negative correlation is mainly due to investors' overreaction mispricing.

Table 7. FM regressions for reaction to over-mispricing

Regression Model	(1)	(2)	(3)	(4)
CGO	0.0203*** (2.92)	0.0145** (2.27)	0.0122* (1.95)	0.0009 (0.16)
Over	−0.0568*** (−5.23)	−0.0743*** (−8.49)	−0.0722** (−8.97)	−0.0406*** (−5.66)
Regression model	(1)	(2)	(3)	(4)
CGO×Over	−0.2171*** (−4.45)	−0.1767*** (−3.88)	−0.1764*** −3.88)	−0.0725* −1.85)
β	0.0027*** (2.74)	0.0029*** (2.93)	0.0031*** (3.12)	0.0034*** (3.88)
BM		−0.0002 (−0.85)	−0.0001 (−0.38)	−0.0000 (−0.17)
LogME		−0.0013*** (−4.04)	−0.0014*** (−4.27)	−0.0015*** (−4.31)
$R_{-12,-2}$			0.0014** (2.09)	0.0021*** (3.17)
Turnover				−0.0007*** (−8.98)
ROE				0.0001 (0.31)

Table 8. Limited attention to mispricing and capital gains independent double ranking analysis

		CGO Grouping						
		Low CGO	2	3	4	High CGO	Long-short spread	t-value
	Minimum	0.0166	0.0158	0.0156	0.0152	0.0152	0.0013	0.24
	2	0.0149	0.0133	0.0110	0.0088	0.0096	0.0053	1.09
Attention	3	0.0136	0.0115	0.0074	0.0082	0.0012	0.0124***	2.81
grouping	4	0.0093	0.0066	0.0074	0.0041	−0.0044	0.0137***	3.18
	Highest	0.0093	0.0049	0.0035	0.0011	−0.0026	0.0119**	2.19

C. Limited Attention Leads to Mispricing

Behavioral finance argues that limited investor attention is also a major cause of market anomalies, and studies have shown that investors' reactions to new information are closely related to limited investor attention, and those stocks with less analyst coverage, a smaller share of institutional investors, and lower abnormal turnover tend to have lower investor attention, and often stocks with lower investor attention have higher expected returns (Hirshleifer *et al.*, 2013; Drake *et al.*, 2014; Jiang *et al.*, 2016).

There is a negative relationship between capital gains and expected stock returns in the Chinese stock market, with floating surplus stocks having lower expected returns and floating deficit stocks having higher expected returns, contrary to theoretical inferences and empirical experience in international markets. From the perspective of limited investor attention, stocks with floating profits tend to receive excessive investor attention, while stocks with floating losses have lower investor attention. Mispricing caused by investor attention may also lead to the anomaly of a negative correlation between capital gains and expected returns in the Chinese stock market.

Therefore, we construct the mispricing variable due to limited attention, and three proxies are also selected in this paper, namely Barber and Odean's (2008) Abnormal Volume (AVOL), Hirshleifer *et al.*'s (2013) Analyst Coverage (AC) and Drake *et al.*'s (2014) Institutional Investor Shareholding (IS), also based on Stambaugh *et al.*'s (2015) construction of stock reaction over-mispricing through anomalous variables, and since all investor attention proxy variables are negatively correlated with expected returns, smaller Attention values indicate greater undervaluation, using a combination of the three variables to measure the mispricing variable Attention of stocks due to investor attention.

The results in Table 8 show that among the most concerned stocks, low CGO stocks have higher expected returns while high CGO stocks have negative expected returns, with a long-short return difference of 1.19%. However, in the lowest concern stock portfolio, the change in CGO does not result in a significant difference in expected returns, and the long-short return of 0.13% is not statistically significant. The results of the bivariate analysis indicate that stocks with high investor attention have a more significant negative correlation between capital gains and expected returns, while stocks with low investor attention have a non-significant predictive t-statistic of capital gains on returns of 0.24. As the limited investor attention rises, the more severe the overvaluation of the floating stock, and more significant return anomalies are observed in the group with higher limited attention, investor The increase in attention exacerbates the negative relationship between capital gains and expected stock returns, where the source of abnormal returns is mainly the severe overvaluation of floating surplus stocks with high investor attention.

We further introduce the investor concern leads to mispricing variables into model 8, the explanatory variables are stock returns in period t+1, the explanatory variables are capital gains in period t, investor concern leads to mispricing, and the interaction term between the two, and the control variables are as described in the previous section and include illiquidity and overreaction mispricing variables to obtain the results in Table 7 through FM regressions.

$$R = \alpha + \beta_1 CGO + \beta_2 Attention + \beta_3 CGO \times Attention + \gamma \sum Control + \varepsilon \quad (8)$$

The results in Table 9 show that the negative correlation between individual stocks' capital gains and expected returns still exist at the 5% statistical significance level after the introduction of the investor concern mispricing variable, but the regression coefficient and statistical significance of its negative correlation are weakened with the increase of control variables, while the regression coefficient of the investor concern mispricing variable in the four regression models ranges from −0.0029 to −0.0033 with t-statistics ranging from −6.99 to −9.27, indicating that investor attention leads to higher expected returns for more undervalued stocks, consistent with the results of related studies. The interaction term regression coefficient, on the other hand, ranges from −0.0055 to −0.0091 with a regression coefficient of −2.10 to −3.35, indicating that there is a significant difference in the effect of capital gains on expected returns across portfolios of stocks mispriced by investor attention, increased investor attention exacerbates the negative relationship between capital gains and stock expected returns, consistent with the results of the bivariate sorted grouping analysis.

Table 9. FM regression with limited attention

Regression model	(1)	(2)	(3)	(4)
CGO	−0.0129*** (−3.19)	−0.0139*** (−3.69)	−0.0090** (−2.40)	−0.0078** (−2.00)
Attention	−0.0029*** (−6.99)	−0.0033*** −9.27)	−0.0031*** (−9.01)	−0.0029*** (−8.56)
CGO×Attention	−0.0091*** (−3.35)	−0.0081*** −3.08)	−0.0055** (−2.10)	−0.0058** (−2.21)
β	−0.0002 (−0.21)	0.0001 (0.09)	0.0018** (1.76)	0.0034*** (3.69)
BM		0.0006** (2.31)	0.0003 (1.40)	0.0000 (0.42)
LogME		−0.0010*** (−2.84)	−0.0015 (−4.56)	−0.0015*** (−4.39)
$R_{-12,-2}$		−0.0007 (−1.09)	0.0009 (1.37)	0.0014** (2.13)
ROE			0.0038 (0.81)	−0.0002 (−0.43)
Turnover			−0.0008*** (−9.06)	−0.0008*** (−9.99)
Under				−0.0212*** (−3.32)
ILLIQ				0.0108*** (4.19)

The above analysis shows that the reason for the predictability of capital gains in stock cross-sectional expected returns in the Chinese stock market is investor mispricing, although the disposition effect brings about different liquidity risk-taking of individual stocks, with floating loss stocks having lower liquidity and floating surplus stocks having higher liquidity, but their long-short excess returns do not come from liquidity risk compensation, but from investor mispricing. Further analysis reveals that the negative correlation between capital gains and individual stocks' expected returns is weakened after controlling for the investor attention mispricing variable, and the negative correlation between capital gains and stocks' expected returns is exacerbated by the increase in investor attention, where the source of abnormal returns is mainly the grossly overvalued floating surplus stocks with high investor attention. After the introduction of investor overreaction mispricing, the negative correlation between individual stocks' capital gains and expected returns disappear, so we argue that mispricing due to investor overreaction and excessive attention to floating surplus stocks is the source of disposition effect anomalies in the Chinese stock market.

IV. Robustness Test

A. Sample of Different Periods and Exchanges

We divide the sample data into three subsamples according to market trends in the Table 10: January 2010–December 2014, a period of broad market shocks; January 2015–December 2016, a period of bullishness followed by bearishness; and January 2017–December 2020, a period of the slow market climb to rapid bearishness followed by recovery. The results show that the capital gains long-short portfolio has significant adjusted returns across periods, indicating that the strategy of going long a low CGO while shorting a high CGO portfolio has anomalous returns that are robust across periods.

Table 10. CGO anomaly gains for different sample periods

Period	Yield	FF3 alpha (%)	FF5 alpha (%)
2010.1–2014.12	0.0124**[2.33]	0.0116**[2.18]	0.0108**[2.02]
2015.1–2016.12	0.0356**[3.10]	0.0402***[3.69]	0.0468***[3.94]
2017.1–2020.12	0.0144**[2.16]	0.0152**[2.23]	0.0144**[2.15]

Table 11 analyzes the performance of the CGO factor under different observation and duration periods. As the holding period increases, the return premium of the portfolio with smaller unrealized earnings gradually decreases, and regardless of the value of the observation period J, when the holding period exceeds 12 weeks, one quarter, the return of the long-short portfolio with unrealized earnings is no longer significant, and when the holding period exceeds 36 weeks, three quarters, the return of the long-short portfolio with unrealized earnings reverses, and the return of the portfolio with larger unrealized earnings is significantly higher than the return of the portfolio with smaller unrealized earnings. The returns of the portfolios with larger unrealized profits are significantly higher than the returns of the portfolios with smaller unrealized profits. On the other hand, the effect of observation period J on the returns of long-short unrealized earnings portfolios is small, but the returns of long-short unrealized earnings portfolios tend to decrease as the observation period increases. The significance aspect shows an inverted U-shape. When the holding period J is small, the long-short portfolio return increases in significance as J increases reaches a maximum when J = 12, and then starts to decrease.

In conclusion through the performance of CGO anomalies for different holding and observation periods, the CGO factors of the A-share market all have a floating loss premium in the short term, and the return of the portfolio with small unrealized profits is significantly higher than that of the portfolio with larger unrealized profits, showing a stable excess return ability. Finally, the study found that by grouping the main board market and the GEM market, the return of the portfolio with smaller unrealized profits is significantly higher than that of the portfolio with larger unrealized profits in different trading markets, and the

strategy of going long the low CGO while shorting the high CGO portfolio has anomalous returns is robustly present in each main board and GEM.

Table 11. CGO anomaly gains for different window periods

J/K (%)		1	4	12	36	48
1	small	1.285	1.097	1.059	1.067	1.224
	Big	−1.131	−0.556	0.481	1.079	1.237
	Small-Large	2.417***	1.653***	0.577**	−0.012	−0.013
	t-statistic	5.326	4.117	2.730	−0.120	−0.137
4	small	1.341	2.014	1.428	1.031	1.225
	Big	−1.086	−0.725	0.511	1.165	1.288
	Small–Large	2.427***	2.739***	0.917***	−0.134	−0.069
	t-statistic	4.824	5.365	3.482	−1.083	−0.584
12	small	2.015	1.384	0.834	0.511	0.575
	Big	−0.709	−0.901	0.373	0.635	0.660
	Small–Large	2.725***	1.474***	0.461***	−0.124*	−0.083
	t-statistic	5.2997	5.9454	3.464	−1.862	−1.358
24	small	1.921	1.376	0.748	0.495	0.563
	Big	−0.359	0.176	0.516	0.706	0.716
	Small–Large	2.281***	1.200***	0.002*	−0.211**	−0.152**
	t-statistic	4.473	4.779	1.809	−3.1417	−2.486
48	small	1.831	1.324	1.552	1.063	1.201
	Big	−0.284	0.231	1.185	1.544	1.616
	Small–Large	2.115***	1.093***	0.367	−0.481***	−0.415***
	t-statistic	4.182	4.344	1.295	−3.050	−2.962

Table 12. The arrangement of channels

Panel A: Capital Gains CGO Grouping

		Low CGO	2	3	4	High CGO	Low–High	t-value
Over Grouping	Underestimation	0.0040	0.0041	0.0045	0.0039	0.0019	0.0020	0.5741
	2	0.0035	0.0032	0.0030	0.0016	−0.0010	0.0045*	1.6981
	3	0.0029	0.0031	0.0022	0.0009	−0.0017	0.0046*	1.7655
	4	0.0029	0.0032	0.0020	0.0005	−0.0028	0.0057**	2.3604
	Overestimation	0.0026	0.0026	0.0027	0.0020	−0.0033	0.0059***	3.1052

Panel B: Capital Gains CGO Grouping

		Low CGO	2	3	4	High CGO	Low–High	t-value
Attention grouping	Minimum	0.0047	0.0040	0.0037	0.0033	0.0035	0.0012	0.31
	2	0.0050	0.0032	0.0023	0.0017	0.0014	0.0036	0.69
	3	0.0024	0.0005	0.0001	−0.0012	−0.0004	0.0028**	2.09
	4	0.0046	0.0029	0.0018	0.0009	−0.0006	0.0052***	2.86
	Highest	0.0032	0.0014	0.0002	−0.0002	−0.0017	0.0049***	3.21

B. Conditional Double Ranking Analysis

In the previous paper, we used independent dual sorting for bivariate analysis, we further use conditional dual sorting, such as overreaction Over with capital gains CGO bivariate analysis in which the overreaction variables are first ranked into five groups from most underestimated to most overvalued, and in each group, they are sorted from low to high capital gains, and then the average excess returns within the groups are examined, and the results are shown in Table 12. The results in the table show that in Panel A, the average excess return of low capital gains in the portfolio with overreaction leading to stock price overvaluation is 0.59% higher than that of high capital gains with a t-statistic of 3.10, while the average excess return of low capital gains in the portfolio with overreaction leading to stock price undervaluation is not significantly different from that of high capital gains stocks, which indicates that capital gains in the portfolio of stocks with different overreaction mispricing have a There is a significant difference in the impact of capital gains on expected returns across overreacting mispriced stock portfolios, and the stronger the negative impact of capital gains on expected returns for stocks whose overreaction leads to an overvaluation of the stock price, consistent with the previous findings.

In Panel B, the average excess return of the low capital gain stock portfolio in the highest attention stock portfolio is 0.49% higher than that of the high capital gain stock portfolio with a t-statistic of 3.21, while the average excess return of the low capital gain stock portfolio in the low attention stock portfolio is not significantly different from the average excess return of the high capital gain stock portfolio, indicating that the increase in investor attention exacerbates the negative correlation between capital gains and expected stock returns, where the source of excess returns is mainly the highly overvalued floating stocks with high investor attention, consistent with the previous research results.

C. Market Value-weighted Rate of Return

In the previous study, we used which also indicates an equal-weighted average for the calculation of returns, we further use market capitalization-weighted returns in our robustness test to further control for the effect of market capitalization size on the study results, which also indicates that in the A-share market, there are low capital gain stocks with significantly higher excess returns than high capital gain stocks, and the source of such anomalous returns is mainly investor overreaction and high investor attention resulting in of mispricing, which is consistent with the results of the previous study.

V. Conclusion

This paper finds a new empirical fact about the relationship between capital gains and expected stock returns in the Chinese stock market. Contrary to existing studies, capital gains are negatively correlated in cross-sectional stock expected returns, stocks with higher capital gains have lower expected returns and going long a portfolio of low capital gain stocks while shorting a portfolio of high capital gain stocks can yield an average monthly excess return of 2.70%, further exploring the reasons for this phenomenon in the A-share market are further explored.

The results show that (1) portfolios with smaller unrealized earnings have significantly higher returns than portfolios with larger unrealized earnings and exhibit stable excess return capacity across market periods, different observed holding windows and different trading venues. (2) We exclude the liquidity premium hypothesis, liquidity does not play a moderating effect, and the source of the negative correlation between capital gains and expected returns of individual stocks is not the higher liquidity risk taken, so using liquidity risk compensation does not explain the disposition effect anomaly that exists in the Chinese market. (3) The impact of capital gains on expected return differs significantly across portfolios of overreacting mispriced stocks, with the stronger negative impact of capital gains on expected return for stocks whose overreaction leads to higher share price overvaluation. (4) The negative relationship between capital gains and stock expected returns is exacerbated by increased investor attention, where the source of excess returns is mainly the severe overvaluation of floating stocks with high investor attention.

The research in this paper contributes to the empirical study of the behavioral finance disposition effect theory in the A-share market. In addition to revealing the anomalies brought about by the disposition effect in the A-share market that cannot be explained by the theoretical model, it further answers the reason for the negative correlation of capital gains in cross-sectional expected stock returns, which helps to deepen people's understanding of the impact of investor behavior on asset pricing. It also reflects that the financial anomalies in the A-share market may differ from those in international markets, and the reasons behind such differences need to be given sufficient attention.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Yong Pan contributed to the conceptualization and design of the study, as well as the writing and revision of the manuscript; Rujie Fan was responsible for the data collection and analysis, and contributed to the interpretation of the results; Gongtao Zhang assisted with the methodology development and provided critical feedback on the manuscript draft; all authors had approved the final version.

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