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The Impact of Technology Attention and Investors on Stock Returns: Taking Science and Technology Innovation Board Company as an Example

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Abstract: Since the fourth anniversary of the opening of the Science and Technology Innovation Board, the number of listed companies on the board has reached 546, with a total fundraising amount of 858.242-billion-yuan, accounting for 42% of the total domestic A-share financing during the same period. The stock return on the Science and Technology Innovation Board has become a topic of concern for investors. This article uses indirect indicators from 2021 to 2023, and uses principal component analysis to construct investor attention and investor sentiment indicators. By using panel analysis, it is found that investor attention has a negative impact on stock return, investor sentiment has a positive moderating effect on investor attention-stock return. In order to further explore the impact and effect of differences in investor sentiment and investor attention in the high and low sentimental group, it conducted a heterogeneity test, which found that the relationship between investor attention and stock returns in the low sentiment group is significantly negative, but not in high group. And there is a significant positive correlation between the investor sentiment moderating effect and stock returns in the high sentiment group, but not in the low sentiment group. This result can be beneficial for guiding market regulatory authorities and consumers to supervise and invest rationally in stocks on the Science and Technology Innovation Board.

Keywords: Science and Technology Innovation Board; Stock Return; Investor Attention; Investor Sentiment.

1. Introduction

The Science and Technology Innovation Board has developed rapidly in the past four years in China. As of July 22nd 2023, there were 546 listed companies on the Science and Technology Innovation Board, with a total market value of approximately 6.4 trillion yuan. The cumulative initial fundraising amount exceeded 850 billion yuan, bringing together a group of high-quality science and technology innovation enterprises with large scale, high market recognition, outstanding scientific research strength, and good growth potential. The development of the Science and Technology Innovation Board has greatly integrated the capital market with technological innovation, providing support for the development pattern of a virtuous cycle in China's technology, industry, and finance.

In November 2018, the president Xi proposed the establishment of the Science and Technology Innovation Board and the pilot of registration system; The establishment of the Science and Technology Innovation Board is conducive to improve risk response plans, strengthen investor education and emphasize the balance between various markets. As of the end of June 2023, it can be seen that the companies listed on the Science and Technology Innovation Board are strategic emerging industries and high-tech industries. Nowadays the Science and Technology Innovation Board has formed industrial clusters in sub industries such as integrated circuits, new materials, new energy, and innovative drugs, and has initially formed a full industrial chain. Under the registration system, the review of the issuance and listing of the Science and Technology Innovation Board adheres to the information disclosure as the core and strives to present the comprehensive corporation information to the market. This requires enterprises and intermediary agencies not to conceal or falsely promote company information. The attribute of the Science and Technology Innovation Board also makes it easier for investors to pay attention to and understand company information, and then make investor decisions.

Barberis and Shleifer and Peng and Xiong found that investors who are susceptible to irrational factors with limited attention tend to switch between different investment styles [1-2], while China's stock market has the distinct theme switching and industry rotation characteristics is often driven by market hot-spots and policy orientations [3-4]. For example, after the outbreak of the COVID-19 pandemic, the stock price of medical enterprises rose for seven months. This situation is caused by investors' attention to information from different types of companies and different time periods, which in turn leads to different correlations between stock returns and attention. Peng and Xiong constructed an "attention allocation model" to study the dynamic relationship between investors' allocation of attention resources and asset pricing. This model suggests that if investors pay more attention to certain specific companies, the corresponding company's stock price will exhibit overreaction characteristics [2]; In response to the issue of under what circumstances a specific stock will attract investors' attention, Seasholes and Wu found that investors' attention has a significant positive impact on stock prices and will reverse over time [5]. Similarly, Yu and Zhang tested the correlation between investor attention and the stock market using samples of companies listed on the ChiNext board. It showed that although investor attention had a positive impact on the current stock return, this impact would quickly reverse on subsequent trading days [6]; Yang and Lv used investor attention to study the relationship between sudden events and stock market volatility. The research results showed that sudden event attention has a good explanatory power on stock market volatility. For every 1 percentage point increase in the event attention index, the stock price fluctuates downward by 0.017 percentage points

[7].

Currently, there is a lack of research on the impact of investor attention on the stock returns of the Science and Technology Innovation Board in existing literature. Therefore, the article conducts research on the relationship between stock returns of science and technology innovation board companies and investor attention. Firstly, this article uses principal component analysis to construct investor attention by collecting the Baidu index from January 2021 to July 2023. Then, the relationship between investor attention as the independent variable and stock return as the dependent variable is tested using panel regression. This article borrows Wurgler's research method of constructing indirect indicators using principal component analysis to construct investor sentiment [8]. The article selected and calculated price to earnings ratio, price to book ratio, price to sales ratio, turnover rate of circulating capital stock, average daily turnover rate, excess return rate, portfolio return using data from WIND economic database to generate investor sentiment and check the moderating effect of investor sentiment on investor attention on stock return.

This article found that investor attention has a negative correlation with the stock returns of science and technology innovation board companies. As investor attention increases, stock returns decrease. Investor sentiment is positively correlated with stock returns, and the coefficient of the interaction term between sentiment and attention is significant and positive, indicating that the impact of investor attention on stock returns is moderated by investor sentiment. This article uses the mean value of investor sentiment to divide all samples into high and low sentiment groups for heterogeneity testing. It is found that the relationship between investor attention and stock returns in the high sentiment group is not significant, while in the low sentiment group, there is a significant negative correlation. After introducing investor sentiment and interaction terms, it is found that there is a significant positive correlation between the interaction term and stock returns in the high sentiment group, but not in the low sentiment group.

The main contributions of this article include: firstly, it confirms that investor attention has a negative impact on the stock returns of companies on the Science and Technology Innovation Board, and investor sentiment has a moderating effect on this impact. This helps regulatory authorities regulate the disclosure of stock information of companies applying for listing on the Science and Technology Innovation Board, thereby guiding investor attention and sentiment to promote healthy competition. Secondly, this article explores whether there is a difference in the impact of investor attention and the moderating effect of investor sentiment under high and low sentiment groups, enriching the influence of irrational factors on stock returns.

The remainder of the paper is organized as follows: Section 2 proposes hypotheses and reviews relevant literature; Section 3 demonstrates data sources and generation methods, and introduces methods used; Section 4 presents regression test results and draws conclusions; Section 5 presents heterogeneity test results and draws conclusions. The last section presents our conclusions.

2. Literature Review and Hypothesis

This article mainly focuses on the impact of investor attention on the stock returns of Science and Technology Innovation Board companies, that is, by observing the intensity of investor attention, it can trigger investor decisions, affect their stock valuations, and make positive or negative reactions to the stock market. The price response of stocks is influenced by investor behavior, so the introduction of investor sentiment as a factor is inevitable in this article. Therefore, the literature related to this study mainly focuses on two aspects: investor attention and investor sentiment.

2.1. Investor Attention

There is sufficient research both domestically and internationally to prove that investor attention has a significant relationship with stock returns. However, due to the different types of companies and the different time and individual effects, there is no clear conclusion on the relationship whether it’s positive or negative. Using media reports as proxy variables for investor attention, Fang&Peress found that s stocks with low media attention have a significant premium, especially among small stocks and stocks with high individual ownership, low analyst following, and high idiosyncratic volatility [9]. Due to the high transparency of information, stocks with high attention tend to reflect their actual value relatively accurately, resulting in limited arbitrage space. Wang and Yang used data from well-known financial websites to construct investor attention indicators and conducted regression. The results showed that companies that previously performed well in the stock market stocks with high attention would have high trading volume on the day and the following day, and high attention on the day had a positive impact on the day's return, but had a negative impact on the stock returns on the following days [10]. Wang and Hao considered industry factors and demonstrated that there is a significant positive correlation between investor attention in the current period and stock returns and average turnover, while investor attention in the later period has a negative impact [11]. Yang believe that investors' attention will increase the activity level of Chinese PM2.5 concept stock trading and the possibility of stock limit up [12]. Due to media coverage and information disclosure, investors' attention to the Science and Technology Innovation Board companies can easily lead to expectation change of the high-tech industry situation, and attention behavior can affect investors' enthusiasm for investing in the stocks of Science and Technology Innovation Board companies. Since there is currently no clear conclusion on how investors’ attention affects the stock returns of companies on the Science and Technology Innovation Board, we cannot determine the positive or negative direction of this relation directly as investors' preferences may contradict or be the same as market information. Based on this, the first basic hypothesis of this article is proposed:

Investor attention has a positive impact on the stock returns of the Science and Technology Innovation Board.

Investor attention has a negative impact on the stock returns of the Science and Technology Innovation Board

2.2. Investor Sentiment

Previous studies have shown a significant relationship between investment sentiment and stock returns, but there is no clear and unified conclusion on the impact of investor sentiment on investor attention-stock returns. Kim et al introduced the concept of investor divergence and found that the more positive investor sentiment, the greater investor divergence, and the lower future stock market returns [13].

However, when investor sentiment is low, investor divergence has no significant effect; Baker and Wurgler found that when investor sentiment is low, certain small, newer, and high volatility stocks will have higher returns, while when investor sentiment is high, these stocks' returns will be relatively low [8]; Brown and Cliff used a survey questionnaire to measure investor sentiment and found that its impact on stock prices is significant. Overoptimistic investor sentiment will drive market prices above their intrinsic value, and as sentiment stabilizes, market prices will gradually return to their fundamental value [14]; Wang and Wu (2015) found that stock issuing companies and underwriters use media to promote IPO companies in order to guide and incite investor sentiment, which is beneficial for attracting investor interest and improving IPO pricing [15]. Lu and Chen (2021) focus on the impact of media coverage. They believe that the information framework of most investors is obtained through news events reported by the media. Therefore, the media coverage that investors pay attention to will have a positive or negative impact on investor sentiment, and further affect investor decision-making, thereby affecting stock price fluctuations.[16] Engelberg (2012) found through empirical research that investors' behavioral decisions are influenced by the comments and opinions of stock analysts on television. If a stock is predicted to rise on the previous trading day by stock analysts, then investor sentiment is high and the stock's return on the next trading day will increase [17];

Due to different levels of investor attention, investors have different impressions of science and technology Innovation Board companies. For example, some investors focus their attention on technological innovation, which can easily increase their enthusiasm. And this high investor sentiment will to some extent moderate investors' attention to the negative impact on stock returns. Based on this, this article proposes the following basic hypotheses:

Investment sentiment has a positive moderating effect on the relationship between investor attention and stock returns Investment sentiment has a negative moderating effect on the relationship between investor attention and stock returns.

This article takes the logarithm of the product of investor attention and investor sentiment as the interaction term, and defines the impact of investor sentiment indicators by studying the relationship between the interaction term and stock returns.

3. Data and Research Methods

3.1. Data Sources

This study selected the corresponding stocks of companies on the Science and Technology Innovation Board, which were issued by the China Securities Regulatory Commission with the "Special Provisions on Major Asset Restructuring of Listed Companies on the Science and Technology Innovation Board", and selected data from January 2021 to June 2023 for a total of 130 weeks. The stock data is sourced from the WIND economic database. Due to the severe lack of daily data, this study used weekly data. The investor attention data used in this article comes from the Baidu Index, but as the Baidu Index cannot be directly obtained, the research used "artificial intelligence", "technological innovation", and "scientific research" search volume data, which were compiled through Python crawlers and Excel spreadsheets. The investor sentiment index is constructed using price to earnings ratio, price to book ratio, price to sales ratio, turnover rate of circulating capital stock, average daily turnover rate, excess return rate, portfolio return. These data are all from WIND database.

3.2. Method

3.2.1. Principal Component Analysis

Principal component analysis was first introduced by Karl Pearson as a statistical method for nonrandom variables, and then Hotelling extended this method to the case of random vectors [18]. Principal component refers to the transformation of a set of potentially correlated variables into a set of linearly unrelated variables through orthogonal transformation, and the transformed set of variables is called principal component. In practical research, we usually use a proxy variable to measure a concept. However, when the concept is influenced by multiple factors, in order to measure the concept of the variable more comprehensively and accurately, we will select multiple variables to measure it. However, due to the varying degrees of influence each variable has on the concept, we need to assign different weights to each variable when measuring. Multiple variables are selected through linear transformation to select a smaller number of important variables, and finally synthesized into a variable that can accurately measure the concept.

Before conducting principal component analysis, KMO testing and Bartlett spherical testing are required to determine whether this set of data is suitable for processing through principal component analysis. The KMO test result is between 0 and 1, with a value above 0.9 indicating that PCA is extremely suitable; 0.8-0.9: PCA method is very suitable; 0.7-0.8: PCA is suitable; 0.6-0.7: PCA is relatively suitable; 0.5-0.6 indicates that PCA can be used, while 0.5 or less indicates that it is highly unsuitable.

The processes and formulas of PCA are as followed:

a) Standardize the original data

$$x_{ij}^{*} = \frac{x_{ij} - \bar{x}_j}{\sqrt{var(x_j)}} \ (i = 1,2,\dots n;\ j = 1,2,\dots,p)$$
$$\text{Where } \bar{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij},\ var(x_j) = \frac{1}{n-1}\sum_{i=1}^{n}(x_{ij} - \bar{x}_j)^2 \ (j = 1,2,\dots,p) \quad (1)$$

b) Calculate the sample correlation coefficient matrix

$$\begin{bmatrix} r_{11} & r_{12} & r_{\dots} & r_{1p} \\ r_{21} & r_{22} & r_{\dots} & r_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ r_{n1} & r_{n2} & r_{\dots} & r_{np} \end{bmatrix} \quad (2)$$

c)Using the Jacobian method to obtain the eigenvalues of the correlation coefficient matrix R() and corresponding eigenvectors.

d) Select the principal components with eigenvalues greater than 1 and write the principal component expression according to their respective proportions.

This article constructs an investor attention and investor sentiment index using principal component analysis method.

3.2.2. The Impact of Investor Attention on Stock Returns

To analyze the impact of investor attention on stock returns, a basic bidirectional fixed effect model is established:

$$Sr_{it} = \delta_i + \vartheta_1 Latten_{it} + \pi X_{it} + \tau_i + \omega_t + \varepsilon_{it} \quad (3)$$

are coefficients and coefficient vector corresponding to and control variable, and is the individual effect (representing the explanatory variable that does not change over time of an individual stock), represents the time effect (used to control the influence of time factors), is the residual.

3.2.3. The Moderating Effect of Investor Sentiments

To analyze the moderating role of investor sentiment in the impact of investor attention on stock returns, following the regression model equation:

$$Sr_{it} = \alpha_i + \beta_1 Latten_{it} + \gamma_1 Lsen_{it} + \rho_1 Latten_{it} Lsen_{it} + \sigma_1 Y_{it} + \theta_i + \mu_t + \epsilon_{it} \quad (4)$$

are coefficients and coefficient vector corresponding to, and intersection term. is the coefficient vector of control variable. is the individual effect, is time effects, and is the residual.

3.3. Variable Selection and Generation

3.3.1. Stock Return

Following the approach of Cai and Yang [19], the study uses a logarithmic return rate, where and Pit is the closing price of stock i at time t.

3.3.2. Investor Attention

There are many methods for measuring investor attention in empirical research, and different reference indicators can lead to different results, such as advertising expenditure [20], extreme returns [21], media coverage [9], and consumer confidence [22]. Da et al used Google search volume as a measure of investor attention due to the reason that search volume is likely to capture investor attention [23]. More and more people generally use Internet search engine to gather information, which indicates Google search volume might show the population's interest on a topic. Yu and Zhang used the Baidu index as a proxy variable to measure investor attention for the first time in China [24], and they demonstrated its rationality and effectiveness as a proxy variable. Drawing on existing research, this article conducts principal component analysis on Baidu search volume (represented by A, B, and C respectively) for the keywords "artificial intelligence", "technological innovation", and "scientific research".

Firstly, KMO test and Bartlett spherical test were conducted, and the results are shown in the table below. Therefore, using Baidu index variables for principal component analysis is reasonable.

Table 1. Testing the suitability of using PCA to construct investor attention

Test method	Index	Test results
KMO test	KMO value	0.546
Bartlett spherical test	Chi-square	2361.162
	Degrees of freedom	3
	p-value	0.000

The standardized calculation formula for investor attention is:

$$Atten_{it} = \frac{A_{it} \times 0.3631 + B_{it} \times 0.6602 + C_{it} \times 0.6575}{0.3631 + 0.6602 + 0.6575} \quad (5)$$

In order to overcome the influence of heteroscedasticity and non-normality on the regression results, take the logarithm of investor attention to generate a new variable, which is the same as the following.

3.3.3. Investor Sentiment

There are many studies on measuring investor sentiment, and the earliest proxy indicator used for sentiment was close-end fund discount. With the development of technology, there are more new methods, such as using the statistics based on market research, IPO issuance and first day returns to measure investor sentiment. Baker&Wurgler used principal component analysis to extract suitable indicators for measuring investor sentiment for the first time [8]. Since B&W method is accepted by more and more people, referring to its practice, this study conducts principal component analysis on price to earnings ratio, price to book ratio, price to sales ratio, turnover rate of circulating capital stock, average daily turnover rate, excess return rate, portfolio return (respectively expressed by D, E, F, G, H, I, J), and obtains the measurement indicators of investor sentiment.

The KMO test result as followed is greater than 0.5, and the P-value of Bartlett spherical test is also sufficiently small, so principal component analysis can be used.

Table 2. Testing the suitability of using PCA to construct investor sentiment

Test method	Index	Test results
KMO test	KMO value	0.554
Bartlett spherical test	Chi-square	8886.870
	Degrees of freedom	21
	p-value	0.000

After using stata processing, as there are four groups of components with eigenvalues greater than 1, it is necessary to first calculate each component and then calculate investor sentiment based on their respective proportions.

The standardized calculation formula is:

$$f_1 = \frac{D_{it} \times 0.0040 + E_{it} \times 0.4023 + F_{it} \times 0.3237 + G_{it} \times 0.5890 + H_{it} \times 0.5939 + I_{it} \times 0.1679 + J_{it} \times 0.0748}{0.0040 + 0.4023 + 0.3237 + 0.5890 + 0.5939 + 0.1679 + 0.0748}$$

$$f_2 = \frac{-D_{it} \times 0.0229 + E_{it} \times 0.5445 + F_{it} \times 0.6505 - G_{it} \times 0.3536 - H_{it} \times 0.3172 - I_{it} \times 0.1027 - J_{it} \times 0.2089}{-0.0229 + 0.5445 + 0.6505 - 0.3536 - 0.3172 - 0.1027 - 0.2089}$$

$$f_3 = \frac{D_{it} \times 0.4461 + E_{it} \times 0.0328 + F_{it} \times 0.1279 - G_{it} \times 0.0434 - H_{it} \times 0.0204 - I_{it} \times 0.4503 + J_{it} \times 0.7606}{0.4461 + 0.0328 + 0.1279 - 0.0434 - 0.0204 - 0.4503 + 0.7606} \quad (6)$$

$$f_4 = \frac{D_{it} \times 0.8667 - E_{it} \times 0.0299 + F_{it} \times 0.0017 - G_{it} \times 0.0176 - H_{it} \times 0.0549 + I_{it} \times 0.4200 - J_{it} \times 0.2612}{0.8667 - 0.0299 + 0.0017 - 0.0176 - 0.0549 + 0.4200 - 0.2612}$$

$$sen_{it} = \frac{0.3125 \times f_1 + 0.1708 \times f_2 + 0.1439 \times f_3 + 0.1432 \times f_4}{0.3125 + 0.1708 + 0.1439 + 0.1432}$$

After taking the logarithm of investor sentiment, is obtained.

Control variables.

Select indicators based on Fama&French's three factor model [25], picking scale factor and price to book ratio. Scale factor, using the company's market value as the scale factor, using the product of the closing price of an individual stock and the total number of shares as the market value, and taking the logarithm of this market value to obtain the scale factor, denoted as ; Book to market ratio is measured by the ratio of net assets per share at the end of the period (t-1) to the closing price per share at the end of the period (t-1), which is reciprocal to the price to book ratio. Therefore, this study selects the price to book ratio as an alternative indicator for book to market ratio, denoted as.

The descriptive statistical results of the main variables are shown in the table below.

It can be seen that investor sentiment has greater volatility compared to investor attention, and from a minimum perspective, investor attention has a relatively greater negative impact on stock returns. What's more, among the two control variables, there is a significant difference in the P/B ratio of companies on the Science and Technology Innovation Board. Besides, the mean value of stock return is -0.017239, the highest return is 0.3978711, the lowest return is -0.4129737. The mean value of scale factor is 24.6332, the highest return is 27.00189, and the lowest return is 21.49386

Table 3. Descriptive Statistical

Notation	Variable	Obs	Mean	Std. dev.	Min	Max
Sr	stock return	5,068	-.0017239	.0718905	-.4129737	.3978711
Lsen	Investor sentiment	5,068	2.26e-09	.9296247	-1.061377	9.132771
Latten	investor attention	5,068	-9.47e-10	.7761801	-3.080234	1.404031
PB	p/b ratio	5,068	9.582589	9.622226	1.0737	167.3054
Lmv	scale factor	5,068	24.6332	.721588	21.49386	27.00189

Table 4. Correlation Analysis

	Stock return	investor attention	Investor sentiment
Stock return	1.0000		
investor attention	-0.0277	1.0000	
Investor sentiment	0.2160	-0.0757	1.0000

From above table, all of the correlation coefficients along the diagonal of the table are equal to 1, indicating that each variable is perfectly associated with itself.

The correlation between "investor attention" and "stock return" is -0.0277, which indicates that there is a negligible correlation. More investor attention is associated with less stock return. The correlation between "investor sentiment" and "stock return" is 0.1827, which indicates that weakly positive correlation. More investor attention is associated with more stock return. The correlation between "investor attention" and "investor sentiment" is -0.0483, which indicates that there is a negligible correlation. More investor attention is associated with less investor sentiment.

4. Regression Analysis

This section uses regression analysis to test the two hypotheses mentioned earlier regarding investor attention and investor sentiment.

4.1. The Impact of Investor Attention on Stock Returns

Table 5. Investor attention's impact on stock returns

	(1)	(2)	(3)
investor attention	-.0025746 ** (-1.97)	-.0031936** (-2.47)	-.0030126** (-2.33)
Market Value		-.0519735*** (-12.91)	-.0536926*** (-13.26)
PB		.0011362*** (8.58)	.0011397*** (8.30)
Year	N	N	Y
Id	Y	Y	Y
Obs.	50668	50668	50668
Firms	546	546	546

The regression results in Table 3 indicate that investor attention has a significant negative impact on stock returns, with a regression coefficient of 0.025 and passing the test at a significance level of 5%. According to the efficient market hypothesis, when investors pay attention on specific industry and individual stock information, stock prices can better reflect the impact of changes in existing information in the market. The higher the investor's attention, the lower trading barriers, the higher the degree of information disclosure, and the less susceptible the securities prices to individual investors, which makes competition more thorough and having a negative impact on individual stock returns. This result is consistent with Zeng Ying and Lu Zhengfei (2006) found that higher disclosure quality can reduce the marginal equity financing cost of a company [26]. When two control variables are considered, it can be seen that Market Value has a significant negative impact on stock returns and pass the test at the 1% significance level, while Price to book value has a positive impact. At the same time, the control variables together strengthen investor attention to the negative role of individual stock returns. When the third group of experiments controlled for the year, the conclusion was similar to the previous one.

4.2. The Moderating Effect of Investor Sentiment

After introducing investor sentiment on the basis of Table 3, Table 4 shows a significant negative impact of investor attention on stock returns. The price to book ratio still has a positive and significant impact on stock returns, while market value has a negative impact on stock returns. After introducing investor sentiment, it can be seen that the coefficient of investor sentiment's impact on stock returns is positively significant at the 1% significance level. The higher the investor's sentiment, the higher their expected returns for the company, which is consistent with Yang et al proposed that investor sentiment has a significant positive impact on stock returns [27]. The interaction between investor sentiment and investor attention has a positive correlation with stock returns, which indicates that after adding investor sentiment as a variable for regression, the impact of investor attention on stock returns is negatively moderated. If investors have a positive expectation of a certain company's future, it will promote an increase in stock returns and weaken the negative impact of investors' concern, suggesting that investor sentiment moderate's investor attention and weaken its negative impact on stock returns.

Table 6. The moderating effect of investor sentiment

	(1)	(2)	(3)
investor attention	-.0001773 (-0.14)	-.0022469* (-1.84)	-.0026543** (-2.19)
Investor sentiment	.0383168*** (20.60)	.0607788*** (25.51)	.0674176*** (26.72)
Intersection term	.0072333*** (3.82)	.0061295*** (3.34)	.00667*** (3.65)
Market Value		-.0644283 *** (-16.86)	-.0639325*** (-16.77)
PB		-.0014907 *** (-9.00)	-.0014706*** (-8.89)
Year	N	N	Y
Id	Y	Y	Y
Obs	50668	50668	50668
Firms	546	546	546

What's more, there is a significant change in the coefficient of influence of investor attention on stock returns comparing column (2) (3) with (1) after controlling two factors, which strength the negative impact of investor attention on stock returns. Among the two control variables added in columns (2) and (3), market value has a negative correlation with investor sentiment and stock returns, with a significance level of 1%. Banz used the data of New York Stock Exchange listed companies' market capitalization and stock returns from 1936 to 1975 in the Relationship between Stock Returns and Market Value to carry out relevant research, and concluded that there is a negative correlation between the market capitalization and stock returns of listed companies[28], which means the higher market value of a company, investors may believe that the expected appreciation space of the company's stock is limited, and therefore are unwilling to hold it for a long time and sell it. Stattman and ChanHamao and Lakonishok found that the book to market ratio (BV/MV) is also a risk factor for stock market returns, and found that this ratio is directly proportional to the company's stock return [29-30]. They believe that if a company's stock has a high BV/MV value, which means its market value is lower than its book value. It indicates that the market has a poor prospect for the company, and the risk of the stock is relatively high, which means the required return on the company's stock should also be high.

5. Heterogeneity Testing

The above results analyze the moderating effect of investor sentiment on the impact of investor attention on stock returns from a holistic perspective. However, there may be differences in this impact within the sample, so this article further conducts heterogeneity analysis from the perspective of the impact of high and low investor sentiment on stock returns and investor attention. It is defined that the group with investor sentiment values higher than the mean of investor sentiment is a high sentiment group, otherwise it is a low sentiment group.

5.1. The Impact of Investor Attention on Stock Returns in Groups of High or Low Sentiment

Table 7. The different impact of investor attention in groups of high/low sentiment

	H			L		
	(1)	(2)	(3)	(1)	(2)	(3)
investor attention	-.0011126 (-0.38)	-.0031013 (-1.08)	-.0041328 (-1.42)	-.0027532** (-2.16)	-.0037476*** (-3.01)	-.0037137*** (-3.00)
Control variables	N	Y	Y	N	Y	Y
Year	N	N	Y	N	N	Y
Id	Y	Y	Y	Y	Y	Y
Obs	50668	50668	50668	50668	50668	50668
Firms	546	546	546	546	546	546

From above table, after being divided into high and low sentiment groups, three regression tests were conducted on each group. The first group only controlled for individual effects, the second group controlled for control variables and individual effects, and the third group controlled for control variables, individual effects, and time effects. Through Table 5, it is found that the coefficient of investor attention is negative in both the high and low sentiment groups, but the impact of investor attention on stock returns in the high sentiment group is not significant, while the negative impact of investor attention on stock returns in the low sentiment group indicates that the low sentiment group is prone to further reducing stock returns due to investor attention. The investor attention of the low sentiment group has a greater and more significant impact on stock returns, while the high sentiment group is relatively less affected, but the regression coefficients of the high and low sentiment groups are not significantly different. The high sentiment group of investors holds a positive attitude towards the stock market, with more irrational or arbitrage investors participating, and the stock price is prone to deviate from its actual value. When investors are pessimistic about the stock market, it indicates to some extent that irrational factors in the stock market have a relatively weak impact on stock prices. Investors tend to pay more attention to stock information.

5.2. The Moderating Effect of Investor Sentiment in Grouping High and Low Sentiment

Table 8. The moderating effect of investor sentiment in grouping high/low sentiment

	H			L		
	(1)	(2)	(3)	(1)	(2)	(3)
investor attention	-.0004615 (-0.13)	-.004047 (-1.19)	-.0069336** (-2.06)	-.0019537 (-1.36)	-.0031631** (-2.25)	-.0027773** (-2.00)
Investor sentiment	.0390044*** (11.35)	.0709231*** (15.51)	.0820767*** (17.43)	.0416132*** (13.46)	.0459899*** (13.60)	.0509493*** (14.78)
Intersection term	.0093037** (2.46)	.0082567** (2.31)	.0092736*** (2.63)	.0006019 (0.20)	.0017396 (0.58)	.0029553 (1.00)
Control Variables	N	Y	Y	N	Y	Y
Year	N	N	Y	N	N	Y
Id	Y	Y	Y	Y	Y	Y
Obs	50668	50668	50668	50668	50668	50668
Firms	546	546	546	546	546	546

Compared with the 5.1 test mentioned above, the regression incorporates an interaction term between investor sentiment and concern. The article has found that investor sentiment positively affects stock returns, but in the high sentiment group, the interaction term regression coefficient is significant, while in the low sentiment group, the interaction term coefficient is not significant. This indicates that investor sentiment has a significant moderating effect on investor attention in the high sentiment group, which can alleviate the negative effect of investor attention on stock returns. When investor sentiment is high, it can more effectively improve the stock returns. This is consistent with Wen et al. finding that in the A-share market, more positive changes in investor sentiment will lead to an increase in stock returns, while negative changes in investor sentiment do not significantly affect stock returns [31].

6. Conclusion

This article takes the data of Chinese Science and Technology Innovation Board companies from 2021 to 2023 as a sample, using data from Baidu Index and WIND Economic Database. The empirical part uses principal component analysis and panel analysis, taking into account the two control variables (market value and PB ratio), individual effects and time effects to generate expressions of investor attention and investor sentiment.

This article examines the impact of investor attention on stock returns of Science and Technology Innovation Board companies and the moderating effect of investor sentiment on investor attention-stock returns. The article found that investor attention has a negative correlation with the stock returns of Science and Technology Innovation Board companies. As investor attention increases, information disclosure becomes more thorough, stock arbitrage space decreases, competition intensifies, and stock returns decrease. Investor sentiment is positively correlated with stock returns, and the coefficient of the interaction term between sentiment and attention is significant and positive, indicating that the impact of investor attention on stock returns is moderated by sentimental factors. When investor sentiment is high, investors have a positive investment attitude and have a good expectation of future stock returns. At this time, if investors focus on a certain stock, the return of that stock will increase. This article uses the mean value of investor sentiment to divide all samples into high and low sentiment groups for heterogeneity testing. It is found that the relationship between investor attention and stock returns in the high sentiment group is not significant, while in the low sentiment group, there is a significant negative correlation. When investors have high sentiment, they are more susceptible to irrational factors interfering in their decision-making. After introducing investor sentiment and interaction terms, it is found that there was a significant positive correlation between interaction terms and stock returns in the high sentiment group, but not in the low sentiment group. The research results of this article supplement existing micro level evidence on the influencing factors of stock returns on the Science and Technology Innovation Board, proving that investor sentiment has a moderating effect on the stock returns of companies on the Science and Technology Innovation Board.

Based on the research conclusions of this article, the following suggestions are proposed for the stock market of Science and Technology Innovation Board companies:

(i) Timely disclose relevant information to stabilize investor sentiment. Investor sentiment can moderate the impact of investor attention on stock returns, so stabilizing investor sentiment is an important measure to mitigate the impact of investor attention on stock returns. The government should timely disclose information, regularly release relevant statistical data, strengthen the supervision and control of market risks, and avoid market imbalances and foam due to excessive attention. The society and relative departments should guide, assist, and supervise the operation and financing activities of science and technology innovation board companies to improve their monitoring, controlling, and governance capabilities, which help to reduce the psychological impact on the public.

(ii) Investors should also avoid blindly following the trend and cannot simply make investment decisions based on market attention and speculation hot-spots. When selecting investment targets, it is necessary to conduct sufficient research and analysis based on one's own investment objectives and risk tolerance to determine reasonable investment strategies and expected returns, which helps to avoid investment risks and losses.

(iii) Guide media supervision, management and orientation. Nowadays, new media has become an important method for investors to gain insight into the information trends of companies on the Science and Technology Innovation Board,

which requires the media should accurately and truthfully report company information. While strengthening media regulation, the government should also increase the publicity efforts of mainstream authoritative media to avoid malicious media information interfering with investors' sentiments and judgments, thereby impacting the stock market.

(iv) The negative relationship between investor attention and stock returns of science and technology innovation board companies derived from this article shows that stocks with high market attention have strong speculation and volatility, as well as high risks. Relatively speaking, choosing high-quality companies with stable operations, good financial condition, reasonable valuation, and growth potential can better control risks and achieve long-term value growth. In addition, when investors determine specific investment targets, it is also necessary to consider factors such as corporate governance and brand influence to ensure rational investment decisions.

This article has shortcomings in the following aspects:

(a) When considering control variables, only market value and price to book ratio were considered, and other variables that may have an impact were not well controlled

(b) In China, there are differences in policy models and operational methods between state-owned and non-state-owned enterprises, and this article does not further analyze the heterogeneity test between state-owned and non-state-owned enterprises

(c) When grouping high and low sentiments, the classification is simply based on the mean value, and there are differences in the number of samples in the high and low groups.

Based on above, in future research, I will improve on the above shortcomings by adding more control variables, such as current asset ratio, intangible asset ratio, capital intensity, etc. In the heterogeneity test section, I will distinguish between state-owned enterprises and non-state-owned enterprises, and observe whether the stock returns of the two types of science and technology innovation board companies have different significant levels and correlations with investor attention and sentiment, At the same time, some more professional regression methods for heterogeneity analysis are adopted, such as Quantile regression.

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