Research on the Impact of Heterogeneous Beliefs and Investor Sentiment on the Stock Returns

Zhixuan Liu[*], Caixia Zhou

School of Economics and management, Nanjing University of Science and Technology, Nanjing, China

*Corresponding author: 1043377834@qq.com

Abstract: Traditional financial theories assume that investors are completely rational and have homogeneous expectations. In fact, this assumption is difficult to satisfy. In China's stock market dominated by retail investors, the behavior of investors has a significant impact on stock returns. Therefore, this paper studies the impact of heterogeneous beliefs and investor sentiment on stock returns, both of which are important investor characteristics. Firstly, this paper reviews the existing research, analyzes the impact of heterogeneous beliefs and investor sentiment on stock returns, as well as the interaction between them, and puts forward research hypotheses. Then, taking February 2011 to December 2020 as the sample interval, taking China's A-share stock as the sample, it selects the monthly turnover rate as the variable to measure the heterogeneous beliefs, and selects four indicators of closed-end fund discount, turnover rate, number of newly opened accounts and consumer confidence index to construct the investor sentiment index by principal component analysis. It establishes a multiple linear regression model and uses group analysis, cross-sectional regression analysis and other methods for empirical test. The result shows that, in China's stock market, heterogeneous beliefs among investors will have a significant negative impact on stock returns, and this negative impact is particularly prominent in the period of low investor sentiment.

1. Introduction

Traditional financial theories are based on the premise of homogeneous expectation of rational investors. However, with the emergence of financial anomalies such as the mystery of equity premium, winner curse and weekend effect, traditional financial theories have been questioned, and more and more scholars begin to carry out research in the field of behavioral finance. At present, the research on behavioral finance theory is mainly carried out from two levels—market inefficiency and investor behavior. The research on investor behavior is divided into two aspects—the research on investor individual behavior and the research on investor group behavior. Heterogeneous beliefs and investor sentiment are two important research branches in the study of investor group behavior. Investor sentiment can be regarded as the optimism of investor beliefs (mean), while heterogeneous beliefs can be regarded as the divergence of investor beliefs (variance). "Mean" and "variance" are important concepts related to asset pricing in financial theory. This paper combines heterogeneous beliefs and investor sentiment to analyze their impact on stock returns. The research results of this paper can comprehensively reveal the impact of investor behavior on the stock market, help investors more deeply understand the characteristics of China's stock price operation, and promote the stable and healthy development of China's capital market.

The main content of this paper is the impact of investor behavior on the future return of stocks. Firstly, this paper summarizes the existing literature on this research, explains the impact mechanism from two aspects of heterogeneous belief and investor sentiment effect, and then makes an empirical test on China's stock market to draw the final conclusion.

The structure of this paper is as follows: the first part is the introduction, including the background and significance of this research, listing the research methods and the general framework of the article. The second part introduces the relevant literature. The third part is the theoretical analysis,

which mainly includes the explanation of the influence mechanism and the proposal of the research hypothesis. The fourth part is the research design, which mainly includes sample selection, variable selection, model construction and so on. The fifth part uses descriptive statistics, grouping analysis, panel regression, cross-sectional regression and other methods to conduct empirical research. The last part gives the research conclusion of this paper.

2. Literature

2.1 Research on the impact of heterogeneous beliefs on stock returns

Heterogeneous belief means that different investors have different judgments on the future return distribution of the same stock under the same holding period. This concept is aimed at the homogeneous expectation in traditional finance. Both the traditional capital asset pricing theory and the efficient market hypothesis assume that investors are homogeneous and have the same expected return on assets. However, in the real world, the assumption of homogeneous expectation is obviously untenable. The gradual flow of information, limited attention and the heterogeneity of a priori belief lead to differences in expectations for the future (Hong and Stein, 2007).

The existing literature uses many indicators to measure heterogeneous beliefs, including analyst forecasts used by early scholars (Diether et al., 2002), stock turnover and excess return volatility (Boehme et al., 2006) , as well as more diversified measurement indicators in recent years, including the shareholding dispersion of fund managers for the heterogeneous beliefs within institutional investors (Jiang and Sun, 2014) and the turnover separation model based on Fama-French three-factor model (Zhu Hongquan et al., 2016).

Miller (1977) first studied the impact of heterogeneous beliefs on stock returns. He believed that under the restriction of short selling, investors' pessimism could not be realized through trading, and the stock price more reflected investors' optimism. Therefore, under the restriction of short selling, the greater the heterogeneous beliefs of market participants, the greater the degree of stock overvaluation. Since then, domestic scholars Chen Guojin and Zhang Yijun (2009) and Meng Weidong et al.(2010) have conducted empirical research on China's stock market and also verified the conclusion that there is a negative correlation between investors' heterogeneous beliefs and stock future returns.

Zhu Hongquan et al. (2016) introduced heterogeneous beliefs into CAPM and Fama-French three-factor model, and also concluded that heterogeneous beliefs will have a significant positive impact on current earnings and a significant negative impact on future earnings. At the same time, they also found that the introduction of short selling mechanism in China's stock market can reduce the asset pricing deviation caused by heterogeneous beliefs to a certain extent.

2.2 Research on the impact of investor sentiment on stock returns

The definition of investor sentiment originated from Lee et al.(1990). They believe that investor sentiment is an investor's judgment of the market based on psychological emotion. The root of this judgment lies in some cognitive deviation caused by the irrationality of investors' psychological factors. Because investor sentiment is rooted in investor psychology, which is very complex and difficult to measure due to various factors, there is no unified standard for the definition of investor sentiment in the academic circles. Brown and Cliff (2004) believe that investor sentiment represents the expectations of market participants related to a standard. The expected return of bullish investors will be higher than the average, and the expected return of bearish investors will be lower than the average. Domestic scholars Rao Yulei and Zhang Lun (2005) believe that investor expectations for the future have systematic deviation, and expectations with this systematic deviation are called investor sentiment.

At present, scholars mainly use direct indicators and indirect indicators to measure investor sentiment. Direct indicators refer to the indicators obtained from investors through questionnaires and other means that can directly represent the sentiment of investors, including CCTV BSI (Wang Meijin and Sun Jianjun, 2004) and Investor Confidence Index (Han Zexian and Ren Youquan, 2006), the

American Association of Individual Investors (AAII)(Verma and Soydemirb, 2009) and Investor Intelligence Index (Statman, 2000), etc. Indirect indicators are proxy variables that can reflect investor sentiment calculated through relevant data, including single indicators such as closed-end fund discount rate (Chopra et al., 1993) (Neal and Wheatley, 1998), overall market turnover rate (Baker and Stein, 2004), and some comprehensive indicators. Among them, the most representative is the BW index constructed by Baker and Wurgler (2006). They use principal component analysis on six proxy variables: stock market turnover rate, closed-end fund discount rate, the number of IPO, the average first day return of IPO, the number of IPO initial shares, and the logarithmic ratio of the average asset market value ratio of dividend paying and non-dividend paying companies to synthesize the comprehensive index of investor sentiment. Since then, Yu and yuan (2011), Rephael et al. (2012), as well as domestic scholars Yin Haiyuan and Li Zhongmin (2011), Huang Delong et al. (2009) have basically used this method to construct the investor sentiment index.

For the impact of investor sentiment on stock returns, scholars first studied the effect of investor sentiment on stock market returns from the overall market. The DSSW model constructed by De Long et al.(1990) introduced investor sentiment into the asset pricing model for the first time, and pointed out that under the limited arbitrage, if the sentiment of investors infect each other, arbitragers will not be able to eliminate the wrong pricing caused by irrational investors in the stock market. Therefore, investor sentiment will become a systematic risk affecting the equilibrium price of stocks. Barberis et al. (1998) constructed the BSV model to explain the formation of investor sentiment and its impact on the stock price from the perspective of psychological cognitive bias. Since then, foreign scholars Lee et al.(2002), brown and cliff (2004) and domestic scholars Li Xindan and Wang Jining (2002), Wang Meijin and Sun Jianjun (2004) have proved through empirical research that there is a significant correlation between investor sentiment and stock returns.

In addition, scholars also studied the impact of investor sentiment on stocks with different characteristics, called the cross-sectional effect of investor sentiment. Yan Yanyang et al. (2010) studied the impact of investor sentiment on stocks with different market capitalization. Jiang Yumei and Wang Mingzhao (2010) studied the impact of dividend yield, tangible asset ratio, stock price, price book value ratio, price earnings ratio, volatility, average household shareholding ratio and asset liability ratio on the sensitivity of stock returns to investor sentiment.

2.3 Research on the impact of investor sentiment and heterogeneous beliefs on stock returns

Heterogeneous beliefs and investor sentiment are both parts of the category of psychological characteristics of investor behavior, so they must have a certain mutual influence. Only by combining the two can we more accurately measure the impact of investor characteristics on stock returns (Jin Yonghong and Luo Dan, 2017).

Some scholars have realized the necessity of combining the two and made a preliminary exploration. Baker and Wurgler (2007) considered the impact of investor sentiment and opinion differences for the first time, and believed that under the restriction of short selling, investor sentiment have a systematic impact on the stock price, and the more serious the opinion differences are, the greater the impact is. Cen et al. (2013) used breadth of ownership to measure heterogeneous beliefs and short selling restrictions. Through empirical research, it is proved that when investor sentiment fluctuates greatly, the change of breadth of ownership often presents a negative correlation with stock future returns, and when investor sentiment fluctuates slightly, this negative correlation will weaken or even be positive. Kim et al. (2014) using analyst forecasts as an indicator to measure heterogeneous beliefs, also found that the relationship between heterogeneous beliefs and expected market returns will be affected by investor sentiment. In the period of high investor sentiment, the expected market returns will decrease with the increase of heterogeneous beliefs, while in the period of low investor sentiment, the impact of heterogeneous beliefs on expected market returns is not significant. Domestic scholars Fu Xuan and Lu Jiaxu (2015) conducted empirical analysis on the Chinese market and confirmed Kim's conclusion. Yu Honghai et al. (2015) combing investor sentiment with opinion dispersion, studied the impact of individual investor irrational preference behavior on the first day return and long-term return of IPO, and revealed the mystery of IPO in China's stock market.

2.4 Literature review

The existing literature on the impact of investor behavior on stock returns mostly focuses on heterogeneous beliefs or investor sentiment. Although a few literature have made preliminary exploration on the combination of the two aspects, there are still some deficiencies. For example, the research of foreign scholar Kim (2014) and domestic scholars Fu Xuan and Lu Jiaxu (2015) only analyze from the overall market level, while the individual stock level is not considered. Yu Honghai et al. (2015) studied the impact on the IPO market and did not pay attention to the secondary market.

Therefore, it is necessary to further study investor sentiment and heterogeneous beliefs on the basis of existing research results, and comprehensively analyze the impact of investors' irrational behavior on stock returns. Based on the shortcomings of the existing literature, this paper analyzed the comprehensive impact of investor sentiment and heterogeneous beliefs on stock returns from the stock level, and supplemented the research in this regard.

3. Hypothesis

3.1 Relationship between heterogeneous beliefs and stock returns

Traditional capital asset pricing theory and efficient market hypothesis are based on the premise of homogeneous expectation of investors, which is obviously not tenable in the real world. Investors often have different expectations for the future because of the gradual flow of information, limited attention and the heterogeneity of a priori beliefs.

When there are heterogeneous beliefs among investors, due to the limitation of short selling mechanism in the market, investors with optimism can express their views by going long in stocks, while investors with pessimism cannot express their views by going short, causing that negative information cannot be fully reflected in the stock price, stock price is overvalued and future returns decrease.

Based on the above theoretical analysis, the research hypothesis of this paper is put forward. H1: The heterogeneous beliefs of investors are negatively correlated with the future return of stocks. The greater the difference of beliefs is, the lower the future return of stocks is.

3.2 Relationship between investor sentiment and stock returns

The traditional financial theory assumes that investors are rational, so the asset price is only related to its internal value, and the irrational factors such as investor sentiment will not affect the asset price. However, the traditional financial theory cannot well explain the financial anomalies in the market, such as the mystery of equity overflow, winner curse, weekend effect and so on. The existence of these anomalies has made more and more scholars begin to study the role of investor sentiment in asset pricing in the field of behavioral finance.

Investor sentiment represents investors expectation of the market and reflects investor subjective investment will. Therefore, it is closely related to investor personality and investment experience and has strong subjectivity. Under the background that the main investors in China's stock market are small and medium-sized investors with immature investment psychology, investor sentiment will have a significant impact on the stock market. In the short term, high investor sentiment will continue to push up the stock price, which will have a positive impact on stock returns, while low investor sentiment will accelerate the decline of stock prices and negatively affect stock returns.

Based on the above theoretical analysis, the research hypothesis of this paper is put forward. H2: Investor sentiment is positively correlated with the future return of the stock. The higher the investor sentiment is, the higher the future return of the stocks is.

3.3 Relationship between investor sentiment, heterogeneous beliefs and stock returns

Heterogeneous beliefs and investor sentiment are two very important investor characteristics. There is a certain correlation between them, and there may be interaction on the impact of stock returns.

The previous analysis pointed out that the impact of heterogeneous beliefs on stock returns can be realized through the restriction of short selling mechanism, and the restriction of short selling will actually be affected by investor sentiment. When investor sentiment is high, investors are optimistic about the market and will go long one after another. When investor sentiment is low, investors are short on the market, and the existence of short selling mechanism limits their behavior, so that many investors cannot fully express their negative emotions. Therefore, in the low-sentiment period, the problem of short selling restriction will be more prominent, resulting that heterogeneous beliefs among investors will have a greater impact on stock returns.

Based on the above theoretical analysis, the research hypothesis of this paper is put forward. H3: The impact of heterogeneous beliefs on stock returns will be affected by investor sentiment. When investor sentiment are low, heterogeneous beliefs will have a greater impact on stock returns.

4. Data and Methodology

4.1 Data and sample

In this paper, the sample period is from February 2011 to December 2020. The sample is China's A-share stocks, excluding Pt, St stocks and company stocks with incomplete data. The sample data is a total of 344060 observations. The data of closed-end fund discount is from CSMAR database, and the number of new accounts, consumer confidence index and macroeconomic prosperity index are from the National Bureau of Statistics, and other data are from RESSET database.

4.2 Investor sentiment index

For the construction of investor sentiment index, this paper refered to CICSI index constructed by Yi Zhigao and Mao Ning (2009) and adjusted it based on the actual situation of China. China's IPO system is not perfect. IPO is greatly affected by the government's macro-economic control, so the IPO indicator is not enough to reflect the changes of investor sentiment in the market. And there have been many times of suspension of issuance, so the IPO data is discontinuous. Therefore, this paper removed the IPO indicator in the construction of sentiment index. Finally, four indicators are selected to construct investor sentiment index—closed-end fund discount (CEFD), stock market turnover (TURN), number of new investor accounts (NIA) and consumer confidence index (CCI).

(a) Closed-end fund discount (CEFD): Many literatures have proved that closed-end fund discount can be used as an effective measure of investor sentiment. The main performance is that when investors are optimistic about future returns, the discount of closed-end funds is small, on the contrary, the discount is large. In this paper, the discount rate of closed-end funds on the last trading day of each month is selected and weighted by the fund share. The calculation formula is as follows:

$$CEFD_t = \sum_{i=1}^{n} \left[(P_{it} - NAV_{it}) \times N_i \right] / \sum_{i=1}^{n} (N_i \times NAV_{it}) \tag{1}$$

Where n is the number of closed-end funds publicly issued in Shanghai and Shenzhen market in the current period, Pi is the closing price of fund i on the last trading day of each month, NAVit is the unit net value on the last trading day of each month, and Ni is the share of fund i. When CEFD is greater than 0, it means fund premium, and when CEFD is less than 0, it means discount.

(b) Stock market turnover (TURN). The turnover represents the active degree of market trading. When investor sentiment is high, investors tend to be active in stock trading. When investors are depressed, the turnover rate will also change significantly. The turnover rate has always been used as an effective index to measure investor sentiment by scholars at home and abroad. This paper selected the weighted turnover rate of the total market value of Shanghai and Shenzhen stock markets in each month as the turnover indicator.

(c) Number of new investor accounts (NIA). For foreign mature markets, the number of new accounts may not reflect investor sentiment. But China's security market is in the process of rapid development, so the number of new accounts opened by investors every month represents the

participation and demand of OTC investors for securities, which can reflect the sentiment of investors. Therefore, this paper selected the number of new investor accounts as one of the proxy variables of investor sentiment, and in order to eliminate the order of magnitude difference, it takes logarithm in the follow-up empirical analysis.

(d) Consumer confidence index (CCI). Consumer confidence index is an index reflecting the strength of consumer confidence. It is a leading index that comprehensively reflects and quantifies consumers' evaluation of the current economic situation and their subjective feelings about economic prospects, income level, income expectation and consumer psychological state, and predicts the economic trend and consumption trend. At present, many scholars take the consumer confidence index as one of the indicators of investor sentiment when doing research on investor sentiment. The reason is that the consumer confidence index is consumers' judgment of the future situation of the national economy, reflecting investors' subjective expectations of future earnings. The higher the consumer confidence index, the more optimistic its judgment of the future economic trend is. If it is optimistic about the economic situation, it will naturally be full of confidence in the stock market.

In order to eliminate the influence of macroeconomic factors, this paper selected the consumer price index (CPI), generalized money supply (M2) and consistency index of business index of macroeconomic (BCIDM) as the indicators of macro fundamentals. And then it regressed the selected four original sentiment indicators with the above three macroeconomic indicators to obtain four residual series RCEFD, RTURN, RNIA and RCCI. Then it took the four residual series as new original variables and combined them into the final comprehensive index of investor sentiment by principal component analysis processing with SPSS.

Table 1. Principal component analysis

	PC1	PC2
RCEFD	0.179	-0.674
RTURN	0.711	0.061
RNIA	0.670	0.252
RCCI	-0.173	0.692
Eigen value	1.728	1.618
Total Variance Explained(%)	43.210	40.459
Cumulative Variance Explained(%)	43.210	83.669

According to Table 1, two principal components and the final investor sentiment index are obtained:

$$PC1 = 0.179 \times ZRCEFD + 0.711 \times ZRTURN + 0.670 \times ZRNIA - 0.173 \times ZRCCI$$

$$PC2 = -0.674 \times ZRCEFD + 0.061 \times ZRTURN + 0.252 \times ZRNI + 0.692 \times ZRCCI$$

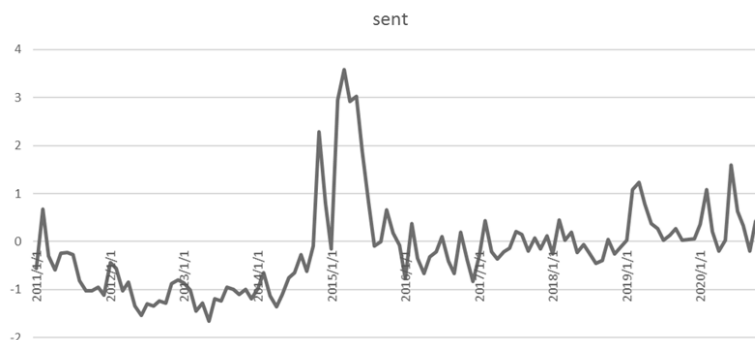$$SENT = 43.210/83.669 \times PC1 + 40.459/83.669 \times PC2$$

Figure 1. Trend of investor sentiment index

4.3 Heterogeneous beliefs

The existing literature has selected many indicators to measure heterogeneous beliefs. The divergence of analyst forecasts is often used in the early literature, which was first proposed by Diether et al.(2002), and it is also used in many subsequent classic literatures. However, the index is controversial. On the one hand, divergence of analyst forecasts can only represent the differences of opinion among analysts, not all investors. On the other hand, analysts usually only predict the stocks of large companies and rarely estimate the stocks of small-scale and growing companies. In fact, these stocks are more sensitive to the impact of heterogeneous beliefs. In addition, China's data on divergence of analyst forecasts are not sufficient, so the relevant domestic literatures generally use volatility, bid ask spread, trading volume and turnover rate as indicators to measure heterogeneous beliefs, of which the most commonly used is turnover. Therefore, this paper uses turnover to measure investors' heterogeneous beliefs.

Table 2. Description of variables

Type	Symbol	Name	Definition
Dependent variable	Rt	Stock return	Logarithmic return Rt=ln (Pt/Pt-1)
Independent variable	TURN	Stock turnover rate	Number of trading shares per month / Number of outstanding shares
	SENT	Investor sentiment index	Comprehensive index synthesized by principal component analysis
	DSENT	Dummy variable of investor sentiment index	Sentiment index is greater than the mean, D= 1; Otherwise D=0
Control variable	lnME	Company size	Natural logarithm of the company's total market value
	BM	Book to market ratio	Total book assets / total market value
	PE	Price earnings ratio	Price / earnings per share
	MOM	Momentum	Stock returns over the past month ln(Pt-1/Pt-2)

The table reports the variables selected. The dependent variable is stock return. The independent variables are turnover and investor sentiment index. The control variables are selected from corporate characteristics and individual stock market performance. Among them, the variables at the level of company characteristics include company size (lnME), book to market ratio (BM) and price earnings ratio (PE) (Fama and French, 1992) and variables of individual stock market performance include momentum (MOM) (Jegadeesh and Titman, 1993).

4.4 The model

Based on the research purpose of this paper and the above research preparation, the core regression model is established as follows:

$$R_{i,t} = \alpha + \beta_1 TURN_{i,t-1} + \varepsilon_{i,t} \qquad (2)$$

$$R_{i,t} = \alpha + \beta_1 TURN_{i,t-1} + \beta_2 BM_{i,t-1} + \beta_3 lnME_{i,t-1} + \beta_4 PE_{i,t-1} + \varepsilon_{i,t} \qquad (3)$$

$$R_{i,t} = \alpha + \beta_1 TURN_{i,t-1} + \beta_2 BM_{i,t-1} + \beta_3 lnME_{i,t-1} + \beta_4 PE_{i,t-1} + \beta_5 MOM1_{i,t-1} + \beta_6 MOM12_{i,t-1} + \varepsilon_{i,t} \qquad (4)$$

Model (2) mainly studies the impact of heterogeneous beliefs on stock returns. In order to prevent other variables from affecting the relationship between them, only one independent variable, turnover, is used to intuitively see whether the impact is significant.

In models (3) and (4), variables such as company characteristics and individual stock market performance are added to control the impact of other factors on stock returns.

5. Empirical Analysis

5.1 Descriptive statistics

Table 3. Description of variables

Variable	Observations	Mean	Median	Maximum	Minimum	Standard deviation
BM	344060	0.4187	0.3472	12.5000	0.0001	0.2993
LnME	344060	9.7739	9.7275	12.3511	7.3064	0.4903
PE	344060	63.7895	35.3000	60974	-33880	470.3338
TURN	344060	0.4928	0.2855	11.5212	-48.9551	0.6933
MOM	344060	-0.0027	-0.0011	2.1875	-1.5563	0.0696
Rt	344060	-0.0030	-0.0012	1.4471	-1.4940	0.0673
SENT	119	-0.1659	-0.2314	3.5816	-1.6623	0.9378

According to Table 3, during the sample period, the return of China's A-share stock is very low, with an average monthly return of -0.30%. The average monthly turnover rate is 49.28%, indicating that China's stock market is relatively active as a whole and there are great differences in beliefs among investors. It should be noted that the mean and median of PE ratio differ a lot, indicating that there are extreme values, and its extreme value and standard deviation also indicate that PE ratios vary greatly among different companies. Some companies have negative PE ratios due to losses. Generally speaking, investor sentiment is relatively low and fluctuates greatly.

5.2 Group analysis

In order to test the impact of investors' heterogeneous beliefs on stock returns, firstly, univariate grouping analysis is used to divide all sample stocks into 10 groups from low to high according to TURN in t-1 month. Each group is a portfolio, and the return of each portfolio is calculated by weighting the circulating market value.

In order to determine whether there is excess rate of return that cannot be explained by the traditional asset pricing model, CAPM model and Fama-French three-factor model are used to obtain the excess rate of return of each portfolio.

$$R_{i,t} - R_{f,t} = \alpha_{CAPM} + \beta_i(R_{m,t} - R_{f,t}) + \varepsilon_{i,t} \dots \qquad \text{.......(5)}$$

$$R_{i,t} - R_{f,t} = \alpha_{FF} + \beta_i(R_{m,t} - R_{f,t}) + s_i SMB_t + h_i HML_t + \varepsilon_{i,t} \dots \qquad \text{.....(6)}$$

Where, Ri,t is the return of the portfolio in group i in month t, α_{CAPM} and α_{FF} are the excess return after risk adjustment by CAPM model and Fama-French three-factor model respectively, Rm,t and Rf,t are the market return and risk-free return in month t respectively, SMB is the scale factor, and HML is the book to market ratio factor.

Table 4. Results of grouping in the whole sample period

TURN	Whole sample period	
	$\alpha CAPM$	αFF
1 (lowest)	-0.006477*** (-4.861914)	-0.005619*** (-5.618222)
2	-0.005936*** (-7.223084)	-0.005531*** (-7.114699)
3	-0.007346*** (-7.170397)	-0.007497*** (-7.384985)
4	-0.007231*** (-6.942718)	-0.007402*** (-7.128837)
5	-0.008609*** (-8.330664)	-0.008970*** (-9.208564)
6	-0.009279*** (-9.010104)	-0.009788*** (-10.80254)
7	-0.011236*** (-8.700247)	-0.011904*** (-10.84523)
8	-0.012761*** (-9.159571)	-0.013736*** (-12.16233)
9	-0.014793*** (-9.633438)	-0.015786*** (-12.59566)
10 (highest)	-0.020517*** (-10.10875)	-0.021808*** (-12.84891)
10-1	-0.014041*** (-4.946528)	-0.016189*** (-8.090957)

(The table reports the mean and t-value of $\alpha CAPM$ and αFF of portfolios grouping by TURN and SENT.* Significant at 10%.** Significant at 5%. *** Significant at 1%.)

It can be seen from the table that basically, the value of $\alpha CAPM$ and αFF of each group in low-sentiment period is significantly less than that in high-sentiment period, indicating that investor sentiment will positively affect the future return of stocks, which verifies hypothesis 2 of this paper. Moreover, the absolute value of the difference between the excess return of group 10 and group 1 in low-sentiment period is significantly greater than that in high-sentiment period, indicating that investor sentiment will affect the prediction ability of heterogeneous beliefs. When investor sentiment is low, the negative prediction ability of heterogeneous beliefs on stock returns is stronger, which verifies hypothesis 3 of this paper.

In order to further test the impact of heterogeneous beliefs on the future returns of stocks under different investor emotions, we adopt the method of bivariate grouping, divide all stocks into 10 equal parts from low to high according to TURN in month t-1, and divide them into high-sentiment period and low-sentiment period according to SENT in month t-1 to study the stock return of each group in high-sentiment period and low-sentiment period respectively month (The period is defined as high-sentiment period if SENT is higher than the average value, and vice versa).

Table 5. Results of grouping in the sample period of high-sentiment and low-sentiment

TURN	high-sentiment period		low-sentiment period	
	$\alpha CAPM$	αFF	$\alpha CAPM$	αFF
1 (lowest)	-0.007769***	-0.006221***	-0.005613***	-0.005614***
	(-2.898885)	(-2.932772)	(-4.933363)	(-6.660741)
2	-0.005459***	-0.005681***	-0.006449***	-0.006163***
	(-4.198700)	(-4.655458)	(-6.139600)	(-5.703321)
3	-0.006914***	-0.008016***	-0.007891***	-0.008088***
	(-3.924248)	(-4.721149)	(-6.673322)	(-6.256904)
4	-0.005260***	-0.005790***	-0.008873***	-0.009465***
	(-3.684495)	(-3.971331)	(-6.040902)	(-6.017290)
5	-0.008554***	-0.009726***	-0.008736***	-0.009966***
	(-5.022637)	(-5.931707)	(-6.751008)	(-8.338795)
6	-0.007705***	-0.008751***	-0.010620***	-0.011595***
	(-4.493451)	(-5.561350)	(-8.504087)	(-10.38229)
7	-0.010609***	-0.012517***	-0.011920***	-0.013397***
	(-4.767128)	(-6.554235)	(-7.888620)	(-10.58175)
8	-0.014931***	-0.016664***	-0.011249***	-0.013084***
	(-6.163827)	(-8.281787)	(-7.069440)	(-10.35997)
9	-0.014005***	-0.015676***	-0.015532***	-0.017783***
	(-5.834540)	(-7.499838)	(-7.696482)	(-11.87462)
10 (highest)	-0.020672***	-0.023179***	-0.020554***	-0.023959***
	(-6.576221)	(-8.738299)	(-7.631045)	(-10.99367)
10-1	-0.012902**	-0.016958***	-0.014940***	-0.018345***
	(-2.579109)	(-4.636323)	(-4.538761)	(-8.020261)

(The table reports the mean and t-value of $\alpha CAPM$ and αFF of portfolios grouping by TURN and SENT.* Significant at 10%.** Significant at 5%. *** Significant at 1%.)

It can be seen from the table that basically, the value of $\alpha CAPM$ and αFF of each group in low-sentiment period is significantly less than that in high-sentiment period, indicating that investor sentiment will positively affect the future return of stocks, which verifies hypothesis 2 of this paper. Moreover, the absolute value of the difference between the excess return of group 10 and group 1 in low-sentiment period is significantly greater than that in high-sentiment period, indicating that investor sentiment will affect the prediction ability of heterogeneous beliefs. When investor sentiment is low, the negative prediction ability of heterogeneous beliefs on stock returns is stronger, which verifies hypothesis 3 of this paper.

5.3 Fama-MacBeth cross-sectional regression

In order to further test the impact of heterogeneous beliefs and investor sentiment on stock returns, this paper makes a regression analysis. Because Fama-Macbeth cross-sectional regression can eliminate the influence of the correlation of residuals on the standard error, which is better than general cross-sectional regression, Fama-Macbeth cross-sectional regression is adopted in this paper. Model (2), model (3) and model (4) are regressed using data of each cross-sectional month in the whole sample period to test the effect of heterogeneous beliefs.

Table 6. Results of Fama-MacBeth cross-sectional regression in the whole sample period

Variable	Whole sample period		
	Model (2)	Model (3)	Model (4)
intercept	-0.018481 (-0.06072)	0.056678*** (4.1367)	0.051807*** (3.8078)
TURN	-0.005304*** (-5.534)	-0.005135*** (-6.0479)	-0.004838*** (-5.8081)
BM		0.006625** (2.5504)	0.007309*** (2.9467)
LnME		-0.006017*** (-4.9084)	-0.005620*** (-4.5895)
PE		-6.873992e-07 (-1.4568)	-6.107529e-07 (-1.3472)
MOM			-0.047996*** (-6.3625)
adj.R²	0.018481	0.043506	0.052560

(The table reports the mean and t-value of regression coefficients of the time series.* Significant at 10%.** Significant at 5%. *** Significant at 1%.)

It can be seen from table that when model (2) uses turnover rate (TURN) and future stock returns for regression alone, the regression results obtained are consistent with the results of group analysis. The higher the turnover rate is, the lower the stock future return is. However, at this time, the goodness of fit of the model is very low, only 0.018481, indicating that there are many variables that have a significant impact on stock return are not included in the model.

The goodness of fit of model (3) is significantly improved by adding company characteristic variables, and the results still show that the turnover rate has a significant negative impact on the stock return at the level of 1%. The book to market ratio (BM) is positively correlated with the stock return at the significant level of 5%, the company size (LnME) is negatively correlated with the stock return at the significant level of 1%, and the price earnings ratio (PE) is negatively correlated with the stock return, but it is not significant. These results are consistent with the conclusions of many classical literatures (Fama and French, 1992).

Model (4) adds market performance variables on the basis of model (3), and also obtains the result that the turnover rate (TURN) is significantly negatively correlated with the next stock return. Momentum (MOM) is negatively correlated with stock returns at the significant level of 1%, which may be because the higher the past return of stocks, the greater the possibility that the stock price is overvalued, and the stock returns will decline in the future.

In order to further test the impact of investor sentiment, according to SENT in month t-1, it is divided into high-sentiment period and low-sentiment period, and the cross-sectional regression is carried out again for model (2), model (3) and model (4).

Table 7. Results of Fama-MacBeth cross-sectional regression in the sample period of high-sentiment and low-sentiment

Variable	High-sentiment period			Low-sentiment period		
	Model（2）	Model（3）	Model（4）	Model（2）	Model（3）	Model（4）
intercept	-0.001839 (-0.3383)	0.061638** (2.3954)	0.055956** (2.1804)	0.001095 (0.3111)	0.052827*** (3.7496)	0.048587*** (3.5023)
TURN	-0.004864*** (-3.6667)	-0.004878*** (-3.9675)	-0.004735*** (-4.1465)	-0.005647*** (-4.1422)	-0.005335*** (-4.5390)	-0.004918*** (-4.1255)
BM		0.007488 (1.5568)	0.007999* (1.7619)		0.005955** (2.1694)	0.006774** (2.5302)
LnME		-0.006544*** (-2.7830)	-0.005667** (-2.5115)		-0.005608*** (-4.6571)	-0.005309** (-4.4499)
PE		-6.727981e-07 (-0.85775)	-6.226519e-07 (-0.84152)		-6.987313e-07 (-1.2017)	-6.015179e-07 (-1.0563)
MOM			-0.047969*** (-3.414)			-0.048017*** (-6.0833)
adj.R²	0.016492	0.042203	0.053982	0.020025	0.044518	0.051457

(The table reports the mean and t-value of regression coefficients of the time series.* Significant at 10%.** Significant at 5%. *** Significant at 1%.)

The results of the table show that under different investor sentiment period, the effect of heterogeneous beliefs on stock returns is different. In the period of high sentiment, the future return of stocks will decrease by 4.86% for each unit of turnover rate, while in the period of low sentiment, the future return of stocks will decrease by 5.65%, indicating that in the period of low sentiment, heterogeneous beliefs have a greater negative impact on future returns. After controlling other variables, the conclusion is still valid.

6. Conclusions

Firstly, this paper combs the impact of heterogeneous beliefs and investor sentiment on stock returns and their interaction from the theoretical level, and then constructs and selects the corresponding variables, and makes empirical tests by constructing portfolios for grouping analysis and Fama-Macbeth cross-sectional regression analysis.

The main results of this paper show that the heterogeneous beliefs among investors will have a significant negative impact on stock returns. The greater the difference of beliefs, the easier the stock is to be overestimated, and the lower the subsequent stock return is. Investor sentiment has a significant positive impact on stock returns. The lower investor sentiment, the lower stock returns are. In addition, the effect of heterogeneous beliefs on stock returns will be affected by investor sentiment. In the period of low investor sentiment, heterogeneous beliefs have a greater negative impact on stock returns.

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