Short- and Long-Horizon Behavioral Anomalies and Institutional Investors' Nudge Behavior: Based on the Data of Listed Chinese Tobacco Companies

Liu Yue, Ph. D Candidate
Liu Tianming, Ph. D Candidate

Liu Yue, Ph. D Candidate in Asset Pricing; Behavioral Finance, School of Finance, Dongbei University of Finance and Economics, Dalian, Liaoning, China, Email:liuyue_010@126.com. Liu Tianming, Ph.D. Candidate in financial market, School of Finance, Dongbei University of Finance and Economics, Correspondence author: Liu Tianming; 292964579@qq.com

Abstract: We use the data of listed tobacco companies in China to study the existence of short- and long-horizon behavioral anomalies and the impact of institutional investors' behavior on them. We found that the existing asset pricing models cannot explain the short- and long-horizon behavioral anomalies based on tobacco enterprise data. Conversely, the short- and long-horizon behavioral anomalies can explain the exciting asset pricing factors. Compared with existing asset pricing models, behavioral anomalies have a stronger ability to explain anomalies. Behavioral anomalies could pass the cross-sectionally test and strengthened over time. The above results indicate that behavioral anomalies exist in China tobacco enterprisest significantly and are time-varying. We found that the limits to arbitrage and cognitive bias lead to the existence of behavioral anomalies through mechanism tests. Institutional investors did not play the role of price discovery. Instead, their nudge behavior strengthens the short- and long-horizon behavioral anomalies. Therefore, tobacco regulatory agencies should guide listed tobacco companies to broaden information channels to reduce information asymmetry in the market through relevant policies, strengthen the supervision of institutional investors' bubble riding behavior, and promote the healthy development of the tobacco market.

Key words: tobacco market, behavior anomalies, institutional investors, cognitive biases

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INTRODUCTION

Among the many industries of listed companies in China, the tobacco industry is one of the industries that can't be ignored. Existing studies on pricing factors in China stock market mainly verify the existence of traditional risk factors, but few studies have verified whether listed companies in the China tobacco industry have long-term and short-term behavioral abnormalities based on behavioral finance theory. In addition, institutional investors are considered to play the role of price discovery, eliminating mispricing and reducing market friction in the market, but some studies have found that they may not use abnormal arbitrage to get profits, but will use abnormal bubble to make rational speculation, thus pushing up the stock bubble[1]. In response, Relying on the data of China Tobacco listed companies, short- and

long-horizon behavioral anomalies were constructed in this paper based on the traditional behavioral finance theory to test their existence and existence mechanism, and further explore the role of institutional investors in the formation of behavioral anomalies.

Regarding how investors perceive tobacco industry companies, existing research mainly discusses investors' perceptions of tobacco industry companies' advertising behavior and advertising content. However, in China stock market, few scholars have studied how investors understand the performance of listed companies in the tobacco industry[2, 3]. According to the existing behavioral finance theory, different mispricing will be corrected in a shorter or longer period of time. In this paper, based on relevant behavioral finance theory and historical documents, two behavioral anomalies are constructed to capture the short- and long-horizon mispricing of China tobacco industry stocks. For short-horizon behavioral anomalies, some investors may not fully receive all the information contained in announcements due to limited attention from investors and inadequate response to information in regular announcements related to fundamentals of tobacco companies(such as earnings information in quarterly reports) [4,5]. As a result, the stock price of the tobacco industry do not respond adequately to this information, which in turn leads to the predictability of future tobacco industry stock returns (i.e. stock price drift after earnings announcements). Compared with short-horizon mispricing caused by limited investors' attention who focused on tobacco stocks, the existence of some prejudices in some tobacco products may lead to longer and more significant mispricing duration, thus leading to long-horizon behavioral anomalies. For example, investors focused on tobacco stocks tend to overestimate their cognitive ability in the process of collecting Tobacco market information to make buying and selling decisions, that is, overconfidence, which leads to the Tobacco industry stocks price deviating from the actual level. It is precisely because of the overconfidence of investors who focused on tobacco stocks in their information that they are unwilling to correct their own views and cognition when receiving Tobacco market information later, which may strengthen the mispricing degree caused by overconfidence[6]. Therefore, similar to the mispricing effect driven by fundamental factors such as tobacco prices, the correction of mispricing driven by overconfidence should last longer than that driven by investors' limited attention who focused on tobacco stocks.

In addition to the construction of behavioral anomalies, focus is laid on the impact of institutional investors' behavior on behavioral anomalies that existing listed China tobacco companies in this paper. It is generally acknowledged that the existence of institutional investors will increase stock liquidity, reduce market friction, and also play the role of price discovery, so it should significantly weaken the abnormal rate of return[7]. However, some studies have found that in China, institutional investors may participate in speculative activities[8], hold and then push up the price of bubble stocks. In addition, some studies have found that institutional investors may not use abnormal arbitrage to get profits, but will use abnormal bubbles to speculate[1] by actively allocating overvalued stocks in the process of overvalued stocks, which pushes up the overvalued stock bubble. Because institutional investors have more funds and more internal information, they will sell overvalued stocks before the bubble burst, so as to get excess returns. Such bubble riding behavior will cause the bubble of overvalued stocks to be further enlarged[9, 10], thus exacerbating the existence of anomalies [11]. Existing studies have basically confirmed that institutional investors have bubble riding behavior, but few of them have studied how institutional investors influence behavioral anomalies.

On the basis of the above analysis, this paper constructs long- (FIN) and short-horizon behavioral anomalies (PEAD) based on the China tobacco industry companies stock-related data in China A-share market. When examining the existence of long- and short-horizon behavioral anomalies, they are found in this paper to be able to better explain the excess returns of mainstream asset pricing factors including Fama-French3 factor and Fama-French5 factor, while in turn the mainstream asset pricing factors cannot explain long- and short-horizon behavioral anomalies. Compared with the mainstream asset pricing

models, behavioral anomalies can explain more anomalies, which highlights the strong explanatory power of behavioral anomalies. Cross-sectional test of behavioral anomalies revealed that behavioral anomalies were time-varying, that is, the significance of behavioral anomalies increased significantly with time. The above results indicate that behavioral anomalies exist significantly in China stock market. Furthermore, arbitrage restrictions and cognitive biases were also found to be the causes of behavioral anomalies: the significance of behavioral anomalies will increase with the increase of arbitrage restrictions and cognitive biases. The bubble riding behavior of institutional investors will promote the overvalued asset bubble under the behavioral deviation, amplify the future gains of undervalued assets and overestimate the future losses of assets, and thus promote the behavioral anomaly.

The innovation and contribution of this paper lies in firstly distinguishing the mispricing caused by different investors' behavioral deviations, and respectively constructing long- and short-horizon behavioral anomalies based on the listed companies in China tobacco industry to investigate the existence and difference of behavioral anomalies in China tobacco industry; secondly discovering the time-varying characteristics of behavioral anomalies, which enhanced the understanding of behavioral anomalies; thirdly exploring the formation mechanism of behavioral anomalies, proving the impact of arbitrage restrictions and cognitive biases on behavior anomalies, and broadening the relevant literature on the causes of behavior anomalies; and finally innovatively considering the role played by institutional investors in the formation of behavioral anomalies, which had policy significance for further liberalizing the access of domestic and foreign institutional investors and supervising the speculative behavior of institutional investors in the future.

The rest of this paper is arranged as follows: the second part is a literature review; the third part is the research design, including sample data, introduction of mainstream asset pricing model and behavior anomaly construction method; the fourth part is empirical analysis to test the existence of behavioral anomalies and the time-varying characteristics; the fifth part is further analysis to explore the existence mechanism test of behavioral anomalies and the impact of institutional investors on behavioral anomalies; and the sixth part is the conclusion.

LITERATURE REVIEW

The theoretical basis of traditional asset pricing model is EMH, which holds that stock price reflects all information in the market and all investors in the market are rational. However, these two hypotheses are inconsistent with the actual trading situation in the stock market that the stock price cannot reflect all the information in time because of the price discovery process and that a large number of irrational investors in the market have overreacted or underreacted. Therefore, stock prices will change together in the market, mainly because firstly, the common mispricing of stocks and the common changes in investor sentiment brought by the policy impact in A-share market have caused the same kind of stock prices to change in the same direction[12] and the spillover effect of the implementation of policies[13] may cause other stocks of enterprises not anchored by the policy to also be affected, resulting in the same change in stock prices; second, investors are under-reacted or over-reacted to the fundamental information of stocks[14], so they can't adjust their expectations of stock prices rationally according to the fundamental information in a timely manner. All of the above factors causing mispricing are related to investors' behaviors, indicating that we can construct behavioral anomalies based on investors' behaviors as a supplement to the traditional asset pricing model to explain anomalies that other asset pricing factors cannot explain in the relevant literature.

According to the theory of behavioral finance, investors will be biased when interpreting the fundamental information of the stock market, and the resulting investment behavior will ultimately affect the stock price, resulting in the assets mispricing. For example, some studies have confirmed the important role of investor sentiment in asset returns[15], and disposition effect can price assets[16], which means that in theory, the mispricing in the market can be used to predict the expected return of stocks[14]. Behavioral finance theory also holds that different mispricing mechanisms can correct

short-term or long-term mispricing, so long-term and short-term time dimensions can be distinguished to construct behavioral anomalies, so as to better describe the expected cross-sectional return difference of stocks.

The formation of short-term anomalies is mainly attributed to the limited attention of investors. In other words, the limited attention of investors leads to the insufficient response of stock market prices to profit information[4, 5], which leads to mispricing. In some studies, this phenomenon is called the drift of earnings announcement, that is, stocks with positive earnings accidents will get higher returns than those with negative earnings accidents in the future, which is not a rational risk premium[17], but a time-lag reflection of information on stock prices mainly caused by limited attention of investors[4]. The limited attention of investors will lead to their inadequate response to the company's fundamental news, excluding major events that are not disclosed regularly and the market value management plan, because the acquisition and merger plan and other noise information required by the strategic adjustment of enterprises are released[7]. Generally, the fundamental news of listed companies that are periodical, planned and meet regulatory requirements mainly refers to the release of quarterly reports, including quarterly reports, semi-annual reports, quarterly reports and annual reports. In the existing studies, both theoretically and empirically, it has been proved that investors can not fully absorb the information of earnings announcement, which leads to insufficient reflection of quarterly reports, resulting in predictability of future earnings[4,18]. When a new quarterly report is disclosed, this misunderstanding of information will be corrected in a short time. Bernard and Thomas[17] found in the empirical study that the mispricing caused by investors' limited attention will be corrected with the continuous publication of information and the disclosure of new quarterly information in the future, so the short-horizon behavioral anomalies based on limited attention may be unstable.

For long-horizon behavioral anomalies, Stein[19] thought that managers have the ability to compare the intrinsic value and market value of company stocks and carry out arbitrage because they have more company information. When the market value of a company is too high or too low, the best thing for a company is to issue or buy back its own shares instead of changing its investment level. If investors are completely rational, they will realize the information contained in the company's stock issuance or repurchase behavior[20] that the company's stock repurchase behavior conveys the information that the stock price is undervalued, then investors should buy stocks, so that the expected rate of return of stocks will drop and the stock price will return to equilibrium; The company's stock issuance behavior conveys the information that the stock price is overvalued. At this time, investors should sell the stock so that the expected return rate of the stock will rise and the stock price will return to the equilibrium level. Therefore, the financing decisions related to the company's equity will not bring excess returns to the stock. Investors' overconfidence will lead to the market not fully understanding the information conveyed by the corporate equity financing behavior, which will lead to the underestimation (overestimation) of the future positive (negative) excess return rate of the stock, and the predictability of the return[6]. Although there will be earnings announcements and other information to prove the information contained in the stock issuance or repurchase, unlike limited concerns, investors are overconfident and paranoid about private information, so they will not revise their investment opinions on the company's issuance or repurchase, thus leading to the persistent and significant abnormal rate of return behind the company's financing behavior. Historical experience has also confirmed the existence of this phenomenon that long-term sustained and significant abnormal negative returns are often associated with additional shares of companies, while long-term sustained and significant abnormal positive returns are often associated with stock repurchase behavior[7], revealing that behavioral deviations caused by overconfidence of investors are not easily affected by other correction information, thus making asset mispricing lasting longer and more stable under overconfidence. Regarding how investors perceive tobacco industry companies, existing research mainly discusses investors' perceptions of tobacco industry companies' advertising behavior and advertising content. However, in China stock market, few scholars have studied

how investors understand the performance of listed companies in the tobacco industry[2, 3]. Considering that there is currently no research to confirm whether behavioral anomalies exist in China listed tobacco companies, the following hypotheses are proposed in this paper based on the above analysis:

H1a: Long- and short-horizon behavioral anomalies exist in listed China tobacco companies.

H1b: Long- and short-horizon behavioral anomalies do not exist in listed China tobacco companies.

In addition to the construction of behavioral anomalies, focus is also laid in this paper on the impact of institutional investors' behavior on behavioral anomalies. According to traditional theory, the existence of institutional investors can increase stock liquidity, reduce market friction, and also play a role in price discovery, so the existence of institutional investors should significantly weaken behavioral anomalies[7]. However, some studies have found that in China, institutional investors may participate in speculative activities[8], hold and then push up the price of bubble stocks. In addition, some studies have found that institutional investors may not use abnormal arbitrage to get profits, but will use abnormal bubbles to speculate[1], even bring a higher risk of collapse[21], all of which seem to deviate from the role of institutional investors as mature investors. A reasonable explanation is that though institutional investors are motivated to arbitrage to eliminate mispricing, they give up the arbitrage behavior of mispricing assets for fear that the existence of arbitrage restrictions will lead to the high cost of arbitrage process and the failure of arbitrage, resulting in the persistent mispricing, so the return on assets is predictable. At the same time, retail investors do not have much internal information, so it is easy to form positive feedback between the transaction direction and the price fluctuation direction in the transaction process[22], while institutional investors are more likely to predict the trend of asset prices because of the larger amount of funds and more internal information. Therefore, for rational institutional investors, they can actively participate in the formation of asset bubbles by virtue of their own information advantages, and at the same time take advantage of the trading behavior characteristics of positive feedback from retail investors to sell overvalued stocks in time before the bubble burst, so they can obtain higher returns[22, 23], which can be regarded as rational speculation by institutional investors[24]. However, bubble riding accompanied by rational speculation will further enlarge the bubble of overvalued stocks[9, 10], aggravate the existence of anomalies[11], and bring higher risk of collapse. Although it has been confirmed that the rational speculation of Chinese institutional investors will bring bubble riding behavior[11], no scholars have studied the influence of institutional investors on behavioral anomalies. Institutional investors' arbitrage by mispricing under behavioral biases will reduce the abnormal returns and assume the role of stabilizing the market, while the existence of rational speculation will push up the abnormal behavior yield. Thus, the following hypotheses are proposed in this paper based on the above analysis:

H2a: The existence of institutional investors will push up the yield of behavioral anomalies.

H2b: The existence of institutional investors will reduce the yield of behavioral anomalies.

RESEARCH DESIGN

Sample Data

In this paper, the data of all listed China tobacco industry companies in Shanghai and Shenzhen stock exchanges were selected for study from January 1, 1997 to December 31, 2020. Since it is necessary to calculate the net stock issuance of listed companies within five years when constructing the long-term behavior anomaly, the calculated anomaly data starts from 2002. The relevant data required for this paper, such as the comprehensive A-share market yield rate, the listed company's monthly yield rate, the monthly risk-free yield rate, the listed tobacco industry company's balance sheet, and the proportion of institutional investors' shareholdings, were all from CSMAR database. The data of mainstream asset pricing factors, such as Fama-French three-factor and Fama-French five-factor, were calculated using factor data calculated by Ishikawa et al. [25]. Considering the impact of abnormal fluctuations in fundamentals on asset prices, stock data with negative net assets and special treatment (including ST and *ST) were excluded when

calculating abnormal returns, and stock data with monthly trading days less than 10 days were excluded to ensure that an effective portfolio could be formed.

Mainstream Asset Pricing Models

In this paper, the existing mainstream asset pricing models were used to test the existence of long- and short-horizon behavioral anomalies. According to relevant literature, the existing mainstream asset pricing models mainly include Fama-French three-factor model (FF3)[26], Fama-French five-factor model (FF5) [27], Carhart four-factor model (Carhart4) [28], Novy-Marx four-factor model (NM4) [29], Hou-Xue-Zhang four-factor model (HXZ4) [30] and Stambaugh-Yuan four-factor model (SY4) [31], and the existing asset pricing factors include information on stock market, company size, company value, company investment behavior, company profitability, stock price trend, and the degree of stock mispricing, but do not include investor behavior factors. The related descriptions of mainstream asset pricing factors are shown in Table 1, covering factor categories, factor names and references. The market factor MKT is measured by the average return rate of all stocks weighted by the total market value in the sample period, and then subtracting the risk-free return rate. The construction methods of other mainstream asset pricing factors are consistent with those of references.

Table 1
Description of Mainstream Asset Pricing Factors

Categories	Factor names	References
Market factor	MKT	Fama and French(1993) Fama and French (1993)
Size factors	SMB	Fama and French(1993) Fama and French (1993)
	SMB(HXZ4)	Hou, Xue and Zhang(2015) Hou, Xue and Zhang (2015)
	SMB(SY4)	Stambaugh and Yuan(2017) Stambaugh and Yuan (2017)
Value factors	HML	Fama and French(1993) Fama and French (1993)
	HML(NM4)	Novy and Marx(2013) Novy and Marx (2013)
Momentum factors	UMD	Carhart(1997) Carhart (1997)
	UMD(NM4)	Novy and Marx(2013) Novy and Marx (2013)
Investment factors	CMA	Fama and French(2015) Fama and French (2015)
	I/A	Hou et al.(2015) Hou et al. (2015)
	PMU	Novy and Marx(2013) Novy and Marx (2013)
Profitability factors	RMW	Fama and French(2015) Fama and French (2015)
	ROE	Hou, Xue and Zhang(2015) Hou, Xue and Zhang (2015)
Mispricing factors	MGMT	Stambaugh and Yuan(2017) Stambaugh and Yuan (2017)
	PERF	Stambaugh and Yuan(2017) Stambaugh and Yuan (2017)

Construction of Long- and Short-Horizon Behavioral Anomalies

The long- and short-horizon behavioral anomalies were constructed in this paper, which are denoted by FIN and PEAD, respectively. According to the above logic, FIN depicts the equity financing behavior made by senior executives based on the mispricing of stocks, so FIN can capture the long-term mispricing information in the stock market. PEAD mainly

describes the phenomenon of stock price drift after the company disclosed its financial report. Previous studies have shown that the phenomenon of stock price drift is caused by the limited attention of investors, so PEAD can effectively measure the short-horizon behavior of investors in the market and capture the short-term mispricing of stocks in the market. FIN and PEAD are calculated as follows:

For FIN: With reference to Pontiff and Woodgate[32] and Daniel and Titman[33], the compound equity issuance (CEI) in the past five years was calculated in May of each year according to the logarithmic value of the tobacco industry company's market value increase in five years Minus the logarithmic value of the compound rate of return in five years. With 20% and 80% quantiles of CEI value of listed tobacco industry companies as the boundary, companies with CEI value above 80% were classified into H group, those with CEI value below 20% were classified into L group, and others were M group. Referring to Fama and French[24], double ranking was made according to the calculated CEI value and the company size, so as to eliminate the influence of the company size. Specifically, on the basis of the existing CEI ranking, with the median market value of listed companies as the boundary, companies above the median market value were classified into large cap group (B), and companies below the median market value were classified into small cap group (S). Finally, FIN was defined as shown in formula (1), where Rk represents the monthly rate of return of k group stocks weighted by market value.

$$FIN = \frac{1}{2}\left(R_{SL} + R_{BL}\right) - \frac{1}{2}\left(R_{SH} + R_{BH}\right) \quad (1)$$

For PEAD: Referring to Daniel et al. [7], the investment portfolio was constructed according to the cumulative abnormal return rate (CAR) of four days before and after the disclosure period of the tobacco industry company's financial statements as the ranking index, in which the calculation method of CAR is shown in formula (2).

Where,

Rid= the return rate of company i on the d-th day in its latest disclosure period window,

d=0 represents the latest financial report disclosure date[32];

RMd= the rate of return of the stock market during the same period.

At the end of each month, with 20% and 80% quantiles of CAR value of listed tobacco industry companies as the boundary, companies with CAR value above 80% were classified into H group, those with CAR value below 20% were classified into L group, and others were M group. Meanwhile, companies above the median market value were classified into large cap group (B), and companies below the median market value were classified into small cap group (S). At last, PEAD was defined as shown in formula (3), where Rk represents the monthly return rate of k group stocks weighted by market value.

$$CAR_i = \sum_{d=-2}^{d=1}\left(R_{id} - R_{Md}\right) \quad (2)$$

$$PEAD = \frac{1}{2}\left(R_{SH} + R_{BH}\right) - \frac{1}{2}\left(R_{SL} + R_{BL}\right) \quad (3)$$

EXISTENCE TEST OF LONG- AND SHORT-HORIZON BEHAVIORAL ANOMALIES

In this paper, the existence of long- and short-horizon behavioral anomalies was tested through the following four steps according to the traditional asset pricing steps. First, if the behavioral anomaly only bears the risk of the mainstream asset pricing model, the time series of abnormal return rate should have a strong correlation with the time series of asset pricing factors, which can preliminarily test the existence of behavioral anomaly by observing the correlation coefficient matrix between behavioral anomaly and mainstream asset pricing factors. Secondly, the mainstream asset pricing models are used to test the behavior anomaly: if the abnormal return rate disappears after the adjustment of the mainstream asset pricing model, the behavior anomaly can be explained by the mainstream asset pricing model, that is, it only bears the risk of the mainstream asset pricing factor, and the behavior anomaly does not exist; on the contrary, if the behavior anomaly still has significant excess return rate after the adjustment of the mainstream asset pricing model, the behavior anomaly exists. Third, the ability to explain the behavioral anomalies in time series is tested. If behavioral anomalies can

explain the rate of return of mainstream asset pricing factors and explain more anomalies in the market compared with mainstream asset pricing models, then the existence of behavioral anomalies can be explained by combining the second step. Fourthly, the ability of cross-sectional interpretation of behavioral anomalies is tested by Fama-Macbeth regression. If it passes, it indicates the existence of behavioral anomalies. Therefore, in this part, the existence of behavioral anomalies is comprehensively tested through the above four steps.

Analysis on the Correlation between Long-and Short-Horizon Behavioral Anomalies and Mainstream Asset Pricing Factors

Table 2 shows the correlation coefficient matrix of the long- and short-horizon behavioral anomalies with the mainstream asset pricing factors to preliminarily test whether the long- and short-horizon behavioral anomalies exist, wherein the Spearman correlation coefficient is at the upper right corner of the main diagonal, and the Pearson correlation coefficient is at the lower left corner. The factor description in table 1 show that some of the factors in the mainstream asset pricing models have the same or similar ranking variables in the process of construction (such as size factors in Fama-French three-factor model (FF3) [26], Fama-French five-factor model (FF5) [27], Hou-Xue-Zhang four-factor model (HXZ4) [30] and Stambaugh-Yuan four-factor model (SY4) [31] all use the stock market value as the grouping variable, so the factor yield after sorting and grouping has a strong correlation), and only one of them is kept in this paper in order to avoid the effect of multicollinearity. Judging from the correlation coefficient matrix, the correlation between FIN and PEAD and the mainstream factors is not high, which indicates that the correlation between the behavioral risks depicted by FIN and PEAD and the fundamental risks depicted by the mainstream factors is not strong. The low correlation between FIN and PEAD and mainstream factors preliminarily indicates that long- and short-horizon behavioral anomalies cannot be explained by fundamental risks contained in mainstream asset pricing factors.

Table 2
Covariance Matrix of Behavior Anomalies and Mainstream Pricing Factors

	MKT	SMB	HML	RMW	CMA	UMD	PMU	ROE	MGMT	PERF	FIN	PEAD
MKT	1	0.21	-0.02	-0.36	0.06	-0.13	-0.29	-0.29	-0.23	-0.15	-0.22	-0.14
SMB	0.16	1	-0.31	-0.75	0.33	-0.31	-0.54	-0.71	-0.40	-0.17	-0.32	-0.24
HML	0.05	-0.35	1	0.09	0.48	-0.26	-0.13	0.04	0.74	-0.45	0.34	0.13
RMW	-0.36	-0.78	0.05	1	-0.52	0.40	0.70	0.83	0.23	0.38	0.26	0.21
CMA	0.07	0.37	0.49	-0.59	1	-0.36	-0.53	-0.46	0.35	-0.47	0.17	-0.02
UMD	-0.09	-0.29	-0.26	0.43	-0.35	1	0.58	0.55	-0.19	0.75	0.04	0.15
PMU	-0.33	-0.55	-0.18	0.76	-0.62	0.56	1	0.72	-0.05	0.60	0.23	0.10
ROE	-0.29	-0.72	0.06	0.86	-0.49	0.58	0.75	1	0.15	0.49	0.32	0.28
MGMT	-0.21	-0.46	0.79	0.23	0.37	-0.24	-0.06	0.18	1	-0.42	0.47	0.20
PERF	-0.12	-0.09	-0.49	0.33	-0.43	0.78	0.58	0.47	-0.49	1	0.05	0.06
FIN	-0.15	-0.34	0.43	0.22	0.19	0.05	0.18	0.29	0.54	0.02	1	0.08
PEAD	-0.11	-0.37	0.29	0.29	0.02	0.13	0.09	0.33	0.36	-0.06	0.13	1

The Ability of the Mainstream Asset Pricing Models to Explain the Long- and short-Horizon Behavioral Anomalies

In this paper, the time series regression method was used to explore whether the mainstream asset pricing model can explain the long- and short-horizon behavioral anomalies. In order to ensure the rigor of the approach, the existence of behavioral anomalies was judged using SpanningTests. Specifically, the mainstream asset pricing factor was taken as the explaining variable, and the expected yield of behavioral anomalies (PEAD and FIN) was taken as the explaining variable. Regression analysis was performed according to model (4). It should be noted that since the explained variable and the explaining variable are both yield rates, in order to avoid the endogenous impact brought by the correlation in the same period, the yield rate of the future period of the portfolio is used as the expected yield rate of the current period in accordance with the traditional asset pricing model. Unless otherwise specified, this method is adopted for the variables explained later when they relate to the return on assets. Table 3 and Table 4 show the empirical results of the explanatory power of the mainstream asset pricing models to PEAD and FIN respectively, in which (1)-(6) are the explanatory power of each asset pricing model to behavioral anomalies, and (7) are the explanatory power of all mainstream asset pricing factors to behavioral anomalies. If the behavioral anomaly can be completely explained by the asset pricing model, α should be close to 0 after the adjustment of pricing factors, that is, there is no significant excess return. Based on the empirical results in Table 3 and Table 4, the short-horizon behavioral anomaly (PEAD) still has significant α after the adjustment of pricing factors, indicating that the pricing factors cannot explain the short-term behavioral anomaly. At the same time, the vast majority of asset pricing models cannot explain the long-horizon behavior anomaly (FIN), and α in many columns in the corresponding Table 4 is significantly non-0. The above results show that the long- and short-horizon behavioral anomalies constructed in this paper exist significantly and cannot be explained by mainstream asset pricing models.

$$PEAD / FIN_{t+1} = \alpha + \beta_{factors,t}\lambda_{factors,t} + \varepsilon_t \quad (4)$$

Table 3
Ability of Asset Pricing Models to Explain Short-horizon Behavior Anomaly (PEAD)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FF3	FF5	Carhart4	Novy-Marx4	HXZ4	SY4	ALL
α	0.006***	0.005**	0.005**	0.004**	0.005**	0.005**	0.005*
	(2.74)	(2.29)	(2.48)	(1.98)	(2.52)	(2.58)	(1.87)
MKT	-0.034	-0.009	-0.033	-0.044	-0.007	-0.007	-0.015
	(-1.09)	(-0.26)	(-1.01)	(-1.29)	(-0.23)	(-0.23)	(-0.38)
SMB	-0.195***	-0.151**	-0.158***		-0.147**	-0.162***	-0.097
	(-3.30)	(-2.33)	(-2.87)		(-2.49)	(-2.62)	(-1.33)
HML	0.154*	0.096	0.200**	0.297***			0.006
	(1.78)	(0.87)	(2.56)	(3.11)			(0.05)
RMW		0.200					0.006
		(1.56)			0.202***		(0.03)
CMA		0.237			(3.16)		0.067
		(1.43)					(0.41)
UMD			0.108	0.173*			0.152
			(1.27)	(1.73)			(1.28)
PMU				0.062			-0.538*
				(0.31)			(-1.83)
ROE					0.187***		0.348**
					(3.76)		(1.98)
MGMT						0.269**	0.138
						(2.50)	(0.91)
PERF						0.046	-0.117
						(0.55)	(-0.93)
N	218	218	218	218	199	218	201

Note.
***, ** and * represent significance at 1%, 5% and 10% levels respectively, and the T statistics adjusted by Newey-West are in brackets, the same below

Table 4
Ability of Asset Pricing Models to Explain Long-horizon Behavior Anomaly (FIN)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FF3	FF5	Carhart4	Novy-Marx4	HXZ4	SY4	ALL
α	0.003*	0.004**	0.003*	0.002	0.004**	0.001	0.001
	(1.94)	(2.25)	(1.74)	(1.40)	(2.33)	(0.90)	(0.69)
MKT	-0.050*	-0.029	-0.050*	-0.041	-0.030	0.016	0.024
	(-1.72)	(-0.92)	(-1.76)	(-1.42)	(-0.99)	(0.63)	(0.77)
SMB	-0.095	-0.113	-0.073		-0.194***	0.030	-0.028
	(-1.56)	(-1.61)	(-1.10)		(-3.62)	(0.53)	(-0.48)
HML	0.250***	0.136*	0.277***	0.325***			0.000
	(3.49)	(1.68)	(3.27)	(5.07)			(0.00)
RMW		0.143					-0.196
		(1.43)					(-1.45)
CMA		0.346**			0.224***		0.155
		(2.39)			(3.69)		(1.31)
UMD			0.062	0.037			-0.167**
			(1.10)	(0.59)			(-2.08)
PMU				0.290			0.332
				(1.45)			(1.28)
ROE					0.093*		0.136
					(1.72)		(1.31)
MGMT						0.647***	0.613***
						(6.47)	(6.09)
PERF						0.245***	0.316***
						(4.43)	(3.01)
N	218	218	218	218	199	218	199

The Ability of Long- and Short-horizon Behavioral Anomalies to Explain the Time Series

The ability of long- and short-horizon behavioral anomalies to explain the assets pricing factor

Further, whether long- and short-horizon behavioral anomalies can explain the mainstream asset pricing factors is explored in this paper, specifically by taking the expected return rate of the pricing factors as the explained variable, and performing time series regression analysis with behavioral anomalies as the explaining variable to test the ability of the long- and short-horizon behavioral anomalies to explain the pricing factors through verification of α . Considering the important position of market factor (MKT) in asset pricing model, the long-term and short-term behavioral anomalies (BF2) and long-term and short-term behavioral anomalies including market factor (BF3) are used as explaining variables for regression analysis. The regression models correspond to models (5) and (6) respectively, and the regression results are shown in Table 5, in which Panel 1 and Panel 2 list the regression results of BF2 and BF3 models respectively. The results show that the mainstream asset pricing factor no longer has significant α after the adjustment of behavioral anomalies, indicating that the long- and short-horizon behavioral anomalies can better explain the yield of the mainstream asset pricing factors.

$$Factors_{t+1} = \alpha + \beta_{PEAD} PEAD_t + \beta_{FIN} FIN_t + \varepsilon_t \quad (5)$$

$$Factors_{t+1} = \alpha + \beta_{MKT} MKT_t + \beta_{PEAD} PEAD_t + \beta_{FIN} FIN_t + \varepsilon_t \quad (6)$$

Table 5
Explanatory Power of Behavioral Anomalies to Mainstream Factors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: The explanatory power of BF2 to mainstream factors									
	SMB	HML	RMW	CMA	UMD	PMU	ROE	MGMT	PERF
α	0.005	0.002	0.002	-0.003	0.000	0.001	0.005	-0.001	0.005
	(1.39)	(0.67)	(0.94)	(-0.99)	(0.02)	(0.82)	(1.18)	(-0.47)	(1.01)
FIN	-0.054	0.157	0.134	0.156	0.200	0.093	0.327	0.321**	0.495
	(-0.23)	(1.00)	(0.73)	(0.62)	(1.53)	(1.16)	(1.00)	(2.51)	(1.60)
PEAD	-0.448**	-0.120	0.354**	-0.427**	0.389***	0.137*	0.708**	0.007	0.461
	(-2.05)	(-0.91)	(2.25)	(-2.00)	(2.88)	(1.69)	(2.36)	(0.08)	(1.47)
N	218	218	218	218	218	218	199	218	218
Panel 2: The explanatory power of BF3 to mainstream factors									
α	0.004	0.001	0.004	-0.004	0.000	0.001	0.007	-0.000	0.006
	(1.24)	(0.54)	(1.64)	(-1.17)	(0.14)	(1.49)	(1.57)	(-0.19)	(1.31)
MKT	0.087	0.036	-0.146***	0.064	-0.030	-0.059***	-0.147*	-0.065	-0.119
	(1.26)	(0.66)	(-3.43)	(1.15)	(-0.67)	(-2.60)	(-1.69)	(-1.52)	(-1.25)
FIN	0.003	0.180	0.039	0.198	0.180	0.054	0.227	0.279**	0.418
	(0.01)	(1.03)	(0.22)	(0.77)	(1.35)	(0.69)	(0.69)	(1.98)	(1.35)
PEAD	-0.434**	-0.114	0.331**	-0.417**	0.384***	0.127*	0.689**	-0.003	0.442
	(-2.04)	(-0.85)	(2.34)	(-1.99)	(2.86)	(1.76)	(2.40)	(-0.03)	(1.47)
N	218	218	218	218	218	218	199	218	218

The ability of long- and short-horizon behavioral anomalies to explain the existing anomalies

An important way to judge the explanatory power of a pricing model is to observe its explanatory power to existing anomalies, that is, if most anomalies no longer have significant α after adjustment of the pricing model, the pricing model has a strong explanatory power, and the existence of the model has practical significance. At present, there are few studies on the existence of anomalies in China A-share market and few empirical studies have examined them. In order to explore the explanatory power of long- and short-horizon behavioral anomalies to existing anomalies, 22 anomalies were constructed by referring to Hou et al. The 22 anomalies include idiosyncratic volatility, idiosyncratic skewness, monthly highest return rate, monthly lowest return rate, stock price residual, illiquidity, turnover rate, illiquidity residual, short-term reversal, momentum, book-to-market ratio, total accruals, asset growth, net operating assets, gross profit margin, return on assets, abnormal capital investment, net stock issuance, institutional shareholding ratio, analyst coverage, analyst coverage residual and analyst dispersion [30]. By calculating the abnormal excess returns and putting them into the model (6) for regression analysis, the significance of α was observed to test the existence and explanatory power of long- and short-horizon behavioral anomalies. If FIN and PEAD can capture the mispricing caused by investor behavior deviation, they should be able to explain more anomalies. In order to compare the explanatory power of long- and short-horizon behavioral anomalies horizontally, the explanatory power of mainstream asset pricing models, such as Fama-French3-factor model and Fama-French5-factor model, is also considered. According to the results, among the 22 anomalies, Fama-French3-factor model can explain 9 anomalies, Fama-French5-factor model can explain 10 anomalies, Carhart4-factor model can explain 9 anomalies, HXZ4-factor model can explain 13 anomalies, NM4-factor model can explain 9 anomalies, SY4-factor model can explain 11 anomalies, and BF3 can explain 13 long- and short-horizon behavioral anomalies. Specifically, the empirical results of behavioral anomaly BF3 on existing anomaly tests are shown in Table 6. Judging from the empirical results, behavioral anomaly BF3 can explain a total of 13 anomalies of illiquidity (Illiq), illiquidity residual (Riliq), book-to-market ratio (BM), total accruals (TA), asset growth (AG), net operating assets (Noa), gross profit margin (GP), return on assets (Roa), abnormal capital investment (ACI), net number

of equity issues (NSI), institutional shareholding ratio (IO), analyst cover (Cover) and analyst dispersion(DISP) rather than 9 anomalies of idiosyncratic volatility (Ivol), idiosyncratic skewness (Iskew), monthly maximum yield (Max), monthly minimum yield (Min), stock price residual (RPRC), turnover rate (Turn), short-term reversal (Rev), momentum (MOM) and analyst coverage residual (Rcover), which can also not be explained by the existing asset pricing models. As this paper only focuses on the number of anomalies explained by the asset pricing model, the behavioral anomalies and the HXZ4 factor model can explain the largest number of anomalies from the quantitative point of view, indicating that the behavioral anomalies have strong explanatory power, further proving the existence of behavioral anomalies.

Table 6
Explanatory Power of Long- and Short-horizon Behavioral Anomalies to Existing Anomalies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Ivol	Iskew	Max	Min	RPRC	Illiq	Turn	Rilliq	Rev	MOM	BM
α	0.120***	0.028***	0.140***	0.048***	0.037***	-0.001	0.082***	0.005	0.344***	0.129***	-0.006
	(13.07)	(6.43)	(22.51)	(6.79)	(8.96)	(-0.07)	(14.84)	(0.93)	(29.72)	(24.89)	(-1.23)
MKT	0.878***	0.166***	0.808***	-0.411***	0.069	0.254**	0.516***	0.271***	0.540***	0.273**	0.039
	(8.10)	(2.63)	(10.64)	(-4.66)	(1.51)	(2.07)	(6.91)	(2.88)	(3.88)	(2.13)	(0.34)
FIN	-0.118	0.058	-0.105	0.467	-0.194	-0.456	-0.039	-0.270	0.004	0.287	0.230
	(-0.33)	(0.18)	(-0.33)	(1.19)	(-0.92)	(-1.12)	(-0.11)	(-0.69)	(0.01)	(0.92)	(0.71)
PEAD	0.141	-0.113	0.312	0.037	0.018	-0.485	-0.177	-0.310	-0.363	0.787**	-0.011
	(0.57)	(-0.51)	(1.50)	(0.14)	(0.10)	(-1.28)	(-0.90)	(-1.25)	(-1.09)	(2.36)	(-0.05)
N	218	218	218	218	218	218	218	218	218	218	218
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	TA	AG	Noa	GP	Roa	ACI	NSI	IO	Cover	DISP	Rcover
α	0.001	-0.001	0.001	0.005	0.001	-0.002	0.001	-0.003	-0.006	-0.005	0.008***
	(0.23)	(-0.43)	(0.30)	(1.44)	(0.25)	(-0.73)	(0.32)	(-1.02)	(-1.35)	(-1.64)	(3.14)
MKT	0.033	-0.100**	0.150**	-0.048	-0.191**	0.008	-0.077*	-0.069	-0.209**	0.124*	-0.104**
	(0.60)	(-2.08)	(2.13)	(-0.65)	(-2.34)	(0.13)	(-1.90)	(-1.16)	(-2.28)	(1.96)	(-2.43)
FIN	-0.078	-0.288	-0.291	0.290	0.166	-0.074	-0.550***	0.530**	0.155	-0.250	0.458***
	(-0.52)	(-1.35)	(-1.06)	(1.64)	(0.71)	(-0.33)	(-3.80)	(2.43)	(0.47)	(-1.20)	(3.29)
PEAD	0.128	0.443**	0.446	-0.028	0.395	0.261	0.221*	-0.227	0.653**	-0.029	-0.139
	(0.95)	(2.39)	(0.70)	(-0.19)	(1.39)	(1.47)	(1.70)	(-1.13)	(2.04)	(-0.20)	(-1.18)
N	218	218	218	218	218	218	218	218	217	217	217

Cross-sectional explanatory power of long- and short-horizon behavioral anomalies

Cross-sectional regression test is needed for the existence of anomalies. In this paper, the long- and short-horizon behavioral anomalies FIN and PEAD are subject to Fama-Macbeth regression according to the model (7), in which the explained variable is the return rate of the stock in the future after excluding the risk-free return rate, and the explaining variable is the factor load of behavioral anomalies. In this paper, the inverse of CEI and CAR, which are the sorting variables of FIN and PEAD, are used as the substitute variables for the loads β_{FIN} and β_{PEAD} of FIN and PEAD, and whether FIN and PEAD have significant risk premium is judged by checking the significance of β_{FIN} and β_{PEAD} coefficients. The full sample regression results are shown in column (1) of Table 7. From the results, there is no significant risk premium between FIN and PEAD. Furthermore, the cross-sectional regression test was conducted in different periods, and the empirical results are shown in Table 7 (2)-(5). From the results, the yields of FIN and PEAD are gradually significant with the passage of time, indicating that behavioral anomalies have time-varying effects. At the same time, compared with PEAD factor, the yield of FIN factor is more significant. The above conclusions are consistent with those of Daniel et al. [7], that is, PEAD is greatly disturbed by noise in the process of construction due to the measurement of short-term behavioral bias, so the yield is affected by noise to affect the yield of its anomalies. The existence of short-term behavioral anomalies cannot be ignored because Fama-Macbeth regression test fails. The significance of FIN shows that behavioral anomalies do exist in China stock market. To sum up, the empirical results support H1a.

$$R_i = \alpha + \beta_{FIN,i}\lambda_{FIN} + \beta_{\mathrm{PEAD},i}\lambda_{PEAD} + \varepsilon_i \quad (7)$$

Table 7
Existence Test and Time-Varying Effect of Behavioral Anomalies

	(1)	(2)	(3)	(4)	(5)
	All sample	Before 2008	2008-2015	After 2008	After 2015
β_{FIN}	0.002	-0.003	0.004*	0.004***	0.005***
	(0.84)	(-0.55)	(1.88)	(2.78)	(4.74)
β_{PEAD}	0.043	0.053	0.006	0.037	0.095**
	(1.34)	(0.74)	(0.19)	(1.28)	(2.51)
N	216	78	96	138	54

FURTHER ANALYSIS

Arbitrage Restriction Mechanism

On the basis of testing the existence of behavioral anomalies, the mechanism of behavioral anomalies was further analyzed in this paper. Because the short-horizon behavioral anomaly PEAD is greatly disturbed by noise in the construction process, the method of Daniel et al. [7] was used for reference to explore FIN in the subsequent relevant research and analysis. As rational investors will eliminate mispricing through arbitrage, and the existence of market friction in the market will bring about arbitrage restrictions, which increases the cost of arbitrage restrictions, thus resulting in the persistence of mispricing. In this paper, enterprise size [34,35] (corresponding variable SIZE, measured by logarithm of total stock market value) and ILLIQ index (corresponding variable ILLIQ, which is constructed by referring to Amihud[36]) were selected as proxy variables of arbitrage restriction to measure the limits of arbitrage, because enterprise size is an important variable to measure information asymmetry. The smaller the enterprise size, the more serious the information asymmetry, the higher the potential cost of arbitrage and the larger the arbitrage limit; the higher the illiquidity of assets, the worse the liquidity, the greater the impact on the price in the trading process; the higher the friction cost in the arbitrage process, the greater the arbitrage limit. Therefore, the smaller the size is, the greater the illiquidity is, the greater the arbitrage limit is, and the greater the degree of mispricing is, the more significant the

abnormal return rate should be. According to the size and illiquidity, double ranking with FIN was used to test the difference of return rate (MIN-MAX) between groups. The empirical results are shown in Table 8. From the results, with the decrease of size and the increase of illiquidity, the abnormal return of FIN rose, and the significance of return increased significantly. The above results indicate that arbitrage restriction is an important mechanism for the generation of behavioral anomalies.

Table 8
Impact of Arbitrage Restriction on Behavioral Anomalies

		FIN					
		MIN	2	3	4	MAX	MIN-MAX
SIZE	1	0	0.002*	-0.001	-0.001	-0.004**	0.006**
		-0.2	-1.82	(-1.26)	(-0.36)	(-2.39)	-2.57
	2	0.010***	0.011***	0.009***	0.007***	0.002	0.012***
		-7.68	-8.68	-6.86	-5.15	-1.1	-5.4
	3	0.020***	0.017***	0.017***	0.012***	0.006***	0.014***
		-13.31	-11.95	-12.16	-8.92	-4.61	-7.07
	4	0.021***	0.021***	0.021***	0.016***	0.011***	0.005**
		-14.07	-13.93	-14.31	-11.41	-9.66	-2.17
	5	0.020***	0.020***	0.025***	0.022***	0.019***	-0.003

		-15.98	-14.35	-18.06	-13.26	-15.41	(-1.56)
		MIN	2	3	4	MAX	MIN-MAX
	1	0.019***	0.021***	0.022***	0.019***	0.018***	0
		-14.97	-14.71	-16.29	-14.99	-14.89	(-0.11)
	2	0.015***	0.012***	0.015***	0.011***	0.008***	0.008***
		-11.67	-8.42	-11.11	-9.08	-6.53	-4.36
ILLIQ	3	0.011***	0.009***	0.009***	0.006***	0.004***	0.008***
		-8.52	-7.17	-7.49	-4.43	-2.83	-4.06
	4	0.008***	0.009***	0.003**	0.004***	0.001	0.008***
		-6.06	-7.29	-2.28	-2.8	-0.47	-4.02
	5	0.008***	0.006***	0.005***	0.006***	0.003	0.013***
		-5.43	-4.76	-3.76	-3.49	-1.58	-5.2

Cognitive Bias Mechanism

Investor overconfidence and underreaction are the important reasons for the formation of long- and short-horizon behavioral anomalies, which are all due to the cognitive bias of investors. If investors' cognitive bias is improved, behavioral anomalies should be weakened or even disappeared. In this regard, the impact of cognitive bias on behavioral anomalies was further explored. Since analysts' analysis reports are generally considered to be an important channel to reduce information asymmetry, with reference to Chung et al. [37] and Deither et al. [38], analyst coverage (corresponding variable COVER) and analyst dispersion (corresponding variable DISP) were taken as proxy variables of cognitive bias, respectively. The lower analyst coverage (corresponding to a smaller COVER) reflects that the company has received less attention, and the information asymmetry may be serious, which makes the cognitive bias of investors more serious. A higher degree of analyst divergence (corresponding to a larger DISP) indicates that analysts have different perceptions of the company. Therefore, the analysis report has a lower reference value and investors have a more serious cognitive bias. The existence of cognitive bias mechanism will lead to the more serious cognitive bias, the higher and significant rate of return on abnormal behavior. In this paper, two agent variables of cognitive bias were sorted by double independent grouping with FIN anomaly, and the statistical results are shown in Table 9. According to Table 9, with the decrease of COVER and the increase of DISP, the degree of cognitive bias increases, and the rate of return of behavioral anomalies increases significantly, indicating that cognitive bias is an important mechanism of behavioral anomalies.

Table 9
Impact of Cognitive Bias on Behavioral Anomalies

		FIN					
		MIN	2	3	4	MAX	MIN-MAX
	1	0.000	0.002*	-0.001	-0.001	-0.004**	0.006**
		(0.20)	(1.82)	(-1.26)	(-0.36)	(-2.39)	(2.57)
	2	0.010***	0.011***	0.009***	0.007***	0.002	0.012***
		(7.68)	(8.68)	(6.86)	(5.15)	(1.10)	(5.40)
COVER	3	0.020***	0.017***	0.017***	0.012***	0.006***	0.014***
		(13.31)	(11.95)	(12.16)	(8.92)	(4.61)	(7.07)
	4	0.021***	0.021***	0.021***	0.016***	0.011***	0.005**
		(14.07)	(13.93)	(14.31)	(11.41)	(9.66)	(2.17)
	5	0.020***	0.020***	0.025***	0.022***	0.019***	-0.003
		(15.98)	(14.35)	(18.06)	(13.26)	(15.41)	(-1.56)
		MIN	2	3	4	MAX	MIN-MAX
DISP	1	0.019***	0.021***	0.022***	0.019***	0.018***	-0.000
		(14.97)	(14.71)	(16.29)	(14.99)	(14.89)	(-0.11)

2	0.015***	0.012***	0.015***	0.011***	0.008***	0.008***
	(11.67)	(8.42)	(11.11)	(9.08)	(6.53)	(4.36)
3	0.011***	0.009***	0.009***	0.006***	0.004***	0.008***
	(8.52)	(7.17)	(7.49)	(4.43)	(2.83)	(4.06)
4	0.008***	0.009***	0.003**	0.004***	0.001	0.008***
	(6.06)	(7.29)	(2.28)	(2.80)	(0.47)	(4.02)
5	0.008***	0.006***	0.005***	0.006***	0.003	0.013***
	(5.43)	(4.76)	(3.76)	(3.49)	(1.58)	(5.20)

Institutional Investors' Nudge Behavior on Behavioral Anomalies

In China, the riding of asset price bubbles due to rational speculation by institutional investors will further push up asset bubbles. In this regard, it is tested in this paper whether the existence of institutional investors will push up the abnormal behavior yield. Table 7 shows that with the passage of time, the significance of behavioral anomalies is obviously improved, and in reality, the market share of institutional investors is also increasing. From the time-varying results of behavioral anomalies, it is preliminarily confirmed that the existence of institutional investors will promote the formation of behavioral anomalies and even push up the rate of return on behavioral anomalies. In order to quantify the impact of institutional investors on behavioral anomalies, based on the study of Nagel[39], the institutional shareholding ratio (corresponding variable IO) was taken as the agency variable of institutional investors. Accordingly, the higher the institutional shareholding ratio is, the greater the impact of institutional investors' behavior on stock return is. If institutional investors use their own information advantages to discover prices and arbitrage behavioral anomalies caused by behavioral factors such as the cognitive bias of retail investors, then the behavioral anomalies should cease to exist with the increase of the proportion of institutional investors, i.e. the abnormal return rate should cease to exist significantly. If institutional investors make rational speculation and bubble riding in the face of the cognitive bias of retail investors, it will further push up the abnormal return rate. In this paper, the shareholding ratio of institutional investors and FIN were sorted in double independent groups, and the statistical results are shown in Panel 1. From the empirical results, the return rate of behavioral anomalies increases significantly with the increase of institutional shareholding.

Considering that the proportion of institutional investors may be related to the size of the enterprise itself, and the size of the enterprise is an important factor affecting the bankruptcy risk and operational risk of the enterprise, the grouping based solely on the proportion of institutional investors will be affected by the size of the enterprise, which leads to the endogeneity of the empirical results. For endogenous reasons, referring to Nagel[39]'s research, the residual of institutional investors' shareholding ratio was calculated according to model (8) to measure the influence of institutional investors, in which the explained variable was the institutional shareholding ratio after logit transformation, and the conversion formula is as shown in formula (9). Specifically, Fama-Macbeth regression was performed firstly according to the model (8) to get the estimated values of the coefficients of each explaining variable, and then the residual error of each period of each stock was extracted. Since the residuals were orthogonal to the explaining variables and related to the explained variable (institutional shareholding ratio), the residuals could be used as an agent variable of institutional investors' influence and eliminate the endogenous influence of factors related to the size of enterprises. In this paper, the residual of institutional shareholding ratio (corresponding variable RIO) was taken as the proxy variable of institutional investors' impact: the higher the residual of institutional shareholding ratio, the greater the impact of institutional investors on stock returns. The empirical results after sorting RIO and FIN into double independent groups are shown in Panel 2 in table 10. The empirical results show that with the increase of institutional investors' influence, the abnormal rate of return on behavior increases significantly, which is consistent with Panel 1 in Table 10.

$$Logit(IO)_i = \alpha + \beta_1 size_i + \beta_2 size_i^2 + \varepsilon_i \quad (8)$$

$$Logit(IO) = \log(\frac{IO}{1-IO}) \quad (9)$$

In addition to sorting and grouping, the influence of institutional investors on behavioral anomalies was also verified through regression. Specifically, Fama-Macbeth regression was performed on the sample data according to model (10), where the explained variable was the return rate of the stock in the next period after excluding the risk-free return rate, IO was a virtual variable of institutional investors, and the stock with the institutional shareholding ratio higher than the current median institutional shareholding ratio was set as 1, otherwise 0; CEI was the ranking variable of behavior anomaly FIN; Control was a control variable, including Size and book-to-market ratio (BM), which controlled the endogenous effects of size and value of an enterprise respectively. As shown in Panel 1-2 in Table 10, the impact of institutional investor shareholding ratio near the median (i.e., Groups 2, 3, and 4 of IO and RIO) on the behavioral anomaly is not monotonic and unstable. However, the focus in this paper was on the influence of institutional shareholding ratio on behavioral anomalies, so only the data of IO in Group 1 and Group 5 were retained in the sample for Fama-Macbeth regression. The empirical results are shown in Panel 3 in Table 10, in which columns (1)-(4) respectively indicate the empirical results without adding control variables, control Size, control value (BM) and simultaneous control Size and value (BM). According to the empirical results of Panel 3, the coefficient β_1 of CEI is significantly negative and very stable, indicating that with the decrease of CEI, the future return rate of assets will increase significantly, while the coefficient β_2 of IO is not significant. In this paper, the attention was paid to the cross-product coefficient β_3 of CEI and IO, which is significantly negative, indicating that the increase of IO will promote the decrease of CEI coefficient, thus increasing the yield of behavioral anomalies. The above analysis and a series of empirical tests show that institutional investors do not play the role of price discovery in the investment process, but will boost behavioral anomalies, which is consistent with the logic of rational speculation of institutional investors put forward by Lu Rong and Sun Xinyu (2021) [11]. The above empirical results support H2a.

$$R_i = \alpha + \beta_1 CEI_i + \beta_2 IO_i + \beta_3 CEI_i \times IO_i + Control_i + \varepsilon_i \quad (10)$$

Table 10
Institutional Investors' nudge Behavior on Behavioral Anomalies

Panel 1: Institutional shareholding ratio

		FIN					
		MIN	2	3	4	MAX	MIN-MAX
IO	1	0.016***	0.013***	0.014***	0.012***	0.015***	0.004
		(10.25)	(9.60)	(10.78)	(8.64)	(8.84)	(1.64)
	2	0.013***	0.015***	0.014***	0.013***	0.009***	0.002
		(8.65)	(11.67)	(10.92)	(8.25)	(5.79)	(1.10)
	3	0.016***	0.015***	0.013***	0.013***	0.011***	0.004*
		(11.31)	(11.00)	(9.40)	(8.22)	(7.06)	(1.94)
	4	0.012***	0.013***	0.014***	0.010***	0.009***	0.003
		(9.48)	(9.58)	(10.25)	(8.03)	(6.95)	(1.60)
	5	0.016***	0.011***	0.011***	0.011***	0.007***	0.004**
		(13.24)	(8.65)	(8.13)	(8.05)	(6.32)	(2.24)

Panel 2: Residual of institutional shareholding ratio

		FIN					
		MIN	2	3	4	MAX	MIN-MAX
RIO	1	0.014***	0.011***	0.013***	0.011***	0.011***	0.002
		(9.38)	(8.28)	(10.02)	(7.76)	(7.27)	(1.03)
	2	0.013***	0.011***	0.013***	0.010***	0.008***	0.004**
		(8.86)	(8.72)	(9.68)	(6.61)	(6.05)	(2.33)
	3	0.013***	0.015***	0.014***	0.010***	0.009***	0.003
		(9.52)	(10.98)	(10.84)	(8.13)	(6.36)	(1.64)

4	0.014***	0.016***	0.014***	0.013***	0.009***	0.005***
	(11.06)	(11.73)	(9.95)	(9.77)	(6.07)	(2.68)
5	0.017***	0.014***	0.013***	0.014***	0.011***	0.005***
	(13.92)	(10.99)	(9.31)	(9.13)	(8.78)	(2.59)

Panel 3: Interactive effect of institutional shareholding ratio and behavioral anomalies

	(1)	(2)	(3)	(4)
CEI	-0.011***	-0.009***	-0.012***	-0.009***
	(-3.59)	(-2.98)	(-4.02)	(-3.34)
IO	-0.002	0.003	-0.002	0.003*
	(-0.81)	(1.43)	(-0.91)	(1.67)
CEI*IO	-0.009**	-0.007*	-0.009**	-0.008**
	(-2.20)	(-1.85)	(-2.36)	(-1.97)
Size		Y		Y
BM			Y	Y
N	218	218	218	218

CONCLUSIONS

In this paper, the data of listed China tobacco industry companies were used to study the existence, time-variability, generation mechanism of long- and short-horizon tobacco industry behavioral anomalies and the impact of institutional investors on them. The study found that the existing mainstream asset pricing models failed to explain the tobacco industry abnormal behavior's excess return rate, and the abnormal behavior could explain the excess return rate of the mainstream asset pricing factors well, which indicated that the tobacco industry abnormal behavior existed significantly in China stock market. It was found in the cross-sectional examination of behavioral anomalies that the behavioral anomalies had significant time-varying characteristics, and the significant degree of behavioral anomalies increased significantly with the passage of time. The explanatory power of behavioral anomalies was better than that of mainstream asset pricing models. The above results indicate that behavioral anomalies cannot be ignored in the China stock market. Furthermore, arbitrage restrictions and cognitive biases are found to be important mechanisms for generating behavioral anomalies: the significance of behavioral anomalies will increase with the increase of arbitrage restrictions and cognitive biases. Because of the rational bubble riding behavior, institutional investors in China will push up the bubble of overvalued assets under behavioral deviation, enlarge the future return of undervalued assets and the future loss of overvalued stocks, and then increase the rate of return on behavioral abnormality, which indicates that institutional investors have a nudging effect on abnormal behavior. In the current context of relatively small institutional investors, although this behavior of institutional investors seems reasonable[24], it will bring about the potential risk of stock market crash[1].

The research in this paper has important practical and policy significance: First, the mispricing caused by investor behavior bias is significant in listed China tobacco industry companies and can not be explained by the existing asset pricing models, which is of practical significance to understand the changes in asset prices and the role of investor behavior in the changes in Tobacco industry stock returns. Second, the existence of cognitive bias will push up the behavior anomaly bubble and lead to irrational asset prices, which will have a greater impact on small-cap stocks. Therefore, for small-scale markets such as listed China tobacco industry companies, more attention should be paid to investors' prior education to guide investors to return to rational investment and reduce blind speculation. Thirdly, since the decline of information asymmetry can effectively reduce the mispricing caused by behavioral anomalies, relevant policies should be adopted to guide listed tobacco industry companies to actively broaden the information announcement channels, so as to reduce the degree of information asymmetry and thus reduce the mispricing caused by investors' behavioral biases. Fourth, institutional investors' bubble riding has exacerbated the mispricing under the behavioral bias of retail investors, which is rational[11] in the current

environment where institutional investors are relatively small. Therefore, it is necessary to further liberalize institutional investors' market access, promote institutional investors' diversification, and guide institutional investors to play the role of price discovery and elimination of mispricing by increasing competition. At the same time, special attention should be paid to the speculative activities of institutional investors and the supervision should be strengthened to prevent the systematic risks caused by the aggravation of mispricing, so as to promote the healthy development of the capital market.

Author Declaration

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