The Impact of Investor Sentiment on Innovation Investment Behavior of Chinese a-Share Listed Companies

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Abstract: Innovative investment activities are of great significance to the development of China's capital market. Based on the data of listed companies in China's A-share market from 2011 to 2020, this paper uses regression residual and Fama-French three-factor models to analyze the impact of investor sentiment on enterprise innovation investment behaviors which is measured by the ratio of total R&D expenditure/total assets and conducts further robustness testing from the perspective of firm nature, firm size and industry respectively. The empirical results show that investor sentiment significantly impacts enterprise innovation investment activities and tends to affect non-state-owned, medium-size companies and companies in pharmaceutical manufacturing, computer, communications, and other electronic equipment manufacturing, TMT (Technology, Media, Telecom) industries more substantially.

1. Introduction

In 1973, Zweig defined investor sentiment as the deviation of investors' expectations of the prospective value of an enterprise. From the behavioral finance theory view, the arbitrage in the market is not fully effective, derived from noise trading and ineliminable fundamental risk. Many scholars such as Lee, Shleifer, and Thaler (1991) believed that investor sentiment would lead to cognitive bias because investors could not be completely rational. Their investment decisions are not optimal, supported by Stein (1996), who confirmed that investors would misestimate the actual value of stocks for irrational reasons, resulting in mispricing and further affect enterprises' investment behaviors. Polk and Sapienza (2004) confirmed that investor sentiment affects the investment behaviors of companies, and there is a strong correlation between the two. Baker and Wurgler (2006) believed that investor sentiment seriously influences investors' speculative investment demands and defined investor sentiment as a speculative tendency.

As a long-term investment of enterprises, the R&D investment activities are characterized by high uncertainty, high return, hysteretic investment return, and incomplete information transparency. Some scholars have also noticed that and linked it with investor sentiment to carry out their researches. For example, Dong et al. (2007) believed that, compared with other capital expenditures, the investment of intangible assets of investors who do not attach importance to long-term interests is more sensitive to the mispricing of stocks. Arif and Lee (2014) found a significant positive correlation between investor sentiment and cumulative corporate investment. While Dong, Hirshleifer & Teoh et al. (2015) also found that the overvaluation of market value would affect enterprises' R&D investment, and more than 85% of this influence is reflected in direct pandering. This paper refers to Richardson's (2006) investment expectation residual model to measure investor sentiment and analyze how it affects the enterprise innovation investment activities.

2. Research Design

2.1 Data

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Our initial test subjects are non-ST, non-ST*, and non-financial listed companies in China's A-share market. We collected their relevant data from 2011 to 2020. The original enterprise data comes from the database of Choice, and the macroeconomic variables come from the database of CSMAR. After removing the missing values and outliers, there are 16,996 observations for our study.

2.2 Construction of Regression Model

we set up the following model to explain the impact of investor sentiment on corporate innovation investment behavior:

$$RDEI_i = \gamma_0 + \gamma_1 \times IS_{i,t-1} + \sum_{j=1}^{n} \gamma_j \times Control_j + \varepsilon_{i,t} \quad (1)$$

We take the investor sentiment (IS) as the explanatory variable and the enterprise's R&D innovation expenditure (RDEI) as the explained variable. Control variables are also introduced in the regression model for strengthening the explanation of the model. We will try to explore the impact of investor sentiment on innovation investment behavior of Chinese A-share listed companies through the Pearson test, panel data regression analysis, and conduct further research by subdividing the observations according to the categories of industry, enterprise nature, and size.

2.3 Variable Definitions

3. Explained Variable

We use the ratio of total R&D expenditure/total assets to measure the level of Enterprise innovation investment.

4. Explanatory Variables

According to the efficient market theory, stock returns should only depend on systemic market risk. Thus investors' irrational emotions can be reflected by the difference between actual stock returns and market model estimates. Therefore, the difference between the actual value and the company's real value is calculated based on the regression residual between the return rate of individual stocks and the actual return rate as a proxy indicator of investor sentiment (IS). In consideration of the accuracy of the measurement and applicability to China's capital market, the Fama-French three-factors model is selected to carry out the calculation, and the model is constructed as:

$$R_{i,t} = \alpha_0 + \beta_i \times Rm_t + s_i \times SMB_t + h_i \times HML_i + \varepsilon_{i,t} \quad (2)$$

$$E(R_{i,t}) = \alpha_0 + \hat{\beta}_i \times Rm_t + \hat{s_i} \times SMB_t + \hat{h_i} \times HML_i \quad (3)$$

Calculate the abnormal return ($AR_{i,t}$) for each stock to represent the monthly investor sentiment:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \quad (4)$$

The value of annual investor sentiment (IS) is obtained by summing up the monthly sentiment value by each enterprise.

$$IS_{i,t} = \sum_{i=7}^{12} AR_{i,t} \quad (5)$$

Considering the managers will make decisions based on the related data of the past year combined with the development strategies of enterprise business decisions, the investor sentiment (IS) causing the behavior catering for the market will also have a certain time lag and investor sentiment of the second half of last year was used as the explanatory variable.

5. Control Variables

From the perspective of internal influencing factors of enterprises, we select several internal control variables. In addition, the industry and years on the market are also considered in the regression analysis.

Table 1 Table of Variables

Variable nature	The variable name	Symbol	Instructions
Explained variable	R&D and innovation investment	RDEI	Total R&D expenditure/total assets at the beginning of the year
Explanatory variables	Investor sentiment	IS	The sum of the monthly investment sentiment from July to December last year
Control variables	Sales revenue	SALES	Main income/total assets at the beginning of the year
	Operating cash flow of the enterprise	CASH	Net cash flow from operations/total assets at the beginning of the year
	Asset-liability ratio	LEV	Total liabilities/total assets at the beginning of the year
	Sales growth rate	GS	The growth rate of revenue compared to the previous year
	EBITDA growth	GE	Growth in EBITDA compared to the previous year
	The enterprise-scale	SIZE	Total assets at beginning of year
	Return on equity	ROE	Net profit/average Stockholders' equity at the beginning of the year
	Profit margin of operating income	PROFIT	Net profit/main business income at the beginning of the year
	The GDP growth rate	GDP	GDP growth rate in the previous year
	Executive compensation	EC	Annual executive compensation
	The shareholding ratio of the largest shareholder of the enterprise	LSR	The shareholding ratio of the largest shareholder of the enterprise
	The shareholding ratio of the top ten shareholders of the enterprise	TTSR	The shareholding ratio of the top ten shareholders of the enterprise
	Industry	IND	Latest China Securities Regulatory Commission industry classification
	Year	YEAR	Years on the market

6. Empirical Results and Analysis

6.1 Descriptive Statistics

Descriptive statistical results of the main research variables are shown in Table 2.

Table 2 Descriptive Statistics Of Major Variables

	mean	std	min	p50	max	No. of observations
RDEI	271.84	368.14	0.00	214.84	29308.09	16996.00
IS	-0.70	47.00	-247.25	-3.68	638.56	16996.00
SALES	0.74	1.19	0.01	0.59	75.05	16996.00
CASH	0.06	0.15	-9.24	0.05	7.04	16996.00
LEV	0.40	0.21	0.01	0.38	8.56	16996.00
GS	0.40	16.33	-0.1	0.11	2071.11	16996.00
GE	0.00	27.97	-3036.49	0.092	1162.69	16996.00
TA	149.95	765.66	0.46	32.28	27331.90	16996.00
ROE	0.05	0.81	-66.54	0.07	43.61	16996.00
PROFIT	0.05	0.31	-17.55	0.06	0.71	16996.00
GDP	6.98	0.52	6.10	6.90	7.90	16996.00
EC	66.47	68.91	2.14	48.97	1688.48	16996.00
LSR	33.75	14.49	2.20	31.72	89.09	16996.00
TTSR	58.40	14.69	4.45	59.08	100.97	16996.00
YEAR	10.19	7.01	1.00	8.22	30.05	16996.00

Descriptive statistical results of major variables (Table 2) show that (1) from the perspective of variables of innovation investment, the highest total R&D expenditure reaches to 29308.09 and the lowest is approximately 0; (2) from the perspective of investor sentiment, the mean value is -

0.699346. The variation is significant that the maximum value is 638.564310, and the minimum value is -247.247767.

6.2 Correlation Analysis and Significance Test among Variables

The correlation analysis of the variables and the Pearson test results (Table 3) show that there is a significant correlation between investor sentiment and enterprise innovation investment. It also indicates that annual sales revenue (SALES), sales growth rate (GS), EBITDA growth rate (GE) and executive compensation (EC) are significantly positively correlated with the innovation investment expenditure (RDEI). While some variables including annual cashflow (CASH), asset-liability ratio (LEV), enterprise total asset (SIZE), time (YEAR), GDP growth rate (GDP) and shareholding ratio of the largest shareholder (LSR) are significantly negatively correlated with the innovation investment expenditure (RDEI).

Table 3 Correlation Analysis Of Variables and Pearson Significance Test Result

	IS	RDEI	SALES	CASH	LEV	GS	GE	TA	YEAR	ROE	PROFIT	GDP	EC	LSR	TTSR
IS	1.0000														
RIDE	0.0200	1.0000													
SALES	-0.00053	0.3031	1.0000												
CASH	0.00990	−0.090	0.2157	1.0000											
LEV	−0.024	−0.140	0.0586	−0.065	1.0000										
GS	-0.00263	0.1116	0.3083	−0.180	0.01121	1.0000									
GE	0.00302	0.0537	0.0663	0.0699	-0.00824	-0.00292	1.000								
TA	0.00823	−0.063	-0.00311	0.00681	0.1810	-0.00260	-0.00107	1.0000							
YEAR	−0.043	−0.139	0.0370	−0.022	0.3612	0.0178	-0.01099	0.0973	1.0000						
ROE	0.00478	0.0194	0.01136	0.0180	−0.073	-0.00223	0.00204	0.00651	−0.033	1.000					
PROFIT	0.0129	0.0152	−0.023	0.1070	−0.174	−0.136	0.00535	0.00302	−0.122	0.174	1.000				
GDP	0.0248	−0.030	0.00541	−0.048	-0.00699	0.00341	0.00956	−0.046	−0.116	0.013	0.01074	1.0000			
EC	0.00589	0.0631	0.0637	0.0767	0.1542	0.0780	0.00679	0.2212	0.1677	0.039	0.040	−0.168	1.000		
LSR	0.0141	−0.077	0.0431	0.0679	0.0660	-0.00150	0.014	0.1560	−0.026	0.024	0.069	0.0601	-0.00798	1.000	
TTSR	0.0501	0.00809	0.0624	0.0926	−0.076	0.0284	0.018	0.1550	−0.290	0.037	0.121	−0.021	0.058	0.623	1.000

Note: ***, ** and * indicate significant at the significance level of 1%, 5% and 10% respectively, the same as below.

6.3 Panel Data Regression Analysis Results

The regression analysis results are shown in Table 4, where (1) is the regression result without control variables and industry dummies; (2) is the regression result adding industry variables without control variables; (3) is the regression result adding control variables without industry dummies; (4) is the regression result of adding control variables and industry dummies.

Table 4 Regression Analysis Results

VAR	(1)	(2)	(3)	(4)
const	0.27193***	0.71026***	0.65694	0.33569***
IS	0.1341***	0.1499***	0.1092***	0.1097**
SALES			0. 11339***	0.11809***
CASH			−0.36200***	−0.48998***
LEV			−0.72437***	−0.15854***
GS			−0.11071***	−0.9552***
GE			0.3904***	0.5426***
SIZE			0.0066	−0.0124***
YEAR			0.36511	−0.47071***
ROE			0.26774	0.18075
PROFIT			−0.13814**	0.74257
GDP			0.45310	−0.32832***
EC			0.02341***	0.05423***
LSR			-0.2247	−0.8356***
TTSR			0. 16357***	0.4712**
Industry	No	Yes	No	Yes
Obs	16996	16996	16996	16996
R-squared	0.0007	0.0869	0.2067	0.2495

Regression analysis results show that the relationship between innovation investment and investor sentiment remains unchanged after including industry dummy variables. Besides, the regression correlativity of corporate investor sentiment is always significant whether with control variables or not. The regression coefficient between the two is 0.1341 without control variables and 0.1097 with 14 control variables.

Based on the empirical test results, we can conclude that the enterprise innovation investment has a significant positive correlation with investor sentiment (IS), which means the management of Chinese listed companies will increase innovation investment of the company for catering for investor sentiment.

7. Robustness Testing

We further subdivided the samples according to some certain standards, and the results of robustness test are as follows:

7.1 Subdivide Industries According to the Industry Categories of Csrc

Table 5 the Robustness Test Results According to the Industry Categories of Csrc

IND	Parameter
Scientific research and technical services	-0.257402*
Information transmission, software and information technology services	0.6319345***
Production and supply of electricity, heat, gas and water	-0.180104***

Table 5 shows that information transmission, software and information technology services and electricity, heat, gas and water production and supply industries are the most significantly affected by investor sentiment, while scientific research and technology services are also significantly affected.

In recent years, the Chinese government encourages the rapid development of high and new technology industry. Since technological innovation is characterized by long cycle, high risk and strong uncertainty, senior managers consider market, industry characteristics, government policy

guidance and the impact of other factors such as their own interests in the innovation activities to make innovation investment decisions. In the decision-making process, senior managers may produce short-sighted behavior, Baber et al. (1991) found that when the firm was under the pressure of profit target, the related R&D expenditure would also decrease significantly. If the market investor sentiment is high, managers are under less pressure and more confident or overconfident when making investment decisions, which may increase the R&D expenditure of enterprises.

7.2 Subdivide by Nature of Enterprise

Table 6 the Robustness Test Results According to Enterprise Nature

Enterprise nature	Parameter
Non-state-owned enterprise	0.150238***

Table 6 shows that non-state-owned enterprises have passed the robustness test, and their investment in innovation and R&D is significantly affected by investor sentiment. However, state-owned enterprises have failed the robustness test.

The managers of state-owned enterprises pay more attention to the completion of political strategies to ensure the political influence of enterprises and are not willing to invest too much in innovation, while the interests of private enterprises focus on profitability. To pursue higher business interests, non-state-owned enterprises take various ways to create new market and occupy the old one. At the same time, according to the signal transmission theory, the enterprise research and development related information that is disclosed reflects the enterprise with high growth opportunities to a certain extent, which is conducive to the judgment of investors on the market, then affect the share price. As the research of institute of China 335 innovative enterprises by Zhang (2020) found that high investor sentiment can promote the financing activities of private enterprises, and then improve their innovation investment.

7.3 Subdivide by Business Size

Table 7 the Robustness Test Results According to Enterprise Size

Enterprise-scale	Parameter
Medium-sized enterprise	0.078087**

The research (Table 7) shows that compared with large and small enterprises, medium-sized enterprises pass the robustness test, and their investment in innovation is significantly affected by investor sentiment. Compared with small enterprises, medium-sized enterprises occupy a certain market position and have a more stable capital to support their R&D and innovation activities. However, compared with large enterprises, medium-sized enterprises have greater development space and therefore are generally more catering for market sentiment.

7.4 Tmt Industry

Table 8 the Robustness Test Results of Tmt Industry

Whether it is in the TMT industry	Parameter
Yes	0.435645***

Table 8 shows that the innovation investment of technology, media and telecommunications (TMT) companies is significantly affected by investor sentiment. As a deep integration of technology-driven and business-model-driven industries, the TMT industry, which requires continuous research and development innovation, is more innovative and risky than other industries. Therefore, the expenditure of innovation investment activities will have a more direct impact on the valuation of TMT enterprises. Thus, the innovation investment activities of the TMT companies are inseparable from the effect of market sentiment.

8. Summary

Investor sentiment affects managers' investment decisions, and enterprise innovation activities are affected by managers' investment decisions. Based on the relevant data of all A-share listed

companies from 2011 to 2020, we build a residual model of regression analysis. And the empirical results show that investor sentiment has a significant impact on the innovation investment activities of enterprises. Besides, we analyze the reasons for these impacts in detail. From the perspective of enterprise nature, compared with non-state-owned enterprises, investor sentiment significantly affects state-owned enterprises. Compared with small enterprises and large enterprises, investor sentiment has the most significant impact on technological innovation activities in medium-sized enterprises from the perspective of enterprise size. From the perspective of major industries, the innovation investment activities of enterprises related to scientific research and technology service industry, information transmission industry, software and information technology service industry, power, heat, gas and water production and supply industry are significantly affected by investor sentiment. From the perspective of industry segmentation, investor sentiment significantly affects the innovation activities of enterprises related to the professional technology service industry, water production and supply industry, other manufacturing industry, pharmaceutical manufacturing industry, computer, communication and other electronic equipment manufacturing industry, Internet and related services and gas production and supply industry. In addition, the innovation investment of technology, media and telecommunications (TMT) companies are also significantly affected by investor sentiment.

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