Research on the Influence of Market Value Fluctuation on Innovation Decision of Listed Enterprises from the Perspective of Loss Aversion

Run Xie *

New York Institute of Technology, New York, United States

* Corresponding author: RunXie03@stu.qhnu.edu.cn

Abstract. Concerns regarding publicly traded companies' R&D investment have long existed among academics domestically and overseas. Scholars have conducted much research on the R&D investment of enterprises from different angles. This study starts from the perspective of market expectation and loss aversion, taking the data of Chinese quoted companies from 2011 to 2020 as a sample and using the empirical analysis method to research the impact of changes in market value on quoted companies' innovation decisions. Robustness tests effectively corroborate the findings of the study, which found a substantial positive association between changes in the market value of listed businesses and the degree of innovation investment. Additionally, this study conducts a group regression test on the R&D investment growth rate (RDI) of state-owned companies (SOEs) and non-state-owned firms using the two explanatory variables of total market value growth rate (RDI) and Tobin's Q value (Tobin's Q) (NSOEs). It is discovered that NSOEs are more vulnerable to market capitalization change than SOEs are, and the listed businesses' intentions to innovate are influenced by changes in market capitalization through the loss aversion mechanism.

Keywords: Listed companies, market capitalization fluctuations, loss aversion, innovation level, R&D investment.

1. Introduction

The innovation-driven national development strategy is essential to China, emphasizing that scientific and technical innovation is the key to increasing social productivity and overall national power. The R&D operations of listed firms are one of the critical components of China's economy and serve as a foundation for developing the nation's independent technical innovation capabilities and a key driver of increased industry core competitiveness. By placing a strong emphasis on R&D spending and boosting its capacity for independent innovation, China may achieve sustainable development. As a result, many academics are now concerned about how much money public firms invest in research and development.

This study investigates the effect of market value fluctuations on the innovation decisions of listed companies to enhance innovation decisions and deepen research on associated enterprise entrepreneurship research and development challenges.

2. Literature Review

Based on the existing literature, corporate R&D investment will be affected by the corporate board of directors and management. Haynes and Hilman found that compared with the depth of board capital, the breadth significantly affects corporate strategy [1]. Dalziel et al. found that the education experience, technical experience, and internal connections of the board of directors significantly and positively affect the R&D investment of enterprises [2]. According to the research of Zhou Jian et al., the human capital of the board of directors is positively correlated with the R&D investment of enterprises, and the greater CEO power negatively regulates this relationship [3]. Research by Zhao Hongjiang et al. shows a significant positive relationship between open-end and closed-end funds on corporate R&D investment [4].

From the above analysis, the existing literature mainly studies the influencing factors of R&D investment and the correlation between the impact of different investment entities on R&D investment. Only some scholars are involved in the research on market expectation and loss aversion affecting the innovation decision-making of listed companies.

3. Research Hypothesis

3.1. Market Value Fluctuation and Innovation Investment Level

The conflict between market expectations and company decisions is unavoidable in the corporate innovation process. As a result, companies frequently need assistance striking a balance between investor attitudes and R&D expenditures. Tahinakis and Samarinas conducted an empirical study using the R&D data of listed firms in Greece from 2005 to 2010 and discovered a solid inverse relationship between R&D spending and company stock prices [5]. According to Shi's research, listed companies' market value movements significantly correlate with their R&D expenditures if investors pay more attention to the risks of R&D rather than the benefits of R&D [6]. Based on the above, this paper puts forward the first hypothesis:

Hypothesis 1: A market capitalization increase significantly increases the innovation investment level of listed companies.

3.2. Loss Aversion Reinforcement Mechanism

According to prospect theory, the risk aversion of a listed company's management may increase when the company faces losses due to declining market value. To control R&D risks, managers hope to obtain a better market evaluation in the follow-up process, thereby reducing innovation investments in enterprises. Moreover, several studies point out that business failure is frightening, emotionally devastating, and costly. For many enterprises, R&D investments may lead to fluctuations in their market value. Such fluctuations cause the managers of listed companies to adopt more sound strategic decisions and continue business developments along their original strategy, such as by reducing operating costs, reducing high-risk projects and investment in R&D and innovation, or investing in more stable projects. This work promotes the second hypothesis based on this consideration.

Hypothesis 2: The decline of market value can reduce the level of innovation investment of listed companies through the strengthening mechanism of loss aversion.

4. Research Design

4.1. Data Source

In order to examine the two hypothesizes, China's quoted corporations will serve as the major sample since 2012 to 2020.Ensuring simultaneously the data's integrity, screened, this study eliminate all PT companies, ST companies, and *ST companies, outliers, and missing samples. The relevant financial data are from the databases of Wind and Guotai Junan (CSMAR). The statistical analysis software used is Stata 17.0.

4.2. Definition of Variable

Explained variables: Since most corporate innovations depend on the level of R&D investments, this study uses the corporate R&D investment growth rate (RDI) as a proxy variable to measure changes in corporate innovation levels and explore how market value changes affect corporate innovations.

Explanatory variables: Considering the stock market changes and the periodicity of corporate decision-making, this study selects a fiscal year as the time dimension to calculate the market capitalization growth rate (MVI) of companies in the population sample.

Alternate explanatory variable: Considering the one-sidedness of the market value growth rate (MVI), this paper re-selects Tobin's Q (tobin) as an alternate explanatory variable in one section of the loss aversion mechanism test.

Control variables: According to the practice of literature, this paper selects company size (Size), financial leverage (Lev), fixed asset ratio (LAr), company age (Age), net profit ratio of total assets (Roa), fixed asset ratio (Tar), operating income (Sale), the top ten Herfindahl Index (HHI) [7-9]. The detailed definitions of each variable are in Table 1.

Dummy variable: Enterprise property (SOE), If the quoted company is a state-owned enterprise, the value of SOE is 1. Otherwise, it is 0.

Table 1. Variable definition

Explained variable	RDI	(R&D spending previous year - R&D spending current year) / R&D spending previous year
Explanatory variable	MV	(Total market previous year - Total market value current year) / Total market previous year
Alternate explanatory variable	tobin	Total market value / Total assets
Control variable	Size	ln (total assets)
	Lev	Total Liabilities/Total Assets
	Roa	Net Profit/Average Total Assets
	LAr	Fixed Assets/Total Assets
	Sale	ln (operating income)
	HHI	The total market share of the top ten
Virtual variable	SOE	SOE=1 for state-owned enterprise; SOE=0 for non-state-owned enterprise

4.3. Model Setting

This study investigates how market capitalization changes affect the choices made by listed companies towards innovation. A reference develops the following empirical model to test the Hypothesis 1 [10].

$$RDI = \partial_0 + \alpha_1 MVI_{i,t-1} + \sum_1^i \beta_i Controls_{it} + Year_{it} + Industry_i + \varepsilon_{it} \quad (1)$$

"RDI" indicates the innovation level of the enterprise. "VI" is an explanatory variable representing the growth rate of the total market value of the enterprise. "Controls" refer to a series of control variables, including "Size", "Lev", "Roa", etc. The "Year" and "Industry" variables refer to the year and industry effects.

This study explores the significance of the regression coefficient of RDI. Hypothesis 1 is validated when the regression coefficient of RDI is considered positive, indicating that total business market capitalization is favorably connected with the degree of innovation investment of listed firms.

5. Empirical analysis

5.1. Descriptive Statistics

In this document, descriptive data for 1% of the continuous variables are indented, and Table 2 provides descriptive statistics results. The maximum enterprise R&D investment (RDI) increasing ratio is 8.200, and the lowest is -0.603. There are considerable disparities across publicly listed corporations' R&D investment plans. The enterprise market value increasing ratio is 2.616, and the average value is 2.122, which shows that the Chinese stock market has shown an overall growth trend from 2011 to 2020.

Table 2. Descriptive results

Variable	N	Mean	p50	SD	Min	Max
RDI	6588	0.325	0.133	1.024	-0.603	8.200
MVI	6588	0.208	0.0580	0.582	-0.553	2.616
tobin	6588	2.122	1.692	1.290	0.865	7.999
Age	6588	8	8	2.582	4	12
LV	6588	0.397	0.389	0.196	0.0480	0.859
LAr	6588	0.207	0.182	0.135	0.00800	0.586
ROA	6588	0.0380	0.0360	0.0580	-0.223	0.204
Sale	6588	21.58	21.48	1.338	18.93	25.31
Size	6588	22.24	22.10	1.139	20.18	25.73
HHI	6588	0.440	0.406	0.190	0.133	0.904

5.2. Correlation Analysis

In Table 3, except for the fixed assets ratio (LAr), which shows no significant relationship with enterprise innovation levels (RDI), all other variables correlate with RDI at a significant level of 1%. Age shows the strongest correlation with a coefficient of 0.126, while tobin negatively correlates with RDI.

Table 3. Correlation analysis results

Variable	RDI	MVI	tobin	Age	LV	LAr	ROA	Sale	Size	HHI
RDI	1									
MVI	0.070***	1								
tobin	-0.028**	0.401***	1							
Age	0.129***	0.115***	0.044***	1						
LV	0.079***	-0.043***	-0.327***	-0.122***	1					
LAr	0.005	-0.009	-0.122***	0.066***	0.095***	1				
ROA	0.054***	0.177***	0.259***	0.105***	-0.332***	-0.115***	1			
Sale	0.082***	-0.032***	-0.301***	-0.228***	0.560***	0.073***	0.117***	1		
Size	0.079***	-0.042***	-0.324***	-0.286***	0.543***	0.0110	0.039***	0.901***	1	
HHI	0.022*	-0.054***	-0.041***	0.071***	0.125***	0.110***	-0.032***	0.123***	0.104***	1

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1 (The tables below share the same identity *)

5.3. Basic Regression Results

The basic regression results are shown in Table 4. In the multicollinearity test, maximum value is 6.22, and the average value is 2.45. Since both are less than 10, there is no multicollinearity indicated. Furthermore, to control the effects of industry and time, this study introduces “industry” and “year” dummy variables in the basic regression test.

Table 4. Basic regression results

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	RDI	RDI	RDI	RDI	RDI	RDI	RDI
MVI	0.253***	0.253***	0.259***	0.259***	0.235***	0.240***	0.240***
	-9.79	-9.79	-10.05	-10.05	-8.94	-9.14	-9.09
Age		0.099***	0.104***	0.104***	0.102***	0.107***	0.109***
		-15.05	-15.84	-15.82	-15.51	-16	-16.18
LV			0.518***	0.514***	0.615***	0.388***	0.386***
			-7.78	-7.64	-8.69	-4.32	-4.29
LAr				0.035	0.072	0.046	0.071
				-0.34	-0.71	-0.45	-0.7
ROA					1.039***	0.598**	0.680***
					-4.51	-2.35	-2.66
Sale						0.053***	-0.003
						-4.1	(-0.13)
Size							0.073***
							-2.63
HHI							0.036
							-0.53
Constant	0.964***	-0.223*	-0.457***	-0.464***	-0.507***	-1.549***	-2.007***
	-7.72	(-1.68)	(-3.37)	(-3.38)	(-3.69)	(-5.36)	(-5.96)
Observations	6,588	6,588	6,588	6,588	6,588	6,588	6,588
R-squared	0.058	0.058	0.067	0.067	0.07	0.072	0.073
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES

5.4. Endogeneity Test

Table 5. Two-stage regression results

	(1)	(2)
Variable	first stage	second stage
	MVI	RDI
L.MVI	-0.034**	
	(0.013)	
MVI		-3.325**
		(1.484)
Age	0.054***	0.196**
	(0.004)	(0.080)
LV	0.207***	1.054***
	(0.053)	(0.360)
LAr	-0.000	0.038
	(0.057)	(0.212)
ROA	2.061***	8.030***
	(0.152)	(3.030)
Sale	-0.043***	-0.164**
	(0.014)	(0.080)
Size	0.009	0.095
	(0.016)	(0.059)
HHI	-0.209***	-0.850**
	(0.041)	(0.336)
Constant	0.488***	0.634
	(0.187)	(1.001)
Observations	5,856	5,856
R-squared	0.085	

The previous article discussed the effects of market value changes on the innovation levels of listed companies. However, companies with higher innovation levels have higher market values, which may lead to deviations in the previous estimation results. The Hausman test rejects simultaneously the null hypothesis that all explanatory factors are endogenous. This research applies the instrumental variable technique to solve the endogenous issues in the hypothesis of this investigation. As the instrumental variable for regression, the company's total market capitalization growth rate trailing one period (L.MVI) is used. Table 5 shows the two-stage regression results. The L. MVI coefficient is positive at a significance level of 1%, suggesting that the finding from the main test that the increase in market capitalization significantly improves the innovation level of state-owned enterprises is relatively robust.

5.5. Robustness Analysis

To evaluate the model's robustness, the overall sample data is divided into data from 2011, 2014, 2017, and 2020, including 688 enterprises. The data from these four years are tested using the proposed multiple regression model. Table 6 displays the regression findings, all of which are significant, demonstrating that Hypothesis 1 is still true.

Table 6. Results of the robustness test

Variable	(1)	(2)	(3)	(4)
	RDI	RDI	RDI	RDI
MVI	1.118***	0.030	0.475*	0.236
	(3.33)	(0.45)	(1.70)	(1.03)
Age	-	-	-	-
LV	0.007	0.781***	0.050	0.187
	(0.01)	(3.68)	(0.17)	(1.12)
LAr	-0.455	0.233	-0.654***	0.012
	(-0.64)	(0.58)	(-2.77)	(0.05)
ROA	-3.085	0.733	-0.352	0.809**
	(-1.42)	(0.75)	(-0.40)	(2.01)
Sale	-0.049	-0.067	0.110*	-0.126
	(-0.28)	(-0.54)	(1.95)	(-1.08)
Size	0.385*	0.082	-0.029	0.243*
	(1.92)	(0.59)	(-0.46)	(1.67)
HHI	1.068***	-0.362**	-0.076	-0.260*
	(2.61)	(-2.00)	(-0.41)	(-1.67)
Constant	-6.709***	-0.326	-1.228	-2.361**
	(-3.30)	(-0.36)	(-0.98)	(-2.52)
Observations	732	732	732	732
R-squared	0.093	0.029	0.072	0.050

5.6. Test of Loss Aversion Mechanism

From the perspective of behavioral economics, the decrease in market value will reduce the level of innovation input of listed companies by enhancing managers' loss aversion. Considering that managers of SOEs and NSOEs have different levels of loss aversion to market value fluctuations, this paper takes whether they are state-owned enterprises as the grouping regression standard. When the market value falls, the profit-driven managers will lead to the loss aversion of NSOE higher than SOEs, which will lead to the termination of long-term R&D investment projects. Therefore, if the decrease in market value reduces R&D investment by strengthening the degree of loss aversion, then

NSOEs will be more likely than SOEs to observe the effect of market value changes on the innovation decision.

5.6.1. Test of loss aversion mechanism by MIV

Table 7 shows the regression results tested by the explanatory variable MIV. At the 1% significant level, the MVI coefficients of SOEs and NSOEs are positive. Despite the apparent lack of a statistical test, there is a substantial difference between the two groups' MVI coefficients, and the corresponding p-value is 0.0067. The effects of surface market value fluctuations on the innovation decisions of SOEs and NSOEs differ.

Table 7. Loss aversion test: MVI

Variable	SOE=1	SOE=0
	RDI	RDI
MVI	0.344***	0.198***
	-3.77	-4.97
Age	0.150***	0.089***
	-6.71	-8.52
LV	0.331*	0.302***
	-1.76	-2.61
LAr	0.336	-0.096
	-1.39	(-0.73)
ROA	-0.321	0.993***
	(-0.44)	-4.05
Sale	-0.004	-0.003
	(-0.05)	(-0.07)
Size	0.058	0.078*
	-0.6	-1.85
HHI	-0.184	0.023
	(-1.17)	-0.28
Observations	2,077	4,511
R-squared	0.094	0.072

5.6.2. Test of loss aversion mechanism by Tobin’s Q

In order to further verify Hypothesis 2, this paper uses the alternative variable Tobin's Q (tobin) replace the company's total market value growth rate (MIV) for another test. In Table 8, the tobin coefficient of SOEs is 0.031 and not significant, while the tobin coefficient of NSOEs is 0.023, which is significantly positive correlation with RID at the 5% level. This aspect verifies Hypothesis 2 again, indicating that the decrease in market capitalization strengthens the loss aversion of corporate managers and thus reduces the level of corporate innovation investment.

Table 8. Loss aversion test: Tobin's Q

Variable	SOE=1	SOE=0
	RDI	RDI
Tobin	0.031	0.023**
	-1.16	-2.33
Age	0.142***	0.084***
	-6.31	-7.85
LV	0.416**	0.356***
	-2.19	-3.03
LAr	0.358	-0.094
	-1.44	(-0.70)
ROA	0.123	1.265***
	-0.16	-4.62
Sale	-0.005	-0.011
	(-0.06)	(-0.29)
Size	0.063	0.094**
	-0.66	-2.21
HHI	-0.239	-0.026
	(-1.47)	(-0.32)
Constant	-1.992**	-2.063***
	(-2.15)	(-4.22)
Observations	2,077	4,511
R-squared	0.082	0.061

6. Conclusion

Taking listed companies as samples, this paper studies the relationship between market capitalization fluctuations and their impact on the innovation decisions of listed companies. It is found that innovation failure can significantly promote the new R&D investment of state-owned enterprises. After two-stage analysis and robustness tests, such as the re-selection of samples, this conclusion remains stable. The loss aversion mechanism test finds that market capitalization fluctuations impact SOEs and NSOEs differently. The decrease in market capitalization will significantly affect the innovation investment level of NSOEs.

The above conclusions show that loss aversion theory has a certain explanatory power for the innovation decision-making behavior of quoted companies, and NSOEs are more susceptible to changes in market value than SOEs in the process of R&D and innovation. Given this, non-state-owned enterprises should establish an effective power check and balance mechanism, optimize the power allocation structure of the management team, and prevent the short-sighted effect of the management, which will affect the long-term innovation and development strategy of the enterprise.

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