The Influence of R&D Background Executives on Enterprise Innovation Investment

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Abstract: Innovation as a necessary condition to keep the vitality and improve the competitiveness of enterprises has been widely concerned. How to improve the innovation ability of enterprises has become the research focus under the realistic background of more small and medium-sized enterprises in China. Based on the upper echelons theory, this paper studies the impact of R&D background executives on innovation investment and its path from 2008 to 2019 in Shanghai and Shenzhen a-share listed companies. It is found that the more R&D background executives, the more innovation investment, and this effect is achieved by easing the financing constraints. The conclusions of this paper expand the related research of enterprise innovation input in theory, and provide a new idea for enhancing enterprise innovation input and improving competitiveness.

1. Introduction

Innovation leads development, innovation creates the future. The 19th National Congress of the CPC points out that innovation is the strategic support for the construction of a modern economic system, and in the critical period of the optimization of China's economic structure and the transformation of its development mode, we must rely on innovation closely to enhance the national competitiveness. So how to improve the level of national innovation? Yu Yihua et al. [1] point out that the core is to promote enterprise innovation. All along, people from all walks of life have also chanted the slogan "Mass Entrepreneurship and mass innovation". Governments at all levels have continuously encouraged innovation in enterprises, stimulated their vitality and promoted their transformation and upgrading, how to promote enterprise innovation effectively is also a research focus in the academic circle. From the microcosmic point of view, human resource is one of the most important resources in an enterprise, in which senior managers, as the main leaders of strategic decision-making, play a vital role. As far back as 1984, Hambrick and Mason pointed out, managers who are influenced by complex environments are not able to make comprehensive observations, but are selective observers, relying on their own cognitive structure to interpret information, that is to say, the characteristics of the manager can influence the strategic choice. This theory has attracted wide attention, and many scholars have also connected the characteristics of managers with the innovation of enterprises. At present, the main characteristics of research are as follows: executive compensation [2], gender [3], tenure [4], etc., there is also a growing body of research that takes executives'backgrounds into account, including academic, overseas, and financial backgrounds, but less research and development. This paper argues that in terms of innovation decision-making, R&D background executives may be more deserving of attention than those with other backgrounds, because they are more professional in technology innovation, can grasp the direction of innovation development, for the enterprise's investment decision-making guidance, more accurate and bold in project selection, improve the enterprise's sensitivity to investment opportunities; bring a lot of hidden technology and other resources to the enterprise, which make the enterprise's R&D activities more active. Therefore, it is more meaningful to study the impact of R&D background on Innovation Investment.

Based on the data of a-share listed companies in Shanghai and Shenzhen from 2008 to 2019, this paper makes an empirical analysis of the proposed hypothesis. The empirical results show that the

increase of R&D background executives can indeed promote the innovation input of enterprises, and there exists a mechanism of "R&D background executives, financing constrains, the innovation input". Further study found that: in the more transparent information environment, the increase of non-R&D background of the number of executives to promote innovation more obvious, when executives face higher career risk, R&D background of the executives to promote the role of the stronger; Different organizational environments also play different roles, and high-tech companies can mask the role of senior executives with R&D backgrounds. The above research findings can provide new ideas for improving corporate governance, enhancing the innovation ability and competitiveness of enterprises.

2. Theoretical analysis and research hypotheses

2.1 R&D background executives and innovation investment

According to the upper echelons theory, managers' cognitive structure and values determine their ability to interpret relevant information. Managers are the key decision-makers of enterprises. When faced with project decision-making, personal cognition will influence their strategic choice, and then influence the behavior of enterprises. Scholars have long noted the role of executives in corporate innovation, and in recent years, there have been a lot of relevant studies, which can be divided into two categories: one is demographic characteristics, the gender of executives [5], age [6], tenure [7], and so on; The other is the background, such as academic [8,9], educational [10], overseas experience [11], financial background [12] and so on. However, the R&D background proposed in this paper has received little attention. As one aspect of executives' social characteristics, this background is also crucial to enterprise innovation. What is the impact of an executive's R&D background on the firm's investment in innovation?

Firstly, executives with R&D background is more professional [13]; their prior experience gives them a clearer understanding of R&D, more emphasis on innovation in corporate project decision making, and more professional advice, give full play to the role of human capital of technical personnel, to a certain extent, increase the input of enterprises to innovative projects.

Secondly, senior executives are more familiar with the objective laws of R&D, and can recognize the importance of financial support for R&D activities, when the number of senior managers with R&D background increases, they can avoid the short-sighted behavior of the management team to some extent and increase the innovation investment [14].

Finally, according to the signaling theory, an increase in the number of senior executives with R&D backgrounds will signal to outside investors that the company values innovation, thereby increasing investor confidence in the company's R&D activities, this makes it easier for companies to secure investment, easing financing constraints and making it more likely to invest in research and development. Based on the above analysis, this paper proposes the following hypothesis:
H1: R&D background executives have a positive impact on enterprise innovation input.

2.2 The intermediary role of financing constraints

The expertise effect of R&D background executives can ease financing constraints. The fact that executives can be referred to as R&D background executives shows that they must have very rich R&D experience and can be regarded as experts in the industry. As senior managers, they are more likely to be able to judge or perceive future directions or technological developments, to make strategic decisions about technology, to allocate resources, and to spend more on research and development, avoid the risk of project disruption. In addition, they can screen quality projects based on experience, improve innovation efficiency, reduce the probability of failure, reduce the amount of external financing.

The network effect of R&D executives can ease the financing constraints. In their long-term working practice, such executives have formed their own network of relationships with many technical experts, high-tech enterprises, scientific research institutes and other individuals or organizations, this kind of relation net not only is helpful to the enterprise technically, but also is advantageous to the enterprise's financing channel.

The information effect of R&D background executives can ease the financing constraints. The increase of R&D background in the senior management team can alleviate the short-sighted behavior of the management, actively engage in innovation activities, the first investors to convey the signal that the enterprise attaches importance to innovation, and at the same time, enhance the confidence of investors. In addition, as an expert, the company will supervise the disclosure of information to investors in a more professional manner, reducing the Information asymmetry of both sides and effectively easing the financing constraints.

This paper argues that the above-mentioned three effects can effectively ease the financing constraints of R&D executives, and the research shows that when the financing constraints are eased, their innovation investment will increase significantly. Therefore, this paper proposes the following hypothesis:

H2: R&D background executives increase innovation investment by easing corporate financing constraints.

3. Research design

3.1 Sample selection and data sources

The initial sample of this paper is A-shares listed companies in Shanghai and Shenzhen, the sample range from 2008 to 2019. The initial sample was treated as follows: (1) the samples of ST and *ST companies were deleted; (2) The financial and utility companies were deleted because these industries were subject to strict regulation; (3) The missing value samples were deleted.

After processing, this article finally obtains 12990 company annual sample. To avoid the influence of extreme values, winsorize is applied to all continuous variables at 1% and 99% levels before analysis. All the data come from CSMAR database, and STATA16.0 is used for follow-up analysis.

3.2 Variable definition

(1) Innovation investment. Referring to Duan Junshan and Zhuang Xudong's practice [15], this paper takes the natural logarithm of R&D Investment as the index of Innovation Investment (RD) .

(2) R&D background executives. R&D background executives (FUNBACK) refers to the work experience of Research and Development and the ability to apply the knowledge and technology to the innovation activities of enterprises, this paper measures R&D background executives by the number of R&D background executives in the executive team.

(3) Financing constraint. The main indicators of financing constraints are KZ index, WW index and SA Index. Considering that the first two indexes may have endogenous problems, the SA index, which is constructed by two exogenous variables of enterprise size and age, can solve this problem to some extent[16]. Therefore, this paper uses the SA index to express the financing constraint. Considering the negative value of SA, the paper takes the absolute value of SA to get the new SA Index.

(4) Control variables. In this paper, we use Leverage to represent capital structure (Leverage), logarithm of total assets to represent Size (Size), sales growth rate to reflect Growth (Growth), and yield valve to reflect profitability (ROE). In addition, it also includes the property rights nature (SOE), Board Size (Board), Dual roles of chairman and general manager (Dual), investment opportunity (Q) , top-1 shareholder ownership (Top-1) , Cash holdings (Cash) , Age of the company(Age), Industry(Ind) and Year(Year).

The specific definitions of each variable are shown in Table.1.

Table.1. Variable definition

Variable name	Symbol	Instruction
Innovation Investment	RD	the natural logarithm of R&D Investment
R&D Background Executives	Funback	the number of R&D background executives in the executive team
Financing Constraint	SA	the absolute value of SA

Leverage	Leverage	total liabilities / total assets
Company Growth	Growth	growth rate of sales revenue
Company Size	Size	the natural logarithm of the average of total assets at the beginning and end of the year
Profitability	ROE	Return on Equity
Board Size	Board	the natural logarithm of the number of board members plus one
Property Nature	SOE	dummy variable
Double Duty	Dual	dummy variable
Investment Opportunities	Q	market value / year-end total assets
Ownership concentration	Top-1	Share of the largest shareholder/total share
Cash Holdings	Cash	cash holdings / total assets
Company Age	Age	the natural logarithm of the company age plus one
Industry	Ind	dummy variable
Year	Year	dummy variable

3.3 Model design

According to the theoretical analysis, this paper uses non-equilibrium panel data to test the above hypothesis. To test the H1, that is, the relationship between R&D background and innovation investment, model (1) is established. Where, RD_{it+1} is the innovation investment of enterprise i in year t+1, and $Funback_{it}$ is the number of senior executives with R&D background in year t; $Controls_{it}$ is the control variables; ε_{it} is the residual term.

$$RD_{it+1} = a_0 + a_1 Funback_{it} + a_k \sum Controls_{it} + \varepsilon_{it} \quad (1)$$

$$SA_{it} = b_0 + b_1 Funback_{it} + b_k \sum Controls_{it} + \varepsilon_{it} \quad (2)$$

$$RD_{it+1} = c_0 + c_1 Funback_{it} + c_2 SA_{it} + c_k \sum Controls_{it} + \varepsilon_{it} \quad (3)$$

To verify H2, the model (2) is established. SA_{it} is the financing constraint index of enterprise i in t year, and $Funback_{it}$ is the number of senior managers with R&D background in t year. b_1 represents the total effect of R&D background executives on R&D investment, b_1 represents the effect of R&D background executives on financing constraints, and c_1 represents the direct effect of R&D background executives on R&D investment after controlling for corporate financing constraints, c_2 indicates the degree to which R&D investment is influenced by financing constraints after controlling the number of R&D background executives. $c_2 b_1$ indicates the indirect effect of R&D background executives on enterprise innovation investment, that is, the intermediary effect of financing constraints, other variables have the same meaning as the model (1).

4. Empirical analysis

4.1 Descriptive statistics

Table.2. provides descriptive statistics of the main variables. The mean and median of R&D investment variable are close to each other, which shows that they are not affected by the extreme value and the results are credible. The number of R&D background executives is 23 at most, which is quite different from the average of 1.47, and the number of R&D background executives is only 2 in the third quartile, which shows that the number of R&D background executives is very small in most listed companies, but once the company has a R&D background executive, the percentage is high on the executive team. Table.3. is a mean test of the differences between groups of R&D and Non-R&D executives based on whether there are R&D executives in the sample. The results show that the R&D background group is superior to the other group in R&D investment level, which also preliminarily

confirms our conjecture that the R&D background has a positive effect on enterprise innovation investment.

Table.2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	P25	P50	P75	Max
RD	12,990	17.72	1.72	12.73	16.76	17.78	18.78	21.97
Funback	12,990	1.47	1.51	0	0	1	2	23
SA	12,990	3.83	0.24	2.53	3.67	3.83	3.99	4.59
Leverage	12,990	0.43	0.21	0.05	0.27	0.43	0.59	0.92
Size	12,990	22.06	1.26	15.42	21.17	21.89	22.74	28.14
Growth	12,990	0.18	0.40	-0.51	-0.01	0.12	0.28	2.60
ROE	12,990	0.07	0.11	-0.48	0.03	0.07	0.12	0.37
SOE	12,990	0.36	0.48	0	0	0	1	1
Board	12,990	2.24	0.21	0	2.08	2.30	2.30	3.05
Q	12,990	2.01	1.69	0.17	0.85	1.53	2.59	9.29
Top1	12,990	35.27	14.85	0.29	23.50	33.68	45.23	89.09
Cash	12,871	0.18	0.13	0.01	0.09	0.14	0.23	0.64
Age	12,990	2.79	0.37	0.69	2.56	2.83	3.04	4.13

Table.3. Difference test

Variable	Funback		NOFunback		Diff(F-NOF)
	N	Mean	N	Mean	
RD	9020	17.8315	3970	17.4640	0.3675***

4.2 Basic regression

Table.4. The impact of R&D background executives on innovation investment

Variable	(1)		(2)		(3)	
	F. RD		SA		F. RD	
	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat
Funback	0.143***	-6.810	-0.015***	-5.825	0.140***	-6.629
SA					-0.183	-1.047
Leverage	-0.121	-0.650	0.030	-1.272	-0.141	-0.756
Size	0.007	-0.223	-0.007*	-1.805	0.004	-0.121
Growth	0.025	-0.532	0.004	-0.742	0.032	-0.695
ROE	0.096	-0.419	0.013	-0.485	0.111	-0.482
SOE	0.072	-1.011	0.026***	-2.712	0.080	-1.103
Board	0.003	-0.024	0.022*	-1.661	-0.010	-0.090
Dual	-0.040	-0.701	-0.010	-1.338	-0.040	-0.697
Q	0.009	-0.548	0.002	-0.88	0.007	-0.438
Top1	-0.003	-1.575	-0.000*	-1.928	-0.003	-1.610
Cash	-0.036	-0.174	0.002	-0.063	-0.026	-0.125
_cons	16.738***	-23.265	3.709***	-39.731	17.509***	-18.469
N	9624		12738		9536	
Adj. R2	0.042		0.199		0.043	
Ind	Yes		Yes		Yes	
Year	Yes		Yes		Yes	

As shown in Table.4., model (1) a_1= 0.143 is positive at 1% significance level, that is, increasing the number of R&D background executives can significantly improve the level of innovation investment, this is consistent with the H1. Funback' s coefficient b_1=-0.015 is significantly negative at the level of 1% in model (2), it shows that increasing the number of R&D background executives

can alleviate the financing constraints of enterprises. In the model (3), both R&D background executives and financing constraints are included in the equation, and the coefficient of financing constraint index c_2 =-0.183 is not significant. In this case, we use Bootstrap method to test b_1c_2. The test results are shown in Table.5. The indirect effect P is about 0, the 95% confidence interval does not contain 0, which indicates that the indirect effect is significant and the intermediate effect does exist. In the model (3) , the coefficient before the number of R&D background executives is 0.140, which is positive at the level of 1% significance, and is the same as b_1c_2, which shows that it is part of the intermediary effect, consistent with the assumption of H2.

Table.5. Bootstrap test result

	Coef.	Std.Err	Z	P>|Z|	[95% Conf. Interval]	
Indirect Effect	-0.0030	0.0012	-2.63	0.0000	-0.0053154	-0.0007722
Direct Effect	0.1521	0.0120	12.71	0.0000	0.1286637	0.175583

4.3 Robustness test

Table.6. Robustness test

Variable	(1)	(2)	(3)	(4)	(5)
	F.RDrate	F2. RD	F3. RD	F. RD (SOE=1)	F. RD (SOE=0)
Funback	0.479***	0.130***	0.131***	0.189***	0.126***
	(8.849)	(5.787)	(5.367)	(4.705)	(5.576)
Leverage	-0.422	0.021	0.087	-0.071	-0.131
	(-1.155)	(0.108)	(0.432)	(-0.224)	(-0.582)
Size	0.074	0.004	0.027	-0.024	0.033
	(0.975)	(0.128)	(0.785)	(-0.504)	(0.880)
Growth	0.017	-0.016	0.030	0.060	0.015
	(0.192)	(-0.296)	(0.551)	(0.771)	(0.255)
ROE	-0.994*	0.282	0.210	0.639*	-0.299
	(-1.936)	(1.184)	(0.842)	(1.878)	(-0.988)
SOE	-0.387**	0.099	0.142*		
	(-2.538)	(1.299)	(1.777)		
Board	0.052	-0.082	-0.091	0.048	0.018
	(0.199)	(-0.722)	(-0.793)	(0.285)	(0.120)
Dual	-0.087	-0.038	-0.008	-0.006	-0.046
	(-0.607)	(-0.616)	(-0.124)	(-0.039)	(-0.763)
Q	-0.032	0.005	0.021	-0.001	0.018
	(-0.918)	(0.272)	(1.130)	(-0.023)	(0.968)
Top1	0.002	-0.005**	-0.006**	-0.003	-0.004
	(0.439)	(-2.102)	(-2.406)	(-0.804)	(-1.475)
Cash	0.386	0.088	0.174	-0.264	0.074
	(0.940)	(0.405)	(0.749)	(-0.521)	(0.340)
_cons	0.120	17.326***	16.805***	16.930***	16.356***
	(0.071)	(22.470)	(20.520)	(14.915)	(18.627)
N	9624	7906	6500	3426	6198
Adj. R2	0.064	0.037	0.037	0.040	0.048
Ind	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes

1. Replace dependent variable. Most of the literature [14][17] uses relative metrics to measure innovation investment to improve comparability among different firms. In this paper, we use the absolute index in the base regression, that is, the natural logarithm of R&D investment. Therefore, we

use the relative index to replace the absolute index as the dependent variable to see the change of the result, in this paper, the R&D intensity, which is the proportion of R&D investment to operating income, is chosen as the substitute variable of innovation input, and is brought into the model (1) for regression. The result is listed in column (1) of Table.6., the coefficient of independent variable is significantly positive at 1% level, which is consistent with the original conclusion and shows that the conclusion of this paper is robust.

2. Replace independent variable. R&D activities often take a long time to get results, and the increase in the number of R&D background executives in the current period is not necessarily reflected in the current investment in innovation. In the part of the robustness test, the independent variables of the second and third lag periods are used to replace the original independent variables, the results of the regression are shown in columns (2) and (3) of Table .6. The regression results show that the coefficient of R&D background is significantly positive, that is, the increase of R&D background can promote R&D activities in the next 2-3 years, which is consistent with the result of basic regression.

3. Subinterval estimation. According to whether the sample is divided into two sub-samples for state-owned enterprises, the model (1) is estimated under different samples, and (4) of Table.6. is listed as the regression result under the sub-samples for state-owned enterprises, (5) as the regression result of the non-state-owned enterprise subsample, the result of the different subsample has no difference with the whole sample.

5. Heterogeneity analysis

5.1 Different levels of information transparency

Information transparency is the information characteristic of the enterprise, which can be understood as the information environment of the enterprise. The impact of R&D background on enterprise innovation may vary with the information environment. This article mainly analyzes from two aspects: external financing and internal incentive.

In China, the majority of small and medium-sized enterprises, these enterprises have internal problems, it is difficult to rely on internal funds to carry out innovation activities, so some of the resources needed must be obtained from the outside. When executives make innovation decisions based on their knowledge and skills, if the enterprise is short of funds or the funding chain is broken in the process of R&D, The innovation ability of the enterprise will be affected, and the initial investment can not be recovered, or access to technology. If the enterprise information transparency is high, the information environment is good, to the creditor, may be more convenient, accurate understanding enterprise management situation, the repayment ability and the future development prospect and so on information, enhances the creditor’s capital contribution willingness; for external shareholders, it can effectively ease their information asymmetry with management, strengthen the supervision of management, improve the utilization of funds[18], so that enterprises can obtain more funds to invest in R&D activities.

From the inside, risk averse managers often don’t choose high risk investments, when there are more non-R&D executives on the management team or when they have more power, the whole team was more likely to show risk aversion. This is because most managers’ compensation is not explicitly contractual, but implicit in shareholders’ perceptions of their abilities, so when they make innovative decisions for the long term, shareholders may see only poor short-term performance and not the innovative efforts of managers, so they become conservative in their investments and instinctively resist innovation [19]. Then, when in an environment of high information transparency, it is better for shareholders to see the efforts made by managers and motivate them to innovate.

This paper, based on the practices of Xin Qingquan et al. [20], measures corporate transparency from five aspects: earnings quality, disclosure score, number of analysts, accuracy of analyst forecasts, and whether or not a company is audited, based on the average of the sample percentage grade of these five indexes, the comprehensive transparency index TRANS was constructed. On this basis, this article sets the information transparency dummy variable High_TRANS, when High_TRANS=1, represents

the high information transparency of the enterprise environment; on the contrary, when High_TRANS=0, represents the low information transparency of the environment. Table.7. shows the effects of R&D and Non-R&D background executives on firm innovation investment in different information environments, with columns (1) and (2) being regression results under high information transparency, columns (3) and (4) are the results of regression under low transparency. The coefficients of top management indicators are all positive at 1% significance level in column (1)-(4), which indicates that the increase of top management will enhance the level of innovation activities of enterprises, especially for those with R&D background, because of their past R&D experience and resources to inject new vitality to the enterprise, rather than R&D background in the impact of investment in innovation than R&D background executives. Under different information environments, when the information environment is improved (from low transparency to high transparency) , the coefficient of Non-R&D background executives is increased, while the Coefficient of R&D background executives is decreased, this suggests that greater transparency is better for executives from non R&D backgrounds to make innovative decisions, and that the more information they have and are observed, the more motivated they are to act.

Table.7. Regression results under different information environments

Variable	(1)		(2)		(3)		(4)	
	High_TRANS=1				High_TRANS=0			
Funback	0.130***	-4.957			0.142***	-5.721		
NOFunback			0.091***	-5.002			0.075***	-4.167
Leverage	-0.006	-0.025	0.014	-0.057	-0.223	-1.014	-0.270	-1.225
Size	0.027	-0.712	0.017	-0.457	-0.011	-0.304	-0.005	-0.131
Growth	0.004	-0.053	-0.013	-0.205	0.020	-0.314	0.011	-0.172
ROE	0.088	-0.292	0.073	-0.24	0.089	-0.302	0.003	-0.008
SOE	0.036	-0.395	-0.003	-0.032	0.115	-1.336	0.082	-0.948
Board	0.018	-0.121	0.001	-0.010	-0.025	-0.176	-0.029	-0.204
Dual	-0.032	-0.441	0.003	-0.048	-0.03	-0.405	-0.034	-0.466
Q	0.001	-0.043	0.002	-0.104	0.025	-1.250	0.027	-1.371
Top1	-0.002	-0.696	-0.001	-0.493	-0.004*	-1.738	-0.004	-1.571
Cash	0.004	-0.015	-0.065	-0.259	-0.044	-0.171	-0.082	-0.317
_cons	16.083***	-18.147	16.100***	-18.618	17.324***	-19.162	16.979***	-18.883
N	4893		4893		4731		4731	
Adj. R2	0.052		0.052		0.033		0.026	
Ind	Yes		Yes		Yes		Yes	
Year	Yes		Yes		Yes		Yes	

5.2 Different occupational risks

Ownership structure is one of the key determinants of managerial innovation incentives [19]. Francis and Smith [21] found that firms with dispersed internal ownership were less innovative than firms with concentrated internal ownership. When managers have a lower stake, they are less able to bargain and are more likely to be replaced, so these managers face higher career risks in companies where ownership is fragmented. If the R&D investment fails, they may have to bear all the consequences; even if they succeed, due to the long payback period, they may not be able to recoup the investment or even gain a profit during the tenure of the managers, and the high investment in the early stage will reduce the performance of the managers, which will affect their reputation. It is generally believed that when managers face higher career risks, they will not choose to carry out innovative activities, but this article has a different point of view, this article focuses on R&D

background executives, for such background executives, they have worked in R&D, understood the high risk nature of R&D, preferred risk to other executives, and were more risk tolerant than other executives. In such cases, when executives faced higher career risks, the positive effect of the increase in the number of R&D background executives on the innovation activity is more obvious, while the Non-R&D background executives can accept the innovation activity when the career risk is lower, to a certain extent, cover up the role of R&D background executives.

Table.8. Regression results under different occupational risks

Variable	(1)		(2)	
	High_Career=1		High_Career=0	
	Coeff.	t-Stat	Coeff.	t-Stat
Funback	0.204***	-6.312	0.092***	-3.379
Leverage	-0.2	-0.733	-0.086	-0.399
Size	0.042	-0.978	-0.013	-0.347
Growth	0.072	-1.041	-0.021	-0.375
ROE	0.023	-0.072	0.101	-0.351
SOE	0.199**	-1.969	-0.182**	-2.083
Board	-0.073	-0.485	0.132	-0.862
Dual	-0.042	-0.425	-0.045	-0.716
Q	0.029	-1.034	0.002	-0.094
Top1	-0.005*	-1.698	0	-0.156
Cash	0.039	-0.11	-0.049	-0.229
_cons	15.808***	-14.75	16.996***	-19.658
N	4818		4806	
Adj. R2	0.058		0.037	
Ind	Yes		Yes	
Year	Yes		Yes	

Based on the practice of Lei Xintu and Wen Qingyuan [22], this paper measures the occupational risk by the proportion of managerial ownership. The higher the proportion, the smaller the occupational risk. We establish dummy variable High_Career. When High_Career=1, it means high occupational risk, on the contrary, when High_Career=0, it means low occupational risk. Table.8. shows the regression results for different occupational risks, with (1) classified as high occupational risk and (2) classified as low occupational risk. The results show that the coefficient of independent variable under high occupational risk is higher than that under low occupational risk, and the test of inter-group difference proves that there is a significant difference between the two groups in R&D background, in other words, when managers face higher career risks, the R&D background of senior managers on the innovation activities of greater impact.

5.3 Different organizational settings

R&D background executives may be influenced by the organizational environment in their decision-making. For innovation, the difference of the organizational environment is whether or not they are high-tech enterprises. Compared with non-high-tech enterprises, high-tech enterprises pay more attention to innovation and have more R&D background executives, so whether R&D background executives play a greater role in high-tech enterprises?[23] It is precisely because non-high-tech companies do not pay enough attention to innovation and are not innovative enough overall, the increase in R&D background executives will play a greater role in such enterprises; on the contrary, high-tech enterprises should pay more attention to R&D background, which may cover up the effect of top management on enterprise innovation. Considering the influence of organizational environment, this paper divides the samples into high-tech enterprises and non-high-tech enterprises. For the identification of high-tech enterprises, this paper adopts the method of Zhang Dong et Al. [23] to judge. Taking the qualification documents of CSMAR database as the data source, the high-tech enterprises

that meet one of the following conditions are: (1) the company or its parent company obtained the qualification certification of national/provincial high-tech enterprises in the same year; (2) the period of validity of the qualification certification (normally 3 years). According to this standard, 7958 samples were confirmed as high-tech enterprises and 5032 samples as non-high-tech enterprises. Table.9. examines the mean and median differences of the major variables by whether they are high-tech enterprises. The results show that after grouping, the number of high-tech firms with innovation input and R&D background is significantly higher than that of non-high-tech firms.

Table.9. Difference test

Variable	G1(0)	G2(1)	Mean1	Mean2	MeanDiff	Median1	Median2	Diff
RD	5032	7958	17.4110	17.9141	-0.5031***	17.501	17.884	115.228***
Funback	5032	7958	1.0582	1.7313	-0.6731***	1.000	1.000	550.869***

Table.10. shows the regression results of R&D background executives and enterprise innovation innovation under different samples. Column (1) is the regression under the sample of high-tech enterprises, while column (2) is the regression under the sample of non-high-tech enterprises. The results in Table.10. show that the R&D background executives coefficient is significantly positive at the level of 1%, which shows that the increase of R&D background executives can improve the innovation investment of enterprises, which is consistent with the hypothesis in this paper. For the same dependent variable in different organizational environments, the coefficient in high-tech enterprises is generally smaller than that in non-high-tech enterprises, that is to say, in non-high-tech enterprises, the R&D background executives plays a greater role in enterprise innovation investment, this may be because these enterprises do not attach importance to innovation, and when the number of R&D background executives increases, it may inject new vitality into such enterprises, improve the outlook of R&D activities, and influence the decision-making of the senior management team, the increasing effect of R&D background executives will not have a significant impact on the original innovation decision-making. It can be said that the role of R&D background executives is covered by the corporate environment.

Table.10. Regression results of sub-sample

Variable	(1)		(2)	
	Coeff.	t-Stat	Coeff.	t-Stat
Funback	0.070***	3.001	0.225***	5.253
Leverage	0.080	0.385	-0.232	-0.710
Size	-0.050	-1.410	0.085*	1.736
Growth	0.023	0.438	-0.003	-0.034
ROE	0.294	1.174	-0.117	-0.280
SOE	0.108	1.307	0.132	1.078
Board	0.062	0.446	-0.065	-0.373
Dual	-0.071	-1.154	-0.000	-0.002
Q	0.003	0.149	0.015	0.434
Top1	-0.001	-0.506	-0.007**	-2.039
Cash	0.033	0.148	-0.246	-0.635
_cons	18.110***	21.006	15.170***	13.034
N	6038		3586	
Adj. R2	0.029		0.048	
Ind	Yes		Yes	
Year	Yes		Yes	

6. Conclusions and suggestions

Innovation is an important strategy for enterprises to seek competitive advantage. Under the background of the new era, enterprises must rely on innovation if they want to develop stably for a long time. So, how to enhance enterprise innovation activities? According to the upper echelons theory and human capital theory, senior managers are an important human resource, and its characteristics and experience have an important influence on strategic decision-making. R&D background as an important type of work experience for executives has a significant impact on enterprise innovation, and in order to explore this impact and its mechanisms, based on the non-equilibrium panel data of A-share companies listed in Shanghai and Shenzhen stock markets from 2008 to 2019, this paper draws the following conclusions:

(1) the increase of R&D background executives can promote the innovation investment of enterprises, there exists the mechanism of "R&D background executives - financing restriction - innovation investment".

(2) good information environment enhances the positive effect of non-R&D background executives on enterprise innovation investment, but for R&D background executives, their own risk tolerance is high, and the improvement of information environment has relatively weak effect on it.

(3) when executives face higher career risks, non-R&D executives resist high-risk innovation activities, and the improvement effect of R&D executives on enterprise innovation investment is more obvious; on the contrary, in low career risks, executives are more receptive to innovation, at which point the impact of their R&D background is somewhat overshadowed.

(4) in the non-high-tech enterprises, the R&D background executives can promote the innovation investment more strongly, but for the high-tech enterprises, the R&D background executives' role will be covered by the good innovation environment.

The research conclusion of this paper has reference significance for enterprises to carry out innovation activities efficiently, and puts forward the following suggestions.

Firstly, enterprises should pay attention to human resource management. The quality of the top management team determines the correctness and rationality of the enterprise decision-making. The management team with professional background makes the enterprise run more efficiently. R&D background executives have a significant positive impact on the innovation activities of enterprises, not only to optimize the allocation of internal resources, but also to integrate external resources. Therefore, enterprises should pay attention to the introduction and cultivation of R&D talents and strengthen the innovation atmosphere, which is especially important for non-high-tech enterprises, innovation is the most important task to increase our competitiveness, which can be achieved by bringing in top executives with R&D background or training them from the R&D backbone of our company.

Secondly, enterprises should establish a sound system of information disclosure. A transparent information environment will help the shareholders to correctly identify the innovation efforts of the managers, to a certain extent, ease the managers' resistance to R&D, and at the same time, effectively supervise the managers' behavior, to avoid the occurrence of internal transactions and other acts to the detriment of the interests of the company, for external, to enhance the confidence of external investors, ease the problem of financing constraints. Enterprises should start from long-term interests, establish and improve the information disclosure system, create a good information environment and improve corporate governance.

Finally, the enterprise should establish a reasonable incentive mechanism. Most managers are reluctant to innovate because of the high risk, the investment, the long process, and the risk of being fired if something goes wrong, so they are conservative. In addition to the implicit incentives for information transparency, companies should develop more incentive mechanisms for innovation, such as job promotion, compensation, equity, and so on, to stimulate their innovative initiative.

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