Executive Equity Incentive, R&D Investment and Enterprise Performance

-empirical research based on economic innovation

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Abstract. With the vigorous implementation of China's economic innovation and transformation and the deepening of market-oriented reform, "innovation driven" is an important national strategy to realize China's economic transformation and upgrading and sustainable development. This paper takes the manufacturing listed enterprises in 2009-2019 as the research sample, and selects multiple regression and hierarchical regression analysis methods to study the data of the proportion of senior executives' shareholding, the ratio of R&D expenditure to operating income and the rate of return on total assets. This paper discusses the relationship among executive equity incentive, R&D investment and enterprise performance. The empirical results show that: executive equity incentive has a significant positive effect on R&D investment. There is a significant positive correlation between the proportion of executives' shareholding and the growth of corporate performance; R&D investment plays a partial mediating role between executive equity incentive and firm performance.

1 Introduction

With the vigorous implementation of China's economic innovation and transformation and the deepening of market-oriented reform, although the scale of China's manufacturing industry ranks first in the "Thirteenth Five-Year Plan" period, it still faces enormous challenges, including the weak innovation ability of traditional manufacturing industry and the weakening of demographic dividend, which makes the comparative advantage of low production cost gradually weaken. The "14th Five-Year Plan" period is a key stage connecting the preceding with the following for the manufacturing industry, and the innovation-driven development strategy is mentioned. Therefore, in order to successfully transform and upgrade the traditional manufacturing industry, we must adhere to independent innovation, incubate new competitive advantages, and face challenges with the opportunity of building a new development pattern^[1].

In the modern corporate governance, the executive equity incentive scheme plays an increasingly significant role, on the one hand, it exerts a subtle influence on the management's R&D decision-making, on the other hand, it has an important impact on the steady growth of enterprise performance. Management is the maker of enterprise strategy and the promoter of innovative R&D projects^[2]. Moreover, R&D investment is closely related to enterprise performance. With the increasingly stable governance of the market environment in China and the further optimization of the perfection of the enterprise management concept, the role played by the

management in the enterprise governance becomes more and more critical^[3]. However, what executive incentive schemes can effectively improve the R&D investment mechanism of enterprises and achieve sustainable development of enterprises, and there is still room for further theoretical research on how to link R&D investment between executive equity incentive and enterprise performance.

2 Theoretical analysis and research hypothesis

2.1. Research on the relationship between executive equity incentive and corporate performance

Jensen and Meckling (1976) studied the relationship between the two rights -- the control right and the residual value claim right of the enterprise^[4]. They found that the imbalance of the managers' income, that is, the deviation is one of the main reasons for the agency cost. Based on the "interest convergence hypothesis" - the theory of equity incentive value. The hypothesis of "interest convergence hypothesis" has been proved in the research of the interaction between executive equity incentive and corporate performance. For example, yimeiqun et al. (2018) analyzed a lot of effective data, and found that the interests of managers and managers are unbalanced, but equity incentive can alleviate this problem and arouse managers' attention to innovative

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R&D projects^[5]. It is helpful for enterprises to improve the sustainability of business capacity and optimize the performance of enterprises to a certain extent. Taking listed companies as the research object and constructing multiple model equations for empirical analysis, Li Lianwei (2017) confirmed that equity incentive really has the effect of improving corporate performance^[6]. To sort out and integrate the above literature, effective equity incentive is beneficial to corporate performance optimization.

H1: executive equity incentive has a significant positive impact on corporate performance.

2.2. Research on the relationship between R&D investment and enterprise performance

This paper investigates the relationship between R&D investment and enterprise performance by many academic teams at home and abroad. For example, "arithmetic average of sales", "total operating profit" and "enterprise's market share" are selected by McGee and Dowling (1994), Dougherty and Hardy (1996) for empirical analysis, which proves that the optimization of the above indicators depends on the R&D and innovation activities of enterprises^[7]. In the research on the relationship between R&D innovation activities and enterprise performance, Lu Guoqing (2011) found out the following benefits: (1) R&D innovation can replace high-cost production factors, achieve the effect of cost saving, so as to improve enterprise performance (2) When the market share of enterprises is low, R&D innovation is the best way to break the bottleneck, rely on new product research and development to seize market share^[8]. To sum up, it is necessary to promote the R&D innovation activities if the enterprise wants to be based on the changeable market environment for a long time and achieve considerable enterprise performance. Therefore, we have the following conjecture about the relationship between R&D investment and enterprise performance.

H2: R&D investment has a significant positive impact on firm performance.

2.3. Research on the effect of R&D investment on the relationship between executive equity incentive and firm performance

In the process of the influence of executive equity incentive on enterprise performance, R&D investment plays a subtle role in linking them. In order to confirm the relationship among the above three, we choose the method of proving the transmission path of intermediary variables provided by Wen Zhonglin et al. (2004), and the explanatory variable is designated as the shareholding ratio of senior executives^[9]. The explained variables are designated as the ratio of R&D expenses to operating income and return on total assets. The explained variables (executive equity incentive indicators) do not directly affect the explained variables (enterprise performance indicators), but first affect R&D investment, that is, bless R&D investment funds to

obtain innovative results, R&D investment serves as an intermediary variable in this process. Therefore, looking at the above, the result variable of executive equity incentive is R&D investment, that is, the innovation project of the enterprise has a certain intermediary effect between the proportion of executive equity and net profit.

H3: R&D investment plays an intermediary role in the process of the influence of executive equity incentive on enterprise performance.

3 Empirical research design

3.1. Sample selection and data sources

In order to avoid the influence of industry factors on the research results and ensure the accuracy and continuity of the research results, this research sample will select the listed manufacturing enterprises from 2009 to 2019, and select the original samples according to the following requirements: screening out the sample enterprises lacking R&D expense data; Screening out sample enterprises with ST and *ST; Screening out sample enterprises whose relevant data are not disclosed; Sample enterprises with negative operating gross profit margin are screened out. Finally, the unbalanced panel data of 13175 sample enterprises are selected.

CS-MAR Guotai 'an Database is the main source of empirical data in this paper, and only the data of R&D expenses of sample companies are taken from Flush Database and Wind Database. The descriptive statistical analysis, correlation analysis and regression analysis of the model were carried out by using SAS26 software. In order to reduce that useless influence of extreme values on the research conclusion, winsorize tail reduction is used to process continuous variables at the level of 1% above and below the sample enterprises^[10].

3.2. Variable definition

Table 1. Variable description

Variable type	variable symbol	Variable name	Variable definition
Interpreted variable	ROA	return on total assets	Net profit/Book value of total assets
Explanatory variables	MSR	Executive equity incentive	The ratio of the number of senior executives holding shares to the total shares of the company in the current year
Intermediary variable	R&D	R & D investment intensity	R & D expenditure/Main business income
control variable	SIZE	company size	In (book value of total assets)
	GROW	Revenue Growth Rate	(current period revenue - previous period revenue) / last period revenue
	LEV	Asset liability ratio	Total liabilities at the end of the period/Total assets at the end of the period
	LIQJ	Turnover rate of total assets	Revenue / average assets
	LS	Equity concentration	Sum of shareholding ratio of top ten shareholders

3.2.1 the interpreted variable

In this paper, return on total assets (ROA) is taken as an interpreted variable.

3.2.2 Explanatory variables

In this paper, the method of Lv Changjiang et al. (2008) is adopted, and the ratio of the number of senior executives' shares to the total number of shares of the company in that year. That is, the ratio of senior

executives' shares (MSR), is used to measure.

3.2.3 Intermediary variables

In this paper, the ratio of R&D expenses to operating income will be used to measure the R&D investment index of enterprises, which is abbreviated as R&D. .

3.2.4 Control variables

Because enterprise performance will be affected by many factors, in order to improve the reliability of the research results, on the basis of referring to relevant research, this paper will designate five control variables as enterprise size, grow capacity, asset-liability ratio, total asset turnover ratio and equity concentration ratio. Specific variable definitions are shown in the following table:

3.3. Model building

According to the above hypothesis, this paper establishes the following model^[6], as shown in the following figure:

Fig. 1. Schematic diagram of model construction

The core of this paper is based on the unbalanced panel data of manufacturing listed companies to explore the relationship among executive equity incentive, R&D investment and enterprise performance, and construct the following three regression models for empirical analysis:

$$ROA = \alpha_0 + cMSR + \beta_{11}SIZE + \beta_{12}GROW + \beta_{13}LEV + \beta_{14}LIQJ + \beta_{15}LS + \varepsilon_1 \quad (1)$$

$$ROA = \alpha_0 + bR\&D + \beta_{21}SIZE + \beta_{22}GROW + \beta_{23}LEV + \beta_{24}LIQJ + \beta_{25}LS + \varepsilon_2 \quad (2)$$

$$ROA = \alpha_0 + cMSR + bR\&D + \beta_{31}SIZE + \beta_{32}GROW + \beta_{33}LEV + \beta_{34}LIQJ + \beta_{35}LS + \varepsilon_3 \quad (3)$$

In the above three models, the influence degree of each explanatory variable on the explained variable is C, C', a, B, B', respectively β Representatives, α_0 is a constant term, ε as a random error term, it shows that there may still be other factors influencing the conclusion.

4 Empirical results and analysis

4.1. Descriptive statistics

The descriptive statistical analysis of this empirical study focuses on executive equity incentive indicators, R&D investment indicators and enterprise performance indicators.

Table 2. Descriptive statistical analysis of variables

	N	minimum value	Maximum	mean value	standard deviation
MSR	13175	0	0.8433	0.103702	0.1645357
R&D	13175	0.002	88.56	4.53486	3.9820814
ROA	13175	0.0001	1.2016	0.062756	0.0509735
SIZE	13165	18.9869	27.4677	21.89039	1.1670344
GROW	11897	-0.9132	665.5401	0.324282	7.3754161
LEV	13175	0.0075	1.3035	0.361426	0.1863387
LIQJ	13175	0.006	7.8714	0.695092	0.4242353
LS	13175	8.97	99.79	61.197602	14.5631366

According to the results of descriptive statistics, it is known that:

- The proportion of senior executives' shareholding is from 0. 00% to 84. 33%, with an average of 10. 37%. The equity incentive has a long span.

- The average proportion of R&D expenditure to operating revenue is only 4. 53%, and the overall situation of R&D expenditure has not reached the internationally recognized level (companies with R&D expenditure exceeding 5% of operating revenue are more competitive).

- On the average, the average return on total assets of listed manufacturing enterprises is 6. 28%, which keeps a good profitability; There is a big difference between the minimum value of 0. 01% and the maximum value of 120. 16%, which reflects the unbalanced development of the industry and the disparity of performance level.

4.2. Correlation analysis

In order to avoid collinearity, Pearson correlation analysis is used to preliminarily judge the relationship between the main variables. The correlation coefficient and significance level of executive equity incentive, R&D investment and enterprise performance are shown in the table below.

Table 3. Relevance

	MSR	RD	ROA	SIZE	GROW	LEV	LIQJ	LS
MSR	1							
RD	0.138**	1						
ROA	0.166**	0.038**	1					
SIZE	-0.318**	-0.180**	-0.128**	1				
GROW	-0.004	-0.001	-0.001	0.029**	1			
LEV	-0.248**	-0.225**	-0.381**	0.551**	0.030**	1		
LIQJ	-0.081**	-0.292**	0.163**	0.118**	0.008	0.191**	1	
LS	0.240**	0.001	0.284**	-0.094**	0.023*	-0.168**	0.057**	1

**At the 0. 01 level, the correlation was significant.

*At the 0. 05 level, the correlation was significant.

From the significance level and correlation coefficient presented in the above table, it can be preliminarily judged that:

- There is a positive correlation between executive equity incentive and corporate performance. It can be concluded that the performance of listed manufacturing enterprises in China has reached a new high at the present stage. Maybe we can refer to the executive equity incentive scheme.

- R&D investment is positively correlated with executive equity incentive and corporate performance.
- The correlation coefficients of all variables were less than 0.6, and it was preliminarily judged that there was no multiple collinearity among variables.

4.3. Test and analysis of the relationship between executive equity incentive and corporate performance

Table 4. Regression analysis results of executive equity incentive and enterprise performance

Model I	Unstandardized coefficient		Normalization coefficient	t	significance
	B	Standard error	Beta		
(constant)	-0.106	0.009		-12.076	0
MSR	0.018	0.003	0.058	6.622	0
SIZE	0.007	0	0.174	17.614	0
GROW	1.43E-05	0	0.002	0.265	0.791
LEV	-0.121	0.003	-0.458	-46.479	0
LIQJ	0.025	0.001	0.223	26.843	0
LS	0	0	0.141	16.791	0

A. dependent variable: ROA

Based on the running analysis results of model I, it can be seen that the regression coefficient between executive shareholding ratio and enterprise performance is 0.058 as a positive value, and H1 is assumed to hold through the significance test.

The above conclusions can show that the executive equity incentive can promote the executives to participate in corporate governance as masters, and combine their own interests with corporate performance, thus helping enterprises to obtain more benefits.

4.4. Test and analysis between R&D investment and enterprise performance

Table 5. Regression analysis results of executive equity incentive and enterprise performance

Model I	Unstandardized coefficient		Normalization coefficient	t	significance
	B	Standard error	Beta		
(constant)	-0.095	0.009		-10.932	0
R&D	0	0	0.014	1.582	0.114
SIZE	0.007	0	0.16	16.589	0
GROW	1.39E-05	0	0.002	0.257	0.797
LEV	-0.121	0.003	-0.459	-46.256	0
LIQJ	0.025	0.001	0.223	25.927	0
LS	0.001	0	0.153	18.59	0

A. dependent variable: ROA

Based on the operational analysis results of model II, it can be seen that the regression coefficient between R&D investment and enterprise performance is 0.014, which is significant. The current market environment is unpredictable, which will affect the promotion of R&D investment on enterprise performance to a certain extent. Generally speaking, the promotion is more obvious, so there is a significant positive correlation between R&D income and enterprise performance. H2 is established.

4.5. Test of Intermediary Effect of R&D Investment

Table 6. Test results of intermediary effect of R&D investment

Dependent variable independent variable		Unstandardized coefficient		Normalization coefficient	t	significance
		B	Standard error	Beta		
ROA	MSR	0.051	0.003	0.166	19.266	0.000e
R&D	MSR	3.337	0.209	0.138	15.979	0.000a
ROA	MSR	0.051	0.003	0.163	18.835	0.000e'
	R&D	0	0	0.016	1.801	0.072b'

Set up program I and program II to explore the intermediary effect: program I is to judge whether the executive equity incentive positively affects the enterprise performance. Based on the analysis of the above data, it can be concluded that the influence degree of executive equity incentive (MSR) on enterprise performance (R&D) is significant, and the regression coefficient of 0.166 is positive, that is, it has a significant positive impact. Therefore, further explore whether R&D investment has intermediary effect between them.

Procedure II is to judge whether executive equity incentive is active in R&D investment. The regression coefficient of executive equity incentive (MSR) and R&D investment (R&D) is 0.138, which is a significant positive impact.

In procedure III, the intermediary variable R&D investment (R&D) is inserted to further judge whether R&D investment plays a mediating transmission effect between the two in the process of executive equity incentive affecting enterprise performance. The regression coefficient of R&D investment and enterprise performance is 0.016, which is positive, and its influence degree is significant, that is, significant positive impact. The significance level is 10%, that is, the coefficient B 'is significant. We can infer that the results of R&D investment may lag behind, but it can still effectively stimulate the growth of enterprise performance again.

According to the above program operation analysis, it can be seen that after the intermediate variable R&D investment is inserted into model III, it is proved that it does play a subtle role in convergence, that is, the mediating conduction effect. The impact of executive equity incentive on corporate performance is significant (and the significance level is 1%), 0.166 is the regression coefficient of the two is positive, that is, significant positive impact. Even if the intermediary variable R&D investment is inserted into the model, the significant positive impact of executive equity incentive on corporate performance is not affected. The three coefficients a, b', c' mentioned in the model construction are significant. Therefore, it can be concluded that R&D investment plays a mediating role in the process of the impact of executive equity incentive on corporate performance, H3 was verified.

5 Conclusion

With the vigorous implementation of China's economic innovation and transformation and the deepening of market-oriented reform, according to the literature analysis and empirical test, the following conclusions are summarized.

- In the current competitive market environment, there is a significant positive correlation between the shareholding ratio of senior executives and corporate performance. The proportion of shares held by executives in the company to a certain extent can effectively regulate the management's attitude towards venture capital. That is, R&D projects, consider the development of enterprises from a long-term perspective, reasonably plan the forms of profit, and optimize the level of financial performance.

- Most of the investment in innovation projects comes from executives' decision-making. If executives hold shares of enterprises, they are similar to the owners of enterprises. Executives' eyes will shift from personal interests to corporate interests, and the maximization of corporate interests is the maximization of individual interests. The maximization of enterprise benefits comes from its market share. Enterprises with core competitiveness can take the lead. The core competitiveness depends on the innovation ability of the enterprise, and the innovation is inseparable from the R&D investment.

- Moreover, R&D investment plays a subtle link between the two. That is, part of the intermediary effect. The impact of executive equity incentive on corporate performance is as follows: the proportion of executive equity - R&D innovation capability - corporate profitability.

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