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Career stage, manager incentive and R&D innovation in high-tech companies-Evidence from a share stock market

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ABSTRACT

This paper examines the effect of compensation incentive and equity incentive on R&D investment during manager's different career stage using high-tech companies which discloses R&D cost from 2009 to 2012. We find that both compensation and equity induce more R&D investment, and the effect of compensation incentive declines as the manager's career becomes shorter, but the effect of equity incentive not. This paper shows that shareholders need to choose proper incentive according to the manager's career stage in order to promote more technology innovation.

Key words: Career, Equity incentive, Compensation incentive, R&D innovation

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INTRODUCTION

With the development of globalization, the traditional business model is no longer suitable for the development of the society. The innovation of R&D can higher the core competitiveness of companies, which keeps their leading advantages in competition. As the organizers and promoters of the activities of R&D innovation, they does play important roles in their companies. It's reported, the incentives to the mangers force them to pay more attention to the development of their companies and promote more R&D innovation. However, there exist many kinds of incentives, including compensation incentive, equity incentive and etc. So we must find the suitable ways of incentives to inspire managers efficiently.

The paper uses high-tech enterprises as examples to empirical test the affection of the managers' compensation incentives and equity incentives to managers to enterprises' R&D innovation. It shows that the effect of equity incentives doesn't change with the change of managers' career. However, the effect of compensation incentive declines with the short of managers' career. The paper validates the positive effect of incentive of managers to R&D activities. In addition, it also provide us a new view how enterprises advance R&D innovation by using proper ways of incentive.

2 Literature Review

R&D innovation is the important activity of companies' reducing production cost and advancing competitiveness. Because of its long cycle and high uncertainty, the managers who are risk-averse aren't willing to invest more in R&D though R&D might do good to the further development of the companies.

Long-term incentive may align the interests of mangers and shareholders, which can promote the enterprises' R&D innovation(Jensen and Meckling,1976). If the managers share the stocks of the companies, their benefits and the ones of shareholders will align more tightly. So they will focus on the maximum of the long-value of their companies and invest a lot in R&D for their companies' future development, which is proved by several scholars. Balkin et al.(2000)study the relations between managers' compensation and enterprises innovation through 90 high-tech companies' data. The result shows that the enterprises invest more in R&D and obtain more patents while

the managers have more equity incentive. Lerner and Wulf(2007)find the positive correlation between long-term incentive to senior executives and R&D innovation of the companies. Wu and Tu(2007)explain that the managers are willing to invest more on R&D because there will be a long time for the redemption of their equity. Xia, Tang(2008)and Wang(2011)figure that the equity incentive to managers urges the amount of R&D investing.

3 Hypothesis in the Models

Currency compensation is the main kind of incentive in China. To most of the managers in public companies, the short-term compensation incentive not only promote their working enthusiasm but also have low the risk and short-period redemption. That means short-term incentive such as currency compensation has great attraction to managers, and even more effective than long-term incentive(Tang and Zheng, 2009). Based on the investigation data on Chinese manufacturing enterprises by the World Bank, Li and Song(2010)figure that the compensation incentive to managers promote the activities of R&D in companies. Lin et al.(2011)think that compensation incentive has positive effect on R&D activities in enterprises by studying private enterprises. So, here is the first hypothesis:

H1:Both equity incentive and compensation incentive can promote more R&D innovation in enterprises.

Although incentive promotes innovation, different kinds of incentive create different effects on the enterprises' innovation activities. Harley et al.(2002)test the R&D innovation different effects of the stock option and restricted stock through simultaneous equations models. That shows there must be no limited fixed kind of incentive to managers. And the board should consider both the residual risk on managers and the investment opportunities the companies have. Xue(2007)find that managers are prone to outside purchasing for R&D innovation with compensation incentive while they are prone to inside developing for R&D innovation with equity incentive. After derivation of mathematical model, Manso(2011)think that the possibility of short-term failure must be considered for the most effective incentive to R&D innovation..

The careers of the managers have great effects on their behaviors. The reason why companies are willing to invest on R&D is the heavily expectation return of the investment. However, that will be high risk and long-term period of return. During the early careers of managers, they probably get long-term benefits from the R&D. But during the later period, it is hard to share the benefits from R&D. So they aren't eager to invest on R&D. Dechow and Sloan(1991)find that CEO probably reduce expenditure on R&D before their leaving for the high the performance. Barker and Mueller(2002)figure the expenditure of R&D has the negative correlation with the ages of CEO. Moreover, it has positive correlation with their terms of office. Liu(2007)and Hu(2009)figure the ages of senior leaders determines the R&D invest activities .

Equity incentive is a long-term incentive, so they can receive benefits from R&D investment even their career is over. So the effects of equity incentive to R&D innovation may not change with the change of the careers of managers. But it is different for compensation incentive. It is hard to have great effects of incentive even giving powerful compensation incentive to managers who are the late career period. Because the rational managers aren't willing to invest more on R&D, which means the effects of compensation incentive to R&D innovation declines with the shortening of managers' career period . So, here is the second hypothesis, including two sub-hypothesis:

H2:The effects of different kinds of incentive to R&D innovation have significant difference, considering the careers of managers.

H2a:The effects of equity incentive to R&D innovation don't change with the change of the careers of managers.

H2b:The effects of compensation incentive to R&D innovation declines with the shortening of managers' career period.

4 Research Design

The paper studies the effects on R&D innovation by equity incentive and compensation incentive to managers under their different career periods. We estimate the career period of managers according to their ages. If the manager is younger, his remaining career period is long, and vice versa.

According to the classification of industry, medicine, electronic and IT are classic high-tech enterprises. So we study about the three kinds of enterprises. We use the data of R&D expenditure from the Sequence Database , the data of finance and managers from Guo Tai-an database. To the assurance of R&D expenditure, we have check the data according to finance reports. We choose 323 medicine, electronic and IT companies as samples from 2009 to 2012 and get 1022 observations.

The dependent variables in regression model are the percentage of R&D expenditure, which are measured by the ratio of R&D expenditure and the main business income. The main independent variables are equity incentive and compensation incentive which are measured by the managers' share holding and compensation. Here list the models. Based on the reference, we control such variables as Age, Size, TobinQ, ROA, Cash and Lev. The table 1 shows the definition of variables.

$$RD_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Size_{it} + \beta_3 TobinQ_{it} + \beta_4 ROA_{it} + \beta_5 Cash_{it} + \beta_6 Lev_{it} + \beta_7 Stock_{it} + \beta_8 Pay_{it} + Year + Industry + \xi_{it}$$

Table 1 c

Variables	Definition	Computing Method
RD	R&D Innovation	R&D Expenditure / Main Business Income
Age	Companies' age to Market	The years from IPO to now
Size	Capital Scale	Natural Logarithm of Total Assets
TobinQ	Opportunity of Increasing	Market Value / Replacement Cost
ROA	Return on Assets	Net profits / Total Assets
Cash	Cash Flow	Operating Cash Flow / Main Business Income
Lev	Finance Ratio	Total Liabilities / Total Assets
Stock	Equity Incentive	Value is 1 if holding Stock, otherwise Value is 0
Pay	Compensation Incentive	Natural Logarithm of Currency Compensation

RESULTS

5.1 Descriptive Statistics

Descriptive statistics of the regression variables is showed in table 2. It shows that there is huge difference among different high-tech companies. The average ratio of R&D expenditure and main business income is about 5.1%. And the lowest is 0.03% while the highest is up to 51.1%. Focus on the sharing stocks and compensation of managers, almost half of the companies' managers hold the stocks of their companies. Among them, the lowest salary of them is 1,000RMB(its' Natural Logarithm is 9.210)and the highest is 6,620,000 RMB(its' Natural Logarithm is 15.706).

Table2 Descriptive statistics of the regression variables

Variables	Observations	Avg	SD	Min	Max
RD	1022	0.051	0.056	0.0003	0.511
Age	1022	7.604	5.827	0	22
Size	1022	21.397	0.952	19.032	25.400
TobinQ	1022	2.355	1.578	0.406	13.207
ROA	1022	0.060	0.064	-0.404	0.494
Cash	1022	0.047	0.078	-0.585	0.378
Lev	1022	0.344	0.196	0.008	0.983
Stock	1022	0.495	0.500	0	1
Pay	1022	13.052	0.804	9.210	15.706

Table 3 Effects on R&D by Incentive to Mangers

	Dependent Variable = RD		
Age	-0.002*** (-6.24)	-0.002*** (-6.91)	-0.002*** (-5.96)
Size	0.004** (2.06)	0.002 (1.06)	0.002 (1.05)
TobinQ	0.006*** (4.73)	0.006*** (4.72)	0.006*** (4.56)
ROA	-0.090*** (-2.93)	-0.102*** (-3.28)	-0.100*** (-3.21)
Cash	0.050** (2.18)	0.044* (1.91)	0.047** (2.04)
Lev	-0.051*** (-5.24)	-0.054*** (-5.51)	-0.051*** (-5.28)
Stock	0.011*** (3.49)		0.011*** (3.29)
Pay		0.005** (2.52)	0.005** (2.24)
Years	Control	Control	Control
Industry	Control	Control	Control
Sample Number	1022	1022	1022
Adjusting R2	0.261	0.257	0.264

5.2 Result Analysis of Regression

Table 3 shows the effects on R&D by incentive to mangers. It shows that the variable Stock is significantly positive at 1% level while the variable Pay is significantly positive at 5% level. That means their R&D innovation levels are higher in those companies which give equity incentive to their managers. Moreover, the higher the compensation of mangers is, the more advanced R&D innovation the companies have. Thus, the hypothesis 1 is supported. In addition,we find there exists positive correlation between the R&D innovation levels of companies and their cash flow. In the meantime, the R&D innovation levels of companies also and opportunity of increasing have the negative correlation with companies' age to Market, return on assets and finance ratio.

To test the effects on R&D innovation by equity incentive and compensation incentive to managers under their different career periods, we first generalize the distribution of the ages of managers in the samples. As showed in table 4, during the samples, the youngest manager is 32 years old and the oldest is 72 years old. And most of them are range from 40-49 and 50-59. Thus, we regard the managers below 50 years old as being their early period of career and those over 50 years old as being their later period of career. Then , we carry out regressing analyses over the two sub-samples to test the effects on R&D innovation by incentive to managers.

Table 4 the Distribution of Ages of Managers

The age range of Managers	30-39	40-49	50-59	Over 60
Observation Number	94	538	340	50

Table 5 shows the result of the regression of sub-samples, and it is easy to see that the variables Stock and Pay are statistically significant on the level of 1% by managers' early career, it means that both equity and compensation incentive for managers can promote the R&D of behavior of enterprise. On the other hand, the variables Stock is statistically significant on the level of 5% by managers' twilight career, while the variables Pay is not significant, it means compensation incentive may be very difficult to play the original incentive effect, but the equity incentive may still give the motivation.

Table 5 the Effect of Enterprise's Research and Innovation by Incentive to Manager's on Different Career stages

	Dependent Variable = RD			
	Early career stage		Twilight career stage	
Age	-0.002***	-0.002***	-0.002***	-0.002***
	(-4.86)	(-6.43)	(-4.27)	(-4.29)
Size	0.005**	0.002	0.002	0.001
	(2.05)	(0.73)	(0.58)	(0.30)
TobinQ	0.007***	0.007***	0.003*	0.003
	(3.60)	(3.73)	(1.86)	(1.62)
ROA	-0.090*	-0.102*	-0.097	-0.112**
	(-1.71)	(-1.92)	(-1.59)	(-2.37)
Cash	0.086**	0.079**	0.003	-0.001
	(2.54)	(2.37)	(0.10)	(-0.03)
Lev	-0.050***	-0.050***	-0.058***	-0.061***
	(-3.46)	(-3.48)	(-3.47)	(-4.63)
Stock	0.015***		0.009**	
	(3.57)		(1.96)	
Pay		0.008***		0.004
		(2.93)		(1.44)
Year	Controlled	Controlled	Controlled	Controlled
Industry category	Controlled	Controlled	Controlled	Controlled
Sample number	632	632	390	390
Adjust R2	0.283	0.280	0.265	0.242

Table 6 shows the incentive effect of managers under different career period, we define a new variable Career., which represent the manager's career period, we also design a new interaction term between the manager's incentive and career . The specific definition of career is as follows: when the age of a manager is between 30 and 39, the Career's value is 0, when the age of a manager is between 40 and 49, the Career's value is 1, when the age of a manager is between 50 and 59, the Career's value is 2, when the age of a manager is over 60, the Career's value is 3. According to the result of table 6, if we discard the effect of interaction term, variable Career is negative, it means that the R&D innovation of enterprise would reduce with the career stage of manager shortened. If we consider the effect of interaction term, the interaction term between variable Stock and Career is not significant, the interaction term between variable Pay and Career is negative, it means the effects of equity incentive to R&D innovation may not change with the change of the careers of managers, while the effects of compensation incentive to R&D innovation decrease with the shorten of managers career life, hypothesis 2 receive support according to analysis above.

Table 6 the Effect of Career Stage to Incentive of Manager

	Dependent Variable = RD		
Age	-0.002*** (-5.62)	-0.002*** (-5.87)	-0.002*** (-6.56)
Size	0.002 (1.12)	0.004** (2.30)	0.002 (1.05)
TobinQ	0.006*** (4.61)	0.006*** (4.77)	0.006*** (4.69)
ROA	-0.109*** (-3.51)	-0.097*** (-3.15)	-0.109*** (-3.50)
Cash	0.048** (2.10)	0.051** (2.23)	0.045** (1.97)
Lev	-0.055*** (-5.67)	-0.054*** (-5.56)	-0.056*** (-5.74)
Stock	0.011*** (3.38)	0.020*** (3.09)	
Pay	0.006*** (2.71)		0.014*** (3.34)
Career	-0.007*** (-3.31)	-0.003 (-1.11)	0.064 (1.49)
Stock * Career		-0.007 (-1.54)	
Pay * Career			-0.005** (-2.10)
Year	Controlled	Controlled	Controlled
Industry category	Controlled	Controlled	Controlled
Sample number	1022	1022	1022
Adjust R2	0.271	0.267	0.266

According to the result of table 5 and table 6, different career stage has an important impact on incentive of manager, especially on compensation incentive. With the shortening of the manager's career, promoting effect of monetary compensation for R&D innovation decline continuously, even more, the monetary compensation will make little incentive effect on twilight career. In order to encourage R&D investment, it is necessary for enterprise to select the appropriate incentive mode according to the career stage of managers. Especially for the manager on their twilight career stage, the incentive effect of monetary compensation will be very limited, equity incentive always be much more reasonable.

6 Robustness Test

In order to ensure the robustness of the conclusion, a part of the regression variables were replaced, including using the ratio of R&D expenses and total assets represent the innovation strength, using the shareholding ratio of managers represent the intensity of equity incentive, etc. we found no significant change after that. At the same time, we measured the manager's career in another way according to the tenure, we find that compensation incentive and equity incentive both promote the R&D innovation at the beginning of manager's career. However, in one to two years before the manager turnover, only the equity incentive can play a weak incentive effect, so it is obvious that our research is quite robust from the side.

CONCLUSION

This paper examines the effect of compensation incentive and equity incentive on R&D investment during manager's different career stage using high-tech companies which discloses R&D cost from 2009 to 2012. the result of the regression shows that equity incentive and compensation incentive for manager can promote enterprise to more R&D innovation, however, different way of incentive will lead to different effect, incorporate is: the positive effect of equity incentive to R&D innovation does not vary with the change of manager's career stage, but the effects of compensation incentive to R&D innovation decrease with the shorten of managers career life.

Exploring the effect from manager incentive to R&D innovation according to different career stage and incentive way, we not only enrich the theoretical literature about manager incentive and enterprise R&D innovation domain, but also we give many reality guiding significance for the enterprise choose the appropriate incentives in practice, so as to improve the level of R&D innovation, and strengthen technological innovation and sustainable development ability.

As a long-term way of incentive, equity incentive has great effect, it can urge enterprises to make more R&D investment which would be necessary in the future, it also can avoid short-sighted behavior of operators, linking the manager interest and the shareholders' interest effectively. In contrast, the effect of compensation incentive is limited, because the effect of compensation incentive depends on consistency of manager's goal and expected return.

At the end of manager's career stage, it is difficult for managers to obtain real benefits through making more R&D investment, therefore, the compensation may not play the role of an incentive, and it isn't up to promote the effect of enterprise R&D innovation.

The development of the times makes the scientific and technological innovation has gradually become the key of enterprise's core competitive advantage. In order to enhance china's listing corporation's independent innovation capacity, especially for the high-tech listing corporation, in one hand, government should encourage more companies adopt the equity incentive instead of the traditional salary incentive, in the other hand, government should also create a good system and legal environment for the implementation of equity incentive. Only in this way can we truly conducive to enterprise R&D and the independent innovation, and let the chinese enterprise maintain a leading competitive position in the globalization trend.

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