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R&D Intensity and Executive Compensation: An Empirical Study Based on China's listed IT Companies

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Abstract: R&D investment is both an impetus for growth and a source of competitive advantage for IT companies. The executive compensation plan based on company short-term performance may impede the R&D investment. This paper examines the relationship between the R&D investment and the executive compensation in China's listed IT companies from 2007 to 2008. The result indicates that the boards of directors respond to, and promote the R&D investment through the executive compensation plans. The result also suggests that the executive compensation plans are more likely to focus on the top management teams than the CEOs.

Keywords: R&D; executive compensation; innovation; IT companies

1 Introduction

According to agency theory, in large publicly-held companies, agency problems result from the separation of residual risk bearing and decision making. In the classic principal-agent model (Holmström, 1979; Grossman and Hart 1983), if the agent's actions are not directly observed, imperfect information may be used for performance measurement.

R&D investments are both an impetus for growth and a source of competitive advantage for IT companies. However, the executive compensation plan based on current corporate performance may impede the R&D investments because managers may sacrifice R&D investments to meet earnings goals (Dechow and Sloan, 1991; Bushee, 1998).

In recent years, the central government of China has been consistently emphasizing the importance of technology development in the manufacturing sector and viewing technology development as an engine for the process of catching up with advanced industrial economies and industrialization. However, the level of R&D investment of Chinese corporations is still very low. In order to encourage top management increase R&D investments, the corporate board may have R&D investment induced into executive compensation plans. In extant literature, few researches examine the relation between the R&D investment and the executive compensation.

Using a sample of China's listed IT companies from 2007 to 2008, I investigate the relation between the R&D investment and the executive compensation. The result indicates that the boards of director respond to, and promote the R&D investment through the executive compensation plans. The result also suggests that the executive compensation plans are more likely to focus on the top management teams than the CEOs.

The remainder of this study proceeds as follows. Section 2 reviews the literature. I review the research design in section 3. Section 4 provides the main results and additional analyses, and the final section provides concluding comments.

2 Literature review

The agency theory focuses on the optimal contract governing the principal agent relationship. The objectives of the optimal contracting model are to align divergent interests between shareholders and managers (Jensen and Murphy, 1990) and provide informative performance measures (Holmström, 1979), under the assumptions of arms-length contracting and unbiased rational decision making.

A long-term horizon and a high degree of uncertainty characterize R&D investment. The long-term nature of R&D may cause managers to reduce R&D investment because managers are often compensated on short-term accounting measures (Jensen, 1986). On the other hand, investment uncertainty imposes risk on managers, whose human capital is difficult to diversity. Fama (1980) argue that managers who bear greater residual risk have the incentives to invest less in risky investment to reduce the residual uncertainty of their investment outcomes.

Prior studies find a negative effect of R&D spending on CEO compensation (Bizjak et al., 1993) and no effect of R&D spending on the value of employee option grants (Matsunaga, 1995) in general settings. Managers may reduce R&D spending to opportunistically boost short-term performance (Bushee, 1998). Cheng (2004) that opportunistic reductions in R&D spending become more likely when: 1) the CEO approaches retire-

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ment—the horizon problem, and 2) the firm faces a small earnings decline or a small loss—the earnings benchmarking myopia problem. He investigates whether the compensation committees of boards of directors deter opportunistic reductions in R&D spending in the presence of the horizon and myopia problems. The results indicate that the association between changes in R&D spending and changes in the value of CEO annual option grants is significantly positive in the above two situations, and insignificant otherwise.

Xue (2007) use data from U.S. high-tech industries to explore the extent to which management compensation policies are aligned with strategy choices for obtaining new technology. The results indicate that managers are willing to implement the "buy" strategy if their compensation is heavily weighted on accounting-based performance measures. Conversely, managers with more stock-based compensation, especially stock options, are more likely to choose to develop new technology internally.

The extant research of China's capital markets focuses on the influence factors of corporate R&D intensity. Bai et al. (2008) examine the effects of ownership structures on R&D intensity and find the non-linear relationship between the ownership of the largest owner and R&D intensity. Liu and Liu (2007) show that management ownership is significantly positive with R&D intensity for a sample of high-tech listed firms. Some researches examines the characteristics of the top management, such as the tenure of top management (Wei, 2006), the education levels (Wen and Hu, 2009), and the risk preference (Tang and Zhen, 2009). However, these researches have made great progress in the influence factors of corporate R&D strategy, but fail to link the corporate R&D strategy to other corporate strategies.

R&D investment is more important for IT companies as a source of competitive advantage or an impetus for firm growth. Wang (2005) examines the internal determinants of R&D investment based on top 100 companies of Chinese electronic and information industry. Liang and Ma (2009) examine the relationship between R&D capital management and indigenous innovation based on the data of China's listed IT companies from 2002 to 2007. It's important to find out whether the boards of directors encourage managers to increase R&D investment through compensation plans and how. So this paper examines the relationship between the R&D investment and the executive compensation in China's listed IT companies.

3 Research design

3.1 Sample selection and data source

Since the adoption of China's New Accounting Standards from 2007 has highly improved the comparability of corporate R&D investment, the initial samples comes from the China's capital markets from 2007 to 2008. The firm that does not have R&D investment in current year is got rid of, and the final sample consists of 41 firm-years. The financial information of firms is obtained from CSMAR-A database, which collects financial and market information of all firms listed in Shanghai and Shenzhen stock exchanges. The corporate governance information is obtained from CCER-A database.

3.2 Variable measurement

Dependent variable. Listed firms in China disclose the sum of total compensation for the three highest-paid managers and the three highest-paid board members. We divide the single aggregated pay number by three to get an estimate of the pay received by the "typical" executive. The use of cash compensation is consistent with previous research. So we use the logarithm of cash compensation of the CEO (*Salary1*) and of the three highest-paid managers (*Salary3*).

Independent variable. A key metric for the assessment of innovative activity at the firm level is R&D intensity. The measure of corporate R&D intensity, *R&D*, indicates the ratio of R&D investment to total sales (Xue, 2007).

Control variables. The control variables consist of corporate characteristics variables (*Size*, *Lev*, *Growth*, *ROA*, *Risk*) and corporate governance variables (*Share*, *AntiSh*, *DSize*, *Indep*, *Meet*) from earlier findings.

3.3 Model specifications

Since the sample is pooled across company-year observations, the annual observations of a given company might not be drawn independently and, to correct this statistical problem, I adjust the coefficients' standard errors by "clustering" on each company (Petersen, 2007). The model used is as follows:

$$\begin{aligned} Salary = {} & b_0 + b_1 R\&D + b_2 Size + b_3 Lev + b_4 Growth \\ & + b_5 ROA + b_6 Risk + b_7 Share + b_8 AntiSh \\ & + b_9 DSize + b_{10} Indep + b_{11} Meet + e \end{aligned} \quad (1)$$

Where

Salary = *Salary1* or *Salary3* (*Salary1* = the logarithm of cash compensation of the CEO; *Salary3* = the logarithm of cash compensation of the three highest-paid managers); *Size* = ln(assets); *Lev* = total liabilities/total assets; *Growth* = change rate in sales; *ROA* = net income/total assets; *Risk* = monthly stock return standard deviation during the fiscal year; *Share* = percentage of shares held by the first largest shareholder; *AntiSh* = percentage of shares held by the second largest shareholder/percentage of shares held by the first largest shareholder; *DSize* = number of corporate board; *Indep* = number of independent board/number of corporate board;

Meet = number of board meeting.

4 Empirical results

4.1 Descriptive statistics

Table 1 reports descriptive statistics for the variables. The mean of *Salary1* and of *Salary3* are 12.95 and 13.81, respectively. I winsorize all the continuous independent variables at the top 5% and bottom 95% percentiles in order to avoid outlier problems. The mean of *R&D* is 0.03, which is higher than that in Wen and Hu (2009). Zhao and Xia (2009) examine all the listed companies that have R&D investment in current year. The mean of *R&D* in that research is 0.008, which is much lower. This result shows that R&D investment of IT companies are average higher than other companies. The values of other control variables also make sense and are similar with the values of previous papers.

Table 1. Descriptive Statistics (N = 41)

Variable	Mean	S. D.	Min	Median	Max
Salary1	12.95	0.74	11.47	13.08	14.70
Salary3	13.81	0.67	12.50	13.84	15.40
R&D	0.03	0.04	0.00	0.02	0.12
Size	21.11	1.15	19.72	21.08	23.62
Lev	0.39	0.20	0.12	0.38	0.72
Growth	0.15	0.27	-0.21	0.10	0.85
ROA	0.05	0.05	0.00	0.04	0.15
Risk	0.19	0.04	0.13	0.19	0.26
Share	0.36	0.13	0.19	0.35	0.57
AntiSh	0.27	0.25	0.01	0.20	0.92
DSize	9.51	2.74	6.00	9.00	15.00
Indep	0.36	0.03	0.33	0.33	0.43
Meet	9.80	4.04	5.00	9.00	21.00

Table 2 reports a Pearson correlation matrix for the main independent variables. It indicates that *R&D* is negative with *Size*, *Lev*, *Growth*, and *ROA*.

Table 2. Pearson Correlation Matrix (N = 41)

	R&D	*Size*	*Lev*	*Growth*	*ROA*
R&D	1.00				
Size	-0.10	1.00			
Lev	-0.20	0.63**	1.00		
Growth	-0.11	0.27*	0.24	1.00	
ROA	-0.03	0.00	-0.17	0.34**	1.00

Note: * and ** denote significance levels of 10% and 5%, respectively.

4.2 Regression results

Table 3 reports the regression results when dependent variable is *Salary1*. The coefficient of *R&D* in model 1 is 6.411, which is marginally significant (t-statistics = 1.94). In model 2, I get rid of the insignificant variables. The coefficient of *R&D* is increased to 6.438, which is significant (t-statistics = 2.07). I induce the governance variables in model 3. The coefficient of *R&D* is 3.195, which is not significant. When the insignificant governance variables are got rid of, the coefficient of *R&D* is 4.528, which is marginally significant (t-statistics = 1.80). In a word, I get some evidence that the higher the R&D investment is, the higher the CEO compensation is.

Table 3. Regression Results

	Dependant Variable: Salary1			
	Model 1	Model 2	Model 3	Model 4
R&D	6.411*	6.438**	3.195	4.528*
	(1.94)	(2.07)	(1.18)	(1.80)
Size	0.224	0.242**	0.308***	0.337***
	(1.68)	(2.11)	(3.39)	(4.34)
Lev	0.186			
	(0.21)			
Growth	-0.117			
	(-0.34)			
ROA	3.989	4.001*	4.083*	3.546*
	(1.35)	(1.94)	(2.03)	(1.90)
Risk	-0.847			
	(-0.29)			
Share			2.256*	1.947*
			(2.01)	(1.72)
AntiSh			1.525***	1.449***
			(3.31)	(3.05)
DSize			0.027	
			(0.59)	
Indep			5.218	
			(1.34)	
Meet			-0.021	
			(-0.39)	
Constant	7.922**	7.446***	3.015	4.433**
	(2.71)	(3.07)	(1.34)	(2.53)
N	41	41	41	41
Adj. R^2	0.166	0.228	0.310	0.326
F	1.892	3.640	3.453	6.418

Note: I adjust the coefficients' standard errors for the effects of non-independence by clustering on each company. t-statistics are reported in parenthesis. *, **, and *** denote significance levels of 10%, 5%, 1%, respectively.

Table 4 reports the regression results when dependent variable is *Salary3*. The coefficient of *R&D* in model 5 is 7.159, which is significant (t-statistics = 2.54).

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Compared to the results of model 1, the coefficient of *R&D* in model 5 is bigger and more significant, suggesting the effect of R&D investment on the compensation of top management teams is bigger than that of the CEOs. I put all the governance variables into model 7, the coefficient of *R&D* is 3.861, which is marginally significant (t-statistics = 1.74). However, when the insignificant variables are got rid of, the coefficient of *R&D* in model 8 is 4.946, which is significant (t-statistics = 2.27).

Table 4. Regression Results

	Dependant Variable: Salary3			
	Model 5	Model 6	Model 7	Model 8
R&D	7.159**	6.840**	3.861*	4.946**
	(2.54)	(2.56)	(1.74)	(2.27)
Size	0.222*	0.249**	0.317***	0.336***
	(1.96)	(2.56)	(4.33)	(5.08)
Lev	0.429			
	(0.57)			
Growth	-0.222			
	(-0.74)			
ROA	3.137	2.014		
	(1.18)	(0.99)		
Risk	0.796			
	(0.34)			
Share			2.306**	2.077*
			(2.24)	(1.98)
AntiSh			1.206**	1.191**
			(2.72)	(2.66)
DSize			0.031	
			(0.85)	
Indep			2.929	
			(0.88)	
Meet			-0.016	
			(-0.34)	
Constant	8.444***	8.235***	4.630**	5.470***
	(3.56)	(4.00)	(2.59)	(3.55)
N	41	41	41	41
Adj. R^2	0.216	0.265	0.316	0.348
F	2.044	3.812	7.088	9.940

Note: I adjust the coefficients' standard errors for the effects of non-independence by clustering on each company. t-statistics are reported in parenthesis. *, **, and *** denote significance levels of 10%, 5%, 1%, respectively.

To summarize, the results indicate that the boards of directors respond to, and promote the R&D investment through the executive compensation plans. The results also suggest that the executive compensation plans are more likely to focus on the top management teams than the CEOs.

4.3 Robustness checks

In untabulated tests, I use the unwinsorized variables in all the regression models and the results are similar to those tabulated. Liu and Liu (2007) defined *R&D* as the ratio of R&D investment to total assets. I use this measure in all the regressions and the results are also similar to those tabulated.

5 Conclusions

I use data from China's listed IT companies from 2007 to 2008 to examine the relationship between the R&D investment and the executive compensation. Controlling other effects, the results indicate that the boards of directors respond to, and promote the R&D investment through the executive compensation plans. The result also suggests that the executive compensation plans are more likely to focus on the top management teams than the CEOs.

On February 9, 2006 the State Council presented its plan to strengthen China's scientific and technological progress in the coming fifteen years to become a world leader in innovation. R&D investments of firms are highly encouraged by the play and these firms are becoming important drivers of innovation in the country. It is believed that over the long-term, China's economic performance will ultimately depend upon its ability to acquire, adapt, and create new technologies. Corporate governance may have important effects on both the extent and the consequence of R&D investment. Future research may focus on these issues.

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