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The Relationship between Executive Internal Compensation Gap and R&D in IT Industry

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Abstract

Taking listed companies in the information technology industry as the research object, this paper discusses the impact of the salary gap among senior officials on R&D investment, and takes the managerial power as a moderating variable to study its impact on the relationship between R&D investment and senior officials. salary gap among senior officials on R&D investment, and takes the managerial power as a moderating variable to study its impact on the relationship between the two. It is found that the compensation tournament has a significant incentive effect in information technology industry, and the internal executive compensation gap has a positive relationship with the internal compensation of senior officials. It is found that the compensation tournament has a significant incentive effect in information technology industry, and the internal executive compensation gap has a positive relationship with R&D investment, and will be affected by managerial power. According to the strength of managerial power, further analysis shows that the proportion of managerial ownership has a restraining effect on the relationship between the two, while the decentralized compensation gap has a positive relationship with R&D investment, and will be affected by managerial power. After grouping the samples according to the strength of managerial power, further analysis shows that the proportion of managerial ownership has a restraining effect on the relationship between the two, while the decentralization of ownership and the integration of two jobs have a positive effect on the relationship. paper provides empirical evidence for compensation system design and R&D decision-making of listed companies in information technology industry.

Keywords

Internal Executive Pay Gap; R&D Investment; Managerial Power; Tournament Theory.

1. Introduction

In 2021, the 14th Five-Year Plan states that it is important to insist on the central position of innovation in the overall situation of China's modernization. R&D activities are an important way for the Company to improve its competitiveness. Particularly in the information technology industry, where competition is fierce and product technology iterates quickly, decisions on R&D investment will be a key component of management's decision-making. Unlike other industries where the focus of investment is on production or sales activities, etc., companies in the information technology industry must invest heavily to maintain competitive R&D activities in order to survive and remain viable in the long term, maintain or expand market share, and enhance cash flow.

However, the Lenovo incident has given us a wake-up call. on December 21, 2021, the China Economic Weekly sponsored by the People's Daily published an article criticizing Lenovo Group for its "poor temple and rich abbot" and high indebtedness, and pursuing the capital vice of "too big to fail" by turning the computer manufacturing enterprise into a "financing platform in the name of its main business" and taking up scarce financial resources. Computer production

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enterprises into a "financing platform in the name of the main business", taking up scarce financial resources. Lenovo Group from the "North Lenovo South Huawei" known as the Internet technology company evolved into today's microfinance company, the essence of the lack of innovation, insufficient investment in research and development and research and development will continue to decline. According to Lenovo Group 2021 disclosure of the company's financial report, its CEO Yang Yuanqing remuneration as high as 168 million yuan, and two other anonymous executives pay more, up to 197 million yuan. In this case, Yang Yuanqing said: Lenovo will suspend the recruitment and promotion of salary increases, to use the "tight days" to realize the "long days". Lenovo's senior management team and affiliates shareholding ratio is too high can't help but let us think, such a blatant "poor temple rich abbot" situation is affected by the management of power is too high. Based on this, this paper will use management power as a moderating variable to study the relationship between the internal pay gap of executives in the information technology industry and R&D investment, and provide a certain degree of empirical evidence for information technology companies to design a reasonable pay system and increase innovation investment.

2. Literature Review

2.1. Executive Pay Gap and R&D Investment

2.1.1. Tournament Theory

The tournament theory, developed by Lazear and Rosen [28], compares the pay gap within a company to a sports tournament, in which ordinary management and employees can work hard to win the tournament within an acceptable period of time, i.e., to achieve hierarchical advancement. The greater the pay gap between different levels, the harder the general management and employees will work, which will ultimately lead to an increase in the company's performance. Rosen [30] further suggests that a moderate internal pay gap reduces the cost of monitoring.

To summarize, tournament theory suggests that the pay gap can motivate executives to work diligently, move up the ladder, and not be satisfied with the current pay level [7], which reduces the principal-agent cost, and thus brings about the enhancement of the company's value. Therefore, the tournament theory advocates widening the pay gap to increase the strength of pay incentives.

2.1.2. Behavioral Theory

Contrary to the previous theory, behavioral theory tends to shrink the gap in compensation design, thus enhancing firm value. There are four main schools of behavioral theory [11]: (1) Relative exploitation theory, which focuses on horizontal comparisons within the executive team; if income is too low, executives perceive that they are being exploited and thus disregard the firm's goals [25]. (2) Organizational politics theory emphasizes that when pay is unfair, employees will engage in disruptive behavior to harm the firm's interests [29]. (3)Distributional preference theory argues that pay design should take into account the responses of pay recipients and not be determined by pay designers alone [27]. (4) Social Comparison Theory states that employees care about the relative amount of pay and will directly determine their work effort [24].

2.1.3. The Relationship between Executive Pay Gap and Innovative R&D

The current literature mainly focuses on the two major aspects of the economic consequences of the pay gap and the influencing factors of the firm's innovation investment, and there are relatively few studies in the relevant literature on the relationship between the executive pay gap and the firm's innovation R&D. Based on tournament theory, for private listed companies, Gong Na and Liu Qingyuan [3] concluded that the executive internal pay gap is positively

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correlated with R&D investment and pointed out that the size of the executive team and the controlling shareholders' shareholding inhibit this incentive effect. Adding a psychological perspective, expanding the internal pay gap of executives has a facilitating effect on improving the company's innovation efficiency, such as the number of patents granted [10]. And based on the social comparison theory, Lu Wei and Zhang Shukai [9], relying on the value of the pay gap ratio, concluded that there is an inhibitory effect of the internal pay gap of executives on the intensity of R&D investment, and with an eye to company growth, this inhibitory relationship will be more significant in high-growth firms, while in low-growth firms on the contrary, it promotes the company's innovation R&D intensity. At the same time, this effect is significantly reflected in state-owned enterprises, too obvious pay gap may even cause some executives to "vote with their feet" and tend to resign from the enterprise [20]. In addition, Zhen Liming and Yang Qunhua [22] and Kong Dongmin et al. [4] argue that tournament theory and social equity theory are not mutually exclusive, but complementary. When the pay gap is appropriate, its impact on innovation investment and efficiency is positive, but when the pay gap is further widened, the social comparison theory dominates and the relationship between the two is negative, i.e., an inverted U-shaped relationship.

2.2. Management Power and the Executive Pay Gap

Based on the theory of management power, most of the existing studies have focused on the impact of management power on pay levels, and its impact on pay gaps is still relatively understudied. In firms with strong management power, the pay gap within executives and between executives and employees is larger [8]. And in SMEs, the pay gap has a negative effect on firm growth, and management power exacerbates this inhibitory effect [18]. In addition, the impact of management power is not limited to internal firms, as Li et al. [5] show that when executive compensation exceeds the industry average in the previous period, the stronger the management power of executives in SOEs, the more they increase their compensation in that year, which similarly suppresses the incentive effect of the external pay gap. After the introduction of the "Salary Restriction Order", executives are more willing to compete for promotion opportunities by actively reducing the pay gap [1]. All of the above studies have come to the same conclusion that managerial power reduces pay incentives. In general, the theory of managerial power is gradually replacing the optimal contract theory in the current series of "pay mystery" issues, and has come to prominence.

3. Theoretical Analysis and Research Hypothesis

3.1. Intra-Executive Compensation Gap and R&D Investment

Based on principal-agent theory, management will not be motivated to work diligently out of personal self-interest when there are no external factors driving them. However, when the pay gap is taken into account as an incentive, management is motivated to compete out of self-interest. Although from the behavioral theory, the pay gap will make the employees who have a sense of unfairness take actions that infringe on the company's value and do not cooperate with teamwork. However, with the gradual establishment and widespread application of performance-related pay systems in China, it is theorized that tournament theory should play a dominant role in the pay system in the country.

The research and development of a company's new product is characterized by a long cycle and unpredictable results, which is a risky project with great uncertainty. According to the tournament theory, the internal pay gap of executives is the company's reward for management's excellent performance, and the higher the reward is the more favorable to the executives' motivation to carry out innovative R&D [31]. That is, if each executive chooses the same level of risk, then under the tournament hypothesis, their final output will also be the

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same. Of course, smart executives will pick projects with higher risk levels and win the tournament, a situation that will make it difficult to distinguish the portion of performance due to risk compensation from the portion due to individual ability, which from a Nash equilibrium perspective means that the larger the internal pay gap is, the more willing executives will be to take on higher-risk projects. Especially in the information technology industry, which naturally relies on innovation to survive, technology iteration is fast, and innovation is the core competitiveness, the tournament effect of the pay gap will incentivize executives to invest in R&D to a higher degree. Based on the above analysis, this paper establishes the following hypotheses:

Hypothesis H1: The internal pay gap of executives is positively related to R&D investment in companies in the information technology industry.

3.2. The Moderating Role of Management Authority

The management power theory suggests that excessive power of corporate executives can influence the formulation of compensation contracts, and even executives may set their own compensation, thus management power can weaken the effectiveness of executive compensation contracts. This represents the fact that executive compensation not only does not serve as a mechanism for solving the agency problem, but instead is part of the problem itself [23]. In the absence of external regulation, management will use its power to increase hidden income and increase the stickiness of executive pay, and thus the pay gap within executives will only grow.

In firms with strong managerial power, the effect of the pay gap in incentivizing non-power executives to strive for improved performance is difficult to achieve. From the perspective of power executives, power executives themselves do not necessarily seek performance improvement, even if their performance is poor, but given their considerable control, it is difficult to be removed or reduced in salary, which also weakens the motivation of the rest of the executives, but rather more inclined to flatter the power managers [Lu Rui, 2007], and executives lose the incentives to take risks and increase R & D investment in order to have a high level of compensation for the risks involved. From the perspective of the executive team as a whole, as long as they can reach a consensus of interests, they will cooperate in the whitewash, such as financial report data falsification and so on. As a result, executives can negotiate internally to receive compensation that satisfies them. In this case, executives' efforts to improve performance become almost meaningless, and thus will inhibit the firm's R&D investment intensity. Therefore, this paper establishes the following hypotheses.

Hypothesis H2: In the information technology industry, managerial power attenuates the contribution of intra-executive pay gaps to firms' R&D investment.

Drawing on Lu Rui [2007] and Wang Ye et al. [15], this paper uses the following three single-dimension indicators to measure management power: the unity of the two positions, the degree of equity dispersion, and the percentage of management shareholding. When the chairman and the general manager are the same natural person, the general manager's voice in investment decisions is enhanced, and he or she can also maintain his or her own interests by controlling, for example, the compensation committee. Even if the executive's performance is poor, it is difficult to be removed from office or have his salary reduced. In turn, the executive will gradually realize that he or she can use the power to profit even if it is against the long-term interests of the company, and thus will no longer consider the sustainability of the company. At the same time, this greatly reduces the likelihood that the rest of the executives will be promoted to CEO through improved performance. Therefore, non-powered executives will lose the incentive to improve performance by investing in high-risk, high-return innovation projects. In addition, the natural high-risk nature of R&D investment requires executives to spend considerable time and energy on screening and decision-making, and executives also have

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incentives to settle in the present and reduce or not to do R&D due to the private cost perspective. With the above analysis, this paper establishes the following hypotheses:

Hypothesis H2a: In the information technology industry, the promotion of R&D investment by the internal pay gap among executives is attenuated when the general manager and the chairman of the board are the same natural person.

With relatively decentralized shareholdings, major shareholders may lose the incentive to actively manage and instead develop the idea of free-riding, which in turn leads to insufficient supervision of management. According to the theory of managerial power, the general manager may actually control the company, when the effectiveness of the compensation contract is weakened [16]. And in this case, the general manager will benefit himself by widening the pay gap, and reduce the degree of diligence and reduce the long-cycle and risky R&D activities. Thus, this paper establishes the following hypothesis:

Hypothesis H2b: A high degree of equity dispersion in the information technology industry reduces the contribution of the internal pay gap among executives to R&D investment.

Larger management shareholding generally means higher control of the company by the executives, at which time it is often difficult for small and medium-sized shareholders to control the opportunistic behavior of the executives in the compensation design, which enables the executives to make use of their power to a considerable extent to design the terms of the compensation contract to maximize their own interests. At the same time, executive performance will become less important, because there is no need to highlight the performance of the support, power executives can also pull up the pay gap, frustrating the action and enthusiasm of ordinary executives, the company's investment in research and development will be further scaled down, and the incentive effect of the pay gap is reduced. Thus, this paper establishes the following hypothesis.

Hypothesis H2c: In the information technology industry, high management shareholding weakens the contribution of the internal pay gap of executives to R&D investment.

4. Research Design

4.1. Study Sample and Data Sources

Due to the natural qualities of the information technology industry itself, which is fast in updating and iterating, and the fact that more than 80% of listed companies have missing data in their annual reports in FY2021, this paper selects all listed companies in the industry from 2015 to 2020 as the original sample. And the following treatments are made: [1] excluding ST and *ST companies; [2] excluding companies with non-positive internal compensation gaps of executives; [3] excluding companies with missing data and incomplete corresponding indicators in annual reports. After screening by the above conditions, this paper finally obtains 1163 valid observations. All data come from the database of Cathay Pacific, and the basic data processing applies EXCEL software and uses Stata/SE 15.0 software to do in-depth processing and statistics and analysis.

4.2. Description of Variables

4.2.1. Explanatory Variables (innergap)

The internal pay gap of executives is the explanatory variable of this paper. Broadly speaking, executive compensation mainly includes monetary compensation, equity compensation and non-material compensation. However, China's market economy starts relatively late, the equity incentive system and disclosure system also need to be improved, executives generally "zero shareholding", low shareholding ratio [6], and it is difficult to distinguish the shareholding of executives in the part of the remuneration incentives based on the listed companies' annual reports [2], equity-based compensation is very difficult to measure. It is very difficult to

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measure the equity-based compensation. At the same time, in light of China's national conditions, it is also difficult to measure non-material remuneration. Therefore, this paper draws on existing research [19] and defines executive compensation as monetary compensation. The internal pay gap of executives usually refers to the pay gap between the core managers and the rest of the executives, this paper draws on the practice of Lai, Wenjing et al. [2014], Xia, Ning, and Dong, Yan [17], and adopts an absolute value measure, taking the three highest executive pay as the core executives, and taking the natural logarithm of the difference between the mean of the top three executives' pay and the mean of the rest of the executives' pay to measure the internal pay gap of executives.

4.2.2. Explained Variables (R&D)

R&D investment is the explanatory variable of this paper. Currently, domestic and foreign scholars' measures of R&D investment are broadly categorized into two types: relative value indicators and absolute value indicators. Drawing on Wang Wei et al. [14], this paper defines research and development investment [R&D] as the natural logarithm of a company's R&D expenditures, where R&D expenditures include expensed expenditures and capitalized expenditures.

4.2.3. Moderator Variable

The moderating variable in this paper is management power. Current research has not yet agreed on the measurement of management power, but most of them construct indicators in accordance with the four perspectives proposed by Finkelstein [26], organizational structure power, owner power, expert power, and reputational power. In this paper, the following three single-dimension indicators are used to measure management power:

(1) Whether the two positions are combined (dual) indicates whether the chairman and general manager are the same natural person. When both positions are held, the control of the company is relatively centralized and represents more power to the management. Therefore, when the two positions are combined, dual is 1, otherwise it is 0.

(2) The degree of shareholding dispersion (sep) The lower the degree of shareholding dispersion, the more concentrated the shareholders' control over the company, which can weaken the management power. This paper takes the ratio of the proportion of shares held by the first largest shareholder to the sum of the proportions of the second to tenth shareholders to measure, specifically, when the ratio is less than 1, sep takes 1, otherwise it takes 0.

(3) Management shareholding ratio (mnghld) Obviously, the higher the management shareholding ratio, the greater the control over the company. The management shareholding ratio here refers to the number of shares held by the management as a percentage of the total share capital.

4.2.4. Control Variable

(1) Firm Size (SIZE) This paper selects the year-end total assets of listed companies in the information technology industry to reflect firm size and argues that the larger the firm size, the higher the cost of shareholder regulation of management.

(2) Corporate Financial Risk (DA) In this paper, the year-end gearing ratio of listed companies in the information technology industry is selected to reflect the financial risk and can reflect the agency cost of creditors and management. The greater the gearing ratio, the greater the governance effect of creditors and the higher the power constraints on management.

(3) Firm performance (roa) In this paper, the return on assets of a listed company in the information technology industry is selected to measure the profitability of the company.

(4) Firm Asset Turnover [TURNOVER] In this paper, the asset turnover of a listed company in the information technology industry is selected to measure the company's sales ability and performance.

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(5) Year Dummy Variables (YEAR) In this paper, year dummy variables are set to control for year differences according to the selected time span.

4.3. Model Building

In order to test the hypotheses proposed above, this paper draws on the practice of Lu Rui [2007] to design the following model for testing:

Model (1):

$$R\&D=\beta_0+\beta_1 innergap+\beta_2 size+\beta_3 DA+\beta_4 roa+\beta_5 turnover+\sum year+\varepsilon_1 \quad (1)$$

Models (2) through (4) test hypothesis H2 by constructing a cross-multiplication term between management power indicators and the internal pay gap of executives.

Model (2):

$$R\&D=\beta_0+\beta_1 innergap+\beta_2 size+\beta_3 DA+\beta_4 roa+\beta_5 turnover+\beta_6 dual+\beta_7 dualgap+\sum year+\varepsilon_2 \quad (2)$$

Model (3):

$$R\&D=\beta_0+\beta_1 innergap+\beta_2 size+\beta_3 DA+\beta_4 roa+\beta_5 turnover+\beta_6 sep+\beta_7 sepgap+\sum year+\varepsilon_3 \quad (3)$$

Model (4):

$$R\&D=\beta_0+\beta_1 innergap+\beta_2 size+\beta_3 DA+\beta_4 roa+\beta_5 turnover+\beta_6 mnghld+\beta_7 mnghldgap+\sum year+\varepsilon_4 \quad (4)$$

5. Empirical Analysis

5.1. Descriptive Statistical Analysis and Correlation Analysis

The results of the descriptive statistics are shown in Table 1, which reports the total number, mean, standard deviation and maximum and minimum values of each variable. The table shows that the standard deviation of research and development investment (R&D) is 1.855 and the mean is 17.68, which indicates that there is a significant difference in R&D investment between companies in the information technology industry, but the overall investment in R&D seems to be higher, which is indeed in line with the natural qualities of the information technology industry, which is very innovative. The standard deviation of innergap is 0.96, with a mean value of 12.58, indicating that there is a certain degree of difference in the pay gap of executives in the industry, but the absolute gap value is larger, and the maximum even reaches 15.53. The standard deviation of dual is 0.455, with a mean value of 0.291, which indicates that only 29.1% of the companies in the sample have a general manager and chairman who are the same natural person. general manager and chairman of the board of directors are the same natural person, and most of the companies have weak management power. And the mean value of the degree of equity dispersion (sep) is 0.452, indicating that nearly half of the companies in the sample have more dispersed shareholdings, and dispersed shareholdings increase the difficulty of shareholders' supervision of management. Meanwhile, the mean value of management shareholding is 14.02%, while the standard deviation is 17.18%, which indicates that management shareholding varies greatly within the IT industry, with the highest management

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shareholding being 67.4% and the lowest being zero shareholding. In addition, the asset turnover ratio (turnover)has a maximum value of 0.282 and a minimum value of 0.0124, which indicates that the sales capacity of different companies in the industry varies greatly, and some of the companies' sales capacity needs to be improved.

Table 1. Table of descriptive statistics

	[1]	[2]	[3]	[4]	[5]
VARIABLES	N	mean	sd	min	max
DA	1,163	0.377	0.180	0.0360	1.213
dual	1,163	0.291	0.455	0	1
size	1,163	1.200e+10	3.984e+10	3.384e+08	6.153e+11
roa	1,163	0.0274	0.0852	-0.866	0.482
sep	1,163	0.452	0.498	0	1
turnover	1,163	0.519	0.282	0.0124	2.282
innergap	1,163	12.58	0.960	8.311	15.53
RD	1,163	17.68	1.855	10.02	21.86
mnghld	1,163	0.140	0.172	0	0.674

5.2. Analysis of Regression Results

5.2.1. Intra-Executive Compensation Gap and R&D Investment

This paper carries out linear regression analysis on model (1) as a way to verify whether there is a correlation between company performance and executive pay gap, and the results of the analysis are shown in Table 2. The internal pay gap of executives in model (1) is significantly and positively correlated with R&D investment at the 1% level, indicating that the expansion of the internal pay gap of the executive team has a facilitating effect on the company's R&D investment, which proves Hypothesis H1. At the same time, it can be seen that the company's level of indebtedness has a facilitating effect on the R&D investment, which shows that the company's appropriate level of indebtedness increases the possibility of strengthening the R&D investment. Overall, the company's R&D investment increases over time.

Table 2. Table of regression results for R&D investment, internal pay gap

	[1]	[2]	[3]	[4]	[5]
VARIABLES	RD	RD	RD	RD	RD
innergap	0.462***	0.386***	0.376***	0.375***	0.287***
	[8.20]	[6.89]	[6.79]	[6.77]	[5.25]
DA		2.137***	2.497***	2.381***	1.839***
		[7.31]	[8.42]	[7.41]	[5.79]
roa			3.314***	3.212***	2.939***
			[5.34]	[5.10]	[4.80]
turnover				0.184	0.308
				[0.94]	[1.62]
size					0.000***
					[8.66]
Constant	11.625***	11.792***	11.637***	11.594***	12.706***
	[16.56]	[17.17]	[17.13]	[17.03]	[18.89]
Observations	1,163	1,163	1,163	1,163	1,163
R-squared	0.071	0.112	0.134	0.134	0.187
Year FE	YES	YES	YES	YES	YES

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics in parentheses, YES indicates that the year is controlled.

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5.2.2. Moderating Effects of Management Power

Models (2), (3) and (4) in Table 3 test the moderating effects of three single dimensions of the management power variable, two positions, degree of equity dispersion, and management shareholding, on the relationship between the internal pay gap and R&D investment, respectively. The estimated coefficient of the cross-multiplied term in model (4)with R&D investment is negative, which indicates that the combined effect of management power variable management shareholding ratio (mnghld) and internal pay gap has a dampening effect on R&D investment. The cross-multiplication term of equity dispersion (sep) and internal pay gap with R&D investment in model (2) is significant at the 10% level and the coefficient is positive, which suggests that equity dispersion plays a positive role in the positive correlation between internal pay gap and R&D investment to a certain extent. And in model (3), the cross-multiplied terms of dual and internal pay gap and R&D investment are significant at 1% level, which indicates that dual plays a significant role in promoting the relationship between the two. In order to further test the relationship of management power variables on internal pay gap and R&D investment, this paper draws on Qinggang Wang and Jingya Wang [13] to group the samples and apply model (1).

Table 3. Table of regression results for model (2),(3) and (4)

	Model [2]	Models [3]	Models [4]
VARIABLES	RD	RD	RD
innergap	0.189***	0.204***	0.301***
	[2.59]	[3.30]	[4.58]
DA	1.822***	1.841***	1.611***
	[5.73]	[5.82]	[5.00]
roa	3.030***	2.990***	2.881***
	[4.95]	[4.90]	[4.73]
turnover	0.316*	0.257	0.263
	[1.66]	[1.32]	[1.38]
size	0.000***	0.000***	0.000***
	[8.40]	[8.55]	[8.24]
sep	-2.341*		
	[-1.77]		
sepgap	0.196*		
	[1.87]		
dual		-4.632***	
		[-3.08]	
dualgap		0.358***	
		[3.01]	
mnghld			1.154
			[0.27]
mnghldgap			-0.183
			[-0.54]
Constant	13.875***	13.818***	12.839***
	[15.34]	[18.06]	[15.59]
Observations	1,163	1,163	1,163
R-squared	0.191	0.194	0.197
Year FE	YES	YES	YES

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics in parentheses, YES indicates that the year is controlled.

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Table 4 shows the results of the subgroup tests. First, there is the equity dispersion variable [sep], when management power is large i.e. sep=1, the internal pay gap of executives in the information technology industry is positively correlated with R&D investment at significance of 1%, while when management power is small, the positive correlation between the two only passes the significance test of 5% and the coefficient becomes smaller. This is contrary to the previous hypothesis H2b. According to the results of Zhang Yinghui and Zhang Jiayu [21], this situation occurs mainly because, the degree of equity dispersion exists in a reasonable range, although the dispersion of equity may inhibit to a certain extent the constraints of shareholders on managers, but the major shareholders are in the state of mutual checks and balances to monitor each other, there is no one share of a dominant share, and for the long-term interests of the company's point of view of the joint decision-making is conducive to the enhancement of the value of the company. And when the equity is more concentrated, the major shareholders may actively manage and control the company's major decisions with their high equity, and may even place more emphasis on maximizing their personal interests and give up long-term R & D investment in favor of the company. Thus, a high degree of equity dispersion can better utilize the incentive effect of the pay gap.

The next variable is the two-job [dual] variable. The internal pay gap of executives in the information technology industry is positively related to R&D investment at the 1% significance level for both dual of 0 and 1, and the estimated coefficient for dual = 0 is 0.196, which is much smaller than the estimated coefficient for dual = 1, which violates Hypothesis H2a. This situation exists because it reduces overinvestment of a firm when the firm has a good system of internal control, but it reduces overinvestment of a firm when the power of management becomes larger, it can weaken the positive impact of internal control, i.e., the firm's investment worsens along with the increase in management's power. When the chairman of the board and the general manager are the same natural person, the management will have an incentive to weaken the cash dividend and reduce the free cash flow affluence thus causing overinvestment.

Table 4. Table of regression results for subgroups

	sep		dual		mnghld	
VARIABLES	sep=1	sep=0	dual=1	dual=0	mnghld>mean	mnghld<mean
innergap	0.360***	0.187**	0.560***	0.196***	0.026	0.352***
	[4.51]	[2.42]	[5.54]	[2.96]	[0.35]	[4.88]
DA	1.422***	2.139***	1.572***	1.977***	1.162**	1.415***
	[2.95]	[5.01]	[2.81]	[5.09]	[2.48]	[3.32]
roa	1.712**	5.997***	2.645***	3.125***	1.960***	3.518***
	[2.41]	[5.22]	[2.60]	[4.13]	[3.34]	[3.22]
turnover	0.372	0.207	-0.112	0.304	-0.393	0.290
	[1.43]	[0.74]	[-0.23]	[1.39]	[-1.31]	[1.20]
size	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	[5.97]	[6.11]	[3.61]	[7.55]	[7.74]	[7.11]
Constant	11.912***	13.815***	9.488***	13.823***	15.717***	12.417***
	[12.21]	[14.49]	[7.65]	[17.03]	[17.22]	[13.80]
Observations	526	637	339	824	430	733
R-squared	0.242	0.166	0.258	0.174	0.273	0.166
Year FE	YES	YES	YES	YES	YES	YES

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics in parentheses, YES indicates that the year is controlled.

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Finally, there is the management shareholding [mnghld] variable. Here, the management shareholding ratio is lower than the average value of the information technology industry as a weak management power situation, at this time, the internal pay gap of executives and R&D investment are positively correlated at the 1% significance level; while when the management shareholding ratio is higher than the industry average, the positive relationship between the two becomes no longer significant, which is consistent with the hypothesis H2c, which suggests that when the management shareholding ratio is high, it is unfavorable to the tournament incentives of the pay gap. Role.

5.2.3. Robustness Check

This paper relies heavily on the substitution of variables for robustness testing. Here, drawing on Wang Jitian and Kan Yumeng [12], the explanatory variable R&D investment is measured by total R&D expenditure/operating income (rdtoincome).

Table 5 is a test of model (1), where the internal pay gap of executives is positively related to R&D investment at the 5% level of significance, which is basically consistent with the previous findings.

Table 5. Robustness test table for model (1)

	[1]	[2]	[3]	[4]	[5]
VARIABLES	rdtoincome	rdtoincome	rdtoincome	rdtoincome	rdtoincome
innergap	0.002	0.003	0.003	0.003	0.004**
	[0.88]	[1.45]	[1.49]	[1.58]	[2.04]
DA		-0.035***	-0.038***	-0.009	-0.003
		[-3.13]	[-3.30]	[-0.77]	[-0.25]
roa			-0.026	-0.002	0.002
			[-1.11]	[-0.07]	[0.07]
turnover				-0.045***	-0.046***
				[-6.04]	[-6.24]
size					-0.000***
					[-2.58]
Constant	0.028	0.025	0.027	0.037	0.024
	[1.07]	[0.97]	[1.01]	[1.43]	[0.92]
Observations	1,163	1,163	1,163	1,163	1,163
R-squared	0.001	0.010	0.011	0.041	0.047
Year FE	YES	YES	YES	YES	YES

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics in parentheses, YES indicates that the year is controlled.

Table 6 shows the test of models (2) to (4). From the results in the table, there is a significant negative correlation between the cross term of management shareholding and the internal pay gap of executives and R&D investment, while there is a positive relationship between the cross term of two positions and the cross term of the degree of equity dispersion and R&D investment, but the results are not significant. In summary, the test results of models (2) to (4) are generally consistent with the previous paper.

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Table 6. Robustness test table for model (2) to table (4)

	Model [2]	Models [3]	Models [4]
VARIABLES	rdtoincome	rdtoincome	rdtoincome
innergap	0.007**	0.004	0.007***
	[2.33]	[1.48]	[2.71]
DA	-0.003	-0.003	-0.014
	[-0.28]	[-0.25]	[-1.14]
roa	-0.002	0.002	-0.002
	[-0.09]	[0.08]	[-0.07]
turnover	-0.047***	-0.048***	-0.048***
	[-6.29]	[-6.32]	[-6.54]
size	-0.000**	-0.000***	-0.000***
	[-2.45]	[-2.67]	[-3.20]
sep	0.039		
	[0.76]		
sepgap	-0.004		
	[-0.92]		
dual		-0.053	
		[-0.90]	
dualgap		0.004	
		[0.83]	
mnghld			0.270*
			[1.65]
mnghldgap			-0.026**
			[-1.99]
Constant	-0.000	0.036	0.007
	[-0.00]	[1.20]	[0.21]
Observations	1,163	1,163	1,163
R-squared	0.051	0.048	0.068
Year FE	YES	YES	YES

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics in parentheses, YES indicates that the year is controlled.

6. Conclusion

Based on the tournament theory and management power theory, this paper explores the impact of the internal pay gap of executives on R&D investment with listed companies in the information technology industry as a data window from 2015 to 2020, and the main conclusions are as follows:

(1) The executive internal pay gap has a positive impact on R&D investment. Consistent with the tournament theory, the larger the internal pay gap of executives, the greater the incentive of "reward" for executives, the more executives have the incentive to improve performance and undertake high-risk and high-return projects, especially for technology-intensive industries such as the information technology industry, and the R&D investment will be further expanded.

(2) This positive effect of the internal pay gap of executives will be affected by the power of management. The above empirical analysis shows that in companies with a high percentage of management shareholding, the incentive effect of internal pay gap for executives will be suppressed, thus reducing the expenditure of R&D investment. Instead, in the case of a high

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degree of equity dispersion and two positions, the incentive role of the tournament in the information technology industry is favored.

The conclusions of this paper are instructive for companies in the information technology industry to optimize the compensation system and expand R&D investment.

(1) Appropriately expand the internal pay gap of executives. In the information technology industry, the role of tournament incentives is obviously more applicable than the behavioral theory. When designing executive compensation, due consideration should be given to the rationality of appropriately expanding the pay gap to incentivize executives to increase R&D investment and maintain the company's long-term activity and vitality.

(2) Improve the governance structure of the company. The above incentives will be affected by the power of management, and the effectiveness of the executive compensation contract will be disturbed at the same time. The above research shows that management shareholding will weaken the incentive role of the championship, while the two positions and equity dispersion can promote incentives to a certain extent. Therefore, we should improve the management's power configuration, strengthen its supervision, and at the same time, squarely face the positive promotion effect of management's power.

(3) Incorporate R&D investment into the performance appraisal index of executives. In high-tech industries such as the information technology industry, product innovation is its core competitiveness, and the R&D investment of executives should be appropriately assessed in order to encourage the company to innovate and maintain its vigorous vitality.

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