

Research on Managerial Power, Internal Control and Enterprise's R&D Investment

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Abstract: By using the data of A-share listed companies from 2009-2014 which reveal continuous R&D investment, this paper studies the relationship among the managerial power, internal control and R&D investment. It is found that: 1. The managerial power has a significant positive correlation with R&D investment. Especially, the ratio of executives' ownership has an inverse U-correlation with the R&D investment; 2. Compared to the non-state-owned enterprises, state-owned corporate executives has stronger affect to R&D investment; 3. The quality of company's internal control will affect the correlation between managerial power and R&D investment; This article puts eyes inside the enterprise environment, especially the factor of "man", it provides technical support and scientific basis for enhancing the core competitiveness of Chinese listed companies, accelerating enterprise technological innovation and promoting industrial upgrading and transformation.

Keywords: Managerial Power, Internal Control, R&D Investment of Enterprises.

1. INTRODUCTION

It is innovation which promotes development of economy. To maintain durable competitiveness nowadays at which technology changes so quick, enterprises have to promote their ability to innovate to defeat other enterprises. At the process of innovation, Dosi(1998) point out that research and development(R&D) is an important strategic investment, and it is the source of innovation development.

It is shown by State Statistics Bureau that the total R&D investment of China, which is only less than that of US, reach 1400 billion Yuan in 2015. However, IRI which belongs to EU found that there are only 301 Chinese enterprises which are among Top 2500 when they were ranking the enterprises by R&D investment, while there are 360 from Japan, 608 from EU and 829 from US. It can be found that the total R&D investment of our country is huge, and there are not so many Chinese enterprises which achieve remarkable R&D investment individually. Huawei is the one who invest most (5.44 billion USD) on R&D among all Chinese enterprises. Prime Minister Li Keqiang raised the "Mass Entrepreneurship and Innovation" policy to encourage enterprise to conduct technology innovation. Innovation of technology needs huge funding, therefore, enterprises' technology innovation achievement depends on the investment of R&D. As objectivefactors, internal governance structure, performance of management and external political and economic environment can be predicted and controlled. Meanwhile, senior executives, as "human", are assumed to be rational-economic men by researchers resulting in ignorance of the subjectivity effect caused by ability and power. On the base of theory of managerial power, principal-agent and bounded rationality, as the highest constitutor and decision maker of enterprises, the managerial power affects the decision of R&D investment directly. Along with the appearance of principal-agent conflict, enterprises promote their internal governance and power supervision, effectiveness of internal governance, in turn, affects the managerial power. Based on above, how does managerial power affect the R&D investment of enterprises? Is there any difference regarding effect of managerial power between state-ownedenterprise and non-state-owned enterprises? Does the effect of managerial power on R&D investment change with effectiveness of internal governance?

2. LITERATURE REVIEW

R&D investment of enterprises is affected not only by external environment, including politics, economy trend, society and other factors, but also internal environment which is the principal one. Even in the situation that external environment is pessimistic, as long as there is suitable internal environment, enterprises can explore new opportunity in market by innovation. Technology innovation is not only the key power which promote the economy of a country, but also the foundation to promote innovation competition of enterprises. Researchers at home and abroad start to research factors which affect R&D investment.

2.1 Senior Executives

Characteristics of senior executives include age and education background. Age can decide to which extent they can afford risk. Generally speaking, the older they are, the less risk they can take. Attitudes of older senior executives and younger ones were compared by Hambrick and Fukutomi (1999), and it is obtained that younger senior executives prefer new things willing to increase R&D investment and take risk. While older ones are conservative refusing risk. Mueller (2002) pointed that older senior executives care about their reputation more than younger ones, and they prefer reducing decision under risk and conservative financial strategy. Bushee (2002) conduct further research from the point of outgoing. He thinks that older senior executives have to face outgoing making them considering their reputation and performance before they leave. They do not want to make any decision with risk. While younger ones are willing to accept challenge since they have more space for development. Liu Yunguo and Liu Wen (2007) found that there is negative correlation between R&D investment and old senior executives. Besides, education background of senior executives affects R&D investment. Different education background results in different foresight, different judgement toward future and different information. All these have influence on R&D investment decision.

Different researchers have different opinion on relationship between the tenure of senior executives and R&D investment. Fukutomi and Hambrick (1996) hold the opinion that senior executives are not able to make and implement their long-term strategy in the condition of short tenure. Thus, increasing tenure of senior executives help increasing R&D investment. However, they found that tenure which is too long makes senior executives losing power of innovation and feeling of freshness. This is harmful for R&D investment. It is obtained by Mueller (2002) that, in the situation of long tenure, senior executives' decision tends to be conservative since they have to consider their reputation. Bushee (1998) pointed out that senior executives change intension of R&D investment according to accounting policy to achieve their profit goal within their tenure. This effect is significant at the first year and last year of their tenure. Senior executives have strong motivation to reduce R&D investment aiming at reducing profit risk. Liu Yunguo and Liu Wen have proved that there is positive correlation between tenure and R&D investment. Moreover, senior executives reduce R&D investment before they leave.

As an important characteristic of senior executives, power affect senior executives' ability to make decision. Dong Hongye and Li Xiaorong (2014) try to explore if increment of managerial power is the reason for over-investment of state-own enterprises. It is indicated that there is positive correlation between managerial power and over-investment. Taking state-own enterprises as research samples, Gan Shengdao and Hu Mingxia (2014) found that R&D investment stay at a low level for those enterprises' who have proper internal control. However, concentration of power can weaken this effect. Enterprises came into market from 2002 to 2009 were considered by Xia Yun (2014) to investigate the influence of stock ownership incentive affected by power on R&D investment. Samples are divided into two groups including enterprises' controlled by manager and ones not controlled by managers. It is shown that senior executives can bring influence onto R&D investment by stock ownership incentive using their power.

2.2 Internal Control

"Standard for Internal Control" was published by MOF, CSRC, NAA, CBRC and CIRC in 2008 to improve internal control of enterprises, promote operating management and increase ability to prevent risk. Quality of internal control affects efficiency of R&D investment significantly. However, there is not enough research on relationship between internal control and R&D investment. Cai Jun (2013) found that improving internal control help senior executives to make right decision towards R&D investment, and the R&D decision affect project input and output and efficiency of capital. Fiction of R&D investment is common for many enterprises. Thus, it is necessary to improve internal control to ensure quality of R&D investment. It is pointed out by Gong Yifei (2015) that publishment of internal control institution indicates that internal control is the key factor which affects efficiency of R&D investment.

It is widely researched how to promote R&D investment. Thus, from the point of influence on R&D investment from internal environment, most researchers conduct research from single side such as tenure, shareholding ratio and organization structure etc. ignoring mutual relation between different factors. 1. Most researchers investigate internal control or managerial power separately without considering relationship between internal control and managerial power. They took generalized internal control regime and implement into consideration only failing to research it roundly. 2. Some researchers are aware of relationship between managerial power and internal control. However, they consider influence caused by both of them falling into contradiction analysis easily. 3. Methods used to measure managerial power can be different resulting in different conclusion. 4. There are limitations for R&D investment data announcement. Reasons that R&D investment is not announced should be considered to ensure scale of sample.

3. THEORY ANALYSIS & HYPOTHESIS

As the subjective factor which can affect R&D investment, personal characteristic of senior executives has influence on R&D investment through their mental activity. Power of senior executives determines their ability to plan and execute directly since power is one important characteristic of senior executives. Social psychology indicates that mental activity can be affected by personal power leading to audience or restrain behavior. This reflects change on extent of personal risk-taking. Case study of Anderson and Galinsky (2006) indicated that risk-taking level increases as power attracting attention on benefit rather than potential risk. Magee and Galinsky (2008) verified that the more power they have, the more possibility they have audience behavior. Thus, they made these hypothesis:

Hypothesis 1: There is positive correlation between managerial power and R&D investment of enterprises.

Dong Hongye (2014), Gan Shengdao (2014) and Xia Yun (2014) found that there is positive correlation between managerial power and R&D over-investment for state-own enterprises. Hypothesis 1a was then raised:

Hypothesis 1a: Influence of managerial power on R&D investment of state-own enterprises is more than that of non-state-own enterprises.

Power of senior executives can be measured from many sides and dimensionality, shareholding ratio is an important indicator. Some researchers found that, without considering endophytism, there is reverse U relationship between shareholding ratio and enterprises' value or performance, i.e. the more stock they hold, the more positive effect stock ownership incentive bring if the shareholding ratio is less than a certain value. However, in the condition shareholding ratio is more than that value, the more stock they hold, the worse performance enterprises will have.

Hypothesis 2a: There is reverse U relationship between shareholding ratio and enterprises' R&D investment.

There is significant correlation between managerial power and internal control. Firstly, senior executives determine direction of development by gaining power of operation owing to separation of ownership and right of management. Meanwhile, shareholders exert certain supervision on senior executives to promote efficiency for the sake of reducing cost of agent. Complete internal management structure and proper internal control are adopted by modern enterprises to control and supervise managerial power. Internal control is a prevention mechanism towards operation management and risk prevention & control. Thus, quality of internal control has influence on managerial power and consequently affect relationship between managerial power and R&D investment. If there is positive correlation between managerial power and R&D investment, internal control can reduce power of senior executives decreasing positive influence caused by managerial power. Thus, following hypothesis is proposed:

Hypothesis 2: Quality of internal control can enhance influence of managerial power on R&D investment.

4. RESEARCH DESIGN

4.1 Samples and Data

"Accounting Standards for Business Enterprises" was announced by MOF in 2009. Hence, enterprises list in A-Share and traded in Shenzhen and Shanghai between 2010 and 2014 are selected as samples. Data is withdrew from CSMAR database, and data of DIB - internal control index is from website of China's internal control and enterprises' risk management. Following criterions are adopted when selecting data: 1. Removing listed enterprises from financial and insurance field; 2. Removing ST and delisting enterprises; 3. Removing enterprises without complete data or with abnormal data; 4. Removing abnormal data by winsorization treatment on continuous variable within 1% range.

Considering that there are enterprises whose data of R&D investment is not complete or announced, property of enterprise is used as main data when matching data to ensure scale of samples.

EXCEL and STATA are used for data treatment.

4.2 Variable Design

4.2.1 Dependent Variable

There are two kinds of indicators which can be used to measure R&D expense of enterprises. One is absolute indicator, the other one is relative indicator. R&D expense dividing total assets can be used as relative indicator. At present, there are mainly three methods to measure R&D expense world widely including R&D expense/total assets, R&D expense/prime operating revenue, R&D expense/market value. Surplus control can lead to unconformity between operation revenue and real operation revenue resulting in inaccuracy of above second method. Market value of enterprises cannot be obtained easily, and the third method is also not adoptable. In brief, research method (R&D expense/total assets) used by Chen and Huang (2006), Liu Yunguo and Liu Wen (2007), Ren Haiyun (2010), Tang Qingquan is adopted in this thesis.

4.2.2 Independent Variable

(1) Managerial power: Due to different definition of senior executives given by different researchers, availability of data and uniformity of measurement, CEO, president or general manager of enterprises, who have right to make decision, are taken into consideration according to research of Quan Xiaofeng, Wu Shinong and Wen Fang (2010) etc. Shareholding ratio of senior executives (GCG), independence of board of directors (INDEPENDENT) and degree of shareholding separation (SEPARATE) are taken as main variables from the point of senior executives, internal supervision and external supervision separately. Additional post of senior executives (DUAL) and scale of board of directors are added as variables when conducting robustness test. PCA is followed to measure managerial power by dimensionality reduction.

Shareholding ratio of senior executives (GCG): Senior executives are not only agent, but also shareholder when they hold stock. Hence, shareholding ratio affect right of speech and right of decision having influence on decision on R&D investment.

Independence of board of directors (INDEPENDENT): Number of Independent directors determine intensity of supervision. CSRC requires there should be no less than 1/3 independent directors. The more independence board of directors have, the harder to achieve cooperation leading to more power of senior executives. $INDEPENDENT = \text{Number of independent directors} / \text{Total number of directors}$.

Degree of shareholding separation (SEPARATE): This variable is used to measure ratio of the first majority shareholder dividing the second to tenth shareholders. If the ratio is equal to 1, it means stock rights are separated. SEPARATE should be chosen either in 0 (maximum power of senior executives) or 1.

Additional post of senior executives (DUAL) :In the condition that senior executive is both CEO and president, his/her real power is increase sharply resulting in DUAL set at 1, or DUAL will be set at 0.

Scale of board of directors (DSIZE): The larger of board of directors, the harder to achieve consensus leading to less control on senior executives and more power of them. Therefore, number of board of directors is chosen as the indicator for scale of it.

(2) Quality of internal control: DIB-ICI indicators is selected to measure quality of internal control according to research of Zhao Xi (2013), Mu Shaohong (2014), Gan Shengdao (2014) and Hu Mingxia (2015). ICI indicators are divided into two groups by median. If DIB index is less than median, HIGH will be set at 0 indicating that internal control is on a low level. Details can be found in Table 4-1.

Table 4-1 Means and Calculate Methods of Variables

Type of Variables	Name of Variables	Measurement Method
Independent variable - power of senior executives	Shareholding ratio of senior executives	Shareholding ratio of senior executives such as general manager
	Independence of board of directors	Number of Independent directors/total directors

	Degree of shareholding separation	Ratio of the first majority shareholder dividing ratio of the second to tenth shareholders
	Additional post of senior executives	Two-valued variable, either 1 or 0
	Scale of board of directors	Number of board of directors
Independent variable – internal control	Internal control index HIGH	If DIB index is less than median, HIGH will be set at 0 indicating that internal control is on a low level
Dependent variable	Scale of R&D investment	Expense of R&D/total assets
Control Variable	Size of enterprises InSIZA	Napierian logarithm of total assets
	Financial leverage LEV	Liabilities/ total assets
	Return on equity ROE	Retained profits/ net assets
	Growth of enterprises GROWTH	(Operation revenue of this year - Operation revenue of last year)
	State of cash flow CF	Cash and cash equivalent at end of year/total assets
	Type of real controller	State-own enterprise STATE=1, non-state-own enterprise STATE=0

4.3 Model Design

Hypothesis 1 and 1a are tested firstly to evaluate influence of senior executives on R&D investment. Considering R&D investment is affected by performance of last year, independent variables and control variables are delayed for one year. GLS regression model is built as following. Samples are grouped by STATE, and regression is conduct to state-own group and non-state-own group after that.

$$R\&D_{i,t} = \alpha_0 + \alpha_1 GCG_{i,t-1} + \alpha_2 INDEPENDENT_{i,t-1} + \alpha_3 SEPARATE_{i,t-1} + \alpha_4 \ln SIZA_{i,t-1} + \alpha_5 Lev_{i,t-1} + \alpha_6 ROE_{i,t-1} + \alpha_7 Growth_{i,t-1} + \alpha_8 CF_{i,t-1} + \alpha_9 Year_{i,t} + \varepsilon_{i,t} \quad (1)$$

Considering shareholding ratio of senior executives according to hypothesis 2A, hypothesis 2A is then tested: there is reverse U relationship between shareholding ratio and R&D investment. Two element regression equation is built by adding quadratic term of shareholding ratio:

$$R\&D_{i,t} = \gamma_0 + \gamma_1 GCG_{i,t-1} + \gamma_2 GCG^2_{i,t-1} + \gamma_3 \ln SIZA_{i,t-1} + \gamma_4 Lev_{i,t-1} + \gamma_5 ROE_{i,t-1} + \gamma_6 Growth_{i,t-1} + \gamma_7 CF + \gamma_8 Year_{i,t} + \varepsilon_{i,t} \quad (2)$$

Three regression equations are set up by taking control variable HIGH and three variables measuring power of senior executives as cross terms to test hypothesis 2:

$$R\&D_{i,t} = \beta_0 + \beta_1 GGB_{i,t-1} + \beta_2 GCG^2_{i,t-1} + \beta_3 HIGH_{i,t-1} + \beta_4 (HIGH * GGB)_{i,t-1} + \beta_5 \ln SIZA_{i,t-1} + \beta_6 Lev_{i,t-1} + \beta_7 ROE_{i,t-1} + \beta_8 Growth_{i,t-1} + \beta_9 CF + \beta_{10} Year_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$R\&D_{i,t} = \beta_0 + \beta_1 INDEPENDENT_{i,t-1} + \beta_2 HIGH_{i,t-1} + \beta_3 (HIGH * INDEP)_{i,t-1} + \beta_4 \ln SIZA_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 ROE_{i,t-1} + \beta_7 Growth_{i,t-1} + \beta_8 CF + \beta_9 Year_{i,t} + \varepsilon_{i,t} \quad (4)$$

$$R\&D_{i,t} = \beta_0 + \beta_1 SEPARATE_{i,t-1} + \beta_2 HIGH_{i,t-1} + \beta_3 (HIGH * SEPA)_{i,t-1} + \beta_4 \ln SIZA_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 ROE_{i,t-1} + \beta_7 Growth_{i,t-1} + \beta_8 CF + \beta_9 Year_{i,t} + \varepsilon_{i,t} \quad (5)$$

5. RESULT OF DEMONSTRATION

5.1 Descriptive Statistics

Descriptive statistics of variables are list in Table 5-1. There are totally 2590 R&D samples released from 2009 to 2014, and there is significant difference among them with maximum R&D investment at a level of 9% of total assets and minimum R&D investment at a level of 0.00151% of total assets. Regarding to shareholding of senior executives, maximum GCG is 59.17% while minimum is 0. Data for independence of board of directors indicates that requirement of “independent directors should be no less than 1/3” is met with a maximum value at 45.45%. Number of directors varies from 6 to 12. Variance of assets size is larger than 1 with maximum total asset logarithm at 24.04 and minimum at 19.86. Increase rate of operation revenue lies from 8.91% to 85.32%, and asset-liability ratio is between 8.91% and 85.08%. Ratio of cash varies from -9.40% to 17.83%, while return on net assets is from -10.98 to 26.38%.

Table 5-1 Result of Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
R&D	2590	0.0145	0.0168	0.0000	0.0913
DUAL	2590	0.2301	0.4209	0	1
GCG	2590	0.1050	0.1920	0	0.5917
INDEPENDENT	2590	0.3661	0.0424	0.3333	0.4545
DSIZE	2590	8.8875	1.4825	6	12
SEPARATE	2590	0.7060	0.4556	0	1
LNSIZE	2590	21.6363	1.1335	19.8592	24.0443
GROWTH	2590	0.1588	0.2802	-0.3010	0.8533
LEV	2590	0.4582	0.2230	0.0892	0.8508
CF	2590	0.0420	0.0699	-0.0939	0.1783
ROE	2590	0.0787	0.0871	-0.1098	0.2638

5.2 Multivariate Regression Analysis

5.2.1 Influence of Managerial Power on R&D Investment

Table 5-2 is regression result for model 1 and 3 reflecting relationship between R&D investment and managerial power as well as R&D investment and their shareholding.

Table 5-2 Test of Person Coefficients of Association

R&D	Model1	Model2
GCG	0.0069** (2.36)	0.0256*** (2.73)
GCG^2		-0.0316* (1.92)
INDEPENDENT	0.0242*** (2.7)	
SEPARATE	-0.0016* (1.84)	
LNSIZE	0.0006** (3.14)	0.0008** (3.37)
CF	-0.0007* (1.55)	-0.0019* (1.43)
GROWTH	0.0003* (1.46)	0.0002* (1.62)
ROE	0.0048 (1.17)	0.0049 (1.22)
LEV	-0.0102*** (3.57)	-0.0099*** (3.48)
_cons	-0.0054 (0.43)	-0.0008 (0.07)
sigma_u	0.0142	0.0143

sigma_e	0.0079	0.0079
N	2170	2208
G	728	728

Notes: ***, **, * meansperson and spearman coefficients of association is obvious at 1%, 5%, 10%.

It can be seen from the test result of model 1 that GCG, INDEPENDENT and SEPARATE are obviously correlative to R&D at level 5%, 1% and 10%. Among them, GCG and INDEPENDENT is positively correlative to R&D while SEPARATE is negatively correlative to R&D. It can be concluded that the higher ratio of shareholding, the more independent of board of directors, the more separation of shareholding, the more R&D investment enterprises will have. This proves hypothesis A i.e. there is positive relationship between managerial power and R&D investment.

Test result of model 3 indicates coefficient of GCG^2 is -0.0315945 with negative correlation with R&D at a level of 5% while coefficient of GCG is 0.0256198 with positive correlation with R&D at a level of 1%. It can be known that quadratic equation of R&D with GCG is a reverse U curve. Below a certain shareholding ratio, R&D investment increases with shareholding ratio. Thus, if it is higher than that value, increasing shareholding ratio results in decrease of R&D investment. Above shows shareholding of senior executives should be keep at a proper level to avoid senior executives gaining short-term benefit by raising value of stock and giving up R&D investment which is under high risk. In conclusion, hypothesis 2A is verified.

5.2.2 Influence of Internal Control on Relationship between R&D Investment and Managerial Power

Table 5-3 shows regression result for model 3 – 5. It reflects influence of managerial power on R&D investment after taking variable of internal control into consideration. Every indicator measuring managerial power is used as cross term of internal control separately, and cross section data regression of GLS is conduct.

It is concluded that coefficient measuring managerial power is not increased by adding variable of internal control HIGH indicating that HIGH increase managerial power. HIGH has negative relationship with R&D investment in these three models. It can be known that enterprises prefer reducing R&D investment in good internal control situation. It can be explained that, for enterprises who have high internal control index, high risk investment project will be reduced owing to their strong ability to control risk. Internal control HIGH has positive influence on shareholding ratio, while it has negative influence on independence of board of directors.

Conclusion can be obtained from above model regression result that: 1. The larger size of enterprises, the more R&D investment; 2. Enterprises are not willing to conduct R&D by cash; 3. The faster enterprises grow, the more willing to increase R&D investment to maintain innovation competitiveness; 4. The more debit enterprises have, the less R&D investment they will have. There is no relationship between return on equity and R&D investment.

Table 5-3 Comparison of State-Owned Enterprises and Non-State-Owned Enterprises

R&D	Model3	Model4	Model5
GCG	0.0241** (2.55)		
GCG²	-0.0333** (2.43)		
INDEPENDENT		0.0225** (2.47)	
SEPARATE			-0.0014 (1.43)
HIGH	-0.0005** (2.97)	-0.0019** (2.71)	0.0004* (0.52)
GCG*HIGH	0.0040* (1.9)		
INDEP*HIGH		0.0049** (0.8)	

SEPA*HIGH			-0.0006 (0.66)
LNSIZE	0.0007** (1.32)	0.0005** (0.85)	0.0004** (0.75)
CF	-0.0019* (0.44)	-0.0017* (0.38)	-0.0016* (0.35)
GROWTH	0.0003* (0.35)	0.0006** (0.75)	0.0004* (0.51)
ROE	0.0053 (1.3)	0.0047 (1.16)	0.0048 (1.16)
LEV	-0.0098*** (3.46)	-0.0121*** (4.57)	-0.0119*** (4.35)
_cons	0.0000222 (0)	-0.000125 (0.01)	0.0098 (0.83)
sigma_u	0.0142	0.0142	0.0142
sigma_e	0.0079	0.0079	0.0079
N	2208	2195	2183
G	728	728	728

6. CONCLUSION AND ADVICE

Relationship between R&D investment and managerial power& quality of internal control is investigated. Conclusions can be gained by mathematic model, GLS regression, PCA taking data of listed enterprises' announcement of R&D investment from 2009 to 2014 as samples that:

1. There is positive relationship between managerial power and R&D investment. Reverse correlation can be found for R&D investment and shareholding ratio.
2. Influence of managerial power on R&D investment of state-own enterprises is stronger than that of non-state-own enterprises.
3. Different quality of internal control results in different influence of managerial power on R&D investment. In general, it increases influence of managerial power on R&D investment.
4. Enterprises with huge assets, low asset-liability ratio, high increase rate of operation revenue tends to increase R&D investment. From the view of internal control, considering influence of internal control on managerial power with innovation, managerial power is deeply investigated regarding influence on R&D investment. It can be reference for promoting core competitiveness of Chinese listed enterprises, quickening technology innovation and upgrading of industries.

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