

The Impact of Corporate Governance in Different Industries on Enterprise Scientific and Technological Innovation

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Keywords: Corporate Governance, Scientific and Technological Innovation, R&D Investment

Abstract: Taking 1099 A-share companies in Shanghai and Shenzhen from 2012 to 2017 as samples, this paper uses the method of cluster analysis to divide the samples into labor-intensive, capital intensive and technology intensive enterprises for regression respectively, and compares the impact of corporate governance in different industries on scientific and technological innovation. The results show that CEO duality and salary incentive have a positive impact on the scientific and technological innovation of the three types of enterprises. The lower the shareholding proportion of the first largest shareholder and the higher the proportion of independent directors in capital intensive and technology intensive enterprises, the greater the R&D investment of enterprises. In addition, in technology intensive enterprises, the high proportion of top-level shareholding leads to insignificant equity incentive effect, and state-owned capital has its special position in such enterprises.

1. Introduction

The traditional growth theory holds that scientific and technological innovation is an important driving force for economic growth and social progress. Through scientific and technological innovation, enterprises can improve the competitiveness of their products, profitability and operating performance of enterprises. Scientific and technological innovation helps enterprises to improve production efficiency and management ability, and enable enterprises to maintain long-term competitive advantage. However, there has been controversy about the source of scientific and technological innovation and how to promote technological innovation. While Endogenous growth theory holds that scientific and technological innovation depends on the labor input of existing technologies and researchers.

Although there are many factors affecting enterprise scientific and technological innovation, this paper believes that corporate governance has a fundamental impact on enterprise innovation. Based on previous studies, this paper distinguishes the different importance of innovation in different industries, and studies the corporate governance factors affecting scientific and technological innovation in labor-intensive industries, capital intensive industries and technology intensive industries, and analyzes their differences and commonalities, which has reference significance for China's future industrial upgrading and economic transformation.

2. Literature review

Generally speaking, corporate governance mainly includes three levels: shareholders, board of directors and incentive mechanism.

2.1 Shareholder

(1) Ownership concentration

There are three explanations for the impact of ownership concentration on innovation. The existence of controlling shareholders has a positive impact on enterprise innovation investment (Bogliacino et al. [1], 2013). Yang Jianjun and Sheng Suo [2] (2007) believe that the more concentrated the equity, the more significant the negative correlation. While Wen Fang [3] (2008) found that there

was an "n" relationship between the shareholding ratio of shareholders and the company's R&D investment, and the interval effect of ownership concentration on innovation was obvious.

(2) Nature of equity

Different ownership structures reflect different corporate governance mechanisms, which determine different corporate governance efficiency (Sui Jing [4], 2016). The nature of equity, that is, the identity of shareholders, includes state-owned shares, individual shares and institutional investors. Zhao Hongjiang et al. [5] (2008) and Ren Haiyun [6] (2010) found that the innovation investment of state-owned holding companies is less than that of private holding companies. Wu Yanbing [7] (2012) found that private enterprises are in a leading position in innovation investment and patent innovation efficiency, especially foreign-funded enterprises. Su Wenbing et al. [8] (2010) reached the opposite conclusion. Enterprises whose largest shareholder is state-owned shares or state-owned legal person shares have higher R&D investment intensity.

2.2 Board of directors

Internal directors and external directors in the board of directors have different effects on innovation. Yang Huijun, Yang Jianjun [9] (2015) found that the impact of external directors on enterprise innovation decision-making is jointly affected by the size and structure of the board of directors, which needs to be analyzed according to the specific situation. The leadership structure mainly involves the two positions of chairman and general manager. Whether the CEO duality are conducive to R&D decision-making, the existing research has not reached a consensus conclusion.

2.3 Incentive mechanism

High level incentive mainly includes equity incentive, salary incentive and promotion incentive. With regard to equity incentive, Zhou Jie and Xue Youzhi (2008) [10] found that equity incentive can reduce the short-sighted tendency of managers, significantly improve the company's R&D investment, make the supervision of directors more active, and thus have a significant positive impact on R&D investors. Beyer et al. [11] (2011) found that companies without equity incentive often have insufficient R&D investment. In terms of salary incentive, Li Sihai et al. [12] (2015) found that executive salary incentive is more sensitive in private enterprises, not in state-owned enterprises, and state-owned enterprises are more sensitive to promotion incentive. Zhou Mingshan and Zhang Qianqian [13] (2016) found that promotion incentives make CEOs of state-owned enterprises more focused on effective R&D investment.

Thus this paper believes that different industries have different needs for innovation, and the characteristics of the company's industry should be taken into account. The difference in R&D investment of enterprises in the same industry and of the same scale should be explained from the level of corporate governance.

3. Research Design

3.1 Model establishment and variable selection

This paper establishes the following regression model. Among them, the explanatory variables are R&D investment, the key explanatory variables are shareholders, board of directors and incentive mechanism of corporate governance, and the control variables reflect other characteristics affecting enterprise R&D investment.

$$\text{innov} = c + \alpha_1 \text{shareholder} + \alpha_2 \text{board} + \alpha_3 \text{incentive} + \beta \text{controls} + \varepsilon \quad (1)$$

3.2 Sample and data description

Since the data on R&D expenditure in Ruisi data base are only updated to 2017, this paper takes Shanghai and Shenzhen A-share listed companies from 2012 to 2017 as a sample. Excluding the companies with incomplete data in the financial industry and various variables, 1099 companies were

finally selected. The manufacturing industry accounts for 78.3% and the information technology industry accounts for 7.5%. Then winsorize the continuous variables at the level of 5%.

The descriptive statistics of the main variables are shown in Table 1. The explained variable is the index to measure enterprise innovation, which usually includes input (R&D capital input) and output (number of patents, number of new products, etc.). This paper selects the proportion of R&D investment in total assets and the proportion of R&D expenses in operating revenue to measure enterprise R&D investment. Among them, the average proportion of R&D expenditure in total assets is 0.0256, and the average proportion of R&D expenditure in operating revenue is 0.0455. The standard deviation of the two indicators is large, and there is a large difference in the quartile, indicating that there are great differences in R&D investment of A-share listed companies in China.

The average shareholding ratio of the largest shareholder is 0.3437, with a median of 0.3331, which indicates that the phenomenon of one share dominance is common, and 13.45% of the company's largest shareholder is a state-owned enterprise. The average shareholding ratio of the second to tenth largest shareholders is 0.2405, with a median of 0.2312, which is far from the shareholding level of the first largest shareholder. For the board of directors, 71.94% of the enterprise's chairman and general manager are separated, and the average proportion of independent directors in the board of directors is 37.01%. From the quartile, there is little difference between the two positions and the proportion of independent directors. In terms of incentive mechanism, the average salary of directors, supervisors and senior executives is 533 million yuan, the quarter and three quarter digits are 0.0275 and 0.0695 respectively, and the standard deviation is 0.0533, indicating that there are significant differences in salary incentive strength among companies. In terms of equity incentive, the average shareholding ratio of directors, senior supervisors and supervisors is 0.122, and the three digits of one quarter and one quarter are 0 and 0.2383 respectively, which is also quite different.

Table.1. Descriptive statistics

variable	variable description	N	mean	sd	p25	p50	p75
rd-ta	R&D expenditure / total assets	6954	0.0256	0.0326	0.0103	0.0192	0.0304
rd-in	R&D expenditure / operating income	6594	0.0455	0.0470	0.0203	0.0357	0.0531
sh1	Shareholding ratio of the largest shareholder	6594	0.3437	0.1330	0.2317	0.3331	0.4394
shstate	Nature of equity of the largest shareholder The state-owned property is taken as 1, otherwise it is taken as 0	6594	0.1345	0.3412	0.0000	0.0000	0.0000
sh2-10	Shareholding ratio of the 2nd - 10th largest shareholder	6594	0.2405	0.1202	0.1424	0.2312	0.3317
dir-ceo	Separation of rights If the two positions are separated, take 1, otherwise take 0	6594	0.7194	0.4493	0.0000	1.0000	1.0000
ind	Proportion of independent directors	6594	0.3701	0.0442	0.3333	0.3333	0.4268
s-bam	Annual salary of directors, supervisors and senior executives	6594	0.0533	0.0349	0.0275	0.0418	0.0695
r-bam	Shareholding ratio of directors, supervisors and senior executives	6594	0.1220	0.1683	0.0000	0.0070	0.2383
lev	comprehensive leverage	6594	1.7872	0.9241	1.1805	1.4349	1.9894
size	company size	6594	22.0931	1.1033	21.2682	21.9684	22.7868

3.3 Industry cluster regression

Based on the industry classification of CSRC in 2012, excluding the financial industry, this paper uses Ward method for cluster analysis and divides 24 industries into three categories: labor-intensive, capital intensive and technology intensive. The classification indicators are: 1) The proportion of fixed

assets in total assets. The greater the proportion, the more important the capital is. It is capital intensive.2) the larger the ratio of R&D expenditure to employee compensation payable, it indicates that technical factors are more important than labor, which is technology intensive. Surplus enterprises are labor-intensive the classification results are shown in Table 2:

Table.2. Industry classification by factor intensity

Labor-intensive	Capital-intensive	Technology-intensive
(A) agriculture, forestry, animal husbandry and fishery (B) mining industry (C1) textile, clothing (C2) wood furniture (C9) other manufacturing, (D)electric and hot water production and supply (E)construction (F) wholesale and retail (G)transportation and warehousing (H)accommodation and catering industry (L)leasing, (Q)social work (R) sports and entertainment industry, (S)Public Management	(C3) papermaking and printing (C4) petroleum, chemical, plastics (C6) metal, nonmetal (K) real estate	(C5) electronics (C7) mechanical equipment (C8) medicine (D)information technology (M)scientific research services (N) water conservancy and environmental management

In general, the clustering results are in line with the general industry judgment. Labor intensive industries are the most, and the other two categories are less. Next, the regression is carried out according to the three types of industries. The results are shown in Table 3. The model controls the annual effect, and the regression coefficients of control variables and constant terms are not shown.

Table.3. Classification regression results

variable	Labor-intensive		Capital-intensive		Technology-intensive	
	rd-in	rd-ta	rd-in	rd-ta	rd-in	rd-ta
sh1	-0.009* (0.079)	0.004 (0.379)	-0.010** (0.035)	-0.014** (0.022)	-0.037*** (0.000)	-0.011** (0.028)
shstate	-0.020 (0.211)	-0.007 (0.529)	-0.011 (0.456)	-0.008 (0.646)	0.025** (0.030)	0.032** (0.016)
shdum	0.010* (0.085)	0.005 (0.371)	0.009* (0.081)	0.005 (0.406)	0.002 (0.788)	-0.005 (0.339)
sh2-10	-0.004 (0.412)	0.000 (0.843)	-0.010* (0.052)	0.002 (0.740)	-0.003 (0.691)	-0.008 (0.129)
dir-ceo	-0.002*** (0.002)	-0.001* (0.051)	-0.002*** (0.004)	-0.001* (0.064)	-0.005*** (0.001)	-0.002* (0.078)
ind	0.004 (0.746)	-0.007 (0.559)	0.108*** (0.008)	0.210** (0.039)	0.112*** (0.000)	0.027** (0.041)
s-bam	0.134*** (0.003)	0.086*** (0.000)	0.258*** (0.000)	0.122*** (0.000)	0.305*** (0.000)	0.332*** (0.000)
r-bam	0.021*** (0.000)	0.017*** (0.000)	0.013*** (0.009)	0.012*** (0.007)	0.008 (0.715)	0.001 (0.804)
N	1434	1434	1350	1350	3810	3810
R ²	0.238	0.156	0.275	0.182	0.169	0.163

The corporate governance factors conducive to corporate innovation among different types of industries have something in common, that is, the companies with two positions held by the same person and strong salary incentive also have large innovation investment. This shows that when the chairman and the general manager are held by the same person, the decision-making efficiency is improved, which has a positive impact on the R&D investment of the enterprise.

The regression results of capital intensive and technology intensive enterprises show some commonalities. In these two industries, the coefficient of the shareholding ratio of the first largest

shareholder is significantly negative, while the regression coefficient of the proportion of independent directors is significantly positive, which shows that the lower the shareholding ratio of the first largest shareholder and the higher the proportion of independent directors in the board of directors, the more R & D investment. However, in labor-intensive enterprises, the significance of these two variables is not strong, and the positive and negative coefficients are not clear. We observed that the average shareholding ratio of the largest shareholder of capital intensive and technology intensive enterprises was 37.65% and 37.79% respectively, while the average shareholding ratio of the largest shareholder of labor-intensive enterprises was 33.4%. It is speculated that the negative effect of equity concentration is not significant because the shareholding ratio of the largest shareholder of labor-intensive enterprises is relatively low.

In the regression results of labor-intensive enterprises and capital intensive enterprises, the regression coefficient of equity incentive is significantly positive at the level of 1%, and the p value of the regression coefficient of labor-intensive enterprises is close to 0, while in technology intensive enterprises, the coefficient is positive but not significant. Meanwhile, the average shareholding ratios of directors, supervisors and senior managers in labor-intensive, capital intensive and technology intensive enterprises were 7.43%, 10.85% and 13.77% respectively. This shows that the unit. Equity incentive can make the interests of management consistent with the interests of shareholders, so as to reduce the agency problem and be conducive to the scientific and technological innovation of enterprises. However, with the increase of the proportion of senior shareholding, the positive effect of equity incentive will weaken. It is consistent with the research conclusion of Ran Maosheng (2008).

In addition, technology intensive enterprises have certain particularity, and the regression coefficient of their equity nature is significantly positive at the level of 5%, indicating the importance of state-owned assets in the industry. Generally, state-owned enterprises have strong financial strength and greater support for enterprise scientific and technological innovation. Therefore, for technology intensive enterprises relying on scientific and technological innovation, state-owned capital is particularly important.

4. Conclusions

Regardless of industry type, the separation of two positions and incentive mechanism in the board of directors have a significant impact on R&D investment, and the impact of shareholders is not significant. According to the classification of factor intensity, it is found that CED duality and salary incentive can promote the R&D investment of the three types of enterprises. The proportion of the largest shareholder of labor-intensive enterprises is relatively low, so the negative impact caused by excessive concentration of equity is not significant; The high shareholding ratio of directors and supervisors in technology intensive enterprises is relatively high, which leads to the weakening of the incentive effect of equity. In addition, in technology intensive enterprises, state-owned capital is important, and the shareholding ratio of state-owned shareholders is positively correlated with R&D investment.

Generally speaking, different industries pay different attention to scientific and technological innovation and corporate governance. The R&D intensity of labor-intensive enterprises is relatively low, and innovation can be promoted through salary incentive mechanism. Capital intensive and technology intensive enterprises should pay attention to equity balance and reduce the negative impact of excessive equity concentration on enterprise innovation. For technology intensive enterprises, we need to pay attention to the strategic position of state-owned shareholders and reduce the equity incentive to directors, supervisors and senior managers. We can also consider increasing the incentive level for technicians

References

[1] Acemoglu Daron, Johnson Simon, Robinson James. Institutions as a Fundamental Cause of Long Run Growth [J]. Handbook of Economic Growth. 2005, (06): 385-472.

- [2] Yang Jianjun, Sheng Suo. Empirical Study on the impact of ownership structure on enterprise technological innovation investment [J]. Scientific research. 2007, (04): 787-792.
- [3] Wen Fang. Equity concentration, equity checks and balances and corporate R & D Investment [J]. Southern economy. 2008, (4): 13, 43-54.
- [4] Sui Jing, Jiang Cuixia, Xu Qifa. Research on the nonlinear heterogeneous relationship between equity checks and balances and corporate value - Evidence from Chinese A-share listed companies [J]. Nankai management review. 2016, 19 (1): 70-8.
- [5] Zhao Hongjiang, Chen Xuehua, Xia Hui. Empirical Study on the characteristics of corporate independent innovation investment and governance structure [J]. China soft science. 2008, (7): 145-149.
- [6] Ren Haiyun. Empirical Study on the relationship between ownership structure and enterprise R & D Investment [J]. China soft science. 2010, (5): 126-135.
- [7] Wu Yanbing. Which type of ownership enterprises in China are the most innovative [J]. World economy. 2012, (6): 3-29.
- [8] Su Wenbing, Li Xinhe, Xu Donghui, Xu Jia. Correlation test between manager autonomy and R & D Investment [J]. Research and development management. 2010, (4): 30-38.
- [9] Yang Huijun, Yang Jianjun. Research on the relationship between transactional leadership, competitive intensity, technological innovation choice and enterprise performance [J]. Management science. 2015, (4): 1-10.
- [10] Zhou Jie, Xue Youzhi. The impact of corporate internal governance mechanism on R & D Investment [J]. Research and development management. 2008, (3): 5-15.
- [11] Beyer Mila, Dirk Czarnitzki Korneliusl. Managerial Ownership, Entrenchment and Innovation [J]. European Economic Research. 2011: 11-26.
- [12] Li Sihai, Jiang Xinfeng, song Xianzhong. Executive age and salary incentive: theoretical path and empirical evidence [J]. China's industrial economy. 2015, (5): 122-134.
- [13] Zhang Qianqian, Zhou Mingshan, Dong Zhiyong. Does the capitalization of R & D expenditure convey the company value to the market? [J]. financial research. 2017, (6): 176-19.