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A Research on Control Layers of SOEs and R & D Investment

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Abstract

The pyramid structure of the SOEs along with the process of continuous reform has significantly affected the business activities and the decision-making behaviors of enterprises. Based on the data from 2007 to 2015, the paper validates the influence of the length of the control chain of SOEs on the R & D investment behavior of enterprises. Through analysis, we find that, with the control chain being lengthened, it suggests the significant decrease in R & D investment, but this correlation is not obvious for the central SOEs. Further research finds that, although there is no significant effect between the length of the control chain of the central SOEs and the R & D investment in the case of the whole sample, when the control layer is greater than median, the elongation of the control chain significantly inhibits the R & D investment of central SOEs and local SOEs. What' s more, we find that the negative correlation of the number of control layers and R & D investment for local SOEs is only significant when the agent cost is lower.

Keywords

Reform of SOEs, Control Layers, Agency Costs, R & D Investment

1. Introduction

Before the reform and opening up in 1978, China's state-owned enterprises (SOEs) were directly controlled by the central government or local governments. The decisions of SOEs were directly made by the government departments. Managers only had limited decision-making rights in the business activities of the enterprises. In the situation, the lack of incentives for managers and the political tasks of SOEs make the production efficiency of SOEs tend to be relatively lower [1]. Since then, in order to increase the production efficiency of SOEs,

who have undergone several important reform stages, from decentralization of rights and interests to the implementation of the modern enterprise system, and then from "managing people, managing things, managing assets" to "controlling capital." Based on the continuously deepening of reforms, the four types of control models are eventually formed: central SOEs groups, direct controlled by the SASAC, local SOEs groups, and direct controlled by the local SASAC. Different control modes will directly affect the way and intensity of government intervention in business activities. The pyramid structure of SOEs is formed with reforms of SOEs. Under the structure of pyramid, there are several middle layers, and due to the isolation of the middle layers, it makes the managers of SOEs less subject to the direct intervention from government departments, but at the same time, the agency costs are increased sharply.

In June 2015, the State Council issued "the Suggestion on Several Policies and Measures to Vigorously Promoting Public Innovation", which points that China's resources and environmental constraints are increasingly tightened, the driving force of factors has gradually weakened, and the traditional high input, high consumption and extensive mode of development are unsustainable. We need to shift from factor-driven and investment-driven to innovation-driven. On one hand, SOEs continue to head for the stage of deepening reform; on the other hand, the country actively advocates innovation to lead the economic development. And so, in the process of the continuous reforms of SOEs, what kind of impact will they have on the enterprise innovation? The paper explores the problem from the perspectives of government intervention and agency costs. We hope that the paper could provide a supplementation study for the economic consequences of the pyramid holding structure of SOEs and give some references for the reform of SOEs. However, the paper is just focused on the R&D investment which only represents the input. Maybe, paying more attention to innovation output is a direction worth to study in the future.

The article is organized as follows: the first part is the introduction, in this part, we introduce the background, purposes and significances of the study. The second part is the theoretical analysis and hypotheses, in this part, based on the literature review and theoretical analysis; we put forward the research hypotheses of the article. The third part is the study design, in this part, we introduce the process of sample selection and data source of the study, and the key variables are defined and the regression model is also constructed. Then, in the fourth part of the article, we make specific analyses of the regression results. Finally, the fifth part is the conclusion.

2. Theoretical Analysis and Hypothesis Proposed

Studies have shown that state-owned enterprises in China have granted more effective control right to managers in the process of reforms. This kind of decentralization reduces the cost of government intervention. At the same time, under the Pyramid-holding structure, the organization becomes more complex, the

acquisition and transmission costs of information increase, and it is difficult for ultimate controller to directly supervise managers, resulting higher agency costs of managers. The R & D investment usually has higher uncertainty and the investment cycle is always longer, that is, the R & D investment is relatively inefficient and is difficult to meet the short-term target of the government. Therefore, governments will force companies to postpone or reduce technological innovation investment through direct and indirect ways. Ma and Liu believe that enterprises controlled by governments lack the incentive to strengthen their R & D investment [2]. Therefore, from the perspective of government intervention, the multi-layers SOEs tend to reduce the government' s intervention in companies' decisions-making, and at the same time, the government' s protection for the SOEs also weakens correspondingly; namely, the "supporting hands" and "exacting hands" weakens together. In order to better adapt to the market competition environment, compared to the situation that has stronger government intervention, the company's enthusiasm for innovation has an increasing trend. However, from the view of agency costs theory, as the control chains becoming longer, the government intervention is reduced, and the difficulty of obtaining information by actual controllers increases, so that the cost of obtaining information increases and the degree of information asymmetry increases which provides the chance for management authorities to carry out self-interested behaviors. Since managers' personal interests are often directly linked to the company's operating performance. For the purpose of gaining more personal interests, managers have the incentive to increase companies' short-term profits. R & D investment often has the characteristics of higher risks and the longer investment return period. And some studies have shown that the senior managers of listed companies often have a short tenure. In such a short term, senior managers prefer to improve companies' short-term performance. Thus, from the point of view of agency cost theory, with the number of pyramid control layers increasing, the R & D investment of enterprises has a decreasing trend. Based on the above analysis, it can be seen that, with the extension of the control chain of SOEs, the trend of increasing and decreasing in the R & D investment of enterprises is the balanced result of government intervention and agency costs. Thus, the paper proposes the following hypotheses:

H1a: As the number of control layers increasing, the SOEs' R & D investment tends to increase.

H1b: As the number of control layers increasing, the SOEs' R & D investment tends to decrease.

The study of Wang and Xiao is based on the perspectives of political costs and agency costs, which finds that the decentralization of control rights increases the value of SOEs, but this influence is only significant for local SOEs, not for those controlled by the central government [3]. The study of Su finds that, compared with the enterprises controlled by the central government, the increasing control layers has a greater role in promoting enterprise to take risks for the enterprises

controlled by local governments [4]. As the ultimate controller of local SOEs, local governments can more easily intervene in the operating activities of local state-controlled companies. Compared to the enterprises controlled by the central government, local governments have stronger motives to intervene in the operating activities of local SOEs for social goals, economic goals, and self-interests goals. They want local SOEs can offer more jobs, and prefer to the project that can get returns in a short time and with lower risks. Thus, they are unwilling to put so much on the R & D investment. When the pyramid layers are less, the governments as the ultimate controllers have more convenient conditions to intervene in the operating activities of local state-owned listed companies. With the pyramid layers increasing, agency problems between major shareholders and managers arise which lead to slow and delayed information transmission, resulting in higher intervention costs and agency costs [5]. From the view of agency costs, due to the existence of "government-enterprise talent exchange" in China, compared with local SOEs, the major leaders of central enterprises are issued by the Central Organization Department and are directly under the leadership of the Central Organization Department and the State-owned Assets Supervision and Administration Commission. With the status of "quasi-officers", they generally have higher administrative levels, and are closer to the power center, so that they have greater opportunities for political promotion. At the same time, in recent years, the evaluation of SOEs' leaders has added more innovative indicators. Therefore, in contrast to the pursuit of the short-term performance, central SOEs executives may be more active in catering to the government' s innovation policies, so their motivation for pursuing short-term performance to reduce R & D investment is relatively weaker, and the agency costs incurred in lengthening the control chain are relatively smaller. Based on the analysis above, the paper proposes Hypothesis 2:

H2: Distinguishing the SOEs controlled by central government and local governments, there is a significant difference in the influence of the number of control layers on the R & D investment.

3. Study Design

3.1. Sample Selection and Data Source

The study selects the listed companies data from 2007-2015 as the sample, and the sample is screened as follows: 1) removing financial industry; 2) eliminating ST and *ST companies; 3) eliminating the data that key variable values are missing; 4) In order to avoid the effect of extreme values on the empirical results, we winsorize all continuous variables on the 1% and 99% positions. The financial data used in the paper are from the CSMAR database. The control layers data used in the paper are manually collected from the actual controller map in the annual reports. The paper uses Excel and Stata12.0 for data analysis.

3.2. Variable-Definition

1) R & D Investment (RD): Referring to the research of Zhang, Liu and Yang

[6], the paper selects the ratio of R & D expenditures and operating revenues as the dependent variable.

2) Control Layers (Layer): Learning from the studies of Fan, Wong and Zhang [1] and Liu and Li [7], the paper uses the listed company as the bottom layer of the pyramid structure to determine the number of layers between the ultimate controller and the listed company. If there are multiple control chains between the ultimate controller and the listed company, we take the longest control chain as the basis for determining the number of control layers. This data are manually computed based on the actual controller maps in the annual reports of listed companies.

3) Agency Cost (Dcost): Referring to the research of Wang, Xu and Wang [8], the paper selects two indicators as alternative variables to test problems, which are total assets turnover ratio (Dcost 2) and administrative feeratio (Dcost 2).

In addition to above variables, the paper also controls the company size, asset-liability ratio (Lev), company' s growth (Growth), operating cash flow (Cash), shareholding proportion of the largest shareholder (Top1), industry (Industry) and year(Year).

3.3. Model Construction

With reference to existing researches, the paper uses the following model for empirical testing.

$$\begin{aligned} RD = {} & \chi_0 + \chi_1 Layer + \chi_2 Size + \chi_3 Lev + \chi_4 Growth \\ & + \chi_5 Cash + \chi_6 Top1 + \sum Industry + \sum Year + \varepsilon \end{aligned}$$

4. Empirical Results

4.1. Descriptive Statistical Analysis

The paper conducts the entire sample and sub-samples descriptive statistics. According to the descriptive statistics, we can see the mean of the R & D investment in the entire sample of SOEs is 0.0186, with a median 0.00734. The mean of the R & D investment of the central SOEs is 0.0214, with a median 0.0105. And the mean of the R & D investment of the local SOEs is 0.0155, and the median is 0.00473. It can be seen that the R & D investment of central SOEs is generally higher than that of local SOEs. The reason may be that, as the most important part of the national economy, central SOEs often are more active to respond to the government' s innovation and development policies and then to increase the companies' investment in new technology research and development. About controlling layers, under the full sample, the mean of the control layer of SOEs is 2.797, and the median is 3; under the subsamples, the mean control layer of central SOEs is 3.083, and the median is 3; the mean control layer of local SOEs is 2.478, and the median is 2. We can see that the mean control layer of central SOEs is higher than that of local SOEs. This is due to the fact that central SOEs is generally larger than local SOEs. In recent years, central enterprises tend to conduct horizontal mergers and acquisitions, such as the mer-

ger of China South Locomotive Group and China North Locomotive Group, conduct the industrial chains reorganization and carry out cross-border mergers and acquisitions and so on. Through a series of measures, central SOEs are becoming more and more complicated. For the variable of agency costs, the total asset turnover ratio (Dcost 2) of central SOEs is 0.748, which is slightly lower than that of local SOEs (0.753). In terms of administrative fee ratio (Dcost 2), the average value of central SOEs is 0.0917 which is slightly lower than that of local SOEs (0.0924).That is to say, both Dcost 2 and Dcost 2 of central SOEs is smaller than local SOEs. (Table 1 & Table 2)

4.2. Empirical Regression Analysis

The result of the full sample regression in sheet 3 column (1), suggests that the control layer does not have the significant impact on the R & D investment of the SOEs (Table 3). The possible reason is that, in the process of lengthening the controlling chain, although the government' s ability to intervene in the SOEs is reduced, the agency costs of the shareholders and managers are also rising. The existence of agency costs will weaken the enthusiasm of managers to invest in the technological innovation. Under the balance of the positive direction effect produced by the reduction of government intervention and the negative direction effect by the increase of agency costs, the R & D investment of the SOEs has not shown a significant change. Further, after distinguishing sample as the central SOEs subsample and the local SOEs subsample, we can see that, there is a significant negative correlation between the length of the control chain and the R & D investment of the local SOEs, whose correlation coefficient is −0.00356, which is significant under the significant level 1%. For central enterprises, we have not found the same correlation. The hypothesis 2 is supported. Compared with the central SOEs, with the lengthening of the control chain, the information asymmetry problem is more obvious and the actual controllers lack the supervision of the managers. In the case, the executives of local SOEs show higher agency costs. Their motivation to get private benefits by improving the

Table 1. Full sample descriptive statistics.

Variables	N	mean	max	min	p50	sd
RD	1455	0.0186	0.150	0	0.00734	0.0272
Layer	1455	2.797	8	1	3	1.104
Size	1455	22.41	26.48	19.86	22.24	1.337
Lev	1455	0.515	0.943	0.0664	0.518	0.202
Growth	1455	2.404	9.594	0.909	1.932	1.560
Cash	1455	0.0383	0.202	−0.128	0.0353	0.0634
Top1	1455	38.48	74.30	9.799	37.79	15.03
Dcost 2	1455	0.750	3.058	0.108	0.622	0.496
Dcost 2	1455	0.0920	0.320	0.00893	0.0826	0.0569

Table 2. Sub-samples descriptive statistics.

Sample	Variables	N	mean	max	min	p50	sd
	RD	767	0.0214	0.150	0	0.0105	0.0275
	Layer	767	3.083	8	1	3	1.221
	Size	767	22.37	26.48	19.86	22.23	1.419
	Lev	767	0.506	0.943	0.0664	0.511	0.204
Central SOEs	Growth	767	2.593	9.594	0.909	2.085	1.616
	Cash	767	0.0359	0.202	−0.128	0.0327	0.0623
	Top1	767	40.79	74.30	11.37	41.05	13.94
	Dcost 2	767	0.748	2.875	0.108	0.632	0.459
	Dcost 2	767	0.0917	0.320	0.00893	0.0821	0.0580
	RD	688	0.0155	0.150	0	0.00473	0.0265
	Layer	688	2.478	8	1	2	0.849
	Size	688	22.44	26.48	19.86	22.25	1.240
	Lev	688	0.526	0.943	0.0664	0.527	0.199
Local SOEs	Growth	688	2.194	9.594	0.909	1.758	1.467
	Cash	688	0.0409	0.202	−0.128	0.0370	0.0645
	Top1	688	35.92	74.30	9.799	33.76	15.77
	Dcost 2	688	0.753	3.058	0.108	0.610	0.533
	Dcost 2	688	0.0924	0.320	0.00893	0.0831	0.0557

Table 3. Regression results of the number of control layers and the R & D investment.

	(1)	(2)	(3)
Variables	**Full Sample**	**Central SOEs**	**Local SOEs**
	RD	RD	RD
Layer	−0.000331	−0.000198	−0.00356***
	(−0.524)	(−0.240)	(−3.022)
Size	−0.000546	−5.87e−05	−0.00122
	(−0.774)	(−0.0594)	(−1.180)
Lev	−0.0183***	−0.0183***	−0.0161***
	(−4.541)	(−3.290)	(−2.690)
Growth	0.00155***	0.000363	0.00207**
	(2.746)	(0.454)	(2.446)
Cash	−0.0261**	−0.0311*	−0.0143
	(−2.276)	(−1.894)	(−0.880)
Top1	−9.46e−05*	−0.000254***	−7.37e−05
	(−1.905)	(−3.421)	(−1.010)
Year	controlled	controlled	controlled
Industry	controlled	controlled	controlled
Constant	0.0182	0.00765	0.0412*
	(1.129)	(0.333)	(1.750)
Observations	1455	767	688
R-squared	0.121	0.155	0.116

Note: t-statistics is in parentheses; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

companies' short-term performance is more intense, such as pursuing higher working consumption, so that they are not willing to increase the R & D investment. For the executives of central SOEs, the odds of getting the political promotion are greater, and the pursuit of working consumption is weaker. Wang, Fu, Huang and Wang [9] find that there is an asymmetric substitution effect between political promotion incentive and working consumption. In order to pursue political promotion, the executives of central SOEs will be more active in catering to the assessment standards of the SASAC. The central SOEs' leaders will also actively cater for the national innovation policies while considering the performance of the enterprises. Thus, for the executives of central SOEs, their motivation for the short-term performance to decrease the R & D investment is weaker.

As we can see from the regression results in Table 4, under the condition of lower agency costs, the regression results of columns (1) and (3) suggest that the length of the control chain has a significant negative correlation with the R & D investment, whose correlation coefficients are −0.00520 and −0.00208 respectively, and they are significant at the 1% and 5% significance levels respectively.

Table 4. Grouping regression results using the agency cost.

	Dcost 1		Dcost 2	
Variables	**(1) Lower**	**(2) Higher**	**(3) Lower**	**(4) Higher**
	RD	RD	RD	RD
Layer	−0.00520***	−0.00228	−0.00208**	−0.00308
	(−3.020)	(−1.368)	(−2.064)	(−1.558)
Size	−0.00211*	0.000817	−0.00146**	0.000300
	(−1.803)	(0.425)	(−2.008)	(0.135)
Lev	−0.0222***	−0.0138	−0.00596	−0.0159
	(−2.750)	(−1.554)	(−1.191)	(−1.550)
Growth	4.49e−05	0.00320***	−0.00107	0.00305**
	(0.0348)	(2.687)	(−1.302)	(2.280)
Cash	0.0261	−0.0297	−0.0235**	0.0173
	(1.283)	(−1.085)	(−2.057)	(0.537)
Top1	4.33e−05	−0.000151	9.26e−05*	−0.000178
	(0.464)	(−1.344)	(1.651)	(−1.364)
Year	controlled	controlled	controlled	controlled
Industry	controlled	controlled	controlled	controlled
Constant	0.0814***	−0.00610	0.0403**	0.00693
	(2.980)	(−0.140)	(2.265)	(0.140)
Observations	344	344	344	344
R-squared	0.187	0.128	0.140	0.107

Note: t-statistics is in parentheses; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Conversely, for the groups that the agency cost is higher, the correlation is not so significant. That is, under different agency costs, there are significant differences in the effect of the number of control layers of local SOEs on the R & D investment. The main reason is that, in the case of low agency costs, the personal benefits of managers are not met, and with the control chain becoming longer, it provides a chance for management to perform self-interested behavior, and the managers have strong motivation to improve the personal welfare, working consumption, and personal reputation. In the situation, managers are often more sensitive for the chance and they are prefer to the companies' short-term performance, so that they will reduce the R & D investment which is of higher risk and longer investment return period. On the contrary, when the agency cost is relatively higher, managers' sensitivity to the chance is lower.

Further, to test whether there is a turning point, the paper conduct the regression grouping the sample using the median of the number of control layers (Table 5). The results suggest that, for the central SOEs, although the overall sample regression does not find a significant correlation between the number of control layers and the R & D investment, in the situation of grouping regression,

Table 5. Grouping regression results using the median of the number of control layers.

Variables	Central SOEs		Local SOEs	
	(1) Layer > 3	(2) Layer ≤ 3	(3) Layer > 2	(4) Layer ≤ 2
	RD	RD	RD	RD
Layer	−0.00586***	−0.000948	−0.00473***	0.00120
	(−2.621)	(−0.509)	(−2.957)	(0.204)
Size	−0.00194	−0.000892	−0.000699	−0.00193
	(−0.721)	(−0.848)	(−0.631)	(−1.215)
Lev	−0.0470***	−0.00818	−6.27e−05	−0.0312***
	(−3.603)	(−1.371)	(−0.00883)	(−3.461)
Growth	0.00234	−0.000897	0.00444***	−0.000615
	(1.178)	(−1.048)	(4.944)	(−0.475)
Cash	−0.0119	−0.0317*	−0.0479**	0.0202
	(−0.285)	(−1.893)	(−2.596)	(0.832)
Top1	−0.000184	−0.000230***	−3.45e−05	−3.31e−05
	(−1.132)	(−2.790)	(−0.428)	(−0.287)
Year	controlled	controlled	controlled	controlled
Industry	controlled	controlled	controlled	controlled
Constant	0.0515	0.0270	0.00850	0.0610
	(0.729)	(1.133)	(0.328)	(1.646)
Observations	226	541	265	423
R-squared	0.225	0.174	0.298	0.112

Note: t-statistics is in parentheses; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

for the group which the control layer is more than 3, there is a significant negative correlation between the control layer and the R & D investment. That is, for the central SOEs, when the control layer is more than 3, with the increasing of the control layer, the company's R & D investment is decreasing. On the other hand, from the regression results of columns (3) and (4), we can see that, for the local SOEs, there is a significant negative correlation between the control layer and the R & D investment for the group which the control layer is more than 2, and the correlation coefficient is −0.00586, compared with the coefficient −0.00473 in the sheet1, we can find the negative effect is bigger when the layer is more than 2. The negative effect is caused by the significant increase in agency costs, which is consistent with the finding of Zhong, Ran and Wen [10].

4.3. Robust Test

In order to ensure the accuracy and robustness of the results, considering that the operating revenues may have the risk of earnings manipulation, we use the ratio of the R & D expenditures to the total assets as the explanatory variable referring to the study of Liu and Liu [11] to regress the model again. The results are shown in Table 6, Table 7, and Table 8.

Table 6. Robust test results of the number of control layers and the R & D investment.

Variables	(1)	(2)	(3)
	Full Sample	Central SOEs	Local SOEs
	RD	RD	RD
Layer	−0.000365	−0.000439	−0.00153**
	(−1.002)	(−0.934)	(−2.210)
Size	−0.000916**	−0.000760	−0.00121**
	(−2.254)	(−1.351)	(−1.985)
Lev	−0.00333	−0.00169	−0.00246
	(−1.430)	(−0.534)	(−0.696)
Growth	0.000416	0.000357	−1.83e−05
	(1.278)	(0.784)	(−0.0368)
Cash	0.00805	0.00810	0.0142
	(1.219)	(0.867)	(1.481)
Top1	1.82e−05	−9.42e−05**	8.59e−05**
	(0.635)	(−2.224)	(1.996)
Year	control	control	control
Industry	control	control	control
Constant	0.0189**	0.0151	0.0282**
	(2.028)	(1.152)	(2.031)
Observations	1455	767	688
R-squared	0.098	0.118	0.097

Note: t-statistics is in parentheses; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Table 7. Robust test of grouping regression results using the agency cost.

Variables	Dcost 1		Dcost 2	
	(1) Lower	(2) Higher	(3) Lower	(4) Higher
	RD	RD	RD	RD
Layer	−0.00298**	−0.000634	−0.000852	−0.00191
	(−2.152)	(−1.006)	(−0.821)	(−1.634)
Size	−0.00226**	−0.000526	−0.00161**	−0.00156
	(−2.401)	(−0.724)	(−2.162)	(−1.193)
Lev	−0.00981	−0.00163	0.000205	−0.00337
	(−1.512)	(−0.486)	(0.0399)	(−0.557)
Growth	−0.00169	0.00119***	−0.00244***	0.000712
	(−1.624)	(2.648)	(−2.877)	(0.901)
Cash	0.0233	−0.00536	0.00808	0.0398**
	(1.421)	(−0.517)	(0.689)	(2.097)
Top1	0.000204***	−3.44e−05	0.000239***	−3.93e−05
	(2.716)	(−0.809)	(4.140)	(−0.510)
Year	−0.00140	0.00116	−0.00395	0.00414
Industry	−0.0173	0.00753	−0.000724	0.00500
Constant	0.0691***	0.0101	0.0398**	0.0337
	(3.142)	(0.612)	(2.174)	(1.154)
Observations	344	344	344	344
R-squared	0.175	0.142	0.136	0.108

Note: t-statistics is in parentheses; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Table 8. Robust test of grouping regression results using the median of the number of control layers.

Variables	Central SOEs		Local SOEs	
	(1) Layer > 3	(2) Layer ≤ 3	(3) Layer > 2	(4) Layer ≤ 2
	RD	RD	RD	RD
Layer	−0.00214*	0.000118	−0.00488***	0.00395
	(−1.819)	(0.104)	(−3.793)	(1.277)
Size	−0.00117	−0.00117*	−0.000529	−0.00162*
	(−0.824)	(−1.824)	(−0.593)	(−1.941)
Lev	−0.0154**	0.00400	0.00736	−0.0120**
	(−2.234)	(1.102)	(1.291)	(−2.544)
Growth	0.00149	−0.000173	0.000515	−0.00118*
	(1.429)	(−0.332)	(0.713)	(−1.744)
Cash	0.00764	0.0113	−0.00943	0.0349***
	(0.349)	(1.110)	(−0.637)	(2.741)

Continued

Top1	−8.34e−05	−8.34e−05*	0.000247***	3.30e−05
	(−0.975)	(−1.662)	(3.801)	(0.544)
Year	−0.00127	0.000404	0.00423	−0.00128
Industry	0.0224	0.0141***	0.000616	0.00555
Constant	0.0230	0.0219	0.0116	0.0360*
	(0.618)	(1.515)	(0.554)	(1.853)
Observations	226	541	265	423
R-squared	0.174	0.134	0.242	0.117

Note: t-statistics is in parentheses; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

The results in Table 6, Table 7 and Table 8 are basically the same as those in Table 3, Table 4 and Table 5, which further suggests the credibility of the results.

5. Conclusion

The paper explores the influence of the number of control layers under pyramid structure that is formed during the reform of SOEs on the R & D investment from the views of government intervention and agency costs. Through the analysis above, the study finds that: 1) With the increasing of the number of control layers, agency costs of SOEs have increased significantly, Which leads to the significant reduction in the R & D investment of local SOEs. However, this negative correlation is not obvious for central SOEs; 2) Further study has found that, when agency costs (using total asset turnover ratio and administrative fee ratio as substitute variables) are lower, the R & D investment of local SOEs tends to decrease as the control chain is lengthening; 3) Although, for the sample of full central SOEs, the length of the control chain and the R & D investment do not show a significant correlation, for the group which the control layer is more than 3 in central SOEs; the R & D investment is significantly weakened with the control layer increasing. And then, for the local SOEs, when the control layer is more than 2, as the control chain lengthening, the R & D investment of target local SOEs tends to be decreasing.

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