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The Inner Structure of Pyramid and Capital Structure: Evidence from China

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Abstract
This paper examines the relationship between capital structure and the inner structure of pyramid in an emerging market economy country. The author uses firm-level panel data of Chinese listed companies to analyze the influence of the inner structure of pyramid on capital structure and the differences between different institutional environments of that influence deeply. His results show that the longer the layers of pyramid structure, the stronger the "leverage effect" of pyramid structure, as well as the ultimate controllers' motivation to expand debt financing will be. So the layers of pyramid structure have a significantly positive effect on capital structure. However, the chains of pyramid structure have no significant effects on capital structure. Compared with the areas with poor institutional environment, in the areas with better institutional environment, the effects of the layers of pyramid structure on corporate capital structure is relatively small.

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Keywords Pyramid structure; institutional environment; capital structure; agent chain

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1. Introduction

Previous research has shown that pyramid structure is very common in companies around the world(La Port, Lopez-De-Silanes & Shleifer, 1999； Claessens, Djankov & Lang, 2000). In China, more than seventy percent of listed companies are featured with pyramid structure(Fan, Wong & Zhang, 2005). Firms are facing with great agency costs under such structure, because the ultimate controllers can grasp large controlling rights with a few cash flow rights, which leads to the separation of controlling rights and cash flow rights, and increasing the company's agency cost(Claessens et al, 2002; Bozec & Laurin, 2008; Hughes, 2009). The agency problem is closely related to financing decisions. Up to now, previous studies on the relationship between ultimate controller and corporate financing, is carried out from the perspective of ultimate controller's controlling rights, cash flow rights and the separation between the two(Bunkanwanicha, Gupta & Rokhim, 2008; Bany-Ariffin, Mat & McGowan, 2010). However, the separation between ultimate controller' controlling rights and cash flow rights is just the result led by the pyramid structure. Extant research neither explored the impact of the inner structure of pyramid on capital structure, nor taken the external institutional environment into consideration. This paper not only investigated the effects of the inner structure of pyramid on capital from both the vertical and horizontal dimensions, but also examined the differences under different institutional environment. Specifically, by computing the number of layers between ultimate controllers and listed companies, we tested the impact of the inner vertical structure of pyramid. While in the horizontal dimension, we focused on the number of chains taken by the ultimate controllers to control the listed companies.

A company is always in a certain institutional environment which influences the motivation of market participants as well as their behaviors. North(1990) argues that corporate decision is not only an autonomous behavior, but is also affected by a country's institutional environment, which is the key factor in determining transaction cost. La Port et al.(1998) incorporates law into the study of corporate governance, reveals the effects of different law origins on investor protection and corporate governance, and become the pioneering work of law and finance research. Due to different histories, natural environments, various degrees of regional economy development and social factors, in China, even within the same source of law, the institutional environment in different regions varies largely (Fan et al, 2010). Thus it provides us a unique setting to investigate the influence of the inner structure of pyramid on capital structure under different institutional environments. Based on these factors, this paper combines the inner structure of pyramid and institutional environments together, and systemically investigates their effects on capital structure. Specifically, this paper mainly investigates two questions: (1) how does pyramid inner structure affect capital structure; and (2) whether the impact of the inner structure of pyramid on capital structure varies with institutional environments. Taking all the listed companies in Shanghai and Shenzhen Stock Exchange Market between 2004 and 2009 as the sample, we find that the layers of pyramid structure play an important role for ultimate controllers to expand debt financing behavior, and the improvement of institutional environment helps to mitigate this impact. However, the chains of pyramid structure have no significant impact on capital structure. The function of the leverage effect of pyramid structure is mainly depends on its vertical multi-layers structure, while the horizontal multi-chains structure's effects are

very limited. The results can not only helps us to better understand the pyramid structure and the institutional roots of the irrational capital structure in China, but also has implications for policy-makers.

The rest of the paper proceeds as follows. Section 2 is the theoretical model and the development of the hypotheses. Variables design, data collection process and the research models are discussed in Section 3. Section 4 presents the empirical research results, and Section 5 concludes the paper.

2. Theory and hypotheses

As is illustrated before, the inner structure of pyramid is mainly composed of the multi-layers structure in the vertical dimension and the multi-chain structure in the horizontal dimension. While the multi-layers and multi-chains structure of pyramid lead to the ultimate controllers grasping large controlling rights with relative small cash flow rights, the existence of pyramid structure exacerbates the controlling shareholders' motivation of adopting risky debt financing behavior(Black & Scholes, 1973). The high controlling rights enable the ultimate controllers continue to enjoy the majority benefits of risky-based debt financing. However, because of their relatively small cash flow rights, once the company bankrupts, the ultimate controllers just have to bear a small loss unproportional to their benefits, which further reduces the ultimate controllers' bankruptcy responsibility and increases their motivation to expand debt financing (Du & Dai, 2005).

Meanwhile, under the background of weak investor protection and the ineffective role of debt governance in transition economies, the ultimate controllers, making use of pyramid structure, can control more resources by debt financing(Bany-Ariffin, Mat & McGowan,

2010), which further facilitates their expropriation behaviors(Bunkanwanicha, Gupta & Rokhim et al., 2008). The ultimate controllers could also transfer the debt resources and evade the market's regulation conveniently through the pyramid structure(Liu & Tian, 2012). Therefore, generally speaking, the pyramid structure enhances the motivation of the ultimate controllers to expand debt financing.

The longer the layers of pyramid structure, the more resources the ultimate controllers can control given a certain amount of capital, so that the more significant leverage effect can be achieved with limited resources. To further enlarge the resources under control, the ultimate controllers have motivation to transfer funds from listed companies to the companies in the top layers of pyramid structure, even in their own pockets. In this way, the financing needs of listed companies are further expanded. In essence, the control rights roots in the capital the ultimate controllers invested directly (or indirectly) in the company. The premise of ultimate controllers to control larger resources by smaller capital is to ensure the effective control over listed companies. Compared with equity financing, debt financing has the non-dilution effect of controlling rights (Du & Dai, 2005). Thus, the ultimate controllers prefer debt financing under the pyramid structure. The longer the layers of pyramid structure, the more complicated the pyramid structure will be. Moreover, the behaviors, such as mutual guarantee and affiliate transactions between firms with pyramid structure have expanded the scales of capital credit, and formed higher debt levels of listed companies. Therefore, it can be expected that the longer the layers of pyramid structure, the more motivated ultimate controllers will be to urge the listed companies to adopt debt financing. Besides, the longer the layers of pyramid structure, the more convenient and confidential the ultimate

controllers' expropriation behaviors will be, because the ultimate controllers are on the top of the multi-layers structure of pyramid. Even if the listed companies confront the trouble of bankruptcy, the ultimate controllers' reputation will not be affected significantly (Boubaker, 2007), while the majority loss of bankruptcy will be paid by minority shareholders. The complex multi-layers structure of the pyramid functions as a cushion that weakens the risk hit on the ultimate controllers, and the extension of the layers of pyramid structure enables the ultimate controllers far away from high-risk projects and thus, they are highly tolerant to debt risks(Attig, Gadhoum & Lang et al, 2003). All in all, it is believed that the longer the layers of pyramid structure, the higher the level of debt financing in the listed companies. Therefore, we have the following hypothesis.

H1: There is a positive association between the layers of pyramid structure and capital structure.

In addition to the multi-layers structure of pyramid structure, the multi-chains structure is also a dominant channel for ultimate controllers to expand resources through the pyramid structure. As a distinct feature of the inner structure of pyramid, the multi-chains structure decides the leverage effect of pyramid structure, together with the multi-layers structure. The larger the number of chains in the pyramid structure, the more complicated the pyramid structure will be, and the more resources will be controlled by the ultimate controllers with the same capital. Moreover, the behaviors under the pyramid structure, such as companies' mutual guarantee and affiliate transactions, are easy to form higher debt levels of listed companies. Therefore, the following hypothesis is proposed:

H2: There is a positive association between the chains of pyramid structure and capital

structure.

Institutional environment plays a very important role in corporate governance system. The institutional environment can not only affect the corporate behaviors directly, but also can affect them indirectly through affecting various corporate governance mechanisms. The improvement of institutional environment will mitigate agency problems between the ultimate controllers and minority shareholders (Dyck & Zingales, 2004), and further affect the impact of agency cost on corporate capital structure(Li, Yue & Zhao, 2009). In the poor institutional environment, which is featured with low marketization degree and unimproved law environment, the restriction effect of institutional environment on the agency problems under the pyramid structure is relatively weak. Thus, in these areas, the inner structure of pyramid will have a large impact on corporate capital structure decisions.

On the contrary, in areas with better institutional environment, the effect of pyramid structure on corporate capital structure is relatively weak(Liu, Tian & Wang, 2011). With the reduction of government intervention, the improvement of law environment, especially the bankruptcy law, will enhance the governance and constraint effect of debt. The banks' supervision effects to debtors will be increasingly enhanced with the improvement of institutional environment. Moreover, with the market-oriented reforms of banks and the growth of non-state owned banks, the relationship between banks and companies tends to be more and more market-oriented, the risk awareness of banks is gradually increasing, and the marketization degree of bank credit allocation is gradually improving(Firth, Lin & Liu, 2009; Taboada, 2011). The banks will avoid companies which have serious agency problems of pyramid structures, and pursue less risky companies instead. All these will limit the pyramid

inner structure's effect on corporate capital structure.

Therefore, with the improvement in institutional environments and the degree of market-orientation, and the enhancement of bank operational independence, the effect of the inner structure of pyramid on corporate capital structure will be gradually decreased. In other words, compared with areas under poor institutional environment, the impact of the inner structure of pyramid on corporate capital structure is smaller in areas with better institutional environment. Based on the theoretical analysis above, the effect of institutional environment on the relation between the inner structure of pyramids and capital structure is mainly measured from three aspects, such as marketization degree, government intervention and law environment. Therefore, we have the following hypotheses.

H3: Compared with poor institutional environment areas, in areas with better institutional environment (high degree of marketization, low government intervention and perfect law environment), the impact of the layers of pyramid structure on corporate capital structure is relatively smaller.

H4: Compared with poor institutional environment areas, in areas with better institutional environment (high degree of marketization, low government intervention and perfect law environment), the impact of the number of chains of pyramid structure on corporate capital structure is relatively smaller.

3. Methods

3.1. Measures

3.1.1. Dependent Measure

The dependent measure in this paper is the measurement of capital structure. Since the

short-term debt takes a relatively larger share and is always applied for long-term purposes in Chinese listed companies, this paper calculated capital structure as the total debt divided by total assets.

3.1.2.Independent Measures

According to the analysis above, independent measures in this paper involve the layers of pyramid structure, the number of chains of pyramid structure, degree of marketization, government intervention and law environment. The layers of pyramid structure refer to the length of agency chains experienced by ultimate controllers who exercise power over the listed companies. Considering the fact that the ultimate controllers may control listed companies through many agency chains and that the number of layers in each agency chain may be different, both the longest layers of agency chains(*LLAY*) and the shortest layers of agency chains(*SLAY*) are adopted in this paper. The number of chains of pyramid structure refers to the number of chains that are used by ultimate controllers to exercise control rights over listed companies. We measure institutional environment variables of different regions that listed companies registered in China as proposed by Fan et al(2010) in the book "NERI Index of Marketization of China's Provinces", which is used in previous studies(Wang et al., 2008; Li et al., 2009). We use the index scores of the marketization process, the relationship between government and market and the law environment in the book, to measure the degree of marketization, the degree of government intervention, and the degree of law environment, respectively. The larger the indexes, the better the regional institutional environments will be, i.e. the degree of marketization will be more higher, the degree of government intervention will be more lower and the law environment will be more improved.

Special attention should be paid is that the relationship between government and the market index score is a kind of reverse measure indicator of government intervention, and the smaller the index is, the worse the government intervention is, and vice versa.

3.1.3.Other Measures

We introduce the following control variables based on previous studies: (1) Corporate size, which is included in most research on capital structure (Titman & Wessels, 1988). This paper argues that as the corporate size increases, the probability of bankruptcy decreases, implying a higher ability of debt financing. Corporate size is measured by the natural logarithm of total asset of a corporate at the end of the fiscal period. (2)Collateral value of assets. Since tangible assets can serve as collateral, the risk of debt financing is relatively small for firms with larger amount of tangible assets, which make it easier to obtain debt financing (Myers & Majluf, 1984). Generally speaking, fixed assets and inventory can be used as collateral. The ratio of fixed assets and inventory to total assets is used as a measure of collateral value of assets. (3)Profitability. The pecking order theory points out that companies prefer to raise capital first from retained earnings due to the low cost, and then from debt, and finally issuing equity(Myers & Majluf, 1984). Companies with good profitability normally have sufficient retained earnings, having a lesser need for debt financing, and thus a smaller debt level. In this paper, the return on assets is used to measure the profitability. (4)Growth. From the theoretical analysis, the effect of growth on corporate capital structure is not clear enough, and the empirical research has not reached consistent conclusion. This paper chooses Tobin's Q value, as is used by most researches to measure the company's growth. (5)Industry. Scott and Martin(1975) argue that companies belonging to the same industry

face similar market conditions, and their capital structure will not change too much. According to the "industry classification standard" issued by China Securities Regulatory Commission in 2001, the listed companies are divided into 13 broad industries. This paper further classifies the manufacturing industry (a predominant of the listed companies) into ten sub-categories in terms of the second-code classification criteria. After deleting the financial industry, the sample of this paper consists of 21 industries. Taking the industry of agriculture, forestry, animal husbandry and fishery as the benchmark, 20 dummy variables are used to represent the industries. When a certain listed company belongs to a particular industry, the industry dummy variable take the value of 1, and 0 otherwise. Meanwhile, the sample period is from 2004 to 2009, so we took the year of 2004 as the benchmark, and selected five dummy variables to represent the years.

The definitions of variables are summarized in Table 1:

[Insert Table 1 about here]

3.2. Samples

Data of the inner structure of pyramid are manually collected from the annual report of listed companies, and other data mainly come from CSMAR(China Stock Market Accounting Research) database, which is the most widely used database on Chinese capital market. This paper takes all the listed companies in both Shanghai and Shenzhen Stock Exchange Market between 2004 and 2009 as the original sample. Observations are deleted from our sample if they meet the conditions: (1) the company belongs to Financial industry(considering the special financing characteristics of these firms); (2) ST or PT companies from 2004 to 2009. (3) companies with extreme variable values, such as those

with debt ratio either greater than 1 or less than 0. (4) companies with incomplete data or the relevant data were unable to dig out. After the selection process, we obtain 7729 firm-year observations, with 1193 observations in 2004, 1207 observations in 2005, 1221 observations in 2006, 1292 observations in 2007, 1383 observations in 2008, and 1433 observations in 2009.

3.3 Regression models

To test those hypotheses proposed above, we adopt the following panel regression models. Model (1) is used to test the first and second hypotheses. Variable X_{it} stands for the variables of the inner structure of pyramid, including the layers of pyramid structure and the number of chains of pyramid structure. This paper predicts that the coefficient β_1 of X_{it} is significantly greater than zero. Model (2) is used to test the third and fourth hypotheses. The institutional environment variables $ENVI_{it}$ stands for regional marketization degree, government intervention degree and law environment variables, respectively. We expect that β_2, the coefficient of the interaction term is significantly less than zero.

$$LEV_{it}=\alpha_0+\beta_1 X_{it}+\beta_2 SIZE_{it}+\beta_3 CVA_{it}+\beta_4 ROA_{it}+\beta_5 TOB_{it} +\sum_{j=1}^{20}\beta_{(5+j)} INDU_{jit}+\sum_{k=1}^{5}\beta_{(25+k)} YEAR_{kit}+u_i+\varepsilon_{it} \quad (1)$$

$$LEV_{it}=\alpha_0+\beta_1 X_{it}+\beta_2 ENVI_{it}\times X_{it}+\beta_3 SIZE_{it}+\beta_4 CVA_{it}+\beta_5 ROA_{it} +\beta_6 TOB_{it}+\sum_{j=1}^{20}\beta_{(6+j)} INDU_{jit}+\sum_{k=1}^{5}\beta_{(26+k)} YEAR_{kit}+u_i+\varepsilon_{it} \quad (2)$$

In the models above, α_0 represents the intercept item, β represents the regression coefficients, u_i denotes the random disturb item, ε denotes the random error term, subscript i and t represent firm and time respectively.

4. Empirical research

4.1. Descriptive statistical analysis

Table 2 provides the descriptive statistics of main variables for all samples. It can be seen that the capital structure of all samples is 48.89% on average, the median is 50.18%. Among the longest layers of pyramid structure (LLAY), the maximum is 9, the minimum is 1, with a mean of 2.4372 and the median of 2; while among the shortest layers (SLAY), the maximum is 8, with the mean of 2.2571, and the median of 2, implying great variation among different pyramid structures. The largest number of chains of pyramid structure is 9, with one at the least. The mean of the number of chains is 1.2811, and the median is one, which illustrates that the number of chains of different pyramid structures varies greatly. But at least half of the pyramid structures have only one chain. The minimum value of marketization degree is 1.55, the maximum is 11.71, the mean is 8.4866 and the median is 8.63, which shows that the marketization process varies greatly among different regions in China. The minimum index score of government intervention is -1.09, the maximum score is 10.65, the mean is 9.0782, and the median is 9.3, that is to say, government intervention in different regions differs greatly. The minimum of law environment index is 1.53, the maximum value is 16.61, the average is 8.0157, and the median is 6.92, implying listed companies in various regions confront relatively different law environments. The minimum of collateral value of asset is 0, the maximum value is 97.46% and the mean is 46.85%, suggesting that collateral value of assets varies largely for listed companies. The average of return on assets is 3.61% and the median is 3.41%, suggesting that the overall profitability of listed companies in China is relatively low. Moreover, there are great differences in growth among listed companies.

[Insert Table 2 about here]

In order to understand the inner structure of pyramid more clearly, further description on the distribution of the sample companies is carried out according to the layers of pyramid structure and the number of chains of pyramid structure. The result is shown in table 3. It is obvious that regardless of the longest layers of pyramid structure(LLAY) or the shortest ones (SLAY), two or three layers of pyramid structure is very common, among which over 50% has the two-layer structure. The majority of the sample(81.41%) control the listed companies only through one agency chain, while the proportion of companies controlling through two chains is 12.46%, the proportion of controlling through three or more agency chains is relatively small. Thus, it can be seen that as far as the inner structure of pyramid is concerned, what the ultimate controllers pay more attention to is the multi-layers structure of the pyramid structure, rather than multi-chains structure.

[Insert Table 3 about here]

In order to investigate the relationship between capital structure and the inner structure of pyramid intuitively, the relationship with the mean of the corporate capital structure is portrayed in Figure 1 and Figure 2, according to the classification of layers of pyramid structure and the number of chains. From Figure 1, it can be seen that with the extension of the layers of pyramid structure, the capital structure level is showing an upward trend, which is consistent with the theoretical analysis mentioned above. While from Figure 2, it can be seen intuitively that with the increase in the number of chains of pyramid structure, the capital structure level is showing a downward trend, which is inconsistent with the theoretical analysis and research hypothesis.

[Insert figure 1 and 2 about here]

The statistical description of the level of corporate capital structure and the variance analysis of the mean differences of corporate capital structure among different layers of pyramid structure are presented in table 4 and table 5. It can be seen from table 4 that as far as the longest layer of the pyramid (LLAY) is concerned, the level of capital structure goes up with the increase of the layers. Specifically, when the layer increases from 1 to 6, the mean of the capital structure is 42.38%, 49.22%, 49.66%, 49.59%, 51.96% and 53.32%, respectively. Moreover, the variance analysis shows that the difference is significant. A similar trend can be found in table 5. When the shortest layer of the pyramid(SLAY) increases from 1 to 6, the mean of the capital structure is 42.88%, 49.82%, 49.34%, 50.17%, 51.31% and 53.73%, respectively. What's more, the variance analysis shows that the difference is also significant. These statistics show that the layers of pyramid structure and corporate capital structure are significantly positively associated, which preliminarily verified the first hypothesis.

[Insert Table 4 and Table 5 about here]

4.2 Correlation analysis

The Pearson correlation coefficients of all variables are shown in table 6. The longest layers of pyramid structure(LLAY) and the shortest layers of pyramid structure(SLAY) are significantly positively related to capital structure, suggesting that the longer the layers of pyramid structure, the higher the level of capital structure will be, and this is consistent with H1. On the other hand, the number of chains of pyramid structure and capital structure are significantly negatively correlated, which is inconsistent with H2. The institutional

environment variables and capital structure are significantly negatively correlated, which suggests that the ultimate controller's preference on debt-financing is suppressed in regions where the marketization degree is high, law environment is perfect, the government intervention is low. Relationships between other control variables and capital structure are consistent with our expectation.

[Insert Table 6 about here]

4.3 Multiple regression analysis

We apply the random-effects model according to the Hausman specification test results. The regression results are shown in table 7. It can be seen from columns (1) and (2) in Table 7 that both the longest layers of pyramid structure (LLAY) and the shortest layers of pyramid structure (SLAY) are significantly positively related to capital structure, suggesting that the longer the layers of the pyramid structure, the stronger the leverage effect of pyramid structure, and the stronger motivation for the ultimate controllers to expand the company's debt financing. Therefore, the layers of pyramid structure have a significant and positive impact on corporate capital structure, and thus, H1 is supported.

From column (3), we can see that the number of chains of pyramid structure and capital structure is positively associated, but not significant, suggesting that the number of chains of pyramid structure has no significant impact on capital structure, and thus, H2 is not supported. The analysis results above show that the pyramid structure's leverage effect is mainly dependent on the vertical multi-layers structure, while the horizontal multi-chains structure plays a relatively limited role in expanding the resource control of ultimate controller. This result can also be slightly seen from the descriptive analysis section, which

demonstrates that 81.41% of pyramid structures control the listed companies only through one agency chain, while about 90% of pyramid structures have adopted multi-layers structure (more than two layers), and the multi-layers structure is far more common than the multi-chains structure. Since H2 is not supported, H4 is no need to investigate furtherly.

From columns (4) and (7), we can see that the regression coefficients on the interaction items between the marketization degree and the layers of pyramid structure (the longest layers of pyramid structure (LLAY) and the shortest layers of pyramid structure (SLAY) is significant and negative, suggesting that compared with areas with low marketization degree, in areas with high marketization degree, the layers of pyramid structure have a relatively smaller impact on capital structure. Besides, the regression coefficients on the longest layers of pyramid (LLAY), and the shortest layers of pyramid structure (SLAY) remain significant and positive. From columns (5) and (8), we can see that the regression coefficient on the interaction item between government intervention and the layers of pyramid structure is significant and negative, indicating that compared with areas with more government intervention, in areas with less government intervention, the layers of pyramid structure have a relatively smaller impact on capital structure. In addition, the longest layers of pyramid (LLAY) and the shortest layers of pyramid structure (SLAY) remain significantly and positively related with capital structure. From columns (6) and (9), we can see that the regression coefficient on the interaction item between law environment and the layers of pyramid structure is significant and negative, suggesting that compared with areas with weak law environment, the layers of pyramid structure have a relatively smaller impact on capital structure in perfect law environment. Moreover, the longest layers of pyramid (LLAY) and

the shortest layers of pyramid structure (SLAY) remain significantly and positively related to capital structure.

Above all, it can be concluded that compared with poor institutional environment areas, in areas with better institutional environment (high degree of marketization, low government intervention and perfect law environment), the effect of the layers of pyramid structure on corporate capital structure is relatively small. So, H5 is supported.

What's more, we can see that corporate size is significantly positively related to capital structure, which is consistent with the previous theoretical analysis. Collateral value of assets is also significantly and positively related to capital structure, suggesting that the more assets the corporate can mortgage, the stronger the borrowing capacity will be. Profitability has a significant and negative association with capital structure, which is consistent with the pecking order theory. Growth is not significantly related to capital structure as debt financing may increase financial risk and reduce the debt level.

[Insert Table 7 about here]

5. Conclusion

This paper investigates the effect of the inner structure of pyramid on capital structure and the differences of that effect among areas with different institutional environments. Our results indicate that the longer the layers of pyramid structure, the stronger the "leverage effect" of pyramid structure, as well as the ultimate controllers' motivation to expand debt financing. So the layers of pyramid structure have a significant and positive impact on capital structure. However, the chains of pyramid structure have no significant impact on capital structure. Thus, it can be cautiously concluded that the function of the leverage effect

of pyramid structure mainly depends on its vertical multi-layers structure, while the horizontal multi-chains structure plays a relatively limited role. On top of that, compared with areas with poor institutional environment, in areas with better institutional environment (high degree of marketization, low government intervention and perfect law environment), the cost associated with the effect of the inner structure of pyramid on capital structure is relatively high, therefore, the impact of the layers of pyramid structure on capital structure becomes smaller.

Overall, our results suggest that the layers of pyramid structure play an important role for ultimate controllers to expand debt financing, and that the improvement of institutional environment helps to mitigate the impact of the layers of pyramids on capital structure. Therefore, it implies that some policies could be made to improve the situation. For example, relevant policies and measures should be adopted by the China Securities Regulatory Commission (CSRC) to promote the ultimate controller's incentive to shorten the layers of pyramid structure, simplify the controlling structure, and flatten the organizational structure, so as to weaken the ultimate controllers' motivation to extract private benefit through expanding debt financing. What's more, both regulatory bodies and practitioners should contribute to improve the institutional environments thoroughly, further enhance the marketization degree, reduce government intervention and strengthen the law environment to better protect investors.

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Table 1. Definitions of Variables

Variable type	Name	Label	Definition and computation
Dependent measure	Leverage	*LEV*	Total Liabilities/Total Assets
Independent measure	Longest layer of pyramid structure	*LLAY*	the longest length of layers.
	Shortest layer of pyramid structure	*SLAY*	The shortest length of layers
	Chains of pyramid structure	*CHAIN*	The number of chains of pyramid
	Marketization Degree	*MAR*	the marketization process index scores proposed by Fan et al.(2010)
	Government intervention	*GOV*	The index scores of the relationship between government and market proposed by Fan et al.(2010)
	Law environment	*LAW*	the index of law environment proposed by Fan et al.(2010)
Other measures	Corporate size	*SIZE*	ln(Total assets)
	Collateral value of assets	*CVA*	(Inventory+ fixed assets)/ Total assets
	Profitability	*ROA*	2* Net income/(Total assets last period + Total assets this period)
	Growth	*TOB*	(Total liability+Market value of tradable share +Market price per share*non-tradable share)/Total assets
	Industry dummy	$INDU_j$	1 when the company belongs to industry j, 0 otherwise
	Year dummy	$YEAR_k$	1 when the year is k, 0 otherwise

Table 2. Descriptive statistics

Variable	Obs.	Min	Max	Mean	Median	SD.	Var
LEV	7729	0.0081	0.9938	0.4889	0.5018	0.1847	0.0341
LLAY	7729	1.0000	9.0000	2.4372	2.0000	0.9167	0.8403
SLAY	7729	1.0000	8.0000	2.2571	2.0000	0.8230	0.6773
CHAIN	7729	1.0000	9.0000	1.2811	1.0000	0.7044	0.4961
MAR	7729	1.5500	11.7100	8.4866	8.6300	2.0727	4.2961
GOV	7729	-1.0900	10.6500	9.0782	9.3000	1.3646	1.8621
LAW	7729	1.5300	16.6100	8.0157	6.9200	3.8101	14.5168
SIZE	7729	18.1572	28.0031	21.5122	21.3781	1.1285	1.2735
CVA	7729	0.0000	0.9746	0.4685	0.4650	0.1737	0.0302
ROA	7729	-0.9986	0.4660	0.0361	0.0341	0.0715	0.0051
TOB	7729	0.7341	16.3983	1.6438	1.3220	0.9488	0.9003

Table 3. the distribution of pyramid inner structure

	1	2	3	4	5	6	7and more	total
LLAY	648	4221	2028	594	174	45	19	7729
Percentage(%)	8.38	54.61	26.24	7.69	2.25	0.58	0.25	100
SLAY	975	4460	1797	375	86	26	10	7729
Percentage(%)	12.61	57.7	23.25	4.85	1.11	0.34	0.13	100
CHAIN	6292	963	301	112	46	8	7	7729
Percentage(%)	81.41	12.46	3.89	1.45	0.60	0.10	0.09	100

Table 4. the variance analysis of the LLAY

LLAY	Obs.	Min.	Max.	Mean	SD.	F value	*Sig*
1	648	0.0178	0.9326	0.4238	0.1926	19.1577***	0.0000
2	4221	0.0081	0.9938	0.4922	0.1818		
3	2028	0.0183	0.9695	0.4966	0.1876		
4	594	0.0505	0.9528	0.4959	0.1736		
5	174	0.1209	0.8862	0.5196	0.1811		
6 or more	64	0.0603	0.8483	0.5332	0.1816		
total	7729	0.0081	0.9938	0.4889	0.1847		

Note: *，**，*** represent significant at the 10%，5% and 1%level, respectively

Table 5. the variance analysis of the SLAY

SLAY	Obs.	Min.	Max.	Mean	SD.	F value	*Sig*
1	975	0.0178	0.9326	0.4288	0.1834		
2	4460	0.0081	0.9938	0.4982	0.1837		
3	1797	0.0183	0.9621	0.4934	0.1859	24.6735***	0.0000
4	375	0.0603	0.9528	0.5017	0.1715		
5	86	0.1690	0.7869	0.5131	0.1662		
6 or more	36	0.1190	0.8483	0.5373	0.1660		
total	7729	0.0081	0.9938	0.4889	0.1847		

Note: *，**，*** represent significant at the 10%，5% and 1%level, respectively

Table 6. Pearson Correlation Analysis

	LEV	*LLAC*	*SLAC*	*CHAIN*	*MAR*	*GOVI*	*LAW*	*SIZE*	*CVA*	*ROA*
LEV	1.0000									
LLAC	0.0729***	1.0000								
SLAC	0.0761***	0.8575***	1.0000							
CHAIN	-0.0362***	0.3976***	0.0041	1.0000						
MAR	-0.0465***	-0.0177	-0.1063***	0.1248***	1.0000					
GOVI	-0.0443***	-0.0116	-0.0807***	0.0919***	0.8499***	1.0000				
LAW	-0.0526***	-0.0111	-0.0929***	0.1207***	0.9350***	0.7171***	1.0000			
SIZE	0.3170***	0.0516***	0.0477***	-0.0128	0.0947***	0.0506***	0.0887***	1.0000		
CVA	0.2242***	-0.0196*	0.0049	-0.0571***	-0.1339***	-0.0892***	-0.1377***	0.1731***	1.0000	
ROA	-0.3709***	-0.0571***	-0.0895***	0.0540***	0.1169***	0.0865***	0.0987***	0.1393***	-0.0886***	1.0000
TOB	-0.2120***	0.0030	-0.0205*	0.0601***	0.1118***	0.0571***	0.1165***	-0.1869***	-0.1584***	0.2018***

Note：*，**，*** represent significant at the 10%，5% and 1% level, respectively.

Table 7 Multiple Regression Analysis

	LEV								
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-1.242***	-1.244***	-1.239***	-1.262***	-1.254***	-1.254***	-1.263***	-1.255***	-1.254***
	(-22.920)	(-22.890)	(-22.880)	(-23.190)	(-23.090)	(-23.100)	(-23.140)	(-23.040)	(-23.060)
LLAY	0.003*			0.020***	0.025***	0.010***			
	(1.720)			(4.110)	(3.390)	(3.630)			
SLAY		0.003*					0.021***	0.025***	0.010***
		(1.780)					(3.830)	(3.140)	(3.390)
CHAIN			0.003						
			(1.140)						
MARLLAY				-0.002***					
				(-3.740)					
GOVLLAY					-0.002***				
					(-3.040)				
LAWLLAY						-0.001***			
						(-3.410)			
MARSLAY							-0.002***		
							(-3.630)		
GOVSLAY								-0.002***	
								(-2.900)	
LAWSLAY									-0.001***
									(-3.520)
SIZE	0.078***	0.078***	0.078***	0.079***	0.078***	0.078***	0.079***	0.079***	0.078***
	(32.620)	(32.680)	(32.610)	(32.830)	(32.740)	(32.760)	(32.870)	(32.790)	(32.800)
CVA	0.129***	0.129***	0.130***	0.127***	0.128***	0.127***	0.127***	0.128***	0.127***
	(13.690)	(13.660)	(13.710)	(13.470)	(13.590)	(13.480)	(13.490)	(13.590)	(13.480)
ROA	-0.681***	-0.681***	-0.682***	-0.679***	-0.680***	-0.680***	-0.679***	-0.680***	-0.680***
	(-38.201	(-38.190)	(-38.260)	(-38.150)	(-38.160)	(-38.170)	(-38.140)	(-38.130)	(-38.170)
TOB	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.701)	(0.680)	(0.700)	(0.730)	(0.710)	(0.690)	(0.700)	(0.690)	(0.670)
INDU	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
YEAR	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Within R^2	0.275	0.275	0.276	0.276	0.275	0.275	0.276	0.275	0.275
Wald value	3290.85***	3288.59***	3287.91***	3310.28***	3303.63***	3307.58***	3306.95***	3300.28***	3306.57***

Note: the number in the ( ) represents z value; *，**，*** represent significant at the 10%，5% and 1% level, respectively.

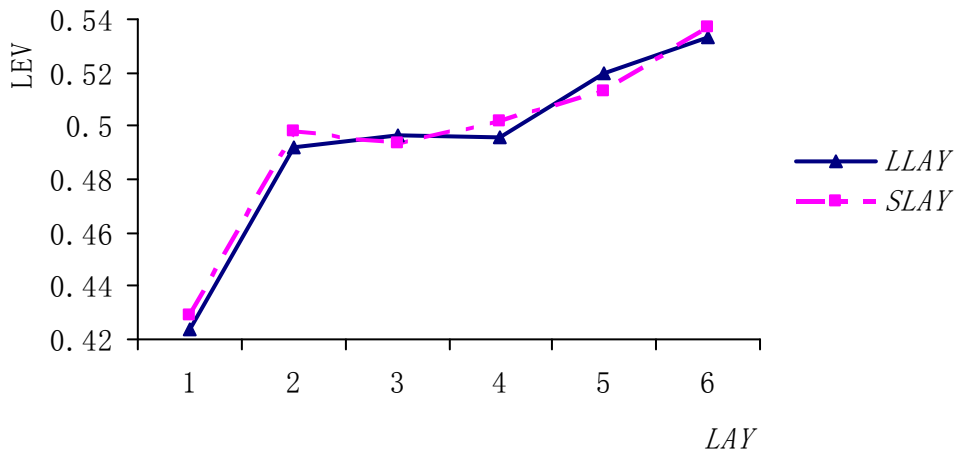

Fig 1. the relationship between capital structure and the layer of pyramid structure

Note: Since the number of companies whose layers are at six or above is relatively small, they are classified into the same category.

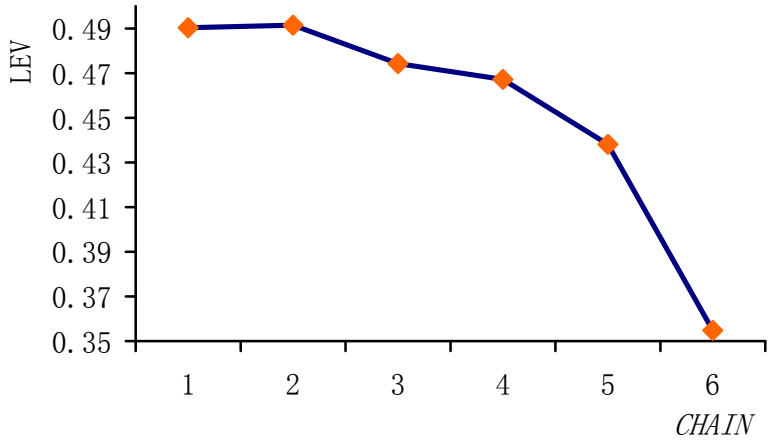

Fig 2. the relationship between capital structure and chains of pyramid structure

Note: Since the numbers of companies whose chains are at six or above are relatively small, they are classified into the same category.