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

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Abstract
This paper examines the effects of the pyramid inner ownership structure of companies on capital structure in an emerging market economy country. The author uses firm-level panel data of Chinese listed companies to analyze the effects of the inner structure of pyramid on capital structure, and the differences in those effects between regions with different institutional environments. The results indicate that the longer the layers of a pyramid structure, the stronger its 'leverage effect', as well as the ultimate owner's motivation to expand debt financing. Thus the layers of pyramid structure have a significantly positive effect on capital structure. However, the chains within a pyramid structure have no significant effect on capital structure. Compared with regions with poor institutional environment, in regions with a better institutional environment the effect of the layers of pyramid structure on capital structure becomes smaller.

JEL G32 G38 M48
Keywords Pyramid ownership structure; institutional environment; capital structure; agency chain

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1 Introduction

Previous research has documented that pyramid ownership structures are very common in companies around the world (La Porta et al. 1999 ; Claessens et al. 2000; Paligorova and Xu 2012; Fan, Wong and Zhang 2012). In China, over seventy percent of listed companies are noted as having a pyramid ownership structure (Fan, Wong and Zhang 2012). These firms face with great agency costs because their structure means that the ultimate owners can claim significant control rights with relatively few cash flow rights, leading to a wedge between control rights and cash flow rights. This, then, creates incentives for the ultimate owners to expropriate minority shareholders by transferring resources for their own benefit (Claessens et al. 2002; Bozec and Laurin 2008; Hughes 2009).

The agency cost is closely associated with financing decisions. Previous research on the association between ultimate owners and corporate finance has been mainly carried out from the perspective of the wedge between the ultimate owner's control rights and cash flow rights (Bunkanwanicha et al. 2008; Bany-Ariffin et al. 2010). However, the wedge between control rights and cash flow rights are arguably just the result led by the pyramid ownership, which can be visualized as the multi-layers and multi-chains structure. Moreover, extant research neither explores the effects of the inner structure of pyramid on capital structure, nor takes the external institutional environment into consideration. This paper not only investigates the effects of the inner structure of pyramid on capital structure from both the vertical and horizontal dimensions, but also examines the differences of those effects under different institutional environments. Specifically, by computing the number of layers between the ultimate owner and the listed company, we investigate the effect of the inner vertical structure of pyramid on capital structure. In terms of in the horizontal dimension, we focus on the effect of the chains of the pyramid structure on capital structure. The original contribution of this paper, therefore, is to focus on the effects of the inner structure of pyramid on capital structure, rather than on the tension between control rights and cash flow rights of the ultimate owner.

As argued by North (1990), the institutional environment is the most important factor affecting national economic growth. Institutional environment can not only constrain the private benefit-seeking of the ultimate owner, but can also affect the company's decision-making directly. La Porta et al. (1998) considers the role of

state law in the study of corporate governance and reveals the important effects of different law origins on investor protection and corporate governance; this was the pioneering work of 'law and finance' research. Following this work, scholars have conducted in-depth, cross-country studies on the association between institutional environments and company behaviors (Fan, Titman and Twite 2012). This strand of literature can be termed as 'cross-country comparative analysis', and assumes that the differences in institutional environments across regions within the same country can be ignored. Unfortunately, this assumption is inconsistent with the reality in China, a large developing country with widely varying internal regions (Wei et al. 2011; Hornstein 2014). Due to the different histories, natural environments, various degrees of regional economic development and social factors, the progress of institutional development between the different regions in China is far from being uniform, despite the same legal roots applying to all (Fan et al. 2010; Li and Qian 2013). Thus, it can be argued that the differences between regional institutional environments within a country may have a profound effect on company behaviors within that country. China's regional differences provide a unique setting within which to investigate this.

This paper combines the inner structure of pyramid and institutional environments together, and systemically explores their effects on capital structure. Specifically, this paper focuses on the following two research questions: 1) What are the effects of pyramid inner structure on capital structure? 2) Do the effects of the inner structure of pyramid on capital structure vary with institutional environments in different regions in China?

Taking all the listed companies on the Shanghai and Shenzhen Stock Exchange Market between 2004 and 2009 as the sample, we found that the layers of pyramid ownership play an important role in expanding debt financing, with improvements in the institutional environment helping to mitigate this effect. Conversely, we found that the chains within the pyramid ownership structure have no significant effect on capital structure. The function of the leverage effect of pyramid structure mainly depends on the vertical multi-layers structure, while the horizontal multi-chains structure's effect is very limited. This research can not only enable us to better understand the pyramid ownership structure and the institutional roots of the irrational capital structure in China, but may also have important implications for policy makers.

This paper contributes to the related literature in the following ways. First, this paper enables further understanding to emerge regarding the relationship between ultimate ownership and capital structure. Past studies have focused on the effect of the wedge between control rights and cash flow rights of the ultimate owner in pyramid companies, demonstrating that the expropriation risk and the distortion through debt financing increase alongside this wedge (Paligorova and Xu 2012; Liu and Tian 2012; Su et al. 2013). However, the wedge between control rights and cash flow rights are arguably just the result led by the pyramid ownership structure, can be visualized as the multi-layers structure and multi-chains structure. We build on the existing research to consider these multi-layers structure and multi-chains structure of the pyramid in an emerging market context.

Second, existing studies have tended to ignore the possible connections between different governance mechanisms. In response to this gap, we combine the pyramid inner structure with regional institutional environments, which are the internal and external governance mechanisms respectively, into a unified analytical framework. This enables us to deepen our understanding of the effect of the interaction between different governance mechanisms, and extend the existing cross-country studies of the institutional environments from a more 'micro' rather than purely macro perspective. Our results suggest that improvements in regional institutional environments may help to mitigate the potentially damaging effects of a pyramid structure, thus indicating a close interaction effect between internal and external governance mechanisms.

The rest of the paper proceeds as follows. Section 2 constructs the theoretical model and develops the hypotheses. Section 3 discusses data collection process, the measurement of variables and the research models. Section 4 presents the empirical results, and Section 5 concludes the paper.

2 Theory and hypotheses

As previously indicated, the multi-layers and multi-chains structure of pyramid enable the ultimate owner to claim large control rights with relatively low cash flow rights, thus potentially exacerbating their motivation to adopt risky debt financing (Black and Scholes 1973). The large control rights enable the ultimate owner continue to enjoy the majority benefits of risky-based debt financing.

However, due to their relatively small cash flow rights, once the company bankrupts the ultimate owner just has to bear a small loss that is disproportional to the benefit they have gained, which further reduces the ultimate owner's bankruptcy responsibility and perpetuates their motivation to expand debt financing (Du and Dai 2005).

Furthermore, given the background of poor investor protection and the ineffective role of debt governance in transition economies, the ultimate owners with more excess control rights usually have an incentive to use more debt to expand their control of resources (Bany-Ariffin et al. 2010), which further facilitate their expropriation behaviors without diluting their controlling rights over the company (Bunkanwanicha et al. 2008; Paligorova and Xu 2012). These ultimate owners can also transfer the debt resources and evade the market's regulation conveniently through the pyramid structure (Liu and Tian 2012). Debt is a mechanism that can be used for the ultimate owner to expropriate outside minority shareholders, especially in countries with weak legal systems (Paligorova and Xu 2012). China, as a typical transitional country, has a weak legal system that provides little protection for creditors or small shareholders (Peng 2001). Its bankruptcy laws are usually poorly enforced and it is often very costly to resolve credit conflicts in court (Fan et al. 2011). Therefore, generally speaking, having a pyramid structure in this context can enhance the motivation of the ultimate owner to expand debt financing.

The longer the layers of this pyramid structure, the more resources the ultimate owner can control given a certain amount of capital, meaning that a more significant leverage effect can be achieved even with limited resources. To further enlarge the resources under their control, ultimate owners may transfer funds from listed companies to the companies in the top layers of the pyramid structure, even transferring these into their own pockets. The financing needs of listed companies are further expanded in this way. In essence, the roots of the control rights lie in the capital that the ultimate owners have invested in the company. The premise of ultimate owners controlling large resources via a small amount of capital is thus to ensure effective control over the listed companies. Compared with equity financing, debt financing has the non-dilution effect of controlling rights (Du and Dai 2005); for this reason, ultimate owners may prefer debt financing under the pyramid structure.

The longer the layers of the pyramid structure, the more complicated the pyramid structure itself will be. Moreover, behaviors, such as mutual guarantee and affiliate transactions among companies within a pyramid structure have expanded the scales of capital credit and engendered higher debt levels in listed companies. Therefore, it can be expected that the longer the layers of a pyramid structure, the more motivated the ultimate owners will be to urge the listed companies to adopt debt financing. In addition, given the fact that the ultimate owners sit on top of the multi-layers of the pyramid structure, it can be argued that the longer the layers of the pyramid structure, the more convenient the ultimate owners' expropriation behaviors will be. Even if the listed companies confront the trouble of bankruptcy, the ultimate owners' 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 thus functions as a cushion that weakens the risk hit on the ultimate owners. The extension of these layers also creates a comfortable distance between the ultimate owners and high-risk projects, making them highly tolerant to debt risks (Attig et al. 2003). All in all, it is believed that the longer the layers of a pyramid structure, the higher the level of debt financing in the listed companies. Therefore, we propose the following hypothesis.

H1: The layers of a pyramid structure are positively associated with the debt to asset ratio.

In addition to the multi-layers structure of the pyramid structure, the multi-chains structure is also a key channel via which ultimate owners can expand their resources through the pyramid structure. As a distinct feature of the inner structure of pyramid, the multi-chains structure can affect the degree of the leverage effect of the pyramid structure as a whole, in tandem with the multi-layers structure. The more chains in the pyramid structure, the more complicated the pyramid structure will be, and the more resources will be controlled by the ultimate owners with the same capital. Moreover, certain behaviors under the pyramid structure, such as companies' mutual guarantee and affiliate transactions, make it easier to generate higher debt levels of the listed companies. Therefore, the following hypothesis is proposed:

H2: The chains in a pyramid structure are positively associated with the debt to asset ratio.

The institutional environment plays an important role in the corporate governance system, as it can not only affect corporate behaviors directly, but can also affect them indirectly through enacting various corporate governance mechanisms. Recently, numerous cross-country studies have confirmed the significance of the external institutional environment in this sense (Fan, Titman and Twite 2012). However, these studies tend to ignore the *regional differences* between the institutional environments within a country, which is inappropriate for China, a large country with unbalanced regional development. China's market-oriented reforms since 1978 has gained notable progress but also a widening regional disparity, which have led to great heterogeneity in marketization and institutional quality across regions in China (Wu et al. 2013). There are huge development gaps among different regions in China (Wei et al. 2011). If cross-country differences in institutional environments have significant effects on company behaviors, then it may also be expected that regional differences between institutional environments within the same country will also have an important impact on company behaviors (Wei et al. 2011).

The concept of the 'institutional environment' is an integrated notion and has several dimensions. The first of these is *Marketization*, which usually measures the extent to which the distribution of a country's economic resources can be determined by the market. In the literature, it is widely believed that market liberalization plays an effective role in promoting free market competition and economic efficiency. The second dimension is *Government intervention*, referring to the degree of a government's intervention in local companies or economic behavior. Thirdly, the *Law environment* means a country's legal systems and law enforcement condition. Although China implements the unified law system, legislation across its provinces differs to a certain extent. At the same time, the law enforcement conditions between its different regions vary widely (measured by the number of lawyers as a percentage of the local population, the efficiency of the local courts, and the protection of property rights). These three elements combine to portray the development of a country's institutional environment. Generally speaking, in regions with a higher degree of marketization, the degree of

government intervention in local companies is lower and the law environment is better.

Contingency theory suggests that the organizational process must fit its context. Recently literature has also supported the notion that the effect of ownership structure on capital structure might be influenced by the institutional environment (Liu et al. 2011). A relatively developed degree of institutional support generally provides companies with a better environment for market-based competition, especially because this means that the market institutions will be more effective, and property rights more likely to be protected (Li and Qian 2013). Moreover, improvement in the institutional environment can also mitigate agency problems between the ultimate owners and minority shareholders (Dyck and Zingales 2004), and further affect the effect of agency cost on capital structure (Li et al. 2009).

Conversely, a weak institutional environment makes it problematic and costly to monitor and enforce contracts (Young et al. 2008). In such an institutional environment, characterized by low marketization and a poor law environment, the restrictive effects of the institutional environment on the agency problems of the pyramid structure are also relatively weak. The ultimate owner can play a role in capital structure through the pyramid structure more conveniently within a poor institutional environment. In addition, Lins (2003) found that the wedge between ultimate owner's control rights and cash flow rights may exert a greater negative effect on corporate value in less-developed regions. Thus, by extention, in less-developed regions, the inner structure of pyramid will have a larger effect on company debt.

In contrast, in regions with better institutional environment, the effect of pyramid structure on capital structure is relatively weak (Liu et al. 2011). A favorable institutional environment will reduce the ultimate owners' expropriation behaviors and protect the minority shareholders' interests. Tunneling behaviors are effectively curbed by a favorable institutional environment with sound legal systems, as the marginal costs of transferring profits from companies to the ultimate owner will increase, thus making these tunneling behaviors more likely to be exposed and punished. Therefore, it can be argued that the ultimate owner in a favorable institutional environment will have a much lower incentive to expand debt financing.

A reduction in government intervention and an improvement in the law environment, especially bankruptcy law, will therefore enhance the governance and constraint effect of debt. In this context, a bank's supervision effects over its debtors will be enhanced. 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 market-oriented, the risk awareness of banks gradually increase, and the marketization degree of bank credit allocation is gradually improved (Firth et al. 2009; Taboada 2011). Since the process of organizational decision-making is normative and follows market principles, the banks will then avoid the risky companies that are led by serious agency problems, and pursue less risky companies instead. All these factors will ultimately limit the pyramid inner structure's effect on capital structure. Su et al. (2013) confirmed this by highlighting that the wedge between ultimate owner's control rights and cash flow rights has a smaller positive effect on capital structure in regions with a well-developed institutional landscape.

Given the arguments here presented, it can be hypothesised that with an improvement in institutional environments, a higher degree of market-orientation, and enhanced bank operational independence, the effect of the inner structure of pyramid on capital structure will be gradually decreased. Based on the previous theoretical analysis, this paper measures the effect of the institutional environment on the relationship between the inner structure of pyramid and capital structure with regard to three key factors: the regional degree of marketization, government intervention, and the law environment. The following hypothesis is proposed:

H3: Both the effects of the layers and the chains of a pyramid structure on the company's debt to asset ratios are relatively smaller in regions with a better institutional environment (those possessing a high degree of marketization, low government intervention and a favorable law environment), than in regions with a poor institutional environment.

3 Methods

3.1 Samples

Data regarding the inner structure of pyramid were manually collected from the annual report of listed companies; complementary data were sourced from the CSMAR (China Stock Market Accounting Research) database, which is the most widely used database on Chinese capital market (Su et al. 2015). This paper takes all the listed companies in both Shanghai and Shenzhen Stock Exchange Market between 2004 and 2009 as the original sample. The sample period was marked as beginning from 2004 because it was since then that all the listed companies in China were required by the CSRC (China Securities Regulatory Commission) to list the identities of their owners, as well as their chains of control, in their annual reports. Observations were deleted from our sample if they met the following conditions: (1) the companies belong to a financial industry (considering the special financial characteristics of these firms); (2) ST or PT companies[1], since these companies are always in abnormal financial conditions and thus subject to great constraints on financing; (3) companies with extreme variable values, such as those with a debt ratio either greater than 1 or less than 0; (4) companies with incomplete data, or whose relevant data we were unable to locate. Following the selection process, we obtained 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.

3.2 Measures

3.2.1 Dependent measure

The dependent measure in this paper is the measurement of capital structure (*LEV*). Capital structure can be defined in several ways (Guney et al. 2011). Rajan and Zingales (1995) argue that the definition of capital structure depends on the

[1] ST is the abbreviation of special treatment, refers to listed companies having negative net profit within the two most recent consecutive fiscal years. PT is the abbreviation of particular transfer, refers to listed companies having negative net profit within the three most recent consecutive fiscal years.

objective of the analysis. Since short-term debt takes a relatively large share and is always applied for a long-term purpose in Chinese listed companies (Su et al. 2013), this paper defines capital structure as the ratio of total debt to total assets. Guney et al. (2011) and Chang et al. (2014) also use the debt to asset ratio (book leverage) in their research about capital structure in China. For the purposes of this paper, we use the book value-based variable rather than the market debt ratio as the measure of capital structure because companies have been shown to be more concerned about book leverage ratios than market leverage ratios (Cho et al. 2014).

3.2.2 Independent measures

According to the previous analysis, independent measures in this paper involve the layers of a pyramid structure, the chains of a pyramid structure, the degree of marketization, government intervention, and the law environment. The layers of the pyramid structure refer to the length of agency chains experienced by ultimate owners who exercise power over the listed companies. The ultimate owner may control listed companies through many agency chains, and the number of layers in each agency chain may be different. Both the number of layers of the longest agency chains (*LLAY*) and of the shortest agency chains (*SLAY*) were adopted to measure the layers of a pyramid structure. The chains of pyramid structure (*CHAIN*) refer to the number of chains that are used by the ultimate owners to exercise their control rights over listed companies. We measure the institutional environment variables of different regions where the listed companies are registered in China as proposed by Fan et al. (2010), which has been widely used in previous studies (Wang et al. 2008; Li et al. 2009; Su et al. 2013). We use the index scores of the marketization process, and the relationship between the government and market, and the law environment, to measure the degree of marketization (*MAR*), the degree of government intervention (*GOV*), and the degree of law environment (*LAW*) respectively. The larger the indexes, the better the regional institutional environment is determined to be, i.e. the degree of marketization will be higher, the degree of government intervention will be lower, and the law environment will be more favorable. It should be noted here that the relationship between the government and the market index score is a kind of

reverse measure indicator of government intervention - the smaller the index, the worse the government intervention is, and vice versa.

3.2.3 Other Measures

We introduce the following control variables based on previous theoretical and empirical studies:

(1) Company size (*SIZE*), which is included in most research on capital structure (Titman and Wessels 1988). This paper argues that**,** as the company size increases, the probability of bankruptcy decreases, implying a higher ability of debt financing. Company size is measured by the natural logarithm of the total asset of a company at the end of the fiscal period.

(2) Collateral value of assets (*CVA*). Since tangible assets can serve as collateral, the risk of debt financing is relatively small for companies with holding a large amount of tangible assets, which make it easier to obtain debt financing (Myers and 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 the measure of the collateral value of assets.

(3) Profitability. Pecking order theory indicates that companies prefer to raise capital first from retained earnings due to the low cost, and then from debt as a second option, and finally to issue equity (Myers and Majluf 1984). Companies with good profitability normally have sufficient retained earnings, a lesser need for debt financing, and thus a smaller level of debt. In this paper, the return on assets (*ROA*) is used to measure profitability.

(4) Growth. From the theoretical analysis, the effect of growth on capital structure is not clear enough, and the empirical research to date has not reached consistent results. This paper chooses Tobin's Q value[2] (*TOB*), used in most studies to measure a company's growth.

(5) Group (*Group*). Companies belong to a group may have well-developed internal capital markets and more financial resources than independent companies,

[2] Tobin's Q is defined as the market value of total assets deflated by the book value of total assets. There are two kinds of shares in Chinese listed companies: tradable shares and non- tradable shares. We calculate the firm market value as the sum of total liability, market value of tradable shares and the book value of non-tradable shares.

arguably suggesting that group affiliated companies should have higher levels of debt.

(6) Industry (*INDU*). Scott and Martin (1975) argue that companies belonging to the same industry face similar market conditions, and that their capital structure will not change much. According to the industry classification standard issued by the China Securities Regulatory Commission in 2001, listed companies are divided into 13 broad industries. This paper further classifies the manufacturing industry (majority represented among the listed companies) into ten sub-categories in terms of the second-code classification criteria. After deleting the financial industry, the sample for this study consisted of 21 industries. Taking the industry of agriculture, forestry, animal husbandry and fishery as the benchmark, 20 dummy variables were used to represent the different industries. Where a certain listed company belongs to a particular industry, the industry dummy variable takes the value of 1, and 0 otherwise.

As the sample period extends from 2004 to 2009, we took 2004 as the benchmark, and selected five dummy variables to represent subsequent years (*YEAR*). The definitions of variables are summarized in Table 1.

Table 1. Definitions of Variables

Variable type	Name	Label	Definition and computation
Dependent measure	Leverage	*LEV*	Total Liabilities/Total Assets
Independent measure	Layer of pyramid structure (longest)	*LLAY*	The number of layers of the longest agency chains of the pyramid structure
	Layer of pyramid structure (shortest)	*SLAY*	The number of layers of the shortest agency chains of the pyramid structure
	Chains of pyramid structure	*CHAIN*	The number of chains of pyramid structure
	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 + Net asset per share *non-tradable share)/Total assets
	Group	*Group*	1, when the company belongs to a group, 0 otherwise
	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

3.3 Regression models

To test our hypotheses, we adopted random-effects estimation technique in analyzing the panel data regression according to the Hausman specification test results. Model (1) is used to test the first and second hypotheses. This paper predicts that the coefficient β_1 of X_{it} would be significantly greater than zero. Model (2) is used to test the third hypotheses. The institutional environment variable $ENVI_{it}$ stands for regional marketization degree, government intervention degree and law environment variables, respectively. We expect that β_2, the coefficient of the interaction term, would be significantly less than zero.

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

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

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 company and time respectively.

4 Empirical research

4.1 Descriptive statistics

Table 2 provides the descriptive statistics of the main variables for the sample. From this, it is evident that the capital structure (debt to asset ratio) is 48.9% on average, and the median is 50.2%. Among the longest layers of pyramid structure (*LLAY*), the maximum is 9 and the minimum is 1, with a mean of 2.437 and a median of 2. Among the shortest layers (*SLAY*), the maximum is 8, with a mean of 2.257 and a median of 2, implying a significant variations between different

pyramid structures. The greatest number of chains in a pyramid structure is 9, and the least is 1. The mean of the chains is 1.281 and the median is 1, indicating that the chains within different pyramid structures vary greatly. However, at least half of the pyramid structures in the sample were found to have only 1 agency chain.

The minimum value of the marketization degree is 1.55 and the maximum is 11.71; the mean is 8.487 and the median is 8.63. Combined, these figures suggest that the marketization process differ widely between the different regions in China. The minimum index score of government intervention is –1.09, the maximum is 10.65, the mean is 9.078, and the median is 9.3, likewise indicating that government intervention across the different regions differs greatly. The minimum value of the law environment index is 1.53, the maximum is 16.61, the average is 8.016, and the median is 6.92, implying that listed companies in the different regions confront relatively different law environments. The minimum collateral value of assets is 0, the maximum is 97.5% and the mean is 46.9%, suggesting that the collateral value of assets varies largely for listed companies. The average of return on assets (*ROA*) is 3.6% and the median is 3.4%, indicating that the overall

Table 2. Descriptive statistics

Variable	Obs.	Min	Max	Mean	Median	SD.	Var
LEV	7729	0.008	0.994	0.489	0.502	0.185	0.034
LLAY	7729	1.000	9.000	2.437	2.000	0.917	0.840
SLAY	7729	1.000	8.000	2.257	2.000	0.823	0.677
CHAIN	7729	1.000	9.000	1.281	1.000	0.704	0.496
MAR	7729	1.550	11.710	8.487	8.630	2.073	4.296
GOV	7729	-1.090	10.650	9.078	9.300	1.365	1.862
LAW	7729	1.530	16.610	8.016	6.920	3.810	14.517
SIZE	7729	18.157	28.003	21.512	21.378	1.129	1.274
CVA	7729	0.000	0.975	0.469	0.465	0.174	0.030
ROA	7729	-0.999	0.466	0.036	0.034	0.072	0.005
TOB	7729	0.734	16.398	1.644	1.322	0.949	0.900

Note: This table offers the summary statistics of the variables in Chinese listed companies for the sample period 2004–2009. There are 7,729 firm-year observations in the sample. The variable definitions are displayed in Table 1.

profitability of listed companies in China is relatively low. Moreover, there are great differences in growth between the different listed companies.

In order to understand the inner structure of pyramid more clearly, a further description of the distribution of the sample companies was carried out according to the layers and chains within the pyramid structure. The results are shown in Table 3. It is clear that, regardless of the longest layers of pyramid structure (*LLAY*) or the shortest ones (*SLAY*), having two or three layers of pyramid structure is very common; over 50% of the sample were found to have the two-layer structure. The majority of the samples (81.408%) control the listed companies through only one agency chain; the proportion of companies controlled through two chains is 12.46%, and the proportion of companies controlled through three or more agency chains is relatively small. From this, it can be deduced that as far as the inner structure of a pyramid is concerned, the focus of the ultimate owner's attention is on the multi-layers structure of the pyramid, rather than multi-chains structure.

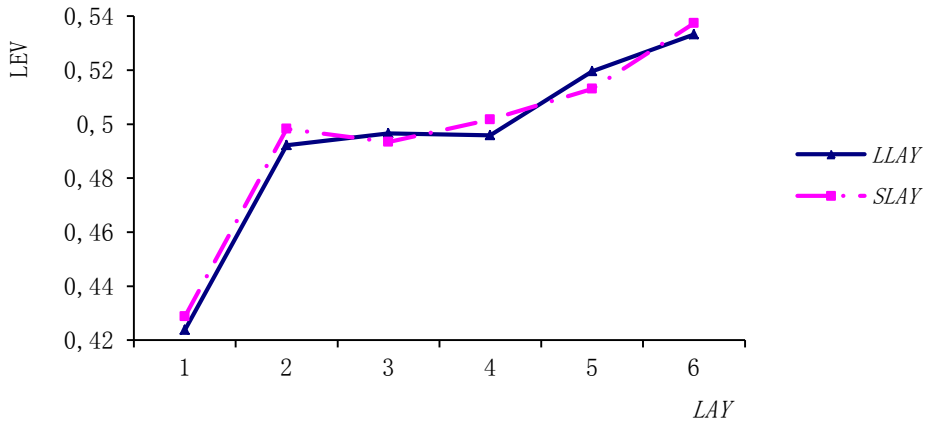
In order to investigate the relationship between capital structure and the inner structure of pyramid intuitively, the relationship with the mean of the capital structure is portrayed in Figure 1 and Figure 2, according to the classification of the layers of the pyramid structure and the chains. From Figure 1, it can be seen that with the extension of the layers of a pyramid structure, the capital structure level demonstrates an upward trend, which is consistent with our previous theoretical analysis. Conversely, Figure 2 indicates that, with the increase in the

Table 3. The distribution of pyramid inner structure

	1	2	3	4	5	6	7 and more	total
LLAY	648	4221	2028	594	174	45	19	7729
Percentage (%)	8.384	54.612	26.239	7.685	2.251	0.582	0.246	100
SLAY	975	4460	1797	375	86	26	10	7729
Percentage (%)	12.615	57.705	23.250	4.852	1.113	0.336	0.129	100
CHAIN	6.292	963	301	112	46	8	7	7729
Percentage (%)	81.408	12.460	3.894	1.449	0.595	0.104	0.091	100

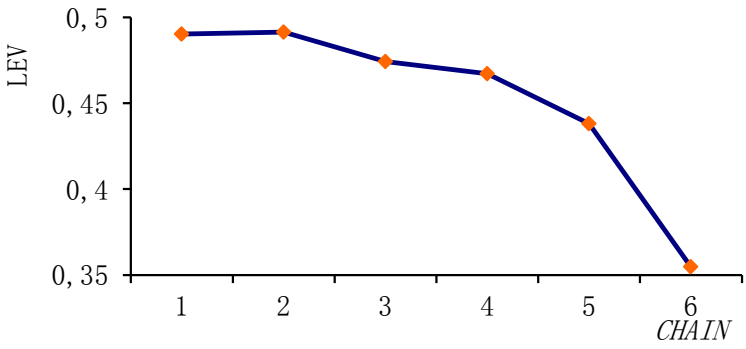
Note: This table descripes the distribution state of Chinese listed companies according to the multi-layers structure and the multi-chains structure for the sample period 2004–2009. There are 7,729 firm-year observations in the sample. The variable definitions are displayed in Table 1.

Figure 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.

Figure 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.

number of chains within a pyramid structure, the capital structure level shows a downward trend, which is inconsistent with the theoretical analysis and research hypothesis.

The statistical description of the capital structure level and the variance analysis of the mean differences of capital structure according to different layers of pyramid structure are presented in Table 4 and Table 5. Table 4 highlights that, as far as the longest layer of the pyramid (*LLAY*) concerned, the capital structure level increases in line with an increase in the number of layers. Specifically, when the layers increases from 1 through to 6, the mean of the capital structure is 42.4%, 49.2%, 49.7%, 49.6%, 52.0% and 53.3%, 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 42.9%, 49.8%, 49.3%, 50.2%, 51.3% and 53.7%, respectively. In addition, the variance analysis shows that this difference is significant. Combined, these results imply that the layers of pyramid structure and capital structure are significantly positively associated, which preliminarily verifies the first hypothesis.

Table 4. The variance analysis of the *LLAY*

LLAY	Obs.	Min.	Max.	Mean	SD.	F value	*Sig*
1	648	0.018	0.933	0.424	0.193		
2	4221	0.008	0.994	0.492	0.182		
3	2028	0.018	0.970	0.497	0.188	19.158***	0.000
4	594	0.051	0.953	0.496	0.174		
5	174	0.121	0.886	0.520	0.181		
6 or more	64	0.060	0.848	0.533	0.182		
total	7729	0.008	0.994	0.489	0.185		

Note: This table offers the variance analysis of the mean of capital structure among companies displayed by different multi-layers structure (*LLAY*); The observations and summary statistics of the capital structure in each group are also displayed. The variable definitions are displayed in Table 1. *, **, *** represent significance 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	0.018	0.933	0.429	0.183	24.674***	0.000
2	4460	0.008	0.994	0.498	0.184		
3	1797	0.018	0.962	0.493	0.186		
4	375	0.060	0.953	0.502	0.172		
5	86	0.169	0.787	0.513	0.166		
6 or more	36	0.119	0.848	0.537	0.166		
total	7729	0.008	0.994	0.489	0.185		

Note: This table offers the variance analysis of the mean of capital structure among companies displayed by different multi-layers structure (*SLAY*); The observations and summary statistics of the capital structure in each group are also displayed. The variable definitions are displayed in Table 1. *, **, *** represent significance at the 10%, 5% and 1%level, respectively.

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 a pyramid structure, the higher the capital structure level - this is consistent with H1. On the other hand, the 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 related, suggesting that the ultimate owner's preference towards debt-financing is suppressed in regions where the market-ization degree is high, the law environment is good, and the government inter-vention is low. The relationships between the other control variables and capital structure are also found to be consistent with our expectations.

Table 6. Pearson Correlation Analysis

	LEV	*LLAY*	*SLAY*	*CHAIN*	*MAR*	*GOVI*	*LAW*	*SIZE*	*CVA*	*ROA*
LEV	1.000									
LLAY	0.073***	1.000								
SLAY	0.076***	0.858***	1.000							
CHAIN	-0.036***	0.398***	0.004	1.000						
MAR	-0.047***	-0.018	-0.106***	0.125***	1.000					
GOVI	-0.044***	-0.012	-0.081***	0.092***	0.850***	1.000				
LAW	-0.053***	-0.011	-0.093***	0.121***	0.935***	0.717***	1.000			
SIZE	0.317***	0.052***	0.048***	-0.013	0.095***	0.051***	0.089***	1.000		
CVA	0.224***	-0.020*	0.005	-0.057***	-0.134***	-0.089***	-0.138***	0.173***	1.000	
ROA	-0.371***	-0.057***	-0.090***	0.054***	0.117***	0.087***	0.099***	0.139***	-0.089***	1.000
TOB	-0.212***	0.003	-0.021*	0.060***	0.112***	0.057***	0.117***	-0.187***	-0.158***	0.202***

Note: This table offers the Pearson correlation analysis of the variables in Chinese listed companies for the sample period 2004–2009. There are 7,729 firm-year observations in the sample. The variable definitions are displayed in Table 1. *, **, *** represent significance at the 10%, 5% and 1% level, respectively.

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. Here, it can be seen from columns (1) and (2) that both the longest layers of pyramid structure (*LLAY*) and the shortest layers of pyramid structure (*SLAY*) are significantly positively

Table 7. Multiple Regression Analysis

Variable	*LEV*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-1.244***	-1.245***	-1.242***	-1.263***	-1.255***	-1.255***	-1.263***	-1.256***	-1.254***
	(-22.949)	(-22.909)	(-22.935)	(-23.219)	(-23.115)	(-23.130)	(-23.158)	(-23.063)	(-23.078)
LLAY	0.002*			0.019***	0.023***	0.009***			
	(1.964)			(3.773)	(3.153)	(3.013)			
SLAY		0.002*					0.019***	0.023***	0.009***
		(1.765)					(3.519)	(2.915)	(2.878)
CHAIN			0.002						
			(0.744)						
MARLLAY				-0.002***					
				(-3.713)					
GOVLLAY					-0.002***				
					(-3.003)				
LAWLLAY						-0.001***			
						(-3.372)			
MARSLAY							-0.002***		
							(-3.564)		
GOVSLAY								-0.002***	
								(-2.843)	
LAWSLAY									-0.001***
									(-3.441)
SIZE	0.078***	0.078***	0.078***	0.079***	0.079***	0.079***	0.079***	0.079***	0.079***
	(32.670)	(32.726)	(32.668)	(32.874)	(32.786)	(32.806)	(32.907)	(32.828)	(32.841)
CVA	0.129***	0.129***	0.130***	0.127***	0.128***	0.128***	0.128***	0.129***	0.128***
	(13.700)	(13.682)	(13.714)	(13.486)	(13.603)	(13.494)	(13.514)	(13.614)	(13.507)
ROA	-0.681***	-0.681***	-0.682***	-0.680***	-0.680***	-0.680***	-0.680***	-0.680***	-0.681***
	(-38.227)	(-38.218)	(-38.271)	(-38.174)	(-38.187)	(-38.200)	(-38.165)	(-38.163)	(-38.196)
TOB	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.691)	(0.681)	(0.695)	(0.722)	(0.707)	(0.686)	(0.703)	(0.690)	(0.669)

Table 7 continued

Table 7 continued

Group	0.008*	0.008**	0.008**	0.007*	0.007*	0.007*	0.008**	0.008**	0.008*
	(1.883)	(2.093)	(2.196)	(1.831)	(1,827)	(1,813)	(1.983)	(2.007)	(1.957)
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	3295.650***	3294.810***	3294.920***	3314.820***	3308.140***	3312.060***	3312.580***	3306.030***	3312.070***

Note: This table reports the results from regression results of the pyramid inner structure on capital structure using the random-effects model in Chinese listed companies for the sample period 2004–2009. There are 7,729 firm-year observations in the sample. The value in brackets represents z values; Coefficients significantly different from zero at the 10%, 5%, and 1% level are marked *, ** and ***, respectively. The variable definitions are displayed in Table 1.

associated with the debt to asset ratio, suggesting that the longer the layers of a pyramid structure, the stronger the leverage effect of that pyramid structure, and the stronger the motivation for the ultimate owner to expand debt financing. Therefore, the layers of pyramid structure may be said to have a significant and positive effect on the debt to asset ratio, thus supporting H1.

From column (3), we can see that the number of chains within a pyramid structure and the debt to asset ratio are positively associated but not significant, suggesting that the chains within a pyramid structure have no significant effect on capital structure, thus not supporting H2. Combined, these results show that a pyramid structure's leverage effect is mainly dependent on the vertical multi-layers structure, while the horizontal multi-chains structure plays a very limited role in expanding the resource control of ultimate owner. This result also can be slightly seen from the descriptive analysis section, which demonstrates that 81.408% of pyramid structures control listed companies through only one agency chain, while approximately 90% of the pyramid structures have adopted the multi-layers structure (i.e. extending to more than two layers). This multi-layers structure is far more common than the multi-chains structure. Since H2 is not supported, there is no further necessity to investigate the difference between the effects of the chains within a pyramid structure on corporate capital structure under different institutional environments.

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*)) are significant and negative. This suggests that, compared with regions with a low degree of marketization, the layers of pyramid structure have a smaller effect on the company's debt to asset ratio in regions possessing a high degree of marketization. In addition, the regression coefficients on *LLAY* and *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. This indicates that, compared with regions with more government intervention, the layers of pyramid structure have a relatively smaller effect on that company's debt to asset ratio in regions with less government intervention. In addition, *LLAY* and *SLAY* remain significantly and positively related to 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. This implies that, compared with regions with a weak law environment, the layers of pyramid structure have a relatively smaller effect on the company's debt to asset ratio in the context of a good law environment. Moreover, *LLAY* and *SLAY* remain significantly and positively correlated with capital structure.

Overall, the strong finding emerges that, compared with regions possessing a poor institutional environments, the effect of the layers of pyramid structure on the company's debt to asset ratio is relatively smaller in regions with a better institutional environment (i.e. a high degree of marketization, low government intervention and a good law environment).

In addition, we can see that company size is significantly positively related to capital structure, which is consistent with the previous theoretical analysis. The collateral value of assets is also significantly and positively related to capital structure, suggesting that the more assets the company can mortgage, the stronger its 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 thus reduce the debt level. Companies belonging to a group were found to have a significant and positive correlation with capital structure.

5 Conclusion

This paper investigates the effects of the inner structure of pyramid on capital structure, and the differences in those effects between regions with different institutional environments. Our results indicate that the longer the layers of a pyramid structure, the stronger the 'leverage effect' of that pyramid structure will be, as well as the ultimate owner's motivation to expand debt financing. Therefore, the layers of pyramid structure have a significant and positive effect on capital structure. However, the chains within the pyramid structure were found to have no significant effect on capital structure. Thus, it can be cautiously concluded that the function of the 'leverage effect' of a pyramid structure mainly depends on its vertical multi-layers structure, while the horizontal multi-chains structure plays a very limited role. Moreover, compared with regions with poor institutional environment, in regions with a better institutional environment (high degree of marketization, low government intervention and a good law environment), the cost associated with the effects of the inner structure of a pyramid on capital structure is relatively high, meaning that the effects of these layers on capital structure become smaller.

Overall, our results suggest that the layers of pyramid structure play an important role in expanding debt financing, and that an improvement in institutional environment can help to mitigate this effects. These findings hold certain implications for policy improvements. For example, relevant policies and measures could be adopted by the China Securities Regulatory Commission (CSRC) to promote the ultimate owner's incentive to shorten the layers of pyramid structure, simplify the controlling structure, and flatten the organizational structure in order to weaken the ultimate owner's motivation to extract private benefit through expanding debt financing. Another recommendation would be that both regulatory theorists and practitioners should contribute to improving China's varying institutional environments, specifically by further enhancing the degree of marketization, reducing government intervention and strengthen the law environment in order to better protect investors.

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