Organizational Structure as a Decentralization Device: Evidence from Corporate Pyramids*

Joseph P.H. Fan[a], T.J. Wong[b], and Tianyu Zhang[c]

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Abstract

This paper examines the pyramidal ownership/organizational structure of newly listed government-controlled firms in China. These controlling owners are constrained by the Chinese laws prohibiting free transfer of state ownership. Pyramiding allows them to credibly decentralize decision rights to firm management without selling off their ownership. Our empirical results support this conjecture. State controlling owners build more extensive corporate pyramids when they are less burdened with fiscal or unemployment problems, when they have more long-term goals, and when their firms' decisions are more subject to market and legal disciplines. The more extensive pyramids are also associated with higher Tobin's Q, better labor and investment efficiency and greater total factor productivity. This relation between pyramidal structure and firm operating efficiency however is found to be endogenous to the local government incentives and the regional institutional environment faced by the firms.

[a]pjfan@cuhk.edu.hk; 852-2609-7839; The Chinese University of Hong Kong, Shatin, N.T., Hong Kong.
[b]tjwong@cuhk.edu.hk; 852-2609-7750; The Chinese University of Hong Kong, Shatin, N.T., Hong Kong.
[c]tyzhang@cityu.edu.hk; 852-2788-8043; City University of Hong Kong, Kowloon, Hong Kong.

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1. Introduction

Many firms around the world are organized into pyramidal-like structures (La Porta, Lopez-de-Silanes, and Shleifer, 1999; Claessens, Djankov, and Lang, 2000; Khanna and Yafeh, 2005). On the apex of a pyramid sits a controlling owner who controls a firm rather indirectly through layers of intermediate companies. Why the owner builds the pyramid is unclear to academicians.

There have been only a few theories. First, a pyramid creates separation of control from ownership that helps a controlling owner to consume private benefits that may include expropriating wealth from minority shareholders (Bebchuk, 1999; Bebchuk, Kraakman, and Triantis, 2000; Wolfenzon, 1999; Morck, Wolfenzon, and Yeung, 2004). Second, a pyramidal structure allows a controlling owner to relieve his/her financial constraint in new investments. Almeida and Wolfenzon (2006) show that the owner can use the firm it already controls to set up a new firm, allowing the owner to access the entire stock of retained earnings of the firm it controls. The owner prefers this pyramidal structure as opposed to simply holding shares of the new firm directly (horizontal structure) when internal funds are important and the security benefits of the new firm that they share with existing shareholders of the original firm are low. They show that such effects can be achieved even when the pyramidal structure does not create separation of control from ownership. Third, the existence and extent of pyramidal corporate structure can be influenced by regulations and tax policies (Morck, 2005).

This paper considers a new explanation of corporate pyramid: it enables credible decentralization of decision rights from a controlling owner (corporate headquarter) to a local

(divisional) manager. Intermediate layers of corporations create information cost between the owner and the manager, making it difficult for the owner to intervene the manager's decisions ex post.

Partition and transfer of decision rights within an organization has been a subject of extensive discussion and theoretical modeling.[1] This literature emphasizes incentive alignment and information cost mitigation as the key determinants of the decision rights allocation. It also suggests ownership and organizational structures as important mechanisms that facilitate credible transfer of the decision rights. However, there have been only a few empirical studies on firm decentralization, e.g., Baker (1992) and Rajan and Wulf (2006), primarily due to data and measurement difficulties.

This paper investigates the decentralization hypothesis in the context of China – the largest transition economy in the world. It tracks pyramidal structures of a comprehensive sample of 742 newly initial public offering (IPO) firms majority-owned by various Chinese local governments.[2] It then examines control rights decentralization as a key determinant of the extensiveness of the pyramids controlling the IPO firms. It also examines whether and how the pyramidal structures are associated with firm performance and operating efficiency after the IPOs.

The state ownership and China's institutional setting provide several important advantages in testing the decentralization hypothesis. First, under China's socialist regime, state assets and their controlling ownership are not freely transferable. Due to the ownership transferability restriction, the state owners almost always possess 100 percent of equity

[1] See, for example, Alchian (1965), Williamson (1975, 1985), Jensen and Meckling (1992), Aghion and Tirole (1997), Burcart, Gromb, and Panunzi (1997), Baker, Gibbson, and Murphy (1999), Rajan and Zingales (2001), Stein (2002), and Prat (2005).

[2] We exclude firms that are controlled by the central government because in our later analyses, we want to take advantage of the variations of institutional settings where the local government-controlled firms operate.

ownership of the intermediate companies along vertical pyramids, precluding equity financing and ownership-control separation as the primary reason for the pyramidal structure. Second, the ownership transfer restriction likely induces pyramid formation as an alternative decentralization device. For a state owner that does not possess the rights to sell, it is unable to use outright sales as a means to transfer its decision rights in the firm to a third party, typical in a market economy (Burcart, Gromb, and Panunzi, 1997; Baker, Gibbson, and Murphy, 1999). When conditions arise making decentralization desirable, the owner will likely consider other methods that allow credible decentralization of the decision rights short of actual transfer of the ownership. It does not work to simply tell a firm manager that he/she has the right to make the decisions because the manager believes there is a non-trivial probability that the owner will intervene and take the power back. Ironically, an advantage of China's state-owned vertical pyramids is that they are generally highly bureaucratic, making information transmission highly ineffective, an important condition for credible decentralization as emphasized in Cremer (1995), Aghion and Tirole (1997), and Baker, Gibbson and Murphy (1999). Third, the output/performance of the newly publicly traded companies at the bottom of the pyramids is observable by owners, as it is reflected in the firms' stock prices and financial reports. By contrast, the firm managers' decision processes are much less observable by the owners due to the high information barrier associated with the vertical pyramids. The transparency of firm output together with the opacity of the managers' decision process provides a suitable condition for credible decentralization as in Prat (2005). Fourth, China's young market economy allows us to investigate corporate pyramids close to their inception, while decentralization clearly has been a theme of China's enterprise and market reforms (Grove, Hong, McMillan, and Naughton, 1994; Brant and Zhu,

2000; Maskin, Qian, and Xu, 2000). Fifth, China's diverse markets and geographic regions provide sufficient variations in institutional settings that facilitate the measurements of local governments' incentives to decentralize decision power to their listed firms.

Our empirical results show that local government owners build more extensive pyramids on top of their listed companies when they are less burdened with unemployment or fiscal problems, and when their spending in long-term objectives (education, research and development, etc.) is higher. This suggests that the local governments' weaker incentives to impose policy burden on the firms and stronger desire for long-term economic achievements result in more decentralization and more extensive pyramidal structures. We also find that local-government-controlled firms belong to more extensive pyramids when the degrees of market and legal disciplines provided to the firms' regions are stronger. The market and legal disciplines not only align the local governments' interest toward value maximization, but also serve as disciplining devices against firm managers' agency problems, both of which encourage more decentralization through pyramid building.

Consistent with our conjecture that pyramids allow controlling owners to commit not to intervene in the firms' day-to-day operations, we find significant positive associations between the number of pyramidal layers and the firms' Tobin's Q, employment and investment efficiency, and total factor productivity. However, these positive associations become statistically insignificant in sub-samples partitioned by controlling owners' incentives and the institutional environment of the firms' regions, indicating that the relation between pyramidal structure and firm operating efficiency is endogenous to the economic and political institutions of the local regions.

The remainder of the paper proceeds as follows. Section 2 discusses the literature and develops the hypotheses of the emergence of corporate pyramids in China. The empirical results of the determinants of corporate pyramids are reported in Section 3, and the evidence of the association between corporate pyramids and firm performance and operating efficiency is presented in Section 4. Section 5 concludes the paper.

2. Development of Hypotheses

In this section we discuss the literature of firm decentralization, and the emergence and organization of China's modern enterprises. We will then discuss key institutional factors that influence local governments' incentives for organizing their enterprises into pyramids, and the association between pyramids, firm performance and operating efficiency.

2.1. Decentralization and organizational structure

The importance of organizational design in firm decentralization has been extensively discussed in the literature. An owner of a multi-segment firm can create an organizational structure that facilitates the delegation of decision rights within the organization. In this organization, as Williamson (1985) posits, the headquarters specialize in allocating human and financial capital among its various divisions while divisional managers obtain decision rights of local activities. Such delegation can enhance efficiency as it co-locates local knowledge (which cannot be transferred without cost) and decision rights, and provides local managers high-power incentives (Jensen and Meckling, 1992). Stein (2002) shows that when information is costly to transmit from the divisional managers to the headquarters, a decentralized decision structure is more likely to be adopted than is a hierarchical structure.

Given decentralization is desirable, how can it be achieved credibly? It will not work to simply instruct divisional managers that they are free to make the decisions, because ex post reneging/intervention is easy for headquarter managers while costly to the divisional managers. A key factor affecting the credibility is the cost of transmitting information. The role of information cost in credible transfer of decision rights is modeled in several papers. Cremer (1995) shows that, in the context of arm's length relationships, lower cost of information makes the principal more difficult to commit not to intervene. As a result, the incentive of the agent is weakened, leading to counterproductive activities. Aghion and Tirole (1997) also consider the role of information and the principal's reneging possibility in the delegation of formal authority. In their model, delegating formal authority provides several benefits. First, the transfer of formal authority to an agent credibly increases the agent's initiative and incentive to acquire information. Such a transfer prevents the principal from overruling the agent in those situations in which both parties have acquired the relevant information about local projects' potential payoff. Second, transferring authority over activities and decisions that matter more to the agent than to the principal, and for which the principal's overruling might hurt the agent, will facilitate the agent's participation in the contractual relationship. The extent of delegating the formal authority depends on the tradeoff between these benefits and the costs of losing control. Prat (2005) distinguishes two types of information that a principal can have about his agent: information about the consequences of the agent's action and information directly about action. The paper shows that transparency on consequences is beneficial, while transparency on action can have detrimental effects. If the principal can observe the agent's activities, the agent will have an incentive to behave in a conformist manner.

Besides information costs, past research has considered ownership structure as a way to decentralize decision rights to the management. Baker, Gibbson, and Murphy (1999) argue that, within an organization, no matter if the boss is informed or not, there is a possibility of reneging of delegated authority. Their model shows that costlessly moving the boss from no information to full information can make the parties worse off, hence the importance of formal delegation, typically through selling divisional managers the assets together with the decision rights. In Burcart, Gromb, and Panunzi (1997), ownership is a valid mechanism to decentralize. The manager is less inclined to show such initiative in searching for new investment projects when shareholders are likely to interfere. Managerial ownership can act as a commitment device to delegate a certain degree of control to management.

Several empirical studies support the view that decentralized organizational form is beneficial to firms with complex activities. Baker (1992), in a case study of Beatrice Company, shows that over the company's long history, the conglomerate's stock performance is positively associated with the extent to which its headquarters delegate decision rights to divisional managers. Rajan and Wulf (2006) report that U.S. corporate structure has become flatter in recent years: there are fewer middle managers between the CEO and divisional managers. However, this is not evidence of centralization because they also find that divisional managers are more empowered, less monitored, and given more incentive inducement in their compensation contracts.

Building on the literature, we examine the hypothesis that pyramidal structure can be a device for the principal (the controlling owner) to credibly decentralize his/her decision making to the agent (the local manager). Intermediate layers of corporations create

bureaucratic costs[3], induce information opaqueness between the principal and the agent, and make it difficult for the principal to intervene in the agent's decisions. We empirically test this hypothesis using a large sample of publicly traded firms "owned" by various local governments in China. These companies, to various extents, are connected to their owners through layers of intermediate companies – vertical pyramids. We discuss the emergence of these Chinese pyramids in the following sub-section.

2.2. The Chinese Pyramids

China's enterprise reforms since the 1980s feature the decentralization of control rights of its state-owned enterprises (SOEs) from the central government to local governments. Since the creation of the stock markets in Shanghai and Shenzhen in the 1990s, local governments have carved out productive assets from their SOEs, organized them into corporations, and then partially privatized the corporations through IPOs of minority portions of the corporate shares. Over 1000 companies have gone public this way by the year 2001, most of which remain majority-owned by local governments.

A local government can choose between two different ways to organize its ownership and control structure of a publicly traded company. One way is to hold the shares of the newly listed company directly through a state asset management *agency*. In that case the ownership structure of the company is simple: the local government directly owns a controlling stake while minority equity investors collectively own the rest (See Figure 1 for an example). Alternatively, the local government can indirectly own the listed company through a pyramid consisting of one to several intermediate companies. If there is only one intermediate company, it is usually a parent SOE or a state asset management *company* which specializes

[3] Organizing business activities within the firm (instead of the market) involves bureaucratic costs. These costs arise from the propensity to manage, to forgive mistakes, and to logroll (Williamson, 1985).

in managing the assets, while the state asset management agency in the apex of the pyramid continues to serve the government administrative and regulatory functions (See Figure 2). However, if there are multiple intermediate layers, it usually suggests that the local government has transferred the control rights of the listed firm to a large state-owned enterprise group with multiple layers of companies. In either case, these intermediate pyramidal layers are non-publicly traded SOEs solely owned by the local government or jointly owned by local government and other government agencies. Non-government equity participation of the intermediate SOEs is uncommon, due to state regulations prohibiting free dilution of state ownership. The chain of intermediate companies is typically formed over a period prior to the IPO, through a series of restructuring of SOE assets.[4]

2.3. Decentralization and corporate pyramids

We pay attention to the possibility that a corporate pyramid serves as a device for a local government to decentralize control rights to firm managers. Due to regulations that prohibit the dilution of state ownership, the government cannot relinquish control by freely selling off its firm's ownership stake.[5] Creating the corporate pyramid serves as an alternative means of decentralization.

[4] The reform of the state asset management system in Shenzhen and Shanghai can shed light on our understanding of the emergence of these intermediate pyramidal layers. Back in 1992, the Shenzhen government gave the administrative and regulatory functions of the SOEs to a newly established state asset management agency called the State Asset Management Committee (SAMC), after the abolition of all industry bureaus which used to administer and regulate the SOEs. Five years prior to this, the Shenzhen government set up its first asset management company called Shenzhen Investment and Management Company, serving the management function like a holding company, rather than a government administrative bureau. This and two other companies, Development and Investment Holding Company and Trading and Investment Holding Company, subsequently established continue to be the intermediate pyramidal layer of listed firms in Shenzhen. Similarly, starting in 1993, the Shanghai government set up its SAMC and 19 large enterprise groups and holding companies, like the three holding companies in Shenzhen, to manage all SOEs under Shanghai government's jurisdiction. Qian (1996) argues that by the setting up the SAMC, and the management and holding companies, both governments hoped to separate the administrative and regulatory functions and the management functions, minimizing the political influence of the government over the SOEs.

[5] Alchian (1965) and Karpoff and Rice (1988) provide analyses on the effects of non-transferable property rights on organization and incentive.

The decentralization decision is made when the local government decides whether to have a state asset management agency directly controlling the listed firm or delegating its control to a state asset management company or SOE group. By choosing the latter option, the additional intermediate layers make it difficult for the government to intervene in the firm's decision making process. [6]

What, then, affects the local government's incentive for relinquishing control of the firm? The key consideration is the degree of conflict between government and firm objectives. The greater the degree of conflict, the greater the benefit of the government's control. Conversely, the local government's control benefit is smaller when its objectives are more consistent with those of the firm.

Specifically, a local government burdened with poor fiscal conditions or unemployment wants a firm to subsidize public expenditure or support employment, either of which is against the interest of a value maximizing firm. However, strong market discipline and legal enforcement work to align the interest of the government and firm management toward firm value maximization.[7] Therefore, it would be in the government's interest to decentralize its firm decision rights to the management. By giving decision rights to firm managers who possess professional skills and local knowledge, the decentralization enhances firm decision making efficiency (Jensen and Meckling, 1992) that is important in the highly competitive market environment.

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[6] Shirley and Walsh (2001) discuss the potential effect of setting up a corporation in reduced government intervention: "*if an enterprise is run as a department of a ministry, with its managers directly appointed by a minister of chief executive, then political interventions will be easy and common. Alternatively, if the government acts as the dominant shareholder of a largely independent firm, acting through a board of directors, political intervention may be possible but is more costly and more transparent.*"

[7] Conflicts of interest can also arise because the firm managers' objectives deviate from firm profit maximization. The alignment-of-interest effect of the strong market and legal discipline work the same under the double agency setting.

We expect that the degree of decentralization is affected by the extent to which the local government focuses on firm efficiency and the degrees of market and legal disciplines that strengthen the focus. That is to say, the degree of decentralization depends on the set of objectives adopted by the local government and the set of institutional factors that collectively affect market and legal disciplines. The complexity of corporate pyramidal layers linked to a publicly traded company, a proxy for decentralization, should vary systematically with these government objectives and institutional factors. Two sets of testable hypotheses follow:

- *The more the local government focuses on firm profit maximization, the more extensive is the firm's associated pyramidal structure.*
- *The stronger the market and legal institutions in which the firm operates, the more extensive is the firm's associated pyramidal structure.*

2.4. Pyramids and efficiency

If pyramidal layers serve as a credible commitment to constrain owner (government) intervention in managerial decision making, we will expect to see that firms under more complex pyramidal structures operate with higher efficiency relative to other firms under less complex structures. We have the following hypothesis:

- *The number of layers in a firm's pyramidal structure is positively associated with post-IPO operating efficiency, and accounting and stock return performances.*

However, given the degree to which decentralization and the complexity of pyramidal structure are presumably determined by the political and economic institutions of the regions where the firms operate, it remains an empirical issue whether the number of layers will have an incremental effect on performance and operating efficiency after taking into account the

institutional effects. We will consider this endogeneity issue when performing the empirical analysis in the next section.

3. Empirical Results – Determinants of Corporate Pyramids

3.1. The sample

Starting in 2001, publicly traded companies in China are required to disclose detailed ownership information in annual reports, including the structures of pyramidal chains, for their controlling shareholders. However, it would be ideal to examine the ownership and organizational structures of these companies around their initial public offering time when these structures are initially determined. We therefore trace back the ownership and organizational structures to the IPO year for each company traded on the Shanghai or Shenzhen Stock Exchanges, based on the information disclosed in the 2001 annual report and other supplementary sources, including company prospectus and media reports.[8] If there is no change in the controlling owner between a company's IPO year and 2001, we consider that the ownership structure to have remained the same since the IPO, unless there is supplementary information indicating changes in ownership structure.[9] If there is a change in a controlling shareholder, we identify the controlling shareholder and the ownership structure on the IPO year from the IPO prospectus, media reports, and the websites of the company and its affiliated companies. Most listed SOEs are restructured and spun off from parent SOEs prior to their IPOs. The restructuring processes are disclosed in IPO prospectuses, which also provide us with information about the identities of ultimate shareholders.

[8] Survivorship bias is unlikely a concern because no firm has been de-listed prior to 2001.

[9] It is possible that, subsequent to IPO, a controlling owner reorganized company ownership/organizational structure without changing his/her controlling owner status. Using the 2001 data to construct the IPO-year pyramidal structure would introduce measurement bias. As a diagnostic check, we rerun key regressions in this paper using observations solely from year 2001 and find similar results.

To facilitate our tests on the effects of regional political and economics institutions on ultimate owners' decisions to form pyramids, hence decentralizing firm decisions, we focus on firms controlled by provincial or county governments. From the complete list of 1,140 IPO firms in China during 1993 through 2001, we exclude firms controlled by the central government (14% of total population), private owners (5%), collectives (4%), other owner types (5%) including the military, public universities, public research institutes, financial intermediaries, and work unions, and firms whose ultimate owners cannot be identified (3%). We also exclude firms whose ownership or financial data are unavailable (4%). Our final sample, as described in Table 1, consists of 742 local government-controlled firms, representing 65 percent of all IPO firms in China during 1993 through 2001. As in Table 1, the year-by-year coverage of the sample is quite representative, covering the majority of IPOs in almost all of the years.

3.2. Measuring the extents of corporate pyramids

For a given company, we identify all intermediate ownership chains connecting the company and its ultimate controlling owner. We measure the extent of pyramidal structure between the company and its controlling owner as the number of intermediate layers of the longest pyramidal chain in the case of multiple chains.

The examples below illustrate how we identify and measure the extent of pyramidal structures of Chinese listed firms. Changchai Company had become publicly traded in 1994. Although it is not until 2001 that publicly listed companies are required to disclose their detailed organizational/ownership structures, Changchai Company actually reports its structure in the 1994 annual reports, showing that 66.67% of outstanding shares of Changchai Company is owned by Changzhou Bureau of State Assets Management, a government agency

in charge of state-owned assets in the Changzhou region. The same structure (Figure 1) is reported in the 2001 annual report, suggesting that there is no change in the organizational structure. In this case, the ultimate owner is a local government and the extent of the pyramidal structure is one layer – the local government directly controls the company. In Figure 2, Guangzhou Pearl River Industrial Development Co. had become publicly traded in 1993. Although its organizational structure is not disclosed in the IPO year, we assume that the firm's structure to be the same as that of 2001 since we can confirm that there is no change in the controlling shareholder after IPO. The 2001 annual report shows that the Company is directly owned by Guangzhou Pearl River Industrial Group and Guangzhou Bureau of State Asset Management through 61.51% and 6.83% of outstanding shares, respectively. In turn, Guangzhou Pearl River Industrial Group Co. is wholly owned by Guangzhou Bureau of State Assets Management. Thus, Guangzhou Bureau of State Assets Management, representing the local government, is the ultimate owner and the number of pyramidal layers is two – the number of layers of the longest pyramidal chain.

Using this method, we systematically measure the extent of corporate pyramids for all the sample firms. Table 1 reports the sample firms' associated pyramidal layers. Among the 742 firms, 200 (27%) are associated with only one corporate layer, suggesting that they are directly controlled by their ultimate controlling owners; 452 firms (61%) are linked with their controlling owners through two-layer pyramids; 82 firms (11%) are linked with three-layer pyramids, and 8 firms (1%) are linked with their controlling owners via pyramids of four or more layers. The year-by-year patterns are similar with the above overall pattern showing that most publicly traded local-government-controlled firms in China are associated with pyramidal structures. In particular, two-layer pyramids are most popular.

Despite the extensive use of pyramidal structures, the Chinese firms are associated with almost no voting rights and cash flow rights divergence, with a mean ratio of cash flow rights over voting rights of 0.97. [10] The lack of separation between voting rights and cash flow rights of the Chinese pyramids reflects state regulations prohibiting local governments from freely selling shares of companies that they directly or indirectly control. Equity financing therefore is unlikely the primary cause of these pyramidal structures in China. As discussed before, by ruling out equity financing as a plausible reason of pyramid formation, the Chinese sample facilitates our investigation of alternative explanations.

3.3. Measuring the determinants of corporate pyramids

As discussed in Section 2, the extents of corporate pyramids and decentralization depend on the incentives of controlling owners (local governments) and the degrees of discipline provided by local markets and legal systems. Our local regions include all the Chinese provinces, and autonomous regions and municipalities, which are given provincial level status. In this subsection, we discuss the regional level empirical measures that capture local government short- and long-term incentives, and market and legal institutions. We also discuss their predicted relations with the extent of corporate pyramids. Appendix I provides the definitions of these variables and their data sources. Appendix II lists the values of these variables by region.

3.3.1. Local government incentives

We employ several regional level variables as proxies for local governments' short- and long-term incentives. The first is the unemployment rate of the region under the jurisdiction of the local government. The second is a dummy variable which equals one if the

[10] The controlling owner's voting rights level is determined as the ownership percentage at the weakest link of the pyramidal chain, while cash flow rights level is estimated by multiplying the ownership percentage of each link across the chain (La Porta et al., 1999; Claessens et al., 2002).

local government's fiscal balance (fiscal revenue minus government expenditure scaled by regional gross domestic product (GDP)) is within the top quartile of the sample, and zero otherwise. The third variable is a proxy for the local government's long-term incentive. It is the total research and development (R&D) expenditures of the local government for the entire region, scaled by regional GDP. We also extract from these three variables a factor score that satisfies the Kaiser criterion using principal component analysis. This linear factor score, called Incentive, is constructed to be negatively correlated with unemployment and positively correlated with fiscal surplus and R&D expenditures, capturing 56% of the total variance of the principal component analysis.

To be consistent with the decentralization hypothesis, a controlling owner's incentive for building pyramids is expected to be negatively related to the regional unemployment rate, while positively related to the local government's fiscal conditions, R&D expenditures and Incentive (the factor score).

3.3.2. Market and legal institutions

We use four regional level variables as proxy for the degree of development of China's regional markets and legal environments. The first variable is a marketization index, which captures the overall market development, including the degrees of market competition and government intervention. The second variable is a legal environment index which measures the development of market intermediaries and the level of protection of producers' and consumers' interests. The third is an index of property rights protection, which measures the economic significance of all the legal cases in the region relative to its GDP and the court's efficiency in resolving these cases. These above indexes are compiled by Fan and Wang (2001). In addition, we use an index of deregulation constructed by Demruger et al.

(2002), which captures the amount of preferential policies granted to a region by the central government. Higher value in the deregulation index suggests more deregulation in the region's markets. Similar to that of the incentive variables, we extract a factor score, named Institutions, to capture 76% of the total variance from the principal component analysis of these institutional variables.

These market and legal discipline variables serve as proxy for controlling owners' (local governments') and firm managers' degrees of incentive alignment towards profit maximization. The extent of the corporate pyramid of a listed company is positively affected by the extent of market and legal discipline imposed on the company.

3.3.3. Control variables

Several control variables are included in the determinant model of corporate pyramids. Firm Size is defined as the natural logarithm of total assets. Growth is the market-to-book equity ratio defined as market value of common equity divided by book value of equity, with the market price measured at the end of the first year on which the firm went public. Financial Leverage is total liabilities divided by total sales. These control variables are winsorized at the top-one percent level to mitigate any effects of outliers. In addition, we include a regulatory industry dummy variable, which equals one if the firm operates in a heavily regulated sector (i.e., natural resources, electricity, finance, and public utilities), but is otherwise equal to zero. Data for constructing these variables are available from the China Stock Market and Accounting Research (CSMAR) database.

We expect that controlling owners of larger firms, higher growth firms, or firms more burdened by debt are more likely to decentralize decision rights to local managers because their firms are more difficult to manage, and thus they are associated with more extensive

pyramidal layers than otherwise similar firms. Firms in heavily regulated sectors are less likely to be decentralized from the control of local governments and hence are likely to be associated with fewer pyramidal layers.

3.4. Regression results

We regress the number of pyramidal layers on the regional institutional variables and the control variables. Since the values of the dependent variable are discrete and bounded between 1 and 5, we employ the ordered probit model in the regression analysis. Because several of the regional variables are highly correlated, we include these variables one at a time in separate regressions. We lag Unemployment and Fiscal Supplus by one year to mitigate potential endogeneity concerns. However, we have only one period worth of data for the other regional institutional variables. Therefore the values of these variables are fixed across time. To control for any effects of regional wealth and growth, we include provincial GDP and GDP growth as additional independent variables. While the results of the institutional variables remain unchanged, we fail to find the effects of the two GDP variables to be significant. We therefore exclude them from the regression analysis. In addition to the regional variables and the control variables, we include a set of year dummy variables (not reported). There are in total eight year dummy variables representing each year from 1994 to 2001. Each year dummy variable is set to be equal to one if the firm has gone public during that year, and zero otherwise.

Table 2 reports the regression results. Columns (1) through (4) report the results of the regressions with each of the institutional variables separately included. The results show that the extent of a firm's pyramidal structure is significantly positively related to the degree of marketization, legal environment development, property rights protection, and deregulation of

the region in which the firm operates. In columns (5) to (7), we report the results of the regressions with each of the government incentive variables separately included. The corporate pyramid is significantly negatively related to the unemployment rate, while positively related to local government's fiscal health and R&D expenditures. Column (8) reports the results of the regression including the two principal component factors, Incentive and Institutions. Both of these factor scores are positive and statistically significant, suggesting that the degree of firm decentralization, as a proxy for the extent of the corporate pyramid, is significantly affected by controlling owners' (local governments') incentives and the quality of local market and legal institutions.

Across the columns, the effects of the firm-level variables are as expected. Corporate pyramid is positively related to Firm Size, Growth, and Financial Leverage, but is statistically significant only for Firm Size. Whether the firm belongs to a heavily regulatory sector does not matter to its pyramidal structure.

3.5. Endogeneity issues

The relations between corporate pyramid and the institutional factors are subject to alternative interpretation. Decentralized firms might pressure governments to improve market and legal infrastructures. By contrast, owners (local governments) still tightly controlling their firms might obstruct the laws and market development to protect their interests (Shleifer and Vishny, 1994; Morck, Strangeland, and Yeung, 2000). To mitigate these reverse causality issues and other potential spurious correlations, we employ a two-staged regression analysis. In the first stage, Institutions, the principal component factor of the four institutional variables, is regressed on two instrumental variables, Commercial Ports and Leased Territories. Commercial Ports is a dummy variable, which equals one when the region had sea

or inland river ports forced open to foreigners as treaty ports after first Opium War in 1842 in the Qing Dynasty[11], and zero otherwise. Similarly, Leased Territories is a dummy variable, which equals one when the region had leased territories to foreigners in the Qing Dynasty. Since these treaty ports and leased territories were opened to foreigners by exogenous forces over 100 years ago, corporate pyramids cannot have any direct impact on their creation. However, like colonization, the establishment of these ports and territories that were influenced or governed by foreigners was likely to have long-term impacts on the development of local market and legal institutions (Acemoglu, Johnson, and Robinson, 2000). In addition, since these ports and territories were forced open so long ago, they could not directly affect the firms' pyramiding decisions. Therefore, these instrumental variables control for the potential reverse causality and spurious correlation issues between the institutional factors and the pyramid variable.

Compared with Institutions, we are less concerned about reverse causality between the government incentive variables and the firms' pyramiding decisions. For example, firms associated with less extensive pyramids (hence tighter control by local governments) should help to alleviate fiscal deficit and unemployment problems, which is not consistent with the findings in Table 2.

Results of the first stage regressions are reported in columns (1) to (3) of Table 3. The variable Institutions is regressed on Commercial Ports and Leased Territories separately in

[11] After the first Opium War in 1842, China was forced to sign several treaties with foreigner to open treaty ports or setup leased territories. The period between 1842-1943 (or alternatively 1842-1949) was labeled by Fairbank and Goldman (1992) as a Treaty Century which was characterized by increasing openness of China to foreign contact. These treaty ports are located in (1) Fujian, Guangdong, Shanghai and Zhejiang (Treaty of Nanjing, 1842), (2) Fujian, Hainan, Hubei, Guangdong, Jiangsu, Liaoning and Shandong (Treaty of Tianjin, 1858), (3) Tianjin and Xinjiang (Treaty of Beijing, 1860), (4) Anhui, Hubei, Guangxi and Zhejiang (Treaty of Yantai, 1876), (5)Chongqing, Hubei and Zhejiang (Treaty of Maguan, 1895). The locations and establishment years of the leased territories include Tianjin (1860), Shanghai (1845), Jiangsu (1863), Zhjiang (1896), Anhui (1877), Jiangxi (1861), Fujian (1861), Shandong (1889), Guangdong (1857), Chongqing (1901) and Hubei (1861).

columns (1) and (2), and together in the same regression in column (3). The coefficients of the instrumental variables are positive and statistically significant in these regressions, with adjusted R-squares ranging from 0.34 to 0.41. In the second stage, we employ the predicted values of Institutions, called Predicted Institutions, estimated from the first-staged regressions to replace Institutions in the pyramid determination regressions. The coefficients of Predicted Institutions are all positive and statistically significant, regardless of whether only one or both of the instruments are used (columns (4)-(6)). The coefficients of Incentive and Firm Size remain positive and statistically significant.

4. Pyramids and Firm Performance

We next analyze the roles of pyramidal structures in post-IPO firm performance measured by (1) accounting returns, (2) stock returns, (3) Tobin's Q, (4) employment efficiency, (5) total factor productivity, and (6) investment efficiency.

4.1. Accounting and stock return performance

For accounting performance, we regress annual return on sales (ROS) in each of the three years after the IPO year on the number of pyramidal layers, denoted as Pyramid. Firm Size, Growth, and Financial Leverage, are included as firm-specific controlled variables. The regulatory industry dummy variable and the year dummy variables are also included in the regressions. We observe extreme values in the firm-level performance and control variables. To avoid our performance analysis results being biased by the outliers, we winsorize the top- and bottom-five percent extreme values of all firm-level continuous variables in this section. Newey-West standard errors are estimated to account for potential serial correlation in the regressions. As reported in column (1) of Table 4, Pyramid is unrelated to post-IPO ROS.

The stock performance measure is the three-year post-IPO cumulative abnormal market-adjusted stock returns, calculated on the basis of monthly stock returns starting from the first month after the IPO date. We use the equally weighted market index of both the Shanghai and Shenzhen stock exchanges for adjustments in all our analyses, but our regression results remain qualitatively similar to value-weighted indexes. We regress the post-IPO cumulative abnormal stock returns on Pyramid, the firm-specific variables, the regulatory industry and year dummy variables. As reported in column (2) of Table 4, the coefficient of Pyramid remains insignificant.

The above accounting return and stock return regression results fail to suggest that performance of a firm is related to its pyramidal structure.

4.2. Tobin's Q

It could be the case that the association between pyramidal layers and accounting returns takes a longer period than three years to realize. It could also be the case that the stock return measure fails to capture the performance that relates to the pyramidal structure because it is already reflected in the stock price shortly after the IPO. We therefore employ Tobin's Q as another firm performance measure. It is estimated as the market value of common stock plus book value of total liability divided by the book value of total assets, as of the last day of the IPO fiscal year.

Tobin's Q is regressed on Pyramid, Firm Size, Sales Growth, Financial Leverage, the industry dummy variable, and the year dummy variables. Sales Growth is defined as the two-year average annual growth in sales prior to the firm's IPO. Because of missing pre-IPO sales data of some companies, this regression is performed on 584 firms. Table 5 reports the regression results. Based on the full sample, the coefficient of Pyramid is positive and

statistically significant (column (1)), suggesting that more pyramidal layers and hence more decentralization are associated with better firm performance.

To examine whether the above relation is robust to endogeneity issues, we partition the sample based on the median principal factor score of Institutions and alternatively the median factor score of Incentive, and rerun the Tobin's Q regression. As reported in columns (2) through (5), the association between Pyramid and Tobin's Q is generally weak and statistically insignificant in all but the sub-sample of firms with the above median score of Institutions.

Although Pyramid is associated with Tobin's Q, the relation is substantially weakened when institutional factors are considered. To examine this issue more thoroughly, we next perform analyses using several other firm efficiency measures.

4.3. Employment efficiency

State-owned firms typically have an objective of maintaining employment, sometimes even at the expense of firm efficiency. However, decentralized firms are expected to be less burdened by the employment requirement than other firms tightly controlled by the state. It can therefore be expected that labor efficiency of a firm is positively related to the extent of the pyramidal structure. As in column (1) of Table 6, we indeed find such a relation when we regress the number of employees over firm sales, an inverse measure of labor efficiency, on Pyramid, controlling for the industry, year, and other firm effects. This regression is run using 641 firm observations in the IPO year. We do not study the post-IPO years because the employment data of those years are not systematically disclosed in public reports.

To examine whether the relation between Pyramid and employment efficiency is robust to endogeneity issues, we rerun the regression on sub-samples partitioned by

Institutions and Incentive. As reported in Table 6 columns (2) to (5), none of the coefficients of Pyramid is statistically significant in these sub-sample regressions. Any association between the pyramidal structure and employment efficiency is explained away by local institutional and/or government incentive factors.

4.4. Total factor productivity

We next analyze the relation between a firm's pyramidal layers and its total factor productivity based on a log-linear Cobb-Douglas production function. Output is constructed as the logarithm of total sales in each of the three years after the IPO year. Two input factors are Labor and Capital, measured as the logarithm of total number of employees in the IPO year[12] and the logarithm of total fixed assets in each of the corresponding three years after the IPO. In addition, we include Pyramid into the production model to capture any productivity difference due to pyramidal structure. The regulatory industry dummy variable and year dummy variables (not reported) are included in the regression. Newey-West standard errors are used to adjust for serial correlation.

Table 7 reports the regression results. In addition to the full sample, we partition our sample based on Institutions and Incentive. Consistent with prior research, the coefficients of Labor and Capital are positively and highly statistically significant in all regressions. The coefficient of Pyramid is much less consistent. In the full sample regression (column (1)), the coefficient is positive and statistically significant, but it is insignificant in the sub-sample regressions (columns (2) – (5)) except for a weakly positive effect in the sub-sample of firms with above median score of Institutions.

[12] Because post-IPO employee numbers are unavailable, we assume these numbers are similar to those in the IPO year.

Again, although firm productivity is positively associated with the extent of the pyramidal structure, the relation is likely to be endogenous to local institutional factors rather than causal.

4.5. Investment efficiency

Our final analysis is on the role of pyramidal structure in investment efficiency. Following the literature (e.g., Lang, Ofek, and Stulz, 1996), we regress firms' total capital investments, measured as change in fixed assets with adjustment for depreciation scaled by total assets, on lagged Tobin's Q, Firm Size, Financial Leverage, the regulatory industry dummy variable, and the year dummy variables. In addition, we include Pyramid and the interaction term of Pyramid and lagged Tobin's Q to test whether the extent of the pyramidal structure has any significant relation to investment efficiency. Annual data for each of the three post-IPO years are employed in the regression. Newey-West adjustments for serial correlation are used.

From column (1) of Table 8, the coefficient of lagged Tobin's Q is positive and statistically significant, indicating that the firms make more capital investment when they have greater growth opportunities in the prior year. However, in column (2), when the interaction term between Pyramid and lagged Tobin's Q is added to the regression model, the coefficient of lagged Tobin's Q becomes statistically insignificant while the coefficient of the interaction term is significantly positive. Most of the investment efficiency is attributable to firms with more extensive pyramidal structures.

To account for endogeneity, we re-estimate the regression model as in column (2) using sub-samples partitioned by Institutions or Incentive. Similar to the earlier analyses of

the other performance and operating efficiency measures, the effects of Pyramid on investment efficiency disappear in the sub-sample regressions.

In summary, the various performance and efficiency analyses in this section provide consistent evidence that firms with more extensive pyramidal structures tend to have higher Tobin's Q, greater employment and investment efficiency, and higher total factor productivity. This supports our conjecture that the pyramidal structures are credible devices to decentralize local governments' decision rights to the firm manager, resulting in performance improvement. However, the decentralization decisions and associated pyramidal structures are likely endogenous to local governments' incentives and market and legal institutions. After these institutional factors are taken into consideration, we are left with little evidence that the pyramidal structures impact firm performance and operating efficiencies.

5. Conclusion

Based on Chinese data, we have provided a new explanation of corporate pyramids that are widespread not just in China but also around the world. We have shown first-hand evidence of the quick emergence of corporate pyramids that is rather surprising given China's short history of capital market activities. The formation of the corporate pyramids is closely related to controlling owners' (local governments') inability to freely sell off their shares due to strict ownership transfer regulations. However, when the pressure of decentralizing their firms' decision rights becomes large, the state controlling owners adopt the pyramidal structure to credibly decentralize their decision rights to the firm's management. The decentralization is credible because the high bureaucratic and information costs associated with the pyramids deter ex post intervention by the controlling owners. Consistent with this

hypothesis, we find that Chinese firms are associated with more extensive layers of corporate pyramids when local government officers are less burdened with unemployment or fiscal problems, or have stronger long-term incentives as reflected in their R&D expenditures in their jurisdictions. Also consistent with the hypothesis, local governments use more extensive pyramids when their market and legal infrastructures provide strong disciplines that mitigate conflicts of interests between the controlling owners and the firms.

We have investigated the performance effects of the corporate pyramids. Consistent with the beneficial effects of decentralization, we find that Tobin's Q, employment and investment efficiency, and total factor productivity are high when firms are under more extensive pyramids. However, these effects are mostly explained away by differences in the institutional and government incentive factors of the various regions in which the firms are located.

The empirical results in this paper provide overall support to prior theoretical papers predicting that organizational structure can serve as a decentralization device (e.g., Aghion and Tirole, 1997, Baker, Gibbson, and Murphy, 1999, and many others). The evidence that corporate pyramids are more extensively used when agency problems are more contained by market and legal disciplines complements a few prior studies that emphasize the agency cost effect of pyramids and groups (Bebchuk, 1999; Wolfenzon, 1999; Bebchuk, Kraakman, and Triantis, 2000; Bertrand and Mullainathan, 2002; Claessens, Fan, and Lang, 2006).

We conjecture that the decentralization effect of pyramids is neither limited to China nor to government-owned firms, but is applicable to situations where arm's length transfer of ownership is undesirable. The non-transferability of ownership might arise not just from state prohibition but also from high transaction costs of firm specific assets. For example, the

prestige or reputation of an entrepreneur and his/her firm cannot be easily sold to an outsider. Rather, it is best kept within the family. When the agency problem is not too large, the entrepreneur may allow managers some autonomy by indirectly owning the firm through a pyramid. Due to the small number of entrepreneur-owned firms in our sample, we are unable to examine this possibility closely. More research is warranted to understand the causes and effects of corporate pyramids under similar or different institutional and ownership settings.

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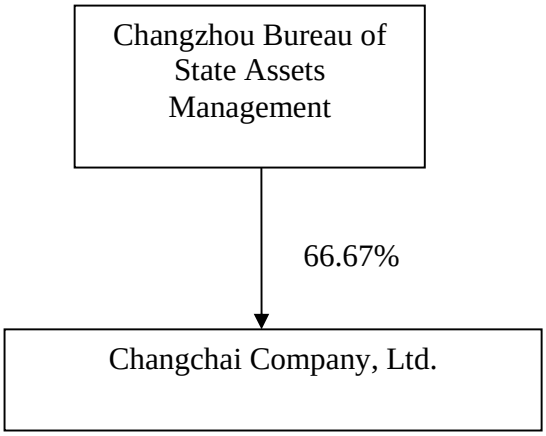
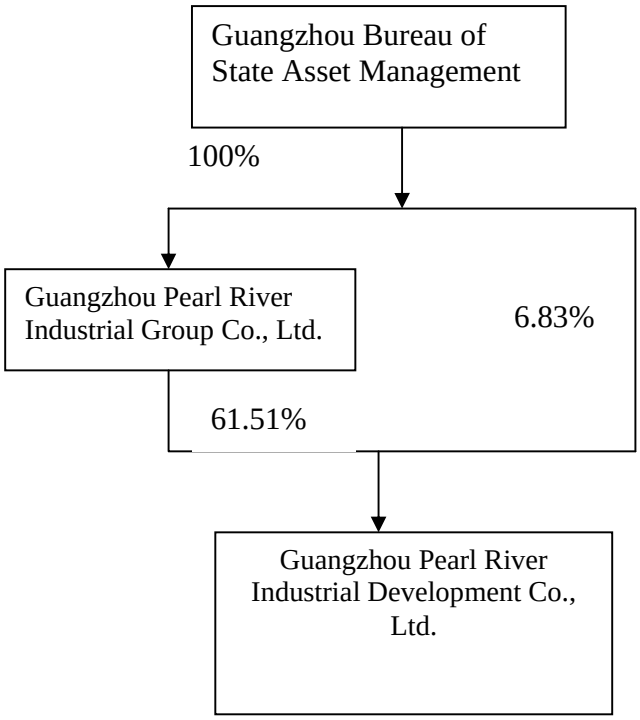
Figure 1
A Listed Company Directly Controlled by a Local Government



Source: The 2001 annual report of Changchai Company, Ltd.

Figure 2
A Listed Company Controlled by a Local Government through a Two-layer Pyramid



Source: The 2001 annual report of Guangzhou Pearl River Industrial Development Co., Ltd.

Table 1 Sample

The table reports the distribution of pyramidal layers of the sample firms by IPO year. The sample is composed of 742 newly listed local-government-controlled firms, representing around 65% of all IPO firms in China between 1993 and 2001. The number of pyramidal layers is defined to be one when a government agency directly controls the listed firm, two when there is one intermediate company between the government agency and the listed firm, and so on. The number of pyramidal layers is counted from the longest controlling chain in case of multiple chains.

Listing Year	Number of pyramidal Layers				Total	As a percentage of total IPO firms
	1	2	3	>=4		
Before 1993	16	13	6	1	36	67.92%
1993	54	34	5	0	93	75.00%
1994	42	32	5	0	79	71.17%
1995	7	8	2	0	17	70.83%
1996	33	82	18	0	133	65.84%
1997	24	94	14	2	134	65.05%
1998	8	59	7	0	74	69.81%
1999	6	43	10	2	61	62.24%
2000	7	50	6	2	65	47.45%
2001	3	37	9	1	50	63.29%
Total	200	452	82	8	742	65.09%

Table 2 Regression Results of the Determinants of Corporate Pyramids

This table reports the regression results of the determinants of pyramidal structure. The dependent variable is the number of pyramidal layers between the controlling owner and the listed firm. Independent variables include the following variables. The five institutional variables, Marketization, Legal Environment, Property Rights, Deregulation and Institutions (factor score), as defined in Appendix I, are included in the regression alternately in columns (1) to (4) and column (8). The four incentive variables, Unemployment, Fiscal Surplus, R&D and Incentive (factor score), as defined in Appendix I, are included alternately in columns (5) to (7) and column (8). Control variables include Firm Size, which is the logarithm value of total assets at the end of IPO year; Financial Leverage, which is the ratio of total liabilities to sales at the end of IPO year; Growth, which is the ratio of market-to-book equity at the end of IPO year; and Regulated Industry, which equals one if the firm is in a highly regulated industry and zero otherwise. All regressions include year dummy variables but they are not reported. The firm-level independent variables with continuous values are winsorized at the top-one percent level. Ordered Probit model is used in the regressions. Absolute Z-values are in parentheses. Asterisks denote levels of statistical significance: *** 1%, ** 5%, and * 10%.

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Institutional Variables	0.094	0.201	0.127	0.252				0.108
	(2.37)**	(3.76)***	(3.05)***	(2.53)**				(2.89)***
Incentive Variables					-0.123	0.539	0.109	0.095
					(3.65)***	(2.35)**	(3.01)***	(2.19)**
Firm Size	0.187	0.142	0.177	0.173	0.183	0.184	0.199	0.142
	(2.97)***	(2.50)**	(3.04)***	(2.67)***	(3.17)***	(3.18)***	(3.31)***	(2.38)**
Financial Leverage	0.018	0.015	0.010	0.009	0.019	0.018	0.020	0.014
	(0.52)	(0.40)	(0.28)	(0.24)	(0.55)	(0.50)	(0.55)	(0.37)
Growth	0.043	0.037	0.040	0.038	0.044	0.040	0.049	0.034
	(1.34)	(1.13)	(1.26)	(1.19)	(1.33)	(1.19)	(1.53)	(1.04)
Regulated Industry	0.110	0.073	0.099	0.094	0.116	0.138	0.129	0.087
	(0.71)	(0.45)	(0.58)	(0.64)	(0.68)	(0.86)	(0.78)	(0.54)
N	742	742	742	739	742	742	742	739
Pseudo R-square	0.084	0.097	0.090	0.093	0.084	0.088	0.084	0.099

Table 3 Two-staged Regression Results of the Determinants of Corporate Pyramids

This table presents the two-staged regression results of the determinants of pyramidal structure. The dependent variable in the first-stage OLS regression is Institutions, the factor score for the components extracted from the four institutional variables including Marketization, Legal Environment, Property Rights, and Deregulation, all defined in Appendix I. The independent variables include two instrumental variables, Commercial Ports, which equals one if the region had treaty ports forced open to foreigners in the Qing Dynasty, and zero otherwise, and Leased Territories, which equals one if the region had territories leased to foreigners in the Qing Dynasty, and zero otherwise. In the second stage, the dependent variable is the number of pyramidal layers. Independent variables include Predicted Institutions, which is the predicted value of Institutions from the first-stage model; Incentive, the factor score extracted from the incentive variables; Firm Size, which is the logarithm value of total assets at the end of IPO year; Financial Leverage, which is the ratio of total liabilities to sales at the end of IPO year; Growth, which is market-to-book equity ratio at the end of IPO year; and Regulated Industry, which equals one if the firm is in a highly regulated industry, and zero otherwise. All of the regressions include year dummy variables but they are not reported. In the second stage regressions, the firm-level independent variables with continuous values are winsorized at the top-1 percent level. Ordered Probit model is used in the second-stage regressions. Absolute t-values are in parentheses of the first stage results, and absolute z-values are in parentheses of the second stage results. Asterisks denote levels of statistical significance: *** 1%, ** 5%, and * 10%.

Independent Variable	First Stage			Second Stage		
	(1)	(2)	(3)	(4)	(5)	(6)
Commercial Ports	1.967		1.135			
	(3.95)***		(1.81)*			
Leased Territories		2.103	1.320			
		(4.09)***	(2.01)*			
Predicted Institutions				0.100	0.076	0.086
				(2.52)**	(2.25)**	(2.63)***
Incentive				0.146	0.142	0.143
				(3.47)***	(3.32)***	(3.39)***
Firm Size				0.160	0.164	0.160
				(2.93)***	(2.83)***	(2.86)***
Financial Leverage				0.020	0.021	0.020
				(0.55)	(0.58)	(0.57)
Growth				0.038	0.038	0.037
				(1.14)	(1.13)	(1.11)
Regulated Industry				0.108	0.117	0.112
				(0.62)	(0.69)	(0.65)
Constant	-1.595	-1.439	-1.678			
	(4.79)***	(4.77)***	(5.27)***			
N	29	29	29	742	742	742
Adjusted (Pseudo) R-square	0.34	0.36	0.41	0.092	0.091	0.092

Table 4
Pyramidal Structures and Post-IPO Firm Return on Sales and Stock Returns
This table presents the OLS regression results of Return on Sales (ROS) in each of the three years after the IPO year, and the cumulative 36-month net-of-market stock returns after the IPO date on Pyramid, the number of pyramidal layers between the controlling owner and listed firm. Additional independent variables include Firm Size, which is the logarithm value of total assets; Financial Leverage, which is the ratio of total liabilities to sales; Growth, which is market-to-book equity ratio, and Regulated Industry, which equals one if the firm is in a highly regulated industry, and zero otherwise. All continuous variables are winsorized at the top- and the bottom-five percent levels. The independent variables are measured at each fiscal year end in the three corresponding years after the IPO in the ROS model and at the IPO year end in the stock return model. Year dummy variables are included but not reported. Newey-west standard errors are used in the ROS model. Absolute t-values are reported in parentheses. Asterisks denote the level of statistical significance: * 10%, **5% and ***1%.

Independent variable	ROS within three years after IPO	CAR of 36 months after IPO
	(1)	(2)
Pyramid	0.001	0.038
	(0.28)	(0.91)
Financial Leverage	0.001	-0.064
	(0.37)	(1.80)*
Firm Size	-0.007	-0.145
	(1.79)*	(4.03)***
Growth	0.008	0.002
	(4.84)***	(0.14)
Regulated Industry	0.139	0.214
	(13.92)***	(2.35)**
Constant	0.212	3.128
	(2.64)***	(4.25)***
N	2217	742
Adjusted R-squared	0.194	0.04

Table 5 Pyramidal Structures and Tobin's Q

This table presents the OLS regression results of Tobin's Q, measured as the sum of market value of equity and book value of liabilities all divided by total assets at the end of the IPO year, on Pyramid, which is the number of pyramidal layers between the listed company and the controlling owner. The control variables include: Firm Size, which is the logarithm value of total assets; Financial Leverage, which is the ratio of total liabilities to sales; Sales Growth, which is the two-year average annual growth in firm sales prior to the IPO; and Regulated Industry, which equals one if the firm is in a highly regulated industry, and zero otherwise. All the independent variables are measured at the end of the IPO year and the continuous variables winsorized at the top- and bottom-five percent levels. Year dummy variables are included but not reported. The regression is performed in the full sample and in the sub-samples stratified alternately by Institutions and Incentive, the factor scores extracted from the regional institutional and government incentive variables, respectively. Absolute t-values are in parentheses. Asterisks denote level of statistical significance: * 10%, **5% and ***1%.

Independent Variable	Full Sample	Sub-sample Stratified by Institutions		Sub-sample Stratified by Incentive	
		Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)
Pyramid	0.122	0.005	0.194	0.098	0.133
	(1.72)*	(0.05)	(1.91)*	(1.03)	(1.21)
Sales Growth	0.874	0.940	0.603	0.962	0.845
	(4.29)***	(3.58)***	(1.97)**	(3.63)***	(2.66)***
Financial Leverage	-0.119	-0.362	0.013	-0.352	0.030
	(2.07)**	(4.30)***	(0.16)	(4.07)***	(0.37)
Firm Size	-0.631	-0.577	-0.714	-0.793	-0.503
	(10.80)***	(7.13)***	(8.37)***	(9.93)***	(5.59)***
Regulated Industry	0.334	0.289	0.387	0.609	-0.008
	(2.18)**	(1.34)	(1.80)*	(3.03)***	(0.03)
Constant	15.008	13.602	16.775	18.276	12.333
	(12.82)***	(8.39)***	(9.78)***	(10.88)***	(6.82)***
N	584	280	301	323	261
Adjusted R-squared	0.30	0.42	0.25	0.38	0.20

Table 6 Pyramidal Structures and Employment Efficiency

This table presents the OLS regression results of Employment Efficiency, measured as the number of employees scaled by sales in the IPO year, on Pyramid, which is the number of pyramidal layers between the listed company and the controlling owner. Control variables include: Firm Size, which is the logarithm value of total assets; Financial Leverage, which is the ratio of total liabilities to sales; Growth, which is market-to-book equity ratio; and Regulated Industry, which equals one if the firm is in a highly regulated industry, and zero otherwise. All variables are measured at the end of the IPO year and all the continuous variables winsorized at the top- and the bottom-five percent levels. Year dummy variables are included but not reported. The regression is performed in the full sample and in the sub-samples stratified alternately by Institutions and Incentive, the factor scores extracted from the regional institutional and government incentive variables, respectively. Absolute t-values are in parentheses. Asterisks denote level of statistical significance: * 10%, **5% and ***1%.

Independent Variable	Full Sample	Sub-sample Stratified by Institutions		Sub-sample Stratified by Incentive	
		Low	High	Low	High
	（1）	(2)	(3)	(4)	(5)
Pyramid	-1.386	-1.172	-1.420	-1.035	-1.180
	(2.41)**	(1.65)	(1.59)	(1.19)	(1.51)
Financial Leverage	4.014	4.533	3.687	6.079	3.013
	(8.12)***	(6.94)***	(5.09)***	(7.08)***	(4.88)***
Firm Size	-3.816	-3.580	-3.555	-4.443	-3.241
	(7.77)***	(6.07)***	(4.55)***	(5.38)***	(5.10)***
Growth	-0.608	-0.471	-0.523	-0.558	-0.486
	(2.86)***	(1.67)*	(1.63)	(1.66)*	(1.76)*
Regulated Industry	0.171	1.084	-0.074	0.519	-0.144
	(0.14)	(0.75)	(0.04)	(0.31)	(0.08)
Constant	88.687	84.294	82.902	109.798	76.626
	(8.80)***	(7.02)***	(5.14)***	(6.35)***	(5.86)***
N	641	297	341	319	322
Adjusted R-squared	0.20	0.29	0.14	0.27	0.16

Table 7 Pyramidal Structures and Total Factor Productivity

This table presents the OLS regression results of firm output, measured as the logarithm of sales in each of the three years after the IPO year, on Pyramid, the number of corporate layers between a listed company and a controlling owner, Labor, the logarithm of number of employees at end of IPO year, Capital, the logarithm of total fixed assets, and Regulated Industry, which equals one if the company is in a highly regulated industry, and zero otherwise. All of the continuous variables are winsorized at the top- and the bottom five-percent levels. Year dummy variables are included but not reported. The regression is performed in the full sample and in the sub-samples stratified alternately by Institutions and Incentive, the factor scores extracted from the regional institutional and government incentive variables, respectively. Newey-west standard errors are used in the estimation. Absolute t-values are in parentheses. Asterisks denote level of statistical significance: * 10%, **5% and ***1%.

Independent Variable	Full Sample	Sub-sample Stratified by Institutions		Sub-sample Stratified by Incentive	
		Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)
Pyramid	0.073	-0.008	0.079	0.048	0.054
	(2.00)**	(0.16)	(1.73)*	(0.84)	(1.22)
Labor	0.199	0.168	0.246	0.176	0.202
	(6.83)***	(4.68)***	(6.21)***	(4.27)***	(4.96)***
Capital	0.528	0.701	0.474	0.606	0.542
	(16.61)***	(20.90)***	(13.65)***	(16.09)***	(14.22)***
Regulated Industry	-0.598	-0.633	-0.538	-0.500	-0.649
	(8.65)***	(7.26)***	(5.77)***	(5.44)***	(6.51)***
Constant	8.203	4.899	9.051	6.810	7.976
	(14.29)***	(7.77)***	(14.71)***	(9.01)***	(12.72)***
N	1922	891	1022	957	965
Adjusted R-squared	0.418	0.569	0.389	0.455	0.433

Table 8 Pyramidal Structures and Investment Efficiency

This table presents the OLS regression results of annual total capital investment, measured as the annual change in fixed assets with adjustment for depreciation scaled by total assets, in the three years after the IPO year, on Pyramid, which is the number of corporate layers between a listed company and its controlling owner, Tobin's Q, measured at the end of the lagged fiscal year, and the interaction between Pyramid and Tobin's Q. The control variables include Firm Size, which is the logarithm value of total assets; Financial Leverage, which is the ratio of total liabilities to sales; and Regulated Industry, which equals one if the firm is in a highly regulated industry, and zero otherwise. All continuous variables are winsorized at the top- and the bottom-five percent levels. These control variables are measured at each fiscal year end in the three corresponding years after the IPO. Year dummy variables are included but not reported. Newey-west standard errors are used in the estimation. Absolute t-values are in parentheses. Asterisks denote the level of statistical significance: * 10%, **5% and ***1%.

	Full Sample		Sub-sample Stratified by Institutions		Sub-sample Stratified by Incentive	
			Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
Tobin's Q * Pyramid		0.024	0.022	0.023	0.029	0.017
		(2.08)**	(1.08)	(1.52)	(1.62)	(1.03)
Pyramid	0.002	-0.065	-0.034	-0.076	-0.054	-0.061
	(0.15)	(1.96)*	(0.59)	(1.72)*	(0.99)	(1.34)
Tobin's Q	0.071	0.027	0.009	0.042	0.012	0.047
	(7.01)***	(1.12)	(0.25)	(1.18)	(0.33)	(1.24)
Financial Leverage	-0.019	-0.019	-0.043	-0.005	-0.029	-0.006
	(2.25)**	(2.24)**	(3.43)***	(0.43)	(2.27)**	(0.55)
Firm Size	0.059	0.060	0.070	0.060	0.106	0.036
	(4.86)***	(4.98)***	(3.95)***	(3.59)***	(5.86)***	(2.24)**
Regulated Industry	-0.006	-0.004	0.050	-0.029	-0.020	0.004
	(0.21)	(0.13)	(1.02)	(0.76)	(0.43)	(0.09)
Constant	-1.073	-0.967	-1.151	-1.005	-1.939	-0.514
	(4.04)***	(3.59)***	(2.99)***	(2.59)***	(4.79)***	(1.38)
N	2224	2224	1041	1174	1110	1114
Adjusted R-squared	0.077	0.055	0.093	0.075	0.073	0.073

Appendix I
Variable Definitions and Data Sources

Variable	Description	Sources
Marketization	This is a comprehensive index that captures regional market development in the following aspects: (1) relationship between government and market, including the role of market in allocating resources and firms' policy burden in addition to taxes; (2) development of non-state business in terms of the ratio of industrial output by private sector to total industrial output; (3) development of product markets in terms of the degree of regional trade barriers; (4) development of factor markets captured by foreign direct investment and labor mobility; (5) development of market intermediaries and legal environment. We use the average of the 1999 and 2000 indexes in our analyses.	Fan and Wang (2001)
Legal Environment	This index measures the development of market intermediaries, protection of property rights, protection of copyrights and consumers. We use the average of the 1999 and 2000 indexes in our analyses.	Fan and Wang (2001)
Property rights	This index measures (1) market order, calculated based on the total economic value of legal cases settled standardized by GDP of the region, and (2) court efficiency, a ratio of the solved legal cases to total cases received. We use the average of the 1999 and 2000 indexes in our analyses.	Fan and Wang (2001)
Deregulation	The amount of preferential treatments granted to a region by the central government to set up special economic zones during 1978 to 1998.	Demruger et al. (2002)
Institutions	The factor score for the first component extracted from the principal component analysis of the four institutional indexes: Marketization, Legal Environment, Property Rights and Deregulation. This is the only component that satisfies the Kaiser criterion, capturing 76% of the total variance.	Authors' estimation
Unemployment	The unemployment rate officially reported for each province, autonomous region and municipality. The data is available annually.	China Information Bank
Fiscal Surplus	A dummy variable, which equals one if the fiscal revenue minus government expenditure scaled by GDP of a region is above the top quartile level of all regions in China, and zero otherwise. The data is available annually.	China Information Network Data Co., Ltd.
R&D (%)	The expenditure on fundamental research, applied research, experimental development and capital construction for scientific research in a region scaled by GDP of the region. The data is as of year 2000.	National Bureau of Statistics
Incentive	The factor score for the first component extracted from the principal component analysis of Unemployment, Fiscal Surplus and R&D. This is the only component that satisfies the Kaiser criterion, capturing 54% of the total variance.	Authors' estimation

Appendix II
Institutional and Government Incentive Variables by Region

Region	Marketization	Legal Environment	Property Rights	Deregulation	Institutions	Unemploy-ment (%)*	Fiscal Surplus (%)*	R&D (%)	Incentive
Beijing	5.56	7.75	7.42	0.67	0.56	0.58	9.42	6.30	4.81
Tianjin	6.65	6.85	7.90	1.43	1.21	1.88	8.61	1.51	1.18
Shanghai	6.71	6.76	8.85	1.76	1.71	2.70	11.13	0.11	0.55
Chongqing	6.27	3.69	4.09	-	-	3.50	4.14	0.64	-0.93
Hebei	6.36	5.04	5.72	1.24	-0.51	2.19	4.43	0.52	0.07
Shanxi	4.52	5.46	6.67	0.33	-1.30	1.85	5.72	0.60	0.37
Neimenggu	4.70	4.85	4.68	0.67	-1.91	3.54	5.05	0.24	-0.98
Liaoning	6.24	5.38	7.04	1.24	0.01	3.13	6.70	0.89	-0.30
Jilin	5.45	5.69	7.30	0.67	-0.43	2.37	5.84	0.74	0.18
Heilongjiang	5.01	5.28	6.32	0.67	-1.09	2.73	5.52	0.46	-0.20
Jiangsu	7.85	6.19	7.71	1.43	1.31	2.50	4.12	0.85	-0.15
Zhejiang	8.15	5.73	6.32	1.43	0.78	3.15	4.51	0.55	-0.44
Anhui	6.37	5.28	6.58	0.62	-0.53	3.13	4.74	0.66	-0.67
Fujian	7.98	6.21	6.82	2.71	1.91	2.46	5.38	1.12	0.27
Jiangxi	5.38	4.69	6.34	0.33	-1.42	2.44	4.82	0.41	-0.13
Shandong	7.07	5.44	5.27	1.43	-0.08	3.27	4.24	0.61	-0.79
Henan	5.58	4.84	4.19	0.33	-1.96	2.67	4.30	0.48	-0.18
Hubei	5.53	4.92	6.30	0.62	-1.09	3.04	4.44	0.81	-0.28
Hunan	5.45	2.44	2.53	0.33	-3.60	3.72	4.58	0.52	-0.97
Guangdong	8.26	7.12	7.83	2.86	2.84	2.46	7.61	1.10	0.66
Guangxi	5.96	4.86	6.33	1.24	-0.54	3.59	4.94	0.40	-0.96
Hainan	6.40	6.27	8.66	1.57	1.19	3.72	6.88	0.17	-0.91
Sichuan	5.62	4.56	5.28	0.62	-1.54	3.76	5.04	1.12	-0.61
Guizhou	4.54	4.24	4.76	0.33	-2.43	5.21	5.67	0.42	-2.00
Yunnan	4.81	3.82	5.99	0.67	-1.92	2.68	10.06	0.36	0.24
Shannxi	4.08	3.04	5.50	0.33	-2.91	3.87	5.46	2.98	0.28
Gansu	4.89	3.88	5.28	0.33	-2.30	4.48	5.48	0.74	-1.35
Qinghai	3.17	4.63	5.36	0.33	-2.59	5.88	1.87	0.49	-2.62
Ningxia	3.96	5.02	8.74	0.33	-1.05	5.12	5.26	0.65	-2.03
Xinjiang	2.75	3.86	4.82	0.67	-3.04	3.67	3.23	0.20	-1.26

* The reported values are the 1992-2000 average values.