

Empirical Study on Corporate Network of Directorship Interlocks

—Based on Chinese listed companies

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Abstract: This paper investigates the interlocking directorates and relative corporate networks by social network analysis (SNA). After presenting the logical network model and relative network index, we conduct empirical analysis on the corporate network of Chinese listed companies. The characteristics of the whole network and the sub-networks, such as the giant components, are analyzed, and three regional sub-networks including Yangtze River Delta, Pearl River Delta and Bohai Rim Region are compared. Implications for future research, policy making, and strategy are discussed.

Keywords: Listed Company; Interlocking Directorate; Interlocking Corporation Network; Social Network Analysis

1 Introduction

The board is the most important part in corporate governance, while corporate governance is essential for building modern corporate system of listed companies. The board has become an important topic in corporate governance research. Interlocking directorates and companies refer to the network of interlocked directors and companies, which is common both in developed and developing countries, and have attracted enormous attention from economists and sociologists. This paper investigates the interlocking directorates and relative corporate networks by social network analysis, and demonstrates the characteristics of interlocking directorates network of the listed companies by analyzing the whole network attribute. Reviewing previous interlocking directorates and social network analysis, as well as conclusions from current research, we present the network model and relative network index, then conduct empirical analysis on the corporate network of Chinese listed companies and analyze characteristics of the whole network and the sub-networks, the giant components of the corporate network. Finally, important implications for future research are discussed.

2 Theory Background

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Overseas studies on interlocking directorates and relative corporate network started much earlier and have accumulated much richer literatures. In 1982, Mariolis and Jones (1982) emphasized the reliability and stability of corporate networks based on interlocking directorates, from three perspectives, i.e. empirical study, method, and theory. Gulati and Westphal (1999) examined the influence of the social network of interlocking directorates on strategic alliance formation, and concluded that the influence is determined by the relationship between inside and outside managers. Their theoretical framework suggested how board interlock ties to other firms increase or decrease the likelihood of alliance formation, depending on the content of relationships between CEOs (chief executive officers) and out-side directors.

By analyzing network index such as network density and clustering coefficient, Barnes and Ritter (2001) presented the changing pattern of interlocking corporation network among approximately 250 corporations across four periods—1962, 1973, 1983, and 1995, they concluded that interlocking directorates in the United States are becoming less concentrated.

Robins and Alexander (2004) proposed a new methodology to examine binary data, which can describe both the interlocking directorate network and interlocking corporation network. They compared global structural properties of US and Australian interlocking corporation network and concluded that network structures tend to be influenced more by the clustering of directors, than the number of independent directors, and that structural power among the Australian companies is denser than that among US companies.

Au et al. (2000) analyzed data from the first 100 listed non-financial companies and 25 listed financial companies from 1976-1986 and found out that while the relationship among all companies is loose, that of interlocking companies is much dense. Peng et al. (2001) analyzed the interlocking directorates in Thailand by comparing the situations in multinational corporations and other companies. Data of the first 200 corporations from 1994-1996 were collected from the stock exchange and corporate annual report. He concluded that the network is much looser among Thailand companies than that among Hongkong companies, but the density of corporate networks of interlocking directorates is higher than that of English and American companies. Also, there are more interlocking directorates among multinational companies than those among non-multinational companies.

The study of interlocking directorates in China is still at its early stages, and mainly focuses on the following four perspectives: (a) Theory investigation on interlocking directorate, (b) descriptive statistical analysis of interlocking directorate in China, (c) the effect of interlocking directorate on firm performance, and (d) the formation of interlocking directorate. Ren et al. (2001) reviewed the relative theory investigation and empirical studies and described the distribution of interlocking directorate of the first 100 companies in China. Chen (2004) proposed the two-level interlocking directorate theory from individual and organizational level, by adopting cost-benefit and limited rationality theory, and empirical analysis of the interlocking directorate of Chinese listed companies. Ren, Qu and Peng (2004) described the respective form of the regional enterprise network in Shanghai and Guangdong, which is shaped by the relationship between companies and interlocking directors, and draw the following two conclusions: (a) path dependence is evident in the formation and development of the regional enterprise networks. (b) interlocking directorate network does affect company behavior and the development of regional economy. Ren (2005) investigated the effect of interlocking directorate and interlocking corporations on corporate governance, and concluded that the interlocking corporation network indicates the clustering of the management. Ren, Qu and Peng (2007) analyzed the relationship between interlocking and the company performance. Taking advantage of China's transition, they collected panel data from 284 listed firms spanning eight years (1994-2001), and concluded that network centrality in the interlocking corporation network is negatively related to its performance.

Duan and Zhong (2008) explored influential factors to the formation of interlocking directorate, empirically tested their hypotheses with data from listed companies in Shanghai Stock Exchange, and finally concluded that, the number of directors is positively connected with the interlocking directorate, while the company size and debt-paying ability (measured by Current

Ratio and Assets Liabilities Ratio) are negatively linked. They also contended that the link between interlocking directorate and the firm's profitability is not significant. No agreement is achieved on whether the resource dependence theory is suitable to the exact interlocking directorate conditions in China, but firms' ownership (whether state-owned or non-state-owned) does affect the interlocking directorate.

As Chinese companies are playing a more important role in the world's economy, director interlocking has become common and relationship among companies has become dense. Not only can interlocking directorate promote information transformation, but can effectively monitor, manage and coordinate relative companies, as a result, the analyzing of interlocking directorate of Chinese companies is quite important.

Similar to Ren, Qu and Peng (2004, 2007), this paper relies on data of 1735 listed companies in 2008 and studies the distribution of interlocking corporation network of Chinese listed companies.

3 Research Methodology

Interlocking directorates refer to directors who are affiliated with one organization and act as director of another company. Networks of interlocking directorates consist of directors (nodes) and relationships (links) among them. Two companies are called Interlocking corporations when they have interlocking directorates. The nodes in interlocking corporation network are companies, while those in the interlocking directorate network are directors.

3.1 Interlocking network

The node degree is defined as the number of other nodes that connected to it, indicating the importance of that node. The Network Clustering Coefficient, which refers to the average value of node clustering coefficients, shows whether it was a dense or sparse network, and can also measure the social capital. In either component, all nodes are linked to others whether directly or indirectly, and the Giant Component is the component that has most nodes. Density is used to measure the degree of network closeness. Greater density indicates larger number of relationship in the network and easier transmission of information.

3.2 Empirical Data

We get data of the listed companies from <http://www.cnlist.com>, including their stock code, stock name, corporation name, address, industry and the list of directors, of all the 1870 listed companies in 2008. Removing the duplicated corporate information, we finally get 1735 companies. All the remaining 1735 companies have complete data of the above mentioned information.

In this paper, we adopt UCINET 6 as our analysis tool, which is a kind of typical software for social network analysis.

4 Result

4.1 Social Network Analysis of interlocking corporation network

Social network analysis provides us with an effective approach to study network structure. In the interlocking directorate network there are 1735 nodes and 2690 relationships among them. We distribute them into three parts, i.e. the Yangtze River Delta, Pearl River Delta and Bohai Rim Region, and then use UCINET 6 to analyze the three interlocking corporation networks (see figure 1-4), which separately consist of companies in these three regions and the relationship among them.

The blue dots represent companies in the network, and sizes of the dots represent firms' size; the black lines between nodes represent the existence of interlocking directors among companies. The thickness of the link indicates the number of interlocking directors. The network figures show the conditions of interlocking corporation in China. Table 1 shows the network

index of the interlocking corporation network.

4.2 Comparison of network index

In 2008, 1470 out of the 1735 listed companies are interlocked, accounting for 84.73% of the whole listed companies. Degrees of the 1470 companies range from 0 to 13. 15.73% of them have degree 1, and the Companies with degree 2, 3, 4, and 5 accounted respectively for 16.25%, 15.04%, 11.82% and 9.91% of the total companies, and there are 5 companies with degree of 13, CHANA Company, Lu-Neng TaiShan, Jian-Feng Chemicals, Friendship Group and Zhuzhou Smelter Group. In a word, most companies have formed interlocking relationship with one or more companies, which means there are dense relationship between the companies.

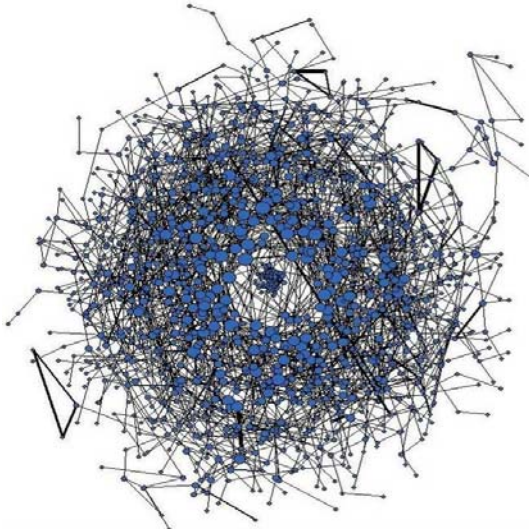


Figure 1 Interlocking Corporation Network in China

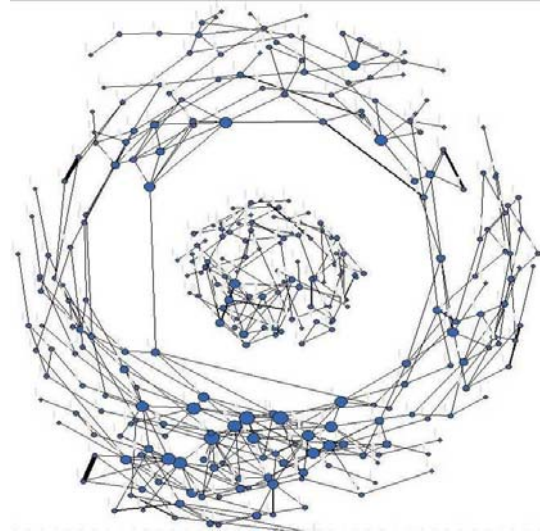


Figure 2 Interlocking Corporation Network in the Yangtze River Delta

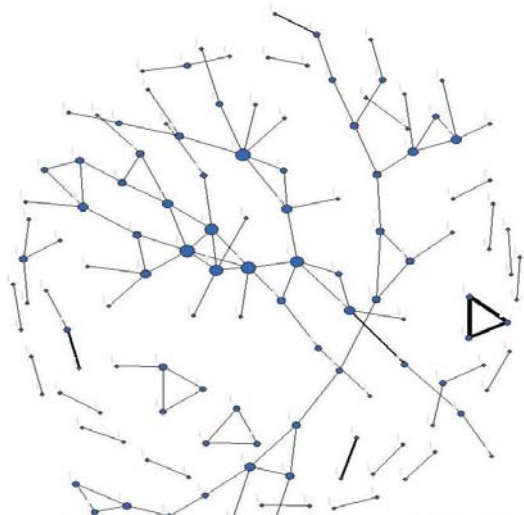


Figure 3 Interlocking Corporation Network in the Pearl River Delta

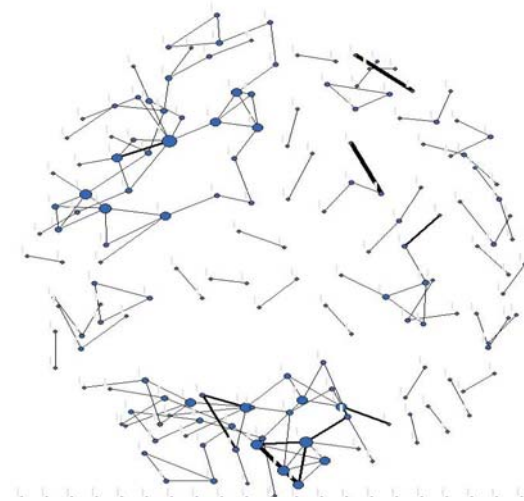


Figure 4 Interlocking Corporation Network in Bohai Rim Region

Table 1 Index of networks of corporate interlocking.

	Entire Country	Yangtze River Delta	Pearl River Delta	Bohai Rim Region
Num of nodes	1735	314	215	278
Log	3.239	2.497	2.332	2.444
Average path length	6.845	6.604	4.743	6.014
Clustering Coefficients	0.409	0.488	0.544	0.422
Giant Component	1386	218	43	41
Giant Component proportion	0.799	0.519	0.2	0.147
Density	0.0019	0.0053	0.006	0.0045

Compared to the result of Ren et al (2001)'s research, which studied interlocking directorates of 1999. In their sample, only 44 companies out of 157 listed companies in China are interlocked, accounting for only 38.1% of the total sample. The degree ranged from 0 to 6. Most companies formed interlocking relationship with only one corporation, which implies the interlocking corporation network is loose. It is evident that from 1999 to 2008, interlocking corporations account for an increasing proportion of the whole listed companies, and the network structure is becoming more and more complicated.

We distinguish the three district interlocking corporation networks (Yangtze River Delta, Pearl River Delta and Bohai Rim Region), which include only companies within the district and the interlocking directorate relationship between them, and three sub-network of the whole China interlocking corporation network (also Yangtze River Delta, Pearl River Delta and Bohai Rim Region), which include companies within the district and their interlocking directorate relationship to companies in the whole listed companies.

In the district network of Yangtze River Delta, companies with degrees above 1 account for 74.76%, and three companies are even with degree 10. In the sub-networks of Yangtze River Delta, 87.38% companies are with degree above 1, the above three companies respectively with degree of 11, 12, and 13. It is evident that interlocking directorates are quite common among companies in the Yangtze River Delta, and there are also trans-regional interlocking corporations.

In the district network of Pearl River Delta, companies with degree above 1 account for 59.53%, and three companies are with the biggest degree 6 in the region. In the regional sub-networks, companies with degree above 1 account for 79.07%, and two companies are with the biggest 11. The core companies in the district network are not that in the regional sub-network, indicating that companies in the Pearl River Delta prefer intra-district interlocking, while the core companies in the regional sub-network prefer inter-district interlocking.

In the district network of Bohai Rim Region, companies with degree above 1 account for 60.79%, and only one company is with the biggest degree 7. In the regional sub-networks, companies with degree above 1 account for 82.37%, two companies with the biggest degree 12, indicating that inter-district interlocking is common in Bohai Rim Region.

Clustering coefficient is adopted to measure the social capital of the network, and bigger value indicates more social capital. Clustering coefficient of the whole network, and of the three district networks are respectively 0.409, 0.488, 0.544 and 0.422, as shown in table 1. It is clear that social capital of companies in the Pearl River Delta is more than the others.

Density is used to measure the closeness of the networks. Density of the whole network, and the three district networks are respectively 0.0019, 0.0053, 0.006 and 0.0045, as shown in table 1. It is clear that companies in the Pearl River Delta have denser relationship than the others, indicating easier information transformation.

This is different from Ren et al. (2001), who concluded that the network density of 100 companies in Shanghai is 0.016, while that of Guangdong is 0.0087, which is lower. The reason for this difference may be there are more listed companies in 2008 than in 2001, and the district

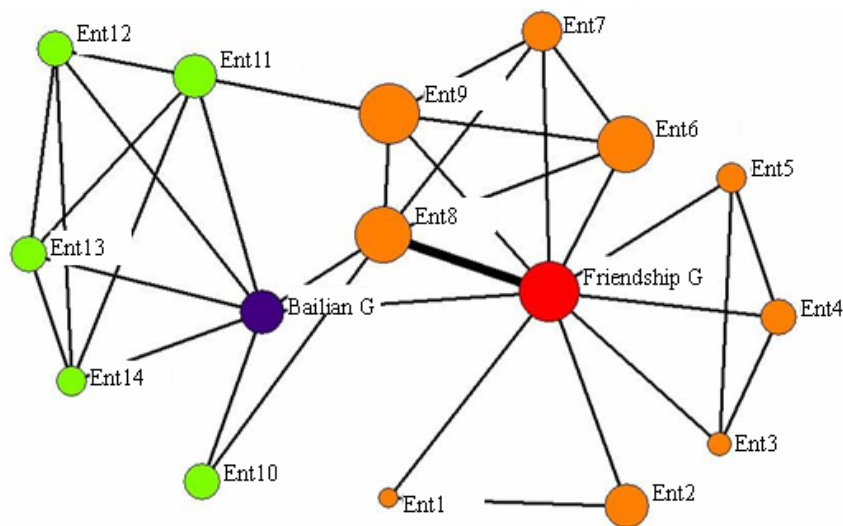
is not exactly the same as Ren et al. (2001).

4.3 Mechanism in the formation of interlocking directorate

We choose the two representative companies in the Yangtze River Delta, Bailian Group and Friendship Group, to investigate their interlocking directorate condition (see figure 2, the size of the nodes indicates its degree). 16 companies have interlocking directorate relationship with them.

6 Of the 9 interlocking directors are from universities, namely, Yong Su, Hong Wu, Xinyuan Chen, Huimin Cao, Gangling Zhao and Jianmin Cai. The proportion indicates that, economic and management scholars are one of the most important sources of interlocking directors.

The other 3 interlocking directors, Jingbo Fu, Yongming Lu, and Jianmin, are directors of two or more subsidiaries of Bailian Group, and at the same time, acted as managers or even worked in the government. It can be inferred that there may be accredited directorates in big state-owned group who are appointed as managers and they have possibly worked in the government at the same time. The situation in Shanghai, as one of the most important industrial base, has many big state-owned companies, can explain the intra-district interlocking corporations, and the biggest component. Finally, the interlocking shareholding of parent company and its subsidiaries is another source of interlocking directorate and interlocking



corporations.

Figure 5 Interlocking relationship of Bailian Group and Friendship Group

5 Discussion

In this study, we analyze the corporate network of interlocking directorates by the examination of empirical data, the data of 1735 listed companies in China in 2008. The result suggested that:

First, the scope of corporate network of interlocking directorates is becoming bigger and bigger, but relationship among the listed companies is loose, comparing with that of European

countries.

Second, there are more core companies in the network of the Yangtze River Delta than those in the Pearl River Delta and Bohai Rim Region, and the intra-district interlocking is preferred, while the inter-district interlocking relationship is popular in the other two districts.

Third, network density and clustering coefficient are much higher in the Pearl River Delta than that in the other two districts, indicating denser relationship and higher social capital among companies in that area.

Forth, the maximum sub-network is much bigger in the Yangtze River Delta, indicating that the network of listed companies is embedded in a bigger network. While there is no maximum sub-network in the Pearl River Delta, the relationship is shown as a chain, which shows the higher market degree. At the same time, less relationship among companies in the Bohai Rim Region.

Finally, working experience in the universities is one of the main reasons for the formation of interlocking directorate. There may be accredited directorates in big state-owned group who are appointed as managers, and they also probably have worked in the government at the same time. The group controlling and crossing shareholding can explain the interlocking of independent director.

The study has significant implications for the decision making of both companies and the government. For one thing, the interlocking relationship can help companies face the uncertain factors in the environment make good use of social capital, but the interest group in the corporate network may prevent the innovation or reform in some companies. The loose corporate network, with higher market degree, is favorable for innovation and reform, but companies may face more difficulties with changes of environment without protection from interest groups. For another, the government is playing a key role in the formation of corporate network. For example, companies are encouraged to develop networks favorable for economy, and prevent networks against economic growth. It must be noted that the government, as the owner of state-owned companies, is also a critical actor in the society, and will inevitably make policy beneficial to itself.

6 Future work

This paper analyzes the corporate network based on interlocking directorates of listed companies in China, including its current structure, evolution process and the role of companies. In our framework, the companies are nodes, and interlocking links are the relationship among them.

Although this paper has made several important contributions to the interlocking directorate

literature and Chinese companies, there are also boundary conditions and other aspects that can be further pursued in future research. First, our study has focused on the data in 2008, which can not demonstrate the evolution of the interlocking network. As a result, we should collect longitudinal data so as to have a more complete understanding of the interlocking network and its evolution. Second, our analysis is based on the most important network indexes, and more systematic and detailed analysis is needed to get the interlocking network characteristics from different perspective. Third, we have described the structure of the interlocking network. Although the description has already given us an understanding of interlocking directorates conditions among Chinese listed companies, future research may try to explain its formation and evolution process, and the mechanism behind that process.

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中国上市公司连锁公司网络研究

——基于2008年我国1735家上市公司的网络分析

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摘要: 文章对公司治理的连锁董事问题运用了社会网络分析法进行研究。首先介绍了进行上市公司连锁董事网络分析的模型和涉及的指标, 以及数据的来源、数据结构的处理。并根据数据、相关模型和相关指标对我国上市公司连锁董事网络进行实证分析, 将我国基于连锁董事的连锁公司网络分为长三角、珠三角及环渤海三大经济区域进行对比, 客观描述网络的现状, 总结出基于连锁董事的中国上市公司连锁网络的特征、发生机理及影响因素, 利用得出的结果同国外的一些研究结果进行比较, 并对现有的连锁董事理论进行解释。同时提出潜在的研究议题和今后的研究方向。

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