An Exploratory Study of Interlocking Directorates in China and Cross Country Comparisons

Zongming Tang
Associate Professor
Antai College of Management and Economics
Shanghai Jiao Tong University
Shanghai, China

Liaoliao Li
Associate Professor
Department of Business Administration
Kutztown University
Pennsylvania, USA

Abstract

The present paper examines interlocking directorates in China using social network analysis method and makes comparisons with 12 industrial countries: the United States, Great Britain, Austria, Belgium, Switzerland, Germany, France, Italy, Netherlands, Finland, Ireland, and Hong Kong. Network measures in our investigation include density, centrality, clustering coefficients, distance, components and structural holes. We observe that interlocking directorates have become progressively more common in China during study period (2000-2012). Using a sub-dataset that contains top 250 listed companies in China in 2012, we find that interlocking directorates in China are smaller, less dense, and less clustering in comparison to networks in industrial countries. China is still at an early development stage of interlocking directorates.

Keywords: Interlocking directorates; Social network analysis; Cross-country comparisons; China

1. Introduction

Extensive literatures have studied interlocking directorates, a board member of a company serves on boards of multiple companies simultaneously, in industrial countries (Battiston and Catanzaro 2004; Croci and Grassi 2014; Drago et al. 2011; Kaczmarek et al. 2014; Simoni and Caiazza 2012, 2013; Wood 2011). In recent years, however, most of growing interlocking directorates have occurred in developing countries. Specific questions on relevant issues in these countries with their distinguished market and economic conditions become increasingly important. Especially, the "market economy with Chinese characteristics" of China provides an appealing institutional environment to examine interlocking directorates for three reasons. First, competition from recently privatized state-owned enterprises (SOEs), characterized by concentrated ownership and state share, has driven up formation of connections among business firms. Second, the Chinese government has enacted several critical laws and regulations to formalize the operation of list companies, which would contribute to the particular structure of interlocking directorate networks in China. Third, Chinese capital market is clearly different from most of others in the world and is usually referred to as a "policy-driven" market, in which policy targets and administrative intervention are more critical than dynamics of market competition (Heilmann 2002).

China has been greatly transformed during its three-decade-plus economic boom. There are two stock exchanges in mainland China: the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE). When they started operations in 1991, there were 14 listed companies in total. By the end of 2012 there were a total number of 2,492 listed companies and market capitalization amounted to 3.697 trillion U.S. dollars. During its tremendous growth, the phenomenon of interlocking directorates has become widespread in China. This paper presents a systematic examination of growing linkages among board members in Chinese listed companies between 2000 and 2012. To the best of our knowledge, this is the first paper to rigorously and comprehensively evaluate interlocking directorates in mainland China during a long research period.

Social network analysis is applied to describe interlocking directorates as a two-mode and a one-mode network. We also address essential characteristics of interlocking directorates in China, including density, centrality, clustering coefficient, distance, components, and structural holes. In addition, cross-country comparisons are made among China, the United States (U.S.), Great Britain (UK), Austria, Belgium, Switzerland, Germany, France, Italy, Netherlands, Finland, Ireland, and Hong Kong to investigate the development status of interlocking directorates in China. A mix of quantitative and qualitative evidence indicates that an increasingly larger number of listed firms are connected in interlocking directorate networks in China. These networks are more stable with tighter ties and it is easier to exchange information, although density and centrality exhibited a decreasing tendency in 2004 and 2005. We interpret our findings from the aspect of Chinese corporate governance regulations and company laws. Compared to industrial countries' interlocking directorates in 80's and 90's, China is still in the early stage of development of interlocking directorates. Greater changes are expected with ongoing reforms in Chinese capital market.

Prior literatures explore interlocking directorates from the following major aspects. Some papers utilize social network methods. For example, Opsahl (2013) transforms two-mode networks to one-node networks to detect clustering coefficients. Researchers like Battistin et al. (2012), Simmons (2011) and Wood (2011) study interlocking directorates in specific industries, such as banking, media, and agriculture. There are also literatures focusing on the world's largest corporations to study elite interlocking directorates, such as Carroll and Sapinski (2010), Chua and Balkunje (2012), and Kentor and Jang (2004). Other research examines international interlocking directorate networks in a larger region. For instance, Van Veen and Kratzer (2011) compare interlocking directorates in fifteen European countries and explain these countries' international positions with relation to their economic system. Heemskerk (2013) talks about the European network of corporate board interlocks. Interlocking directorates may assist firms in exchanging information. Some research has studied how information diffusion has affected corporate profitability and performance (Haunschild and Beckman 1998; Santos et al. 2012; Simoni and Caiazza 2013). Gender, age and industrial differences of interlocking directorates are discussed in O'Hagan and Green (2002). Legal issues (Simmons 2011) and financial fraud (Pawlak 2010) related to interlocking directorates are also examined.

Fewer literatures examine interlocking directorates in developing countries. Salvaj and Lluch (2012) discuss political and economic events that influence the formation of interlocking directorates in Argentina and Chile. Chandrashekar and Muralidharan (2012) and Kim and You (2013) present empirical evidence to identify India's interlocked companies and directors. Research on interlocking directorates in China mainly focuses on micro sectors, i.e., how interlocking directorates have contributed to competitiveness and performance of corporations (Au et al. 2000; Li et al. 2013; Ren et al. 2009). With continued development of Chinese capital market, it is also critical to comprehensively present features and development of interlocking directorates in China at the macro level. Motivated by strong interest to fill this gap in literatures, we conduct our research by examining characteristics of interlocking directorates in the emerging market of China through social network analysis and comparing networks in China and 12 other industrial countries.

This paper proceeds as follows. Section 2 presents data sources and methodologies and builds social network analysis models. Section 3 reports descriptive statistics and Section 4 discusses essential measures of interlocking directorates in China. Cross-country comparisons are discussed in section 5. Section 6 concludes.

2. Data and network models

Our sample is drawn from a comprehensive information database of *Guotai Junan Securities*. We examine shared directorates among listed companies in China from 2000 to 2012, and we observe a densification of a social network that connects decision makers on corporate boards. The sample includes personal information (names, job titles, compensations, etc.) of individual board members and independent directors, excluding non-board directors, such as certain department supervisors. The numbers of firms and directors in study have risen from 1108 and 9991 in 2000 to 2492 and 19624 in 2012 respectively. We checked the dataset for duplicate names and differently reported names by examining personal information of each board member. Excel and Matlab are used to rebuild the database to make it compatible with Pajek, a program visualizing and analyzing large networks. Econometric analysis is done by Eviews 6.0 and all figures are graphed in Pajek.

Interlocking directorates are affiliation networks or inter-organizational relationships among shared board members. This is a standard two-mode network, which includes two different sets of nodes, and ties only exist between nodes belonging to different sets.

8

In the case of interlocking directorates, the two node sets are directors and companies, and ties represent affiliation of directors with companies. The interlocking directorate network including all linked companies in China in 2007 is shown in Figure 1 as an example for a two-mode network. Figures for two-mode networks in other years are similar so they are not presented here. Black points represent companies in the network, and grey points represent board members. The blue lines between nodes indicate existence of interlocking directorates. Figure 1 visualizes highly clustered interlocking directorates. The whole area is intensively covered by blue lines. Note that each blue line is connected by nodes with different colors (i.e. A blue point is connected with a grey point.). This is a major characteristic of a two-mode network.

Figure 1: Two-mode interlocking directorate network in China (2007)
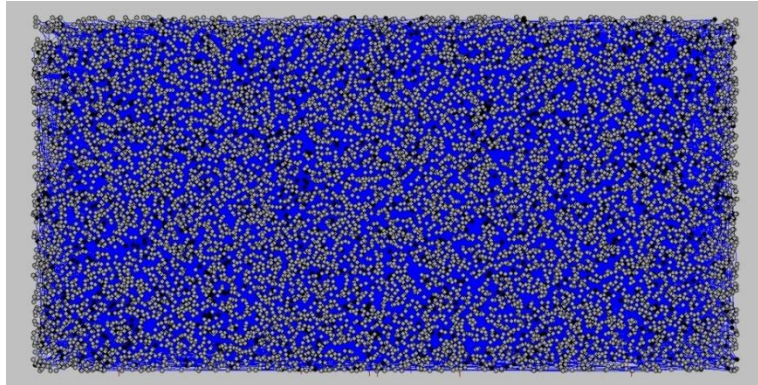
A two-mode network visually captures affiliations between directors and companies. However, it is nearly impossible to measure specific indicators, such as degrees of nodes that belong to two separate sets. Therefore, most network indicators are solely defined for one-mode networks, and it is critical to examine the two-mode network by dividing it into two one-mode networks. We use Pajek to graph interlocking directorate networks in China. In a two-mode network, two companies are linked by a shared board member. Thus, when transferring to a one-mode network, there is a tie entitled by the shared director's name between two companies. Under most of circumstances, there are multiple ties among companies with multiple shared board members. To simplify examinations of network measures, a single weighted line is used to reflect multiple ties. In our paper, line weights are defined as the sum of ties. In the rest of the paper, networks are referred to as one-mode networks derived from two-mode networks unless otherwise specified.

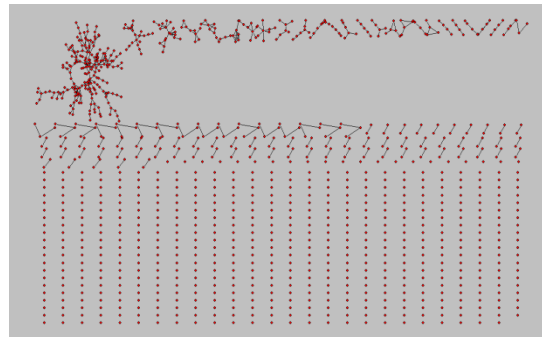**Figure 2: Interlocking directorate network in 2000**

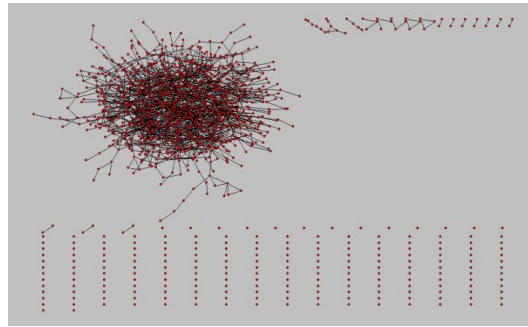**Figure 3: Interlocking directorate network in 2004**

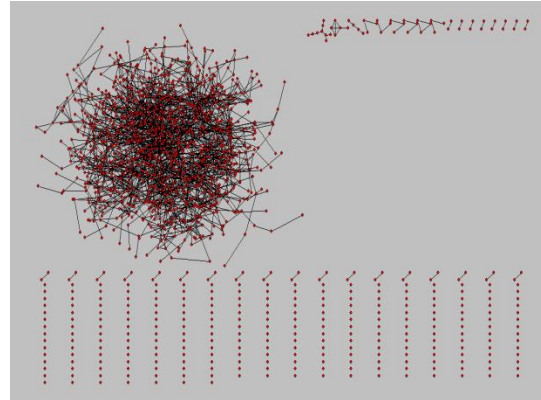**Figure 4: Interlocking directorate network in 2008**

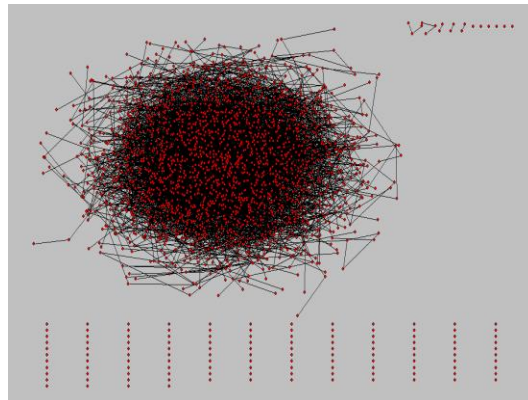**Figure 5: Interlocking directorate network in 2012**

Figure 2 to Figure 5 represent interlocking directorate networks in China in 2000, 2004, 2008, and 2012 respectively. Unlinked companies are represented by independent points and interlocking directorates are represented by two linked nodes. It was observed that in 2000 the interlocking corporation network in China had a very low density, large average distance, and most of nodes were not linked. Most of companies were distant from each other and few of them clustered together as relatively small networks with two or more vertices. Apparently interlocking directorates were not a common feature of listed companies in China in 2000. It changed dramatically from 2000 to 2004. In 2004, it was observed that many companies were featured with interlocking directorates as shown by a large sub-network in Figure 3. In 2012, interlocking directorates became very common in China with few isolates, i.e. companies scattering outside the network. A highly intensive network is shown in Figure 5.

3. Descriptive statistics

The number of companies increased dramatically from 1108 in 2000 to 2492 in 2012, and the number of directors increased from 9991 in 2000 to 19624 in 2012 (see Table 1). Moreover, the number of directors holding multiple positions developed fast from 450 (4% of all directors) in 2000 to 2924 (15% of all directors) in 2012. The number of linked companies has risen from 542 in 2000 to 2362 in 2012, and the percentage of companies that

have interlocks has almost doubled (49% in 2000 and 95% in 2012). The development of interlocking directorates has become steady since 2003.

Table 1: Companies and directors in China (2000-2012) – Two-mode network

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Two Mode													
Node	11,099	11,488	12,338	12,591	13,305	13,046	13,701	13,751	14,562	15,395	17,622	18,978	22,116
No. of firms-N	1,108	1,163	1,229	1,288	1,377	1,375	1,456	1,572	1,626	1,774	2,129	2,363	2,492
No. of directors - D	9,991	10,325	11,109	11,303	11,928	11,671	12,245	12,179	12,936	13,621	15,493	16,615	19,624
No. of director seats-P	10,505	10,962	12,255	12,801	13,582	13,263	13,945	13,923	14,872	15,707	17,997	19,497	23,926
Interlocks	450	547	867	1,087	1,168	1,136	1,232	1,247	1,373	1,446	1,687	1,937	2,924
% of D	4%	5%	8%	10%	10%	10%	10%	10%	11%	11%	11%	12%	15%
P/D	1.05	1.06	1.1	1.13	1.14	1.14	1.14	1.14	1.15	1.15	1.16	1.17	1.22
Interlocked firms	542	634	1,177	1,089	1,170	1,161	1,230	1,296	1,363	1,476	1,818	2,046	2,362
% of N	49%	55%	96%	85%	85%	84%	84%	82%	84%	83%	85%	87%	95%

In Table 2, we note that on average there are 8-10 directors on each corporation's board and each director holds an average of 1.0-1.2 seats. In 2000, there were 533 ties in the network. Specifically, 48.9% of companies had more than 1 link, 29.2% of companies had more than 5 links, and none had more than 10 links. In 2012, there were 6055 ties in the network. Specifically, 95% of companies had more than 1 link, 37.3% of companies had more than 5 links, and 5.7% of them had more than 10 links. Chinese listed companies have become much more connected with each other.

Table 2: Companies and directors in China (2000-2012) – One-mode network

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
One Mode													
Node	1,108	1,163	1,229	1,288	1,377	1,375	1,456	1,572	1,626	1,774	2,129	2,363	2,492
Link	533	680	1,442	1,928	2,196	2,125	2,216	2,294	2,529	2,848	3,532	4,078	6,055
Mean firm directors	9.48	9.42	9.97	9.94	9.86	9.64	9.58	8.86	9.15	8.85	8.45	8.24	9.6
Firms with links>1	542	634	1,177	1,089	1,170	1,161	1,230	1,296	1,363	1,476	1,818	2,046	2,362
% of firms with links>1	48.90%	54.50%	95.80%	84.50%	85%	84.40%	84.50%	82.40%	83.80%	83.20%	85.40%	86.60%	95%
Firms with links>5	324	56	404	308	360	338	354	376	277	323	414	478	929
% of firms with links>5	29.20%	4.80%	32.90%	23.90%	26.10%	24.60%	24.30%	23.90%	17%	18.20%	19.40%	20.20%	37.30%
Firms with links >10	0	2	12	25	38	34	26	26	17	34	40	43	141
% of firms with links>10	0.00%	0.20%	1.00%	1.90%	2.80%	2.50%	1.80%	1.70%	1.00%	1.90%	1.90%	1.80%	5.70%

4. Network measures

To have a comprehensive understanding of interlocking directorates in China, it is critical to examine characteristics of networks, such as density, network centrality, clustering coefficients, distance, components and structural holes. Analysis results of network measures are shown in Table 3.

Table 3: Analysis results (2000-2012)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Density													
Density	0.09%	0.10%	0.19%	0.23%	0.23%	0.22%	0.21%	0.19%	0.19%	0.18%	0.16%	0.15%	0.20%
Centrality													
Degree centrality	0.96	1.17	2.35	2.99	3.19	3.09	3.04	2.92	3.11	3.21	3.32	3.45	4.86
- Standard deviation	0.0013	0.0014	0.0018	0.002	0.0019	0.0019	0.0017	0.0016	0.0016	0.0016	0.0013	0.0012	0.0013
Normalized degree	0.0009	0.001	0.0019	0.0023	0.0023	0.0022	0.0021	0.0019	0.0019	0.0018	0.0016	0.0015	0.002
Degree centralization	0.0073	0.0076	0.0087	0.0117	0.0108	0.0123	0.0124	0.0102	0.0098	0.0106	0.0093	0.0062	0.0069
Closeness centrality	0.0047	0.0107	0.0563	0.0931	0.1013	0.0951	0.0975	0.0818	0.0938	0.0937	0.0974	0.1037	0.1636
- Standard deviation	0.0083	0.0155	0.0406	0.0505	0.051	0.0519	0.0504	0.0497	0.0505	0.0524	0.0505	0.049	0.0439
Betweeness centrality	0.0002	0.0007	0.0026	0.0028	0.0027	0.0025	0.0026	0.0021	0.0022	0.0019	0.0017	0.0017	0.0016
- Standard deviation	0.0009	0.0024	0.0054	0.0048	0.0046	0.0043	0.0043	0.0046	0.0042	0.0038	0.0032	0.0028	0.0021
Betweeness centralization	0.0144	0.0259	0.0581	0.0503	0.0381	0.0423	0.0434	0.0304	0.0991	0.0613	0.0452	0.0335	0.0164
Clustering coefficient													
Watts-Strogaz clustering coefficient	0.3421	0.3267	0.3902	0.3609	0.3654	0.3625	0.3508	0.3983	0.3899	0.3960	0.4118	0.4064	0.3032
Network clustering coefficient	0.337	0.3030	0.3583	0.2998	0.3025	0.3026	0.2891	0.3231	0.3104	0.3112	0.3124	0.3160	0.2463
Distance													
Mean distance	7.94	9.41	8.22	6.81	6.66	6.61	6.76	6.95	6.75	6.59	6.74	6.77	5.50
Medium distance of two nodes	22	27	20	18	18	16	17	20	16	17	18	17	12
Component (comp.)													
Firms in the first como.	191	354	823	1,014	1,119	1,078	1,170	1,170	1,281	1,378	1,707	1,962	2,350
% of firms in the first comp.	17%	30%	67%	79%	81%	78%	80%	74%	79%	78%	80%	83%	94%
No. of components	109	97	51	31	19	34	27	52	34	39	48	34	6
Components with two nodes	67	60	31	19	10	23	20	37	24	25	36	20	3
Isolated node	566	529	265	199	207	214	226	276	263	298	311	317	130
% of isolated node	51%	45%	22%	15%	15%	16%	16%	18%	16%	17%	15%	13%	5%
Density of the first comp.	1.43%	0.78%	0.40%	0.37%	0.35%	0.36%	0.32%	0.32%	0.30%	0.29%	0.24%	0.21%	0.22%
Mean distance of the first comp.	8.19	9.46	8.23	6.81	6.66	6.61	6.76	6.95	6.75	6.59	6.74	6.77	5.5
Structural holes													
Aggregate constraint	0.893	0.862	0.712	0.625	0.601	0.617	0.611	0.646	0.618	0.613	0.604	0.582	0.427

4.1. Density analysis

Density is defined as the number of existing ties divided by all possible ties. Greater density indicates a more stable and cohesive network with more ties among directors. As shown in Table 3, the overall density was 0.09% in 2000, which means that only 0.09% of ties existed among all potential ties. From 2000 to 2003, density increased dramatically while it decreased from 2004 to 2011. In 2012, density went up to the same level as in 2006.

12

With fast growth of ties in early 2000's, interlocking directorates have become progressively more common in China and network density has become significantly higher. However, from 2004 to 2011 the number of nodes and possible ties has increased faster than the number of existing ties. Thus, the network density became lower during this period. Higher density in 2012 is mainly caused by fast growing number of ties (an increase of ties from 4078 in 2011 to 6055 in 2012).

4.2. Network centrality analysis

The network centrality can be analyzed by different measures such as degree (local measure), closeness, and betweenness. Degree is the number of connections a node has with other nodes. Higher degree means that a director has more opportunities and easier access to useful information than others. The degree centrality was 0.96 in 2000, meaning that a company is connected to 0.96 other companies. In 2012, a degree of 4.86 means that a company is connected to an average of 4.86 other companies. Thus, in 2012 there were more outside resources available for Chinese listed companies.

Closeness and betweenness are used to investigate the strategic position in the whole network and are considered as measures of power (Elouaer-Mrizak 2012). Closeness centrality measures how close a node is to other nodes in the network. Companies who are closer to more other companies may be able to exert more influence than those who are more distant. A company with greater closeness also acts as a reference point which others would like to compare themselves to. Closeness centrality in China has increased from 0.0047 in 2000 to 0.1636 in 2012.

Betweenness shows a structurally advantaged position of a node when it lies between others. If an actor wants to contact another, it must pass through the specific node in between. This node therefore gains capacity to isolate actors or control transmission of information. The disappearance of this node would damage paths in the network. In a star network, the center node has access to all other nodes, and the loss of the central node collapses the network. Meanwhile, a node that is solely connected to the center node has zero betweenness and cannot exchange information with other neighbor nodes except for the center node. As shown in Table 3, betweenness centrality increases between 2000 (0.0002) and 2003 (0.0028), and then exhibits a decreasing tendency afterwards. In 2012, the betweenness coefficient reaches 0.0016. It suggests that information diffusion is more likely to be blocked with disappearance of a node at an early development stage of networks. In a more stable and denser network, a single node occupies a less advantaged position and has less control on information exchange.

In general, density and centrality of interlocking directorates have shown an increasing tendency first followed by a decreasing tendency. Interlocking directorates have experienced two rapidly growth periods: 2000 – 2003 and 2011 – 2012. The number of interlocking directorates and ties has risen dramatically in the beginning; however, the growth of interlocking directorates fails to catch up with the fast growth of listed companies later. Interlocking directorates in China have entered another era of rapid growth since 2012.

4.3. Clustering coefficient analysis

The clustering coefficient describes tendency of neighbor nodes to cluster together. Specifically, when a node is connected to two other nodes separately, the clustering coefficient measures the possibility of the two disconnected nodes to form a tie with each other. The bigger the clustering coefficient is, the more stable connections nodes have. As shown in Table 3, the clustering coefficient of directorate interlocks in China has risen steadily since 2000 except for a significant decrease in 2012, which indicates a smaller chance for listed companies to form connections.

4.4. Distance analysis

Distance is the number of paths nodes must go through a particular node to reach one another. If two nodes are adjacent, the distance between them is one. Where there is greater distance, it may take a longer time for information to transit between one another. In 2000, on average a company must pass 7.94 companies to reach another company. The distance rises to 9.41 in 2001 because it takes longer time to reach another company in a larger network. Since 2001, the distance has become smaller and in 2012 on average a company only passes 5.50 companies to reach another company.

4.5. Component analysis

A component is a group of nodes that are connected. Some nodes are not directly connected or their connections are not obvious, but one can still move to reach another through more steps within a component. If there is just one connection between two nodes, it is called a weak network and there is no direction. If a tie exists between any pair of nodes, it is called a strong network.

A component is considered as the largest sub-network, which does not allow entrance of new nodes. A new entrant disconnects the sub-network. In the following figures, different components are represented by different colors. Excluding sub-networks consisting of single nodes, there are 109 components in 2000. The core component in Figure 6 includes 191 companies, accounting for 17% of the sample size. There are 67 components consisting of two firms and there are 566 isolated firms, accounting for 51% of sample size. In 2012, the core component in Figure 7 includes 2350 firms, accounting for 91% of sample size. Isolated firms form 5% of sample size. It is apparent that more and more firms have formed ties in the network.
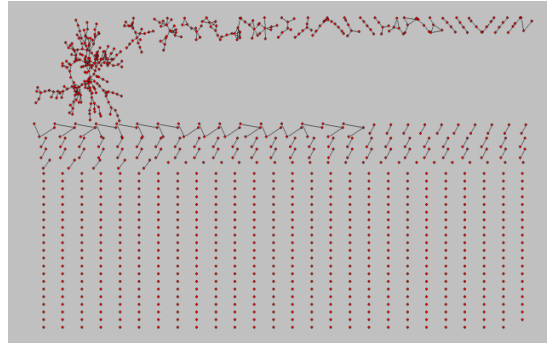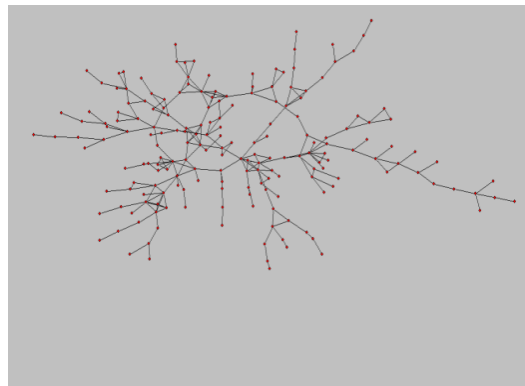
Figure 6: Components in 2000

Figure 7: Components in 2012

4.6. Structural holes analysis

When an individual node is in a relatively less dense area of a local network and broker connections between other nodes, this node is said to be in a structural hole and it benefits from forming ties with others directly and from bridging pairs of nodes that would otherwise be disconnected or sparsely connected. If a node disconnects with another, there will be a structural hole that benefits an outsider who acts as a bridge or intermediary. Structural holes create a competitive advantage for a company that has connections spanning the hole over those that do not. Companies on either side of a structural hole circulate information such that structural holes facilitate information infusion between them. Network constraints measure limitation of companies' access to outside information. Figure 8 shows two structural holes in dashed circles. Aggregate constraints of the structural holes decrease from 0.893 in 2000 to 0.427 in 2012 (Table 3), which indicates that companies are less constrained and possibility of disconnecting with others to benefit a third party falls.

Figure 8: Structural holes
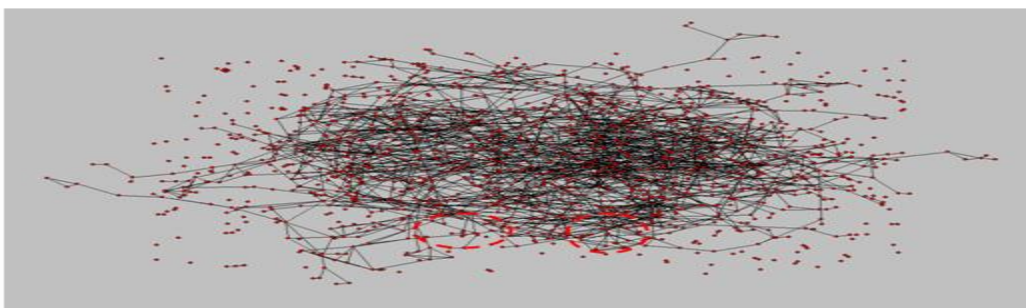
In summary, development of interlocking directorates in China did not take a smooth pathway from 2000 to 2012. In 2004 and 2005 certain measures, such as density and centrality, represented a slowdown of development of interlocking directorates in China. There are a few possible explanations. Chinese capital market is characterized by high concentration of control and lack of efficient legal framework. The first OECD-China Policy Dialogue on Corporate Governance in February 2004 provided guidelines for establishing and strengthening laws and regulations of Chinese corporate governance. Given the fact that majority shareholders of Chinese listed companies are governments, reforms focused on "equitable treatment of shareholders and mechanisms to prevent abusive related party transactions" (OECD 2011). Meanwhile, Chinese Company Law was revised for the second time on August 28, 2004 by the 10th National People's Congress of China, which limited the number of directors up to 19. During the process of modernizing Chinese capital markets and corporate governance practices, interlocking directorates in China exhibited uneven levels of development in our research period.

5. *Cross-country comparisons*

In the end, we would like to extend our research to cross-country comparisons. We are comparing interlocking directorates in the socialist market economy of mainland China to those in the market economy of 12 industrial countries. Data for analyzing interlocking directorates in other countries are collected from Stockman et. al. (1985) for the United States, Great Britain, Austria, Belgium, Switzerland, Germany, France, Italy, Netherlands, and Finland, Canna et. al. (1998) for Ireland, and Au et. al. (2000) for the Hong Kong Special Administrative Region of China (Hong Kong). In their edited book, Stockman, Ziegler, and Scott examine interlocks among 250 largest firms in the United States and other nine European counties. Canna, Brennan, and O'Higgins investigate the top 50 financial and 200 non-financial companies in Ireland. Au et. al. (2000) present interlocking directorates among top 200 corporations by market value in pre-1997 Hong Kong. In order to make an effective comparison, a similar sample size and selection criteria is chosen in our study. As shown in Table 4, our sample includes top 250 listed corporations in China in 2012: 36 financial corporations and 214 non-financial corporations. Interlocking directorates are most common in industries of financial services, mining and real estate. Among them, 81 are state owned enterprises (SOEs) at the national level, and 97 are SOEs at regional and provincial levels.

Table 4: Industrial distribution and nature of top 250 listed companies in China in 2012

Industry Distribution		Nature of the Corporation	
Mining	22	Local SOEs	97
Catering and Tourism	1	Public Enterprises	23
Electronics	2	Collective Enterprises	4
Real Estate	19	Private Enterprises	39
Textiles and Garment	2	Foreign Companies	3
Public Sector	15	Central SOEs	81
Black Metal	9	Others	3
Chemical	7		
Machinery and Equipment	11		
Household Appliances	3		
Building Materials	14		
Transportation	14		
Delivery Equipment	16		
Financial Services	36		
Agriculture, Forestry, Animal husbandry and Fisheries	5		
Commercial Trade	8		
Food and Drink	14		
Information Services	5		
Information Equipment	5		
Pharmaceutical Biotechnology	19		
Nonferrous Metals	21		
Total	**250**	**Total**	**250**

Chinese economic marketization has a relatively short history of less than 40 years and its capital market just started to grow in recent two decades. Scott and Griff (1984) also suggest that interlocking directorates do not exhibit structural changes within a couple of decades. Therefore, it is reasonable to compare interlocking directorates in China in 2000's with those in mature market economies in the 80's. We are investigating interlocking directorates in China, the United States, Great Britain, Austria, Belgium, Switzerland, Germany, France, Italy, Netherlands, Finland, Ireland, and Hong Kong. All test results are presented in Table 5. In 2012, there were 2813 board directors in China's top 250 listed companies, which is less than world average. There were 3976 board directors in America's top 250 companies and 4727 in Germany's top 250 companies in Stokman et al. (1985) research period. There were 2611 individual directors, about world average, in Chinese top 250 corporations. The number of interlocking directorates in China is only comparable to that in Ireland and the percentage of interlocking directorates is the lowest among all examined areas. Cumulation ratio, i.e. the number of directorship positions each director holds, in China is the lowest (1.08) compared to 1.20-1.30 in other countries. A higher cumulation ratio represents higher concentration of directors with multiple positions and a greater level of interlocking directorates. The above analysis shows that interlocking directorates are less common in China than in industrial countries.

In China, 82% of directors sit on two boards and nearly none sits on four or more boards. In other countries, 57-76% of interlocks are between two corporations and some directors sit on five or more boards. This creates a phenomenal number of networks because when links double the number of connected firms increase by a quadratic function. The strength of links may be measured by multiplicity, which is the number of directors that two firms share. Multiplicity equals 1 if there is one shared director between two corporations, for instance. Table 5 shows that multiplicity in China is similar to that in Great Britain. The average number of directors for each network is 1.06 in China and 1.09 in Great Britain. Differently, in Belgium, Italy, and Finland the average is 1.5 and above. It proves stronger connections among top firms in these countries. With respect to components, we find that there is a core component, some smaller components, and isolated firms in each country. The largest component in Chinese network is smaller compared to others except for Irish network. Density in its largest component is also the lowest among all. The size and maturity of interlocking directorates in China during 2000s' is still in the early stage and not comparable to those in industrial countries/areas in 80's and 90's.

Table 5: Cross-country comparisons

	China	Hong Kong	Great Britain	United States	Austria	Belgium	Switzerland	Germany	France	Italy	Netherlands	Finland	Ireland
No. of firms	250	200	250	252	241	270	250	259	250	247	250	237	249
No. of director seats	2813	2,105	3,091	3,976	2,939	3,000	3,681	4,727	2,625	2,358	2,950	4,178	1,935
No. of directors	2611	1,628	2,682	3,108	2,430	2,203	2,999	3,943	1,931	1,737	2,321	3,110	1,751
No. of interlocked directors	169	276	282	564	271	373	405	420	378	322	357	564	138
% of interlocked directors	6%	17%	11%	18%	11%	17%	14%	11%	20%	19%	15%	18%	8%
Cumulation ratio	1.08	1.29	1.15	1.28	1.21	1.36	1.23	1.2	1.36	1.36	1.27	1.34	1.11
No. of director seats held by a director													
2	82%	61%	69%	64%	65%	57%	67%	60%	60%	63%	64%	61%	76%
3	17%	25%	21%	24%	17%	19%	19%	20%	19%	17%	17%	20%	18%
4	2%	6%	6%	8%	9%	9%	6%	9%	9%	7%	8%	6%	5%
5	0%	55	3%	3%	4%	6%	2%	5%	6%	5%	6%	6%	1%
>5	0%	3%	1%	1%	5%	9%	6%	6%	6%	8%	5%	7%	0%
Multiplicity													
1	94%	78%	94%	84%	78%	67%	81%	81%	85%	70%	87%	75%	91%
2	5%	10%	5%	13%	15%	18%	12%	14%	10%	17%	11%	15%	6%
3	1%	5%	2%	2%	4%	7%	5%	4%	3%	7%	2%	5%	2%
>3	0%	7%	0%	1%	3%	8%	2%	1%	2%	6%	0%	5%	1%
Mean links	1.06		1.09	1.2	1.36	1.68	1.31	1.27	1.25	1.55	1,2	1.5	1.17
Total links	220		542	1086	909	1,219	1,002	1,278	1,065	891	980	1,498	207
Independent node	66		61	24	90	80	44	62	30	53	56	27	111
Nodes in core component	137		185	226	147	182	206	195	220	180	190	210	106
Density of core component	0.02		0.03	0.04	0.08	0.07	0.05	0.07	0.04	0.06	0.05	0.07	0.03

Source: Canna, L., Brennan, N. & O'Higgins, E. 1998. National networks of corporate Power: An Irish perspective. Journal of Management and Governance, 2(4): 357–379.

Au, K., Peng, M. & Wang, D. 2000. Interlocking directorates, firm strategies, and performance in Hong Kong: Towards a research agenda. Asia Pacific Journal of Management, 17(1): 28-47.

Stokman, F., Ziegler, R., & Scott, J. (Eds). 1985. Networks of corporate power: A comparative analysis of ten countries. London: Polity Press.

Chinese Company Law was revised the third time in 2013 and Chinese government issued a new guideline to deepen reforms of SOEs in 2015. Major changes include promoting mixed ownership, preventing erosion of state assets, and granting market forces a greater role, especially after the 2015 stock market turmoil. Non-state firms are encouraged to join the process through buying stocks and convertible bonds from SOEs. Boards of directors of SOEs will have greater decision-making power and government intervention will be prohibited. Under the new guideline, we expect to see faster development of interlocking directorates in China.

6. Conclusion

We have used social network analysis methods to examine interlocking directorates in China from 2000 to 2012. Comparisons with other 12 industrial countries are made to determine the degree of development of Chinese interlocking directorate network. Our results show that 1) interlocking directorates grow fast in China and there are more directors occupying multiple board seats; 2) exchange of information among corporations are strengthened because of rising interlocks and smaller distance; 3) the possibility of disconnecting to form structural holes in a network falls; and 4) China is in the early stage of development of interlocking directorates compared to the size/maturity of interlocking directorates in certain industrial countries in 80's and 90's. Interlocking directorates are most common in industries of financial services, mining and real estate. Our study bridges the gap between interlocking directorates and the socialist market economy of China by comprehensively illustrating network performance measures and making cross-country comparisons. For our future research agenda, with widespread reforms in Chinese capital markets and corporate governance, we are interested in investigating interlocking directorates after 2015 under new Chinese Company Law. Jonnergard et. al. (2014) report that board members change their activities responding to corporate governance innovations. China is

among world's largest countries and distribution of economic activities is highly unequal. We are also interested in exploring geographic distributions of interlocking directorates in China. Network centrality measures and distributions of corporate headquarters can be used to differentiate central and edge areas in China.

References

Au, K., Peng, M. P., & Wang, D. (2000). Interlocking Directorates, Firm Strategies, and Performance in Hong Kong: Towards a Research Agenda. Asia Pacific Journal of Management, 17(1), 29-47.

Battistin, E., Graziano, C., & Parigi, B. M. (2012). Connections and Performance in Bankers' Turnover. European Economic Review, 56(3), 470–487.

Battiston, S., & Catanzaro, M. (2004). Statistical Properties of Corporate Board and Director Networks. The European Physical Journal B, 38(2), 345–352.

Canna, L., Brennan, N. M., & O'Higgins, E. (1998). National Networks of Corporate Power: An Irish Perspective. Journal of Management and Governance, 2(4), 357-379.

Carroll, W. K., & Sapinski, J. (2010). The Global Corporate Elite and the Transnational Policy-planning Network, 1996-2006 a Structural Analysis. International Sociology, 25(4), 501-538.

Chandrashekar, S., & Muralidharan, K. (2012). Networks of Power and Influence: Board Interlocks in India 1995-2007 – An Empirical Investigation. IIM Bangalore Research Paper: No. 374.

Chua, A. Y. K., & Balkunje, R. (2012). Interlocking Directorates and Profitability: A Social Network Analysis of Fortune 500 Companies. ASONAM '12 Proceedings of the 2012 International Conference on Advances in Social Networks Analysis and Mining, 1105-1110.

Croci, E., & Grassi, R. (2014). The Economic Effect of Interlocking Directorates in Italy: New Evidence Using Centrality Measures. Computational and Mathematical Organization Theory, 20(1), 89–112.

Drago, C., Manestra, S., & Santella, P. (2011). Interlocking Directorships and Cross-shareholdings Among Italian Blue Chips. European business organization law review, 12(4), 619–652.

Elouaer-Mrizak, S. (2012). A Social Network Analysis of Interlocking Directorates in French Firms. ASONAM '12 Proceedings of the 2012 International Conference on Advances in Social Networks Analysis and Mining, 1018-1026.

Haunschild, P. R., & Beckman, C. M. (1998). When Do Interlocks Matter?: Alternate Sources of Information and Interlock Influence. Administrative Science Quarterly, 43(4), 815-844.

Heemskerk, E. (2013). The Rise of the European Corporate Elite: Evidence from the Network of Interlocking Directorates in 2005 and 2010. Economy and Society, 42(1), 74-101.

Heilmann, S. (2002). The Chinese Stock Market: Pitfalls of a Policy-driven Market. China Analysis, No. 15.

Kaczmarek, S., Kimino, S., & Pye, A. (2014). Interlocking Directorships and Firm Performance in Highly Regulated Sectors: The Moderating Impact of Board Diversity. Journal of Management & Governance, 18(2), 347–372.

Kim, P. S., & You, J. J. (2013). A Study on the Effects of Indian Business Group Interlock and Size on Firm Performance: Evidence from Bombay Stock Exchange 500. Journal of Advanced Management Science, 1(4), 378-382.

Li, L., Tian, G., & Yan, W. (2013). The Network of Interlocking Directorates and Firm Performance in Transition Economies: Evidence from China. Journal of Applied Business Research, 29(2).

Opsahl, T. (2013). Triadic Closure in Two-mode Networks: Redefining the Global and Local Clustering Coefficients. Social Networks Special Issue on Advances in Two-mode Social Networks, 35(2), 159–167.

Pawlak, M. (2010). An Interlocking-directorates Monitoring System. Journal for Perspectives of Economic Political and Social Integration, 16(1-2), 121-154.

Ren, B., Au, K., & Birch, T. (2009). China's Business Network Structure during Institutional Transitions. Asia Pacific Journal of Management, 26(2), 219-240.

Santos, R. L., and Silveira, A., & Barros, L. A. (2012). Board Interlocking in Brazil: Directors' Participation in Multiple Companies and Its Effect on Firm Value and Profitability. Latin American Business Review, 13(1), 1-28.

Simoni, M., & Caiazza, R. (2012). How Does Learning Intent Affect Interlocking Directorates Dynamic?. The Learning Organization, 19(5), 388 – 399.

Simoni, M., & Caiazza, R. (2013). Interlocking Directorates' Effects on Economic System's Competitiveness. Business Strategy Series, 14(1), 30 – 35.

White, S. (2002). Rigor and relevance in Asian management research: Where are we and where can we go?. Asia Pacific Journal of Management, 19(2–3), 287–352.

Wood, B. (2011). The Dislocation of Agriculture and Food: A Network Analysis of Interlocking Directorates in New Zealand's Corporate Economy. Kōtuitui: New Zealand Journal of Social Sciences, 6(1-2), 100-112.