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On the topological properties of the cross-shareholding networks of listed companies in China: Taking shareholders' cross-shareholding relationships into account

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HIGHLIGHTS

- We construct two levels cross-shareholding networks of China's listed companies.
- The new network takes shareholders' cross-shareholding relationships into account.
- The study can reveal the stock market's complex relationships more precisely.
- The paper will be helpful for the further researches about the "agent problems".
- The new network's degree follows power-law distribution with a better fit goodness.

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ABSTRACT

Shareholders are the owners of listed companies, and their relationships can directly affect the structure of the stock market. In this paper, we analyze the topological properties and evolution of the cross-shareholding networks of listed companies in the past 5 years in China from 2007 to 2011, an infrequently considered topic, by taking shareholders' cross-shareholding relationships into account. This analysis arrives at a deeper insight into the inner characteristics of China's stock market. We find that the cross-shareholding networks of listed companies with shareholders' cross-shareholding relationships display statistical features that reveal the stock market's complex relationships more precisely. In particular, the results show that when the shareholders' cross-shareholding relationships are considered, first, the In-degree and Out-degree of the cross-shareholding networks follow power-law distribution and the R^2 of the linear regression analysis of the cumulative degree distribution is relatively higher; second, the modularity of the communities is larger; finally, both the number of members of top-ranked communities and the number of communities that have a large number of members are larger than those of which only considering the relationships between shareholders and listed companies are taken into account. Such cross-shareholding networks analysis taking shareholders' cross-shareholding relations into account would be a helpful tool for supervisory departments and for stock market researchers to grasp the inner cross-shareholding relationships of listed companies in China, and it will be also helpful for the further researches about the "agent problems" in the stock markets from a whole point of view.

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1. Introduction

Shareholders are the owners of listed companies, and their relationships can directly affect the structure of the stock market. Usually, one listed company has more than one shareholder, and shareholders may hold stocks of many listed companies. In addition, some shareholders themselves are listed companies. Therefore, we can construct cross-shareholding networks of listed companies and their shareholders. The relationships between listed companies and the shareholders of stocks of different companies are complicated. Listed companies are connected through holding other listed companies' stocks, and cross-shareholding networks reflect the structure of the relationships of the stock market. Usually, listed companies are not directly linked; instead, they may share the same shareholders or even have the same holdings as their shareholders; therefore, we must take shareholders' holders into account, making cross-shareholding networks even more complex.

Cross-shareholding is one of the features of the ownership structures. Reviewing the literature, we find that ownership structures are well documented. However, only a few papers address the indirect effects arising from the so-called "cross-shareholding" of companies [1]. In the articles discussing cross-shareholding, themes such as the motivations for cross-shareholding [2,3], legal regulations [4], and accounting treatments [5,6] have been studied in several countries and regions, but very few researchers have discussed what domestic or international cross-shareholding networks look like in a quantitative point of view. Although most of researchers know that only a handful of powerful corporations dominate the global economy by the direct or indirect ways, it is still a problem that needs us to find explicit numbers to figure it out [7]. Unlike the western stock markets, the stock market in China started fairly late. The state-owned companies take a large proportion of the listed companies, and some of the state-owned companies hold the shares of the listed companies indirectly. So it is valuable to find out a useful method to analyze what the cross-shareholding networks of listed companies in China look like.

As some common basic models of complex networks have been found, such as random graph, WS small-world networks, NW small-world networks and scale-free BA network, more and more researchers have begun to use complex networks theory to research what empirical networks, such as the World Trade Web (WTW) [8] and the World Wide Web (WWW) [9] look like. Meanwhile, there is an abundance of literatures on the application of complex networks focusing on stock markets. For example, one study on inter-regional direct investment stocks across Europe finds scaling laws relating to investment activity [1]. Some study uses a new data-mining technique for classifying financial instruments based on stock price data to research stock price correlations and finds that stock prices in China follow a power-law model [10]. Another analysis studies the overall trend of economic development and the overall tendency of capital flow of China between 2002 and 2009 based on the cross-shareholding networks [11]. However, only a few papers have studied cross-shareholding networks, and none of them take the relationship between shareholders and shareholders' holders into account. As we know, the relationship between shareholders and shareholders' holders can affect the relationships between listed companies. Therefore, we need to create cross-shareholding networks that take the relationship between the shareholders and shareholders' holders into account, which might reveal the stock market's complex relationships more precisely.

In this paper, we draw lessons from the idea of 'network of networks' [12] and establish two different levels, a fine one and a coarse one, of the cross-shareholding networks of listed companies between 2007 and 2011 to reveal the investment relationships of China's stock market. The fine level takes shareholders' cross-shareholding relationships, i.e., the shareholders' holders, into account. The coarse level only deals with the relationship between shareholders and listed companies. We use H–H–L to represent the fine level networks, and H–L to represent the coarse level networks, H–H to represent shareholders and their holders. We first present a detailed study of the topological properties of the two different levels networks in each year, including the average degree and the cliques, and so on. Then, we analyze the differences between H–H–L and H–L, namely, whether H–H–L can exhibit the cross-shareholding relationship of the listed companies in China more exactly. Finally, we discuss the recent trends in China's cross-shareholding networks.

2. Data and methods

2.1. Data

The data used in this paper are mainly extracted from the CSMAR Financial Research Database (http://www.gtarsc.com/), the Shenzhen Stock Exchange (http://www.szse.cn/) and the Shanghai Stock Exchange (http://www.sse.com.cn/). The selected documents include the Listed Company List, the Main Stockholders List and the Stockholder Relationships List of all the companies listed on the Shanghai stock exchange and the Shenzhen stock exchange between 2007 and 2011. The data used in this paper were mainly collected on March 6, 2013. The information in the Listed Company List includes the Stock Code and the Listed Company Name on the Shanghai stock exchange and on the Shenzhen stock exchange. The information in the Main Stockholders List includes the Stock Code, the Stockholder Name, the Stockholding Rate and the End Date. The information on the Stockholder Relationships List includes the Stock Code, the End Date, the Name of Participant1, the Name of Participant2 and the Stockholding Rate that Participant2 holds in Participant1.

To analyze the data more effectively, we deleted the duplicate items and transferred the Listed Company Name, the Stockholder Name and the Participant Name into codes. "H" is the beginning of the codes, and each code represents a unique company or individual.