Research on the Agency Cost Effect of Director Network Governance

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Abstract: The network of the board of directors has closer and closer connection among enterprises. Different network locations would lead to different director behaviors and efficiency, which would indirectly affect corporate performance and value through agency cost. Based on statistical analysis of 2009-2013 data from the board of directors of A-share listed companies, this thesis sorts and works out the network centrality of the board of directors, and further explores the extent and way of its influence on agency cost and corporate value. As indicated by the result， the agency cost of enterprises would decline and the corporate value would increase to a certain extent, along with the rise of the network centrality of the board of directors.

Key word:Network of the board of directors; agency cost; corporate governance; corporate value

The issue of agency has emerged along with the rapid development of economy and the establishment of a modern enterprise system. Due to the universality of agency, no modern enterprise can avoid it. Agency cost generated therefrom is an important index for investigating this issue. The separation between ownership and management authority is the main cause of agency cost （Berle,Means，1932）. As corporate owners, corporate shareholders hope that the management team can regard maximizing shareholder wealth as the goal of enterprise operation and management. However, managers are not shareholders themselves or are holders of a small percentage of shares. They usually engage in daily enterprise operation and management from the perspective of their own interest, hence triggering the interest conflict between owners and managers. Severe information asymmetry between owners and managers is another important cause of agency cost（Jensen、Meckling，1976）. Managers relatively enjoy information advantage, while owners are disadvantaged in term of information. Managers may impair owner interest to pursue their own interest. In order to solve this contradiction, owners need to take some measures to supervise and control manager behaviors. Agency cost inevitably emerges in this process. Since the emergence and development of modern market economy, enterprises in various countries worldwide have always been pestered by agency cost no matter which techniques they have attempted, including the optimization of the market system, the innovation of the enterprise system and the protection of the legal system.

According to an agency theory, as an internal governance mechanism which controls principal-agent issues, the board of directors can exert restriction over the management through effective supervisory activities, thus reducing the risks of "adverse selection" and "moral crisis" to a very large extent, and attaining the goal of reducing the agency cost of enterprises. In addition, the guiding opinions of independent directors in the board of directors can also be used as reference by companies while making major operation decisions. Therefore, the board of directors can play the role of alleviating the interest conflict between corporate shareholders and managers, reducing agency cost and promoting corporate performance and value. Whether the board of directors can exert desirable control over the agency cost of companies or not chiefly depends on the efficiency of the board of directors. A general survey of existing domestic and overseas literatures would reveal that researches on the efficiency of the board of directors cover the scale of board of directors（Lipton、Lorsch，1992）, the independence of the board of directors（Bhagat、Black，2002；Yu Dongzhi; Wang Huacheng, 2003）, the incentives of the board of directors（Jensen，1993） and the activeness of the board of directors （Jensen，1993；Gu Qi，2001）, etc. However, few of these literatures studied the efficiency of the board of directors under the framework of network analysis, and predecessors ignored the effect of social network (especially different network locations) on director behaviors.

According to the theory of social network, there must be a "social relation" and "bond" between any economic organization or any individual therein and the outside world. Based on the mutually-embedded influence of this complicated correlation interwoven with one or more relations and bonds, a huge overlapped social network relationship has come into being. In the field of corporate governance, directors are found in an intricate and complicated relationship of social network as a part of economy and society. Different social networks in which directors are located would result in their different behaviors of corporate governance (Chen Yunsen, 2011; Larcker, et al, 2011). Therefore, a thorough research and discussion have been conducted to economic consequences resulting from the effect of the network of the board of directors on enterprise behaviors, with agency cost and correlated agency efficiency as research breakthroughs, against the difference of information, knowledge, strategic resource, reputation, influence and other capabilities which are involved when directors located differently in the network of the board of directors exert governance over companies. If we gain a thorough understanding of the effect of network characteristics of the board of directors on agency cost in this way, we can not only help listed companies to optimize and control agency cost, but also carry out more effective corporate governance and exert better supervision over the management.

1.Literature review

1.1 Agency cost

Agency cost originates from the viewpoint of “mutual separation of ownership and right of control” put forward by Berle and Means for the first time (1932). In their opinion, people who control corporate wealth and who are responsible for ensuring the operation efficiency and profitability of companies are not corporate owners, or people entitled to acquire these profits. Jensen and Meckling(1976) defined agency cost, and applied the method of empirical research to analyze the relevant issues of agency cost, thus laying a foundation for empirical research . Since then, agency cost has been an issue that arouses universal attention in the academic and business circles. As indicated by sufficient empirical evidences, the agency cost between corporate owners (shareholders) and management exerts an important influence on corporate financing, investment decision-making and value (Fama and Jensen,1983). As pointed out by Gao Lei and He Shaohua (2006), we could infer from the duties of the board of directors that the board of directors was an important measure and means for corporate owners of modern enterprises to supervise and control corporate management and control and reduce agency cost.

1.2 Individual characteristics of the board of directors

Based on review and analysis of existing research achievements at home and abroad, the efficiency of the board of directors decides whether or not the board of directors can solve the agency problem of companies. The independence of the board of directors（Bhagat, Black，2002；Yu Dongzhi, Wang Huacheng，2003）, the scale of the board of directors（Lipton, Lorsch，1992）, the activeness of the board of directors （Jensen，1993；Gu Qi，2001）and the incentives of the board of directors （Jensen，1993） would exert some influence on the efficiency of the board of directors and the performance of companies. All these factors fall into the category of the reasons of the board of directors itself.

1.2.1 The scale of the board of directors

As indicated by the result of researches, the scale of the board of directors is not directly proportionate to the efficiency of the board of directors or the performance of companies. In the opinion of Jensen（1983）and Lipton(1992), after a board of directors of a certain scale comes into being, the efficiency of the board of directors would be inversely proportional to the scale of the board of directors. Therein, in the opinion of Jensen (1983), when a board of directors has more than 10 members, effective operation would become quite impossible, and the board of directors would be more easily controlled by CEO instead. The number of members of the board of directors should be preferably 8 or 9 for the best efficiency. This viewpoint was further confirmed. As indicated by the result of the researches of Yu Dongzhi and Chi Guohua in 2004, the relationship between the scale of the board of directors and the performance of companies is a kind of “reversed U-type relationship”. That is to say, along with the continuous increase of the scale of the board of directors, its negative correlation would decrease progressively and marginally, with the effective turning point being 9 members.

The expansion of the scale of the board of directors would result in the increase of corporate agency cost, largely because expanding the scale of the board of directors would increase the difficulty in communication, coordination and the formulation of a uniform strategic decision. Next, the objective of corporate owners (shareholders) and management would also deviate to a large extent. Third, the control ability of the board of directors to the management would decline. Since agency cost results from separation of ownership and right of control, the agency cost of companies would increase for the above-mentioned reasons.

1.2.2 The independence of the board of directors

Although there are many domestic and overseas research achievements on the independent director system and corporate performance, the results are quite different from each other.

The first result is the opinion that independent directors and corporate performance are positively correlated. As indicated by the research findings of Weisbach(1988), the promotion of management employees represented by general managers is tremendously related to corporate performance among companies whose directors are mostly external ones. This is because the board of directors whose directors are mostly external ones has stronger control ability than the board of directors whose directors are mostly internal ones. Obviously, the company with more active independent directors would have a better operation. By analyzing 2004 cross section data, Gao Lei (2007) drew a conclusion: the percentage of independent directors in the board of directors is obviously positively correlated with the performance of companies.

The second result is the opinion that the independent director system is negatively correlated or not correlated at all with the performance of companies. David Yermack（1996）used the least square method for regression analysis and drew a conclusion: The percentage of independent directors in the board of directors is obviously negatively correlated with Tobin’s Q. However, after the analytic model or control variable is changed, the result would become “uncorrelated”. After analyzing a lot of data, Bhagat and Black（2002）drew a conclusion: enterprises with a poorer corporate performance would have a more independent board of directors; companies with a more independent board of directors do not have an obviously higher performance than other companies. In the opinion of Yu Dongzhi and Wang Huacheng (2003), the financial and economic performance of companies is not obviously improved due to the existence of independent directors, and sometimes an adverse effect would even occur.

1.2.3. The incentives of the board of directors

Without effective incentive measures, the performance level of companies would not be directly related to the board of directors, and the directors of companies would also be indifferent to the operation state of companies, and would lose their motivation to supervise activities of operation, thus exerting direct influence on the economic benefit of companies.

Management share-holding is an effective incentive measure. In the opinion of Jensen（1993）, enabling directors to hold corporate shares or paying remuneration of directors in the form of share option can associate directors' own interest with the risks they bear, thus motivating directors to try their utmost to attain enterprise goal---the maximization of enterprise value, with the lowest cost. Li Zengquan (2000) carried out a series of researches by using more than 200 Chinese listed companies in 1998 as samples. He found out that members of the board of directors could help to promote corporate performance by holding corporate shares. As pointed out by Xue Zuyun and Huang Tong (2004), the number of share-holding corporate directors was directly proportional to the quality of corporate accounting information; the higher the percentage of the number of shareholding directors is; the more effective supervision the board of directors would exert on the company.

1.2.4. The activeness of the board of directors

The activeness of the board of directors refers to the frequency of board meetings and the duration of meetings, etc. Generally, the more frequent board meetings are and the longer the meetings last; the more active the board of directors would be, the more time directors would have to exchange views and advice, formulate corporate strategies and supervise the management among themselves, and the more possibly directors would fulfill their own duties to the interest of shareholders. However, the subsequent negative effect would be the increase of corporate agency cost.

As pointed out by Jensen（1993）: when the company is in a sound state of operation, members of the board of directors would not often together carry out further discussion on and research into the development strategy of the company, and the activeness of the board of directors would be low. On the contrary, when the company has difficulty with operation, the board of directors would be forced to often convene meetings for discussion, so as to solve emerging problems. Therefore, the activities of the board of directors are not prior measures adopted to promote the governance effect of the company, but the response and reaction to the problems with the company. The role of the board of directors turned from a top governance team of the company into a “fire extinguisher” for solving corporate problems. Gu Qi et al (2001) analyzed the relations between the meeting frequency of the board of directors of Chinese listed companies and the corporate performance of these companies. As indicated by the analytic result, the activity frequency of the board of directors would usually increase after the decline of corporate profit; in the years witnessing the frequency rise of abnormal activities of the board of directors and in the subsequent years, corporate operation would be improved.

1.3 Network of the board of directors

The difference of network locations of the board of directors is undoubtedly one of the factors affecting the efficiency of board of directors. The existing reference literatures have sensitively found out the research value in this regard, and have analyzed and discussed the effect of network of the board of directors on its efficiency and corporate governance behaviors from such perspectives as the classification, manifestation, action effect and action way of network of the board of directors.

1.3.1The theory of binding strength

The reason for the emergence of network connection is that there are interpersonal and inter-organizational communications and contacts. Granovetter（1973）put forward the concept of “binding strength” for the first time, namely, according to the difference of strengths of communications and contacts, network connection, as a kind of bond, can be classified into strong binding relation and weak binding relation. Duration, interactive frequency, intimacy degree and degree of reciprocal exchange can be used to measure the size of binding strength. In the network of the board of directors, members of corporate board of directors consist of internal directors and independent directors. Internal directors are corporate members, and an overwhelming majority of them are corporate managers. They have more opportunities to get in touch with and get along with one another, and have more frequent interaction. Therefore, the intimacy degree among them is far greater than the degree of their intimacy with independent directors. Therefore, according to the division of the theory of binding strength, relations among internal directors are strong binding relations within the organization, while relations between internal and independent directors and relations among independent directors are weak binding relations of network of the board of directors.

1.3.2 The theory of structural holes

As for the manifestations of network of the board of directors, Burt (1991) put forward the theory of structural holes: the social network between individuals and organizations has two manifestations: 1) the structural network without holes: an individual in the network forms direct bonds with all other individuals; 2) Structural network with holes. An individual in network forms direct bonds with some other individuals, but forms no bonds with the rest of individuals. Therefore, phenomena of broken relations occur among some individuals. As a whole, it seems as if holes occur in the entire network structure, namely, structural holes. In the network of the board of directors, each member of the board of directors can be regarded as a small group, and no direct relations occur between the non-concurrent directors and other directors in the board of directors. Their associations only lie in relations of chain directors and indirect communications. Therefore, structural holes exist in the entire network of the board of directors of the company.

1.3.3 Social Embedness Theory

None of individuals which lie in the network structure relationship are static, and they would continuously set up new bonds. For this purpose, Embedness Theory Granovetter（1985）is based on how individuals influence one another dynamically in the network. As pointed out by the Mosaic Theory, economic decisions, individual behaviors and systems are all subject to interactive influence in social network, and all their results are subject to the interference of social network based on interaction of many factors; that is to say, all of them are embedded in the social network.

As also believed by Luo Jiade (2010), informal restriction appeared more important because formal systems were universally marked by weak constraint. Informal constraint can play a greater role in social network. For example, relations embedded among the interpersonal contacts of managers can exert influence on the company because they play the role of the substitute of formal systems. Therefore, the network relations of the board of directors required by this kind of informal systems play an important role for the governance behavior of directors and the efficiency of the board of directors.

2. Theoretical analysis and research hypotheses

If two persons serve as the director at the same time at least in the board of directors of the same company, these two directors can be regarded as being directly related. In terms of social network, the network of the board of directors in which directors are located has an influence on the governance behavior of directors to the company. On the one hand, it reserves the freedom of individual willpower for directors, freeing directors from interference of outside factors in the decision-making of board of directors, because the decisions made by directors can fully connect their own expertise accumulation, academic background and personal preference. On the other hand, it places the decision-making behavior and corporate governance of directors in the interpersonal network in which directors are located for observation. Although directors have their own rational thoughts and personal preferences before making a specific decision, such rational thoughts and preferences are behaviors which emerge in a process of interaction (Chen Yunsen, 2011). Directors would exchange information with people located in the same social network, and would also change their own opinions and hobbies under others' influence and interference. Therefore, the governance behavior of directors to companies is both a spontaneous behavior based on rational thinking and a behavior subject to the influence of social network. The function of director decision-making is, to a large extent, subject to the network embedding of director decision-making. Various members of the board of directors can not only contact one another through routine meetings of the board of directors and other job opportunities, but also can conduct information exchange through private communication. These communication mechanisms can set up a tie for mutual connection and information transmission among individuals, groups and organizations. The importance of network of the board of directors is: various types of information, resources, strategies and social capital embedded in the network have structural effect; all these factors can influence governance behaviors of directors. In addition, the social capital acquired by directors located in different network relations and positions also has structural difference.

Fig 1 is the network connection diagram of directors of A-share non-ST listed companies in the region of Yunnan Province, Guizhou Province, Sichuan Province and Chongqing Municipality in 2013. As indicated by the connections therein, concurrent directors exist between two companies. The diagram vividly indicates that no company is isolated, and each enterprise shares a director with at least another enterprise. It is not difficult to find out from the diagram that some companies are located at the central position of network, e.g. companies coded 600729 and 002312, which have a relationship of shared directors with many other companies. Some companies do not have a very strong network relationship, e.g. companies coded 002053 and 000984, which do not share directors with other companies in addition to mutual relations. In addition, the degrees of director network among different regions are also different. Jiangsu Province, Zhejiang Province and Shanghai Municipality boast rapid economic development, a large number of companies and a lot of relationship. Therefore, the entire region has a large network. In contrast, the region of Guangdong Province, Guangxi Zhuang Autonomous Region and Hainan Province has less relations and a smaller director network. The influence of this kind of different network locations on corporate agency cost and corporate value is the research center of this thesis.

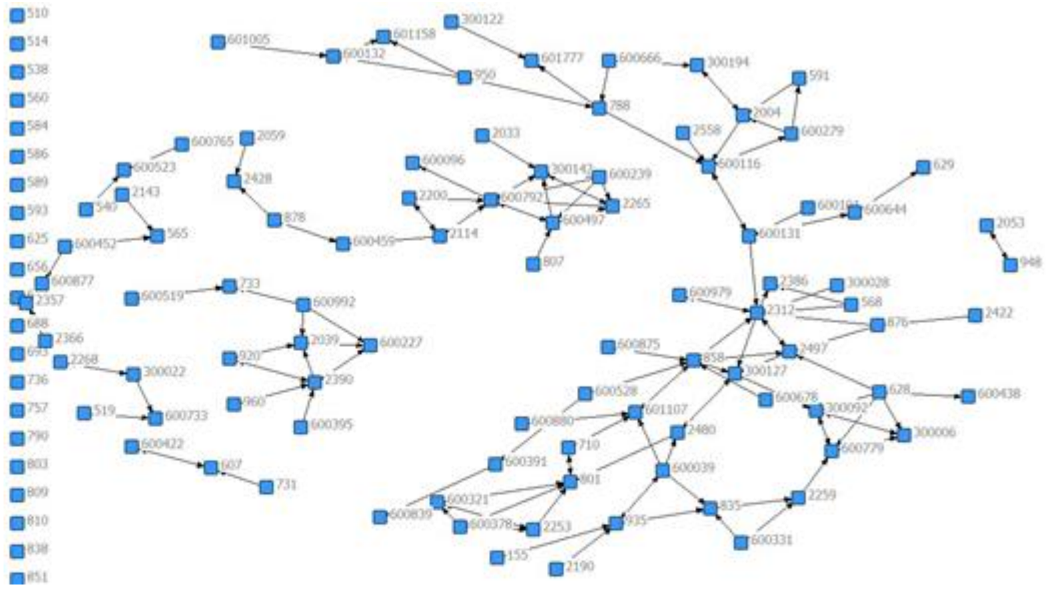

Fig 1: The diagram of director network connection of listed companies in 2013

The agency relations between shareholders and management and the agency relations between major shareholders and small and medium shareholders are two types of agency cost issues. These two types of agency issues always arouse long-term attention among enterprises and in the capital market. The first type of agency issues: management agency. Senior executives hope to acquire more cash or equity returns, but the income distribution gap becomes larger and larger. Senior executives also try another way to search for a reasonable cause to account for their own high salary (Xie Deren et al, 2012). The most obvious consequence of this behavior is the increase of corporate management expenses, which is also directly shown on the financial statements of the company. Next are the agency issues between major shareholders and small and medium shareholders. In the long run, an important factor that hinders the capital market is the asset stripping behavior of major shareholders. Relevant supervisory departments time and again discover regulation-violating companies and mete out corresponding punishments over them, but these punishments fail to thoroughly solve the problem of major shareholders' occupancy of capital of listed companies in the capital market. The phenomenon of major shareholders stripping assets of listed companies is always an issue that must be considered for the healthy development of capital market. In 2001, relevant national policies began to standardize the system of corporate board of directors: the independent directors of the company should play an indispensible role in reducing two types of agency costs of companies and protecting small and medium shareholders. Relevant regulations grant some special rights to independent directors, and encourage independent directors to voice independent opinions; more importantly, to inhibit the asset-stripping behavior of major shareholders, and supervise and motivate management at the same time. According to statistic result, it is difficult to make out whether the supervisory function of independent directors is more effective on the cross sections. While studying the relation characteristics of independent directors, we should take the role of independent directors into consideration, because they have stronger network characteristics of the board of directors.

The more central position an independent director lies in, the more obvious his governance effect would be. This characteristic can exert its function for solving the two types of agency-cost problems through two channels: 1) Independent directors located at the center of network enjoy high reputation, capable of carrying out motivation with this (Fama, Jensen，1983). The more obvious motive these independent directors have in supervising the management; the more obvious motive they would have in inhibiting the asset-stripping of major shareholders. The network relations of the board of directors are transmissible. Strongly motivated by reputation, these independent directors located at the center of network would certainly take anger cost into consideration. In addition, network of the board of directors enables independent directors to acquire more occupational opportunities (Cashman et al，2010), and is not subject to major shareholders and management, with a relatively strong bargaining capability, thus enabling independent directors to more freely voice objective and independent opinions. That is to say, independent directors located at the center of network can more actively supervise behaviors of major shareholders and management, reduce the occurrence of opportunism, enhance agency efficiency, and reduce the agency cost as well. In addition, since the social position and social relations of independent individuals would bring influence of different degrees on the information acquisition and resource acquisition of these individuals and the social restriction to which they are subject, the central locations of independent directors in the network of the board of directors can help directors to acquire information more rapidly and accurately and expand knowledge-acquisition channels. In contrast, it would be more difficult for directors located relatively marginally to acquire more information of various types; they cannot easily discover invisible agency issues of this type, eventually leading to lower agency efficiency of companies.

Accordingly, the following hypotheses have been put forward:

H1: The higher the network centrality of corporate directors; the lower the corporate agency cost and the higher the corporate agency efficiency would be

In China, boards of directors of state-holding enterprises have less power than those of private enterprises and foreign-funded enterprises. First, relevant government departments would intervene in the formulation of senior-executive compensation of state-holding enterprises. In 2002, the annual salary system was carried out among central enterprises for the first time. The government set the ratio between actual average salary of heads of central enterprises and the average salary of enterprise employees to be 12:1. In addition, during compensation assessment of senior executives of state-owned enterprises, not only performance but also taxation, shouldering of social responsibility, employment assistance and other non-shareholder-wealth-growth factors are included in the scope of assessment, which results from the particularity of state-owned assets. These factors enable directors of state-owned enterprises to have less say in the board of directors. Second, the major shareholders of state-owned enterprises are more aggressive (basically because of their mighty government background), with the right to appoint and dismiss independent directors. The governance capability and motive of state-owned enterprises are not as strong as those of private enterprises. Therefore, independent directors in the network of the board of directors will play a relatively weak role while reducing the two types of corporate agency costs.

Accordingly, the following hypotheses have been put forward:

H2: State-owned listed companies have a weaker relationship between the network centrality of directors and the reduction of agency costs and the enhancement of agency efficiency.

3. Research design

3.1 The measurement of indexes of network centrality of directors

According to the research result of Xie Deren and Chen Yunsen (2012), there are 4 indexes of network centrality: degree centrality, betweenness centrality, closeness centrality and eigenvector centrality. We can weigh network characteristics of directors from different perspectives by taking these 4 indexes into overall consideration, so as to more comprehensively measure the network centrality of directors (Wasserman、 Faust，1994; Larcker et al，2011)

（1）Degree centrality

$$Degree_a = \frac{\sum_b x_{ab}}{m-1} \tag{3.1}$$

Degree centrality denotes the percentage of directors (generated by concurrent posts) directly connected with a director in all directors (directly and indirectly) connected with the director. Degree centrality signifies the activeness of director communication; namely: the greater the degree centrality is, the more channels through which this director acquires information in the network would be.

（2）Betweenness centrality

$$Betweenness_a = \frac{\sum_{a<c} j_{ac(n_b)} / j_{ac}}{(m-1)(m-2)} \tag{3.2}$$

Betweenness centrality denotes that a director is located between two indirectly-related directors (with a binding interval of 2 and above); in the shortest interval of mutual relations, the measurement of the category of this director must be carried out. In addition, in order to avoid difference resulting from the scale of directors of different years, an adjustment would be usually made to avoid the influence. Betweenness centrality signifies the control of a director over other directors in the network relations through whom the shortest interval must be produced for binding; the greater the betweenness centrality is, the stronger active position and control ability the director would have during communications.

（3）Closeness centrality

$$Closeness_i = \sum_{b=1}^{j} l(a,b) \tag{3.3}$$

Closeness centrality denotes the sum of the binding intervals of all directors (directly and indirectly) connected with a director.

（4）Eigenvectori centrality

$$Eigenvectori = \frac{1}{\lambda}\sum_{b} j_{ab}E_b \tag{3.4}$$

Eigenvectori centrality denotes that the centrality of other directors bound with a director is taken into consideration for the centrality of this director; that is to say, as for two directors who also have binding relations with three other directors, if the triple binding relations of one of the two directors also have more other bonds, then the eigenvectori centrality of this director would be higher. This means that this centrality weighs that the network centrality of a director is closely related to other directors.

Various centralities weigh the structural characteristics of network from different perspectives, with correlation existing among them. In this thesis, the network structure of chain directors is defined as a concept at the corporate level; namely, as long as one or more directors assume concurrent posts in two companies, these two companies can be affirmed to have a bond of chain director relationship. The specific method is as follows: First, we can collect basic data of corporate directors in sample data and manifest them in the form of matrix according to different years, work out the network centrality data of each director in each year according to indexes, and then we can select required data therefrom to carry out next-step further research and exploration. Then, by conducting binding treatment to personal indexes, we can calculate network centrality in the unit of companies, set up the network centrality indexes at the overall level of the board of directors of the company, and use it to help to analyze the relations between director network centrality and agency cost size. The mean value of corporate director network centrality is used as the major research index in this thesis.

3.2 Research model and variable definition

In order to study the functions of the network locations of corporate directors for directors to reduce agency cost and enhance agency efficiency, we have set up the following model:

(1) $$AC_t = \alpha_0 + \alpha_1 CEN_t + \alpha_2 SOE_t \times CEN_t + \alpha_3 SOE_t + \sum Controls + \varepsilon$$

$$AC_t = \alpha_0 + \alpha_1 CEN_t + \alpha_2 SOE_t \times CEN_t + \alpha_3 SOE_t + \sum Controls + \varepsilon$$

(2) $$AE_t = \beta_0 + \beta_1 CEN_t + \beta_2 SOE_t \times CEN_t + \beta_3 SOE_t + \sum Controls + \varepsilon$$

$$AE_t = \beta_0 + \beta_1 CEN_t + \beta_2 SOE_t \times CEN_t + \beta_3 SOE_t + \sum Controls + \varepsilon$$

The definitions of the variables in the model are shown in Table 1. Therein, according to statements of Ang et al (2000), Luo Wei and Zhu Chunyan (2010) et al, the agency issues of the first type between management and shareholders (AC1) is weighed with the rate of management expense (the management expense/operating income in year t); the research result of Jiang Guohua and Yue Heng (2005) and Jiang et al (2010) can be used as reference. The agency issues of the second type (AC2) are weighed with the rate of capital occupancy (other receivables/total assets at the end of the period of the company at the end of year t). According to Li Shouxi (2007), agency efficiency (AE) is the asset turnover ratio (the main business income/total assets at the end of the period of the company in year t). CEN_t is the network centrality index of corporate directors, namely the major explanatory variable in this thesis, which has already been explained in details above. If α_1 and β_1 are negative, the higher the network centrality of corporate directors is, the lower the agency cost of board of directors would be, and the higher the agency efficiency would be; i.e. the less the agency issues of the two types faced by the company would be, the better supervisory effect the board of directors would have. Based on this hypothesis, we can consider whether the property right nature of the company (SOE, denoted with dummy variables; if the actual controller is state-owned, then it would be 1; otherwise it would be 0) affects the influence difference of director network centrality to agency issues. Controls represent control variables, including corporate scale, industrial effect, indexes of corporate financial performance (ROA, ROE, etc.), percentage of state-owned shares, etc. The part of robustness test takes into consideration the explained variables which occur after different calculation methods and industrial adjustment.

Table 1: Variable definitions

Variable name	Sign	Variable definition
Agency cost	AC1	Ratio of management expense, the management expense/operating income in year t

	AC2	Capital occupancy of major shareholders, other receivables/total assets at the end of the period of the company in year t
Agency efficiency	AE	The ratio of asset turnover, the main business income/total assets in year t
Network centrality of corporate directors	CEN	The comprehensive index of network centrality of independent director of the company at the end of year t
The nature of the final controller	SOE	Dummy variable; if the actual controller is state-owned, it would be 1; otherwise it would be 0
Profitability	ROE	Net profit in year t; average shareholder equity
Corporate scale	SIZE	The natural logarithm of total assets at the end of year t
Leverage	LEV	Total liabilities/total assets at the end of year t
Industry	IND	The dummy variable of industry is based on the industrial classification standards of China Securities Regulatory Commission in 2001

3.3 Samples and data

Initial research samples were 2009-2013 A-share listed companies, excluding samples of financial industrial companies, absent samples of corporate director data and other absent samples of financial and corporate governance data. All other data come from CSMAR database. The large social network data analysis software UCINET was used for the calculation of director network centrality, and SPSS was used for regressive analysis.

4. Result analysis

4.1 Descriptive statistics

Table 2 lists descriptive statistics of major variables. AC1 reaches 17% on average, and the administrative expense among managers accounts for a considerable part of operating income, proving that the agency cost therein is very high. In contrast, the mean value of AC2 is 1.9%; therefore, the agency issues between major shareholders and small and medium shareholders are still relatively optimistic. The standard difference of AC2 is also the smallest among variables, reflecting the smallness of its fluctuation degree. The mean value of comprehensive network centrality is 0.5489.

Table 2: Descriptive statistics

	N	Minimum	Maximum	Mean value	Standard difference

AC_1	6424	.000000	130.695677	.17499316	2.137309296
AC_2	6424	.00000000000	.99319926716	.0192243519708	.04277314096120
AE	6424	.000000	9.309835	.67513744	.580483575
CEN	6424	-18.21575	21.05775	.5488758	2.05473834
SOE	6424	0	1	.05	.220
ROE	6424	-18.718840	4.485186	.08913971	.313843509
SIZE	6424	11.348330	28.482028	21.70540016	1.437239291
LEV	6424	-317.432225	5151.985558	4.43075335	65.415112078

Table 3 analyzes relevant coefficients of major variables: these two explained variables denoting agency costs AC1 and AC2 are obviously negatively correlated with CEN, agency efficiency AE is obviously positively correlated with CEN, and both correlation coefficients are less than 0.5. As indicated by the Correlation coefficients, the higher the director network centrality is, i.e. the closer the director is located to the location of the director at the center of network; the more approaches the director would have for acquiring information, the higher reputation the director would have and the more obviously the director would exert his reputation incentive function; thus resulting in the reduction of the agency costs of the two types, the enhancement of agency efficiency, the increase of the obviousness of his governance function, and his control of occupancy of major shareholders to corporate capital to a very large extent.

Table 3: Analysis sheet of relevant coefficients

	AC1	AC2	AE	CEN	SOE	ROE	SIZE	LEV
AC1	1	.204**	-.053**	-.003	-.005	-.013	-.095**	-.003
AC2	.064**	1	-.015	.011	-.013	-.241**	-.112**	-.003
AE	-.460**	.073**	1	.038**	.051**	.046**	.054**	.015
CEN	-.038**	-.049**	.061**	1	.008	.007	.050**	-.002
SOE	-.023	-.018	.042**	.038**	1	-.004	.089**	.060**
ROE	-.158**	-.011	.174**	-.007	-.028*	1	.059**	-.007
SIZE	-.413**	-.017	.045**	.181**	.093**	.106**	1	.006
LEV	-.021	.115**	.296**	.043**	.038**	-.247**	.051**	1

At the upper right corner is pearson coefficient, At the lower left corner is spearman coefficient, **; when the confidence coefficient is 0.01, correlation is significant; *. When the confidence coefficient is 0.05, correlation is significant.

4.2 Regressive analysis

The major regressive results of the model are shown in Table 4, which displays the regressive coefficients of different variables to agency cost and agency efficiency, and the coefficients which occur after the participation of control variables. As inferred from the table, as for the tests of the agency issues of the first type, CEN and AC1 are negative when no other control variables participate, indicating that the higher the network centrality of corporate directors, the stronger the reputation incentive function exerted by independent directors through director network would be, and the more channels there would be for acquiring resource information; thus promoting the activeness of the board of directors and resulting in the obvious reduction of management expense ratio and the reduction of agency cost between managers and shareholders. After the participation of SOE variable, the absolute value of SOExCEN coefficient would decrease and this type of negative correlation would weaken, indicating that if the actual controller of an enterprise is state-owned, then this listed company would more or less be subject to the intervention of government, and the position of its board of directors would not be as obvious as that of other enterprises, and its management effect would also be affected. Therefore the function of its director network would decline to some extent.

The test result of the agency issues of the second type is: the network centrality of directors and agency efficiency are positively correlated, indicating that the higher the network centrality of corporate directors is, the more effectively the board of directors would control the capital of major shareholders; thus preventing major shareholders from occupying corporate operating capital randomly, and enhancing the efficiency of asset operation and the agency efficiency of companies. SOExCEN reduces coefficients considerably, but the coefficients are still positive, indicating that the nature of property right exerts some influence on the function of director network for enhancing corporate agency efficiency.

As can be inferred from above-mentioned argumentation results, the network centrality of the board of directors can reduce corporate agency cost and enhance corporate agency efficiency, with an obvious acting effect, and Hypothesis H1 is positive. State-owned listed companies have a weaker correlation between network centrality of board of directors and reduction of agency cost and increase of agency efficiency, but private enterprises have a stronger correlation in this regard. The nature of corporate property right weakens the correlation of the two, and Hypothesis H2 has been verified.

Table 4: Regressive analysis between network centrality of the board of directors and agency cost and agency efficiency

	AC_1			AC_2			AE		
CEN	-.003	.002	.002	-.013	.020	.021	.038	.035	.030
SOExCEN	-.001	-.003	-.002	-.013	-.015	-.013	.002	.003	.002
SOE	-.005	.004	.004	-.010	-.001	-.005	.050	.045	.033
ROE		-.007	-.007		-.236	-.239		.044	.041
SIZE		-.095	-.102		-.098	-.138		.046	.099
LEV		-.003	-.002		-.004	-.001		.012	.009

Agriculture, forestry, animal husbandry and fishing			-.018			-.015			-.001
Mining and quarrying			-.014			-.015			.010
Production and supply of electricity, coal gas and water			-.018			-.090			-.066
Construction			-.018			.035			.035
Transportation and storage			-.021			-.049			-.062
Wholesale and retail trade			-.032			-.038			.345
Real estate			-.008			-.046			-.161
Social service			-.032			-.065			-.008
Communication and culture			-.021			-.001			.038
Manufacturing			-.074			-.274			.132
Information technology			-.028			-.128			.038

4.3 Robustness test

First, different definitions were applied to work out derived values to the capital occupancy of major shareholders, ROE and other indexes. The following two calculation methods were adopted for the capital occupancy of major shareholders: (accounts receivables + prepayment + other receivables)/total assets at the end of the period and other receivables/total assets at the end of the period. The following two calculation methods were adopted for ROE: net profit/shareholder equity balance and net profit/shareholder equity average balance. The result indicates that the function of corporate property-right nature declines, but the relevant influence of director network centrality on agency cost and agency efficiency remains unchanged.

Next, the data of the former three years 2009-2011 and the data of the latter three years 2011-2013 were respectively selected for regression. Although the overall data trend remains unchanged, the correlation of the former is not as obvious as that of the latter. Then, the indexes of network centrality are observed respectively, and it has been found out that the difference of network centralities among different companies is much more obvious in the latter three years than in the former three years. Therefore, in our opinion, the stronger the correlation among some members of the board of directors is, the more possibly the difference among the network locations of the board of directors would be intensified; thus further affecting the agency issues. Accordingly, along with the continuous reinforcement of director network in the future, this kind of effect of network location centrality on agency issues will be further intensified.

5. Research conclusion and limitation

5.1 Research conclusion

With the network of the board of directors as its starting point, this thesis studies how the network of corporate directors helps to solve the problem of corporate agency and enhance agency efficiency. Based on the data analysis of chain director networks of four regions in China (Jiangsu, Zhejiang and Shanghai; Beijing, Tianjin and Hebei; Guangdong, Guangxi and Hainan; Yunnan, Guizhou, Sichuan and Chongqing), this thesis uses UCINET software to draw the chain director network structure connection diagrams of the four regions in consecutive five years from 2009 to 2013, and work out the network centrality therein as the index for weighing chain director networks. According to the opinion of this thesis, differentiating network characteristics of the board of directors means differentiating the governance capability and motives for independent directors to supervise major shareholders and management. This thesis applies the analytic method of social network centrality to calculate the network centrality of independent directors. Data display is derived through empirical analysis: the higher the director network centrality of listed companies is, the lower the agency issues of the two types would be, and the higher the agency efficiency would be (the property right background of companies can weaken this effect), and network centrality exerts indirect positive influence on corporate value. As pointed out by the conclusion, the function exerted by the network of the board of directors in different social networks would have different helpfulness to corporate governance, and the directors located at the center of network can govern companies more desirably.

In the opinion of people in academic and practical circles, independent directors exert different functions in the governance of corporate board of directors. The former is mixed viewpoints of various kinds. The latter also negatively holds the opinion that independent directors in the board of directors of listed companies are nothing but “a show”. According to the opinion of this thesis, whether or not independent directors can exert their governance function in companies lies in whether or not the characteristics of independent directors can be found out to differentiate governance behaviors. Supervising the inside of companies, lowering agency costs of two types and protecting small and medium investors are the chief goals for setting up independent directors. However, in most listed companies, major shareholders and managers directly appoint independent directors, or exert an important influence in the process of appointment. Under such circumstances, it would be meaningless to increase the number of independent directors to reinforce supervision. Companies should pay more attention to which type of independent directors can more effectively supervise major shareholders and managers. People with high social prestige can also perform duties and carry out supervision as corporate independent directors.

5.2 Innovative significance

The argumentative significance and innovative point of this thesis lie in: First, studying the functions of directors in corporate governance based on network of the board of directors is a new topic of “social network and corporate governance”. From the perspective of agency cost of corporate governance, this thesis studies the active function of board-of-director network in which corporate directors are located on reducing agency cost and enhancing agency efficiency—Directors located at the center of network can play an active role in solving agency problems. Based on this conclusion, the management team and capital market can reestablish a new concept, i.e., directors with different backgrounds have different functions while participating in important decision-making of companies. Second, not all independent directors are "just for show". Due to the network characteristics of the board of directors, the governance capability and governance effectiveness of independent directors located at the center of the network of the board of directors are far stronger than those of directors located at other positions. This viewpoint provides a new research direction and new evidence for the research of independent directors.

5.3 Research limitation

The sample data of this thesis involve more than 1,000 listed companies. On the one hand, due to miscellaneous data, regions are divided when statistical data are analyzed in groups. This results in artificial severance of director relations among different regions. On the other hand, such a data quantity is far from enough for studying the overall level of director networks.

Financial indexes are chiefly selected as indexes of this thesis, which cannot help to comprehensively weigh enterprise performance and value. During future research, non-financial indexes should be used in connection with financial ones. We can use the relevant data of listed companies about the director governance of companies to test whether or not independent directors located at different network positions have real independent performance in corporate governance and whether or not they can really deliver objective comments and put forward objective methods on corporate governance, thus verifying the hypotheses of this thesis.

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