The Network Of Interlocking Directorates And Firm Performance In Transition Economies: Evidence From China

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ABSTRACT

Using a Chinese sample containing 8727 firm-years over the period from 2005 to 2010, we investigate the economic effect of interlocking directorate networks, and find that firms with central position measured by network centrality in interlocking directorate networks earn superior one- to three-year ahead performance measured by return on assets (ROA) and return on Sales (ROS). We also show that the economic effect of interlocking directorate network is more pronounced in non-state-owned enterprises (NSOEs) compared to state-owned enterprises (SOEs). Our evidence is important, because it shows that to some extent the interlocking directorate network can serve as an solution to the institutional voids which are derived from the reform in Chinese translation economy.

Keywords: Institutional Voids; Interlocking Directorates; Centrality; Performance

1. INTRODUCTION

Social and economic networks have deeply attracted considerable attentions of economists and sociologists in recent years. These networks act a role of a conduit for interpersonal and inter-organizational resource and information flow, and thus are a central feature of virtually all economic activates. One important network in corporate finance is the interlocking directorate network which is exercised by directors who sit on two or more boards of companies, namely, interlocking directorates (Mizruchi, 1996). The interlocking directors in these networks are the channels by which information and resource are communicated, new relationships are formed, and existing relationships are promoted, and in turn have an economic effect on firm performance.

Several exiting studies examine the economic impact of the interlocking directorates on firm performance, while they provide inconsistent evidence. Some studies find that interlocking directorates adversely affect firm performance, manifest in a positive market reaction following the departure of interlocking directors (Fich and Shivdasani, 2006) and increase the probability of accounting fraud (Beasley, 1996). Other studies, however, show that interlocking directorates are positively related to shareholder wealth, offer larger premiums in tender offers (Cotter et al.,1997), and generate superior returns from acquisitions (Harris and Shimizu, 2004). The collective evidence from the literature on the economic effect of interlocking directorates highlight the uncertainty of the association between interlocking directorates and firm performance, and relative absence of investigation beyond US. In this paper, we try to contribute to the existing literature on interlocking directorates by providing additional evidence on its economic effect, but with respect to an translation economy, China. Specifically, we investigate the two following questions: (1) is there an empirical relationship between a firm's performance and its position within an interlocking directorate network; and (2) if it is, dose such a relationship vary across different types of firms?

We carry our investigations by using a comprehensive sample of 8727 firm-years of Chinese listed firms over the period from 2005 to 2010. Implying standard Social Network Analysis, we form annual interlocking directorate networks by interlocking directorates, and then calculate the importance of a firm's position in the

interlocking network using three standard measures of network centrality: degree, eigenvector and betweenness centrality (Grewal et al., 2006). To capture the aggregate character of a firm's network position, we also compute the equal-weight average of the three centralities as a aggregated measure.

First, we investigate the economic impact of interlocking directorate networks on firm performance. By regressing the one- to three-year ahead firm performance measured by return on assets (*ROA)* and return on sales (*ROS*) on the centrality measures, we find that firms that are more networked can earn significantly higher *ROA* and *ROS* in future one to three years. Our results show that, by one interlock increased, *ROA* (*ROS*) of a firm would rise by 1.5% (6.8%) in one-year ahead. Thus, the performance effect of interlocking directorates is economically significant, given that the mean *ROA* (*ROS*) across all firm-years is 2.3% (5%). We interpret the positive centrality-performance relation as evidence that, all else equal, firms on average benefit from being networked in the interlocking directorate network.

Our first investigation is motivated by the idea that the interlocking directorate network is a solution to institutional voids in translation countries (Khanna and Yafeh, 2007). China is undergoing a broadly economic reform, most of central planning policies have been abolished, whereas a mass of market-oriented policies have been built but not yet to be fully implemented. Thus it leads to institutional voids in economic activities (Khanna and Palepu, 1997). Chinese companies deeply suffer from uncertainty of economic policies and the incremental significant transaction cost which are derived from institutional voids. Being networked by interlocking directorates, a firm can use interpersonal relationship of interlocking directors to better archive knowledge, public policies, contracts and resources, which facilitate the ability of settling uncertainty, relaxing resource constrains and reducing transaction cost, and hence yield economic benefits.

Next, we examine the whether the economic effects of interlocking directorate network vary across the state ownership status of firms, namely state-owned enterprises (SOEs) and non-state-owned enterprises (NSOEs). The evidence indicates that the association between centrality and firm future performance is more pronounced in NSOEs. We interpret the results as that, all else equal, NSOEs can benefit more from being networked by interlocking directorates relative to SOEs and that performance measures reflect these benefits.

The second investigation is motivated by the fact that SOE property is owned by Chinese government and most executives of SOEs currently sever as government officers. Thus, SOEs can capture more support and protection from government at a lower cost, and suffer less from uncertainty, resource constraints and institutional voids compared to NSOEs. In turn, NSOEs stand to benefit more from the interlocking directorate networks which provide a solution to these disadvantage caused by institutional voids in Chinese business environment.

Collectively, the results of our paper provide evidence that firms that are more networked though interlocking directorates exhibit better future performance and the economic effect of interlocking directorate network is more pronounced in NSOEs than SOEs. These results are not sensitive to several robust tests that we estimate a change in change specification of centrality-performance relation, and measure firm performance by market-adjusted stock price return and Tobin's Q. Our results contribute to the interlocking directorates literature by extending research setting to a translation economy in which firm are in different ownership control status and hence lead to difference in economic effect of interlocking directorate networks. Further, our evidence also suggest that not only interlocks of a firm matter, but also the network position of a firm matter; the investigation on the network position are rare.

The rest of the paper is organized as follows. Section 2 reviews the related literature and section 3 describes the data, the centrality measures of interlocking directorate networks and its characteristics. Section 4 discusses our empirical results and robustness tests and Section 5 provides the summary and conclusions from our study.

2. RELATED LITERATURE AND HYPOTHESES DEVELOPMENT

2.1. Theories and Evidences on Interlocking Directorates and Firm Performance

The exiting literature on the relationship between interlocking directorates and firm performance falls broadly into two streams. In one link of the studies, resource dependency hypothesis suggests that companies may benefit from appointing directors with multiple positions as their directors (Ferris et al., 2003). Interlocking directors may not only bring in a wealth of accumulated knowledge and experience to the boardroom, but also serve as better conduits for establishing linkages between a firm and its external environments. Interlocking directorates may benefit companies though reducing environment uncertain and promoting the ability to access to network resource, hence resulting in a better future performance and thus an improved market value. This rich body of research consists largely of descriptive work from a range of different countries, such as large-sample statistical work set in US (Booth and Deli, 1996), Chile (Khanna and Thomas, 2009), India (Sarkar and Sarkar, 2009) and so on.

A second important stream of studies based on busyness directors hypothesis emphasizes the negatively effect of interlocking directorates on firm performance. This line of studies was pioneered by Ferris et al., (2003), whose writing argues that an individual who sit on multiple boards would become over-committed, and thereby compromise on his/hers ability to monitor company management effectively on the behalf of the shareholders. Some research find that the number of interlocking directors of a firm is associated with poorer performance in future (Fligstein and Brantley, 1992), lower the sensitivity of CEO turnover, a positive market reaction following the departure of an interlocking director (Fich and Shivdasani, 2006), lead to excess remuneration of CEOs (Core et al., 1999), and increase the probability of committing accounting fraud (Beasley, 1996).

All of the theoretical arguments and most of the limited evidence that exists on the costs and benefits of interlocking directorates are restricted predominantly to developed countries, specifically to the US. It is difficult to generalize the findings of these studies because the ambiguous nature of these findings may be a reflection of uncertainty over the association between interlocking directorates and profitability in different economies. How interlocking directorates affect firm performance is not fully known for transition economies, such as China. Additionally, other limitation in previous studies is that they do not fully capture the position of a firm within an interlocking directorate network, for example, most of the previous literature only count how many interlocking directors of a firm, and take it as an explanatory proxy of firm interests. There is an absence of counting the degree to which a company is networked.

In this paper, we attempt to theoretically analyze how interlocking directorate networks affect firm performance in Chinese transition economy from the institutional economics perspective. We do not disagree with the resource dependent view on interlocking directorates' function in improving firm performance. Companies in Chinese really suffer from insufficient resources and interlocking directorates do help to relax the resource constraint. More importantly, companies suffer more from the institutional voids that currently exist in Chinese transition economy (Ma et al., 2006). A company may connect with other companies by appointing individuals with interlocking directorates, and then is involved into an interlocking directorate network form which the company could capture interlock social capital. We view interlock social capital as the relation among directors and companies that provide companies access to information and resource that flow or embed in the interlocking directorate network. We argue that the interlock social capital plays a critical a role in filling some institutional voids, and hence significantly improve firm performance in Chinese business environment.

2.2. Institutional Voids: Improved Performance by Being Networked

China is undergoing a broadly economic reform from central planning economy to market-oriented economy. In the past three decades, most of central planning policies have been abolished, and a mass of market-oriented policies have been built but not yet to be effectively implemented, which lead to institutional voids. Additionally, the efficiency and enforcement of Chinese legal and court system is regarded as inefficiency in dispute resolution, especially for business litigation. (Allen, et. al., 2005). As a result, Chinese companies suffer from such institutional voids in two ways: uncertainty of economic policies and incremental transaction cost.

As known to all, Chinese economic reform is not based on any exiting case; rather, it is "Crossing River by Groping for Stone", a well-known metaphor often attributed to Deng Xiaoping's "Market Socialism" framework, meaning that the reform is simply guided by an "error-and-adjustment" pattern. It is very frequent for Chinese government to readjust the public policies, industry promotion/demotion plans, interest rate, even tax regulations. In turn, the business environment stays a high level of uncertainty, which acts as a role of operating risk and hence impairs compromise profitability.

Several prominent economists have argued that institutions shape economic outcomes. one important role of institutions is "to reduce uncertainty by establishing a stable structure … institutions affect the performance of economy by their effect on the costs of exchange and production"(North, 1990). The higher transaction cost is an important consequence of institutional voids. In Chinese business environment, contract governance mechanism is not effective and not enough to support transaction parties to predict the outcomes of transaction contracts. So transaction parties always take more action to explore each other's prestige, and monitor each other over payment and after-services. This, in turn, brings our extra transaction cost, even prevents exchange when one party over worries about the unpredicted outcomes of transaction contracts. What's worse, the weak legal and court system has less ability to serve as a final and effective violation-and-punishment mechanism for transaction dispute, and hence result in extra self-protection behavior which is very costly.

Interlocking directorate networks give a company interlock social capital that work as a solution to the incremental uncertainty of business environment and cost of transaction resulted from institutions voids in China. On the one hand, previous research has suggested that interlocking directorates may play a role of linkages between companies and its external environment. Here, we believe that interlock social capital help companies to promote the ability to settle environment changes. In particular, interlock social capital benefit companies by facilitating the access to information about public policies and the activities of other companies, and it also help companies to relax resource constrains through facilitating cooperation within interlocking directorate network. Companies with central position in a network should find it easier to access to useful information and necessary resource; these advantages could be developed into the abilities to adapt themselves to (not necessarily reduce) environment uncertainties, and hence resulting in financial profitability improved.

On the other hand, interlock social capital reduce transaction cost by the way of *guanxi*-based exchanges in Chinese business environment. A company could establish personalized relationships or the *guanxi* with other companies by sharing interlocking directors. Thus, *guanxi*-based exchanges appear to substitute for formal or contract-based exchanges, and it helps to save transaction cost (Peng and Luo, 2000). As an important transaction governance mechanism in Chinese business environment, *Guanxi* control opportunism behavior at much lower cost than that of legal and court system. Pervious works had suggested that *guanxi* had permeated the economic sphere as a "second currency", and it constitutes a secret to corporate success. Companies who maintain a better *guanxi* network in operating activities take competitive advantages over the others. Indeed, a special word "*guanxihu*" derived from *guanxi* is widely used to name such competitive advantages of companies being networked in Chinese business practice (Park and Luo, 2001). Specifically, *guanxihu* as buyers are likely to access to goods of higher quality, and gain more from extension of commercial credit, while *guanxihu* as sellers are expected to achieve a higher performance of sales. Further, guanxi-based exchange helps to simplify trade procedures and deepen relationship among companies involved in the same interlock network. As a result, companies being more networked could benefit more from interlock social capital in a long run.

In summary, there are strong theory and evidence indicate that company performance benefit from its interlocking directorate network in Chinese business environment, achieved by promoting the ability of settling uncertainty, relaxing resource constrains and reducing transaction cost. Building on the above, we seek to examine whether firm performance are facilitated by being networked though interlocking directorates. Therefore, our first hypothesis (in alternative form) is:

H1: Firms that are more networked through interlocking directorates exhibit higher performance.

If the performance effect of interlocking directorate network we argue above is hold, we next consider whether the relation is also persistent across different types of firms. Specifically, identifying the characteristics of

firms for which this association is particularly strong can provide insights into possible underlying economic mechanisms driving the performance associated with interlocking directorates. The idea that interlocking directors provide access to competitive edge such as the ability of settling uncertainty, relaxing resource constrains and reducing transaction cost suggests that the impact of interlocking directorates on firm performance should be most pronounced among firms that are most likely to benefit from such competitive edges, namely, NSOEs.

It is interest to note that SOEs in China is used by the government to facilitate institutional reform (Gupta and Wang, 2004; Yiu et al., 2005). Further, most executives of SOEs are appointed by government and currently sever as government officers. Hence, it is easier for SOEs to capture support and protection from government, and in turn they suffer less from uncertainty, resource constraints, and institutional voids compared to NSOEs. For NSOEs, such an advantage does not exist, but they can use interlocking directorate network as a substitute to make up for the lack of unambiguous contract transaction mechanism and to solve the consequent problems. Thus, NSOEs would benefit more from interlocking director networks. Therefore, our second hypothesis is:

H2: The performance effect of interlocking directorate network is more pronounced in NSOEs than SOEs.

3. EMPIRICAL METHODOLOGY

3.1. Data and Sample Description

The data for our analysis is obtained from the CSMAR database which provides information on listed-firms in China. To select our sample, we take two steps: first, we require that directors' resumes are available in CSMAR to identify interlocking directors, which restricts our sample to the post-2005 period and we obtain 9896 firm-years. Secondly, we delete financial sector because financial firms have special financial statements, and then exclude companies with missing data for multivariate analysis. At last, our sample contains 1893 firms and 8727 firm-years.

3.2. Centrality of Interlocking Directorate Networks

For each node/firm in a network, we construct three measures of centrality that are standard in social network analysis. The measures capture three separate dimensions in which a node can be considered important in a network. Let $\boldsymbol{A}$ be the $\boldsymbol{n}\times\boldsymbol{n}$ adjacency matrix of an network, where $\boldsymbol{n}$ is the number of firms. Cell $\boldsymbol{A_{ij}}=\mathbf{1}$ if firm $\boldsymbol{i}$ and firm $\boldsymbol{j}$ share one or more directorates; otherwise $\boldsymbol{A_{ij}}=\mathbf{0}$. The first measure is *DEGREE* centrality (Faust, 1997), which measures a node's connectedness, and is defined as the number of first-degree links to outside boards, thus:

$$DEGREE_i = \sum_{i=1}^{n} A_{ij} \tag{1}$$

A higher value of *DEGREE* implies that the firm shares directors with more firms. Intuitively, more shared directorships with other firms may provide with a company better ability of settling uncertainty, relaxing resource constrains and reducing transaction cost.

Our second centrality measure, *EIGEN*, is eigenvector centrality (Bonacich,2007), which measures node's importance in terms of the centrality of its neighbors. *EIGEN* defines the centrality of a node to be proportional to the centrality of its neighbors, thus:

$$EIGEN_i = (\sum_{j=1}^{n} A_{ij} EIGEN_j)/\lambda \tag{2}$$

Rewrite $\boldsymbol{n}$ expressions into a linear equation system as: $\boldsymbol{\lambda E=AE}$, where $\boldsymbol{E}$ is equal to a column vector [$\boldsymbol{EIGEN_1}$, $\boldsymbol{EIGEN_2}$,…, $\boldsymbol{EIGEN_n}$]; $\boldsymbol{\lambda}$ is a eigenvalue of matrix $\boldsymbol{A}$. $\boldsymbol{E}$ and $\boldsymbol{\lambda}$ are available by using standard the eigenvector-eigenvalue formulation to solve the linear equation system. To obtain positive values for every members of the network, let $\boldsymbol{\lambda}$ to be the largest eigenvalue. Thus, ***EIGEN*** is exactly the eigenvector centrality (Faust, 1997). As such, ***EIGEN*** attempts to capture the extent to which a firm is connected to other important nodes of the network, i.e., the notions of power and prestige. Since in the eigenvector centrality the sum of direct linkages is weighted by their own centralities, ***EIGEN*** is natural extension of the degree centrality based on adjacency relation.

The position of the firm in network is important if a firm can control many linkages among others. The third measure, betweenness centrality (Linton, 1997), is designed to capture this effect:

$$BETWE_i = \sum_{j<k}[(g_{jk}(i)/g_{jk})], \qquad j,k \neq i \tag{3}$$

Where g_{jk} is the number of the linkages between firm *j* and firm *k*, and $g_{jk}(i)$ is the number of paths between firm *j* and firm *k* that passing firm *i*. One can interpret the distance of the shortest path between two companies to be proportional to the costs of communication or obtaining favors among them, and as such we can interpret *BETWE* as a measure proportional to the average cost of communicating with or obtaining favors from another firm.

At last, in order to capture the total effects of a firm's network position, we combine the three individual measures by taking the equal-weighted average and label it as *CENTR*:

$$CENTR_i = (DEGREE_i + EIGEN_i + BETWE_i)/3 \tag{4}$$

Table 1 contains centrality statistics of our final sample. In the Panel A of Table 2 we report the yearly distribution in term of the number of interlocking directors held by firms. Of the 8727 firm-years, only 16.7% (1457) have no interlocking director, with a minimum value 14.61% in year 2010 and a max value 19.07% in year 2005. Only around 16.36% of the sample firms have five or more interlocking directors. If the board of a firm with five or more interlocking directors is defined as a busy board, thus 16.36% of the sample firms have busy boards. It is a relatively small incidence of busy boards in China which is much lower than the level of 68% in India (Sarkar and Sarkar, 2009) and the level of 21.42% in the USA (Stokman and Wasseur, 2002). Panel B of Table 1 presents the annual summary statistics of firms' network centrality measures.

Table 1. Sample Statistics

Panel A provides the number of firms and *DEGREE* distribution, and Panel B contains the pooled sample averages for each year of the 2005-2010 sample. All centrality measures (*DEGREE*, *EIGEN*, *BETWE*, and *CENTR*) are detailed in Section 3.2.

Panel A: Firms counts and DEGREE distributions by year

DEGREE	2005		2006		2007		2008		2009		2010		All	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
=0	259	19.07	255	18.76	248	17.43	243	15.93	201	14.96	251	14.61	1457	16.70
=1	263	38.44	256	37.60	239	34.22	227	30.82	199	29.76	257	29.57	1441	33.21
=2	222	54.79	223	54.01	246	51.51	245	46.89	209	45.31	252	44.24	1397	49.22
=3	193	69.00	214	69.76	194	65.14	222	61.44	178	58.56	247	58.61	1248	63.52
=4	149	79.97	145	80.43	157	76.18	181	73.31	175	71.58	213	71.01	1020	75.20
=5	85	86.23	102	87.93	126	85.03	143	82.69	129	81.18	153	79.92	738	83.66
>5	187	100	164	100	213	100	264	100	253	100	345	100	1426	100

Panel B: Firm counts and sample averages by year

	Obs.	*DEGREE*	*EIGEN*	*BETWE*	*CENTR*
2005	1358	2.248	3.724	1.572	7.545
2006	1359	2.353	3.527	1.289	7.169
2007	1423	2.296	3.320	0.859	6.474
2008	1525	1.649	3.084	0.959	5.692
2009	1344	1.810	2.854	0.947	5.612
2010	1718	2.137	3.062	0.899	6.098
All	8727	2.071	3.229	1.061	6.362

4. EMPIRICAL ANALYSIS

4.1. Performance Prediction

To test hypothesis H1, we estimate the fallowing regressions:

$$Performance_{t+i}=\alpha_0+\alpha_1 IDNC_t+\alpha_k Controls_t,\ i=1,2\ or\ 3 \quad (5)$$

The dependent variable, *Performance*, is firm future performance which is most widely measured by Return on Asset (*ROA*). Considering some debate concerning on the use of *ROA* rather than return on sales (*ROS*) as a measure of profitability, we also chose to measure it by focusing on *ROS*. *IDNC* is the interlocking directorate network centralities including individual centrality (*DEGREE*, *EIGEN* and *BETWE*) and our aggregated proxy (*CENTR*). To control for systemic variation in future *ROA* or *ROS*, Equation (5) includes five control variables: (1) current *ROA* or *ROS*. As pervious literature showed, financial performance has a strong persistence (Sloan, 1996) and hence the past and future *ROA* or *ROS* is highly correlated (Mozes 1992); (2) *Size* defined as the logarithm of the total assets at the end of year, and firm size is not only found to be positively correlated with profitability, but also suggested to be associated with the number of interlocking directors; (3) *Capex* measured by the ratio of capital expenditure to total assets, which captures the extent to which capital expenditures are spent on fixed asset to create future benefits; (4) *LEV* defined as the ratio of the liabilities to total assets; and (5) *Growth* measured as the growth of sales, which control the larger change in income as a result of a change in revenue. Additionally, to address the unobserved effect of industry and time, we include a vector of industry dummies and a vector of year dummies as controls.

Table 2 provides the descriptive statistics of our final sample and the correlations among the variables involved in multivariate analysis. Generally, the correlations between the explanatory variables are lower than 0.5, it suggests that the problem of multicollinearity is not a concern in multivariate analysis. The firm profitability proxies including *ROA* and *ROS* are correlated positively and significantly with three individual centrality measures and the aggregated proxy, though we do not focus on such homophonous relationship. Additionally, the correlation coefficients among the four centrality proxies are strongly positive. But correlation coefficients between *DEGREE* (*EIGEN*) and *BETWE* is a relatively small value small 0.43 (0.30), it indicates that betweenness centrality could capture the information not adequately captured by degree (eigenvector) centrality (i.e. the number of interlocks).

Table 2 Descriptive Statistics and Correlations

Panel A provides the descriptive statistics of the variable involved in multiple analysis and Panel B reports the correlations among variables. *, **, ***Significant at 10%, 5% and 1%, respectively. Please see Appendix for variable definitions.

Panel A: Descriptive statistics

	Mean	St.dev	P^{25}	Median	P^{75}	Obs.
ROA	0.021	0.089	0.009	0.029	0.056	8727
ROS	0.005	0.434	0.014	0.047	0.107	8727
Size	21.334	1.068	20.612	21.230	21.972	8727
Growh	0.245	0.558	0.006	0.158	0.349	8727
CAPEX	0.063	0.063	0.015	0.043	0.090	8727
Leverage	0.518	0.260	0.366	0.507	0.636	8727
DEGREE	2.071	11.445	0.093	0.233	0.397	8727
EIGEN	3.229	12.600	0.009	0.157	1.000	8727
BETWE	1.061	7.603	0.000	0.098	0.469	8727
CENTR	6.362	29.231	0.142	0.685	2.000	8727

Panel B: Correlation matrix

	ROA	*ROS*	*Size*	*Growth*	*CAPEX*	*Leverage*	*DEGREE*	*EIGEN*	*BETWE*
ROS	0.775***								
Size	0.210***	0.192***							
Growth	0.215***	0.173***	0.077***						
CAPEX	0.236***	0.165***	0.173***	0.053***					
Leverage	-0.471***	-0.383***	-0.0019	0.012	-0.142***				
DEGREE	0.070***	0.053***	0.093***	-0.025**	-0.006	-0.032***			
EIGEN	0.070***	0.049***	0.127***	-0.017	-0.008	-0.016	0.735***		
BETWE	0.049***	0.043***	0.077***	-0.004	-0.017	-0.028**	0.429***	0.297***	
CENTR	0.064***	0.048***	0.098***	-0.016	-0.010	-0.026**	0.765***	0.724***	0.692***

Panel A of Table 3 presents the pooled regression results from regressing future one- to three-year *ROA* on the three centrality measures and aggregate proxy. T-statistics in parentheses are clustered by both firm and year to account for cross-sectional and time-series dependence in the residuals (Petersen, 2009). Industry and year fixed effects are included throughout. The regression results demonstrate that all three centrality measures are significantly related to future performance. For instance, the coefficient of *DEGREE* on one-year ahead *ROA* is 0.015 with a t-statistic of 2.97, implying that the one unit increase in *DEGREE* would rises *ROA* by 1.5%. Thus, the effect of interlocking directorates is economically significant, given that the mean *ROA* across all firm-years is 2.3%.

Given the robust association between the three standard centrality measures and future performance, it is not surprising that our aggregated centrality proxy, *CENTR*, also demonstrates a statistically significant association with the future performance. Additionally, The performance effect of interlocking directorates network is hold when we substitute *ROS* for *ROA*. Panel B of Table 3 reports the results with future *ROS* as dependent variables.

Together, our results are consistent with the hypothesis that being central in interlocking directorate networks allows for better access to the ability of settling uncertainty, relaxing resource constrains and reducing transaction cost, and hence better performance.

Table 3. The regression results of firms' future performance and centrality measures

Panel A and Panel B provide the results on the relationship between firms' centrality and future performance measured by *ROA* and *ROS*, respectively. *DEGREE*, *EIGEN*, *BETWE* and *CENTR* are proxied by *IDNC* in column (1, 5 and 9), (2, 6 and 10), (3,7 and 11) and (4, 8 and 12), respectively. The *t*-values in parentheses are clustered at both year and firm levels. Year and industry fixed effect are controlled but not tabulated. *, **, ***Significant at 10%, 5% and 1%, respectively. See Appendix for definitions of variables.

Panel A: Regression results on future three year firm performance (*ROA*)

	ROA_{t+1}				ROA_{t+2}				ROA_{t+3}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
_cons	-0.041	-0.035	-0.038	-0.038	-0.058	-0.049	-0.052	-0.052	-0.066	-0.069	-0.061	-0.063
	(-1.17)	(-1.06)	(-1.16)	(-1.11)	(-1.12)	(-1.04)	(-1.09)	(-1.07)	(-1.02)	(-1.02)	(-0.97)	(-1.01)
ROA	0.377***	0.383***	0.313***	0.380***	0.287***	0.290***	0.220***	0.291***	0.218***	0.219***	0.219***	0.219***
	(14.05)	(13.99)	(13.74)	(13.93)	(5.06)	(5.10)	(5.09)	(5.09)	(12.67)	(12.74)	(13.04)	(12.81)
Size	0.004	0.003	0.004	0.003	0.005	0.004	0.004	0.004	0.002	0.002	0.002	0.002
	(1.54)	(1.56)	(1.59)	(1.57)	(1.29)	(1.18)	(1.19)	(1.19)	(0.76)	(0.79)	(0.72)	(0.77)
Growth	0.010***	0.010***	0.010***	0.010***	0.004*	0.004*	0.004*	0.004*	0.001	0.001	0.001	0.001
	(4.99)	(4.75)	(4.86)	(4.82)	(1.69)	(1.68)	(1.66)	(1.68)	(0.23)	(0.19)	(0.19)	(0.20)
Capex	0.095***	0.099***	0.098***	0.096***	0.090***	0.091***	0.090***	0.091***	0.044***	0.044***	0.043***	0.044***
	(5.79)	(5.89)	(5.92)	(5.85)	(4.37)	(4.47)	(4.45)	(4.44)	(3.01)	(3.01)	(3.03)	(3.014)
LEV	-0.019**	-0.019***	-0.019***	-0.019***	-0.029***	-0.029***	-0.030***	-0.030	-0.024***	-0.024***	-0.023***	-0.024***
	(-2.53)	(-2.52)	(-2.54)	(-2.54)	(-4.37)	(-4.31)	(-4.41)	(-4.35)	(-5.26)	(-5.33)	(-5.31)	(-5.31)
IDNC	0.015***	0.663***	0.988***	0.543***	0.014*	0.611*	0.826***	0.498**	0.014*	0.463	0.716***	0.347**
	(2.97)	(2.714)	(5.77)	(3.47)	(1.93)	(1.68)	(2.83)	(2.12)	(1.94)	(1.38)	(3.15)	(1.99)
Obs.	8727	8727	8727	8727	7551	7551	7551	7551	6246	6246	6246	6246
Adj. R^2	0.221	0.221	0.221	0.221	0.115	0.115	0.115	0.115	0.101	0.100	0.101	0.101

Panel B: Regression results on future three year firm performance (ROS)

	ROS_{t+1}				ROS_{t+2}				ROS_{t+3}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
_cons	-0.408**	-0.387**	-0.404**	-0.396**	-0.521**	-0.501**	-0.512**	-0.509**	-0.719***	-0.707***	-0.704***	-0.708***
	(-2.45)	-(2.44)	(-2.44)	(-2.44)	(-2.43)	(-2.40)	(-2.45)	(-2.42)	(-3.14)	(-3.21)	(-3.18)	(-3.19)
ROS	0.265***	0.266***	0.266***	0.266***	0.139**	0.140**	0.140**	0.140**	0.161***	0.162***	0.162***	0.162***
	(6.62)	(6.61)	(6.54)	(6.58)	(2.27)	(2.28)	(2.27)	(2.27)	(3.15)	(3.15)	(3.16)	(3.15)
Size	0.020***	0.019***	0.020***	0.020***	0.019**	0.019**	0.019**	0.019**	0.019**	0.020**	0.019**	0.019**
	(2.64)	(2.64)	(2.58)	(2.62)	(2.34)	(2.32)	(2.34)	(2.33)	(2.43)	(2.51)	(2.45)	(2.47)
Growth	0.046***	0.045***	0.045***	0.045***	0.018**	0.018**	0.017**	0.018**	-0.009	-0.010	(-0.010	-0.010
	(3.25)	(3.25)	(3.26)	(3.25)	(2.27)	(2.22)	(2.21)	(2.22)	(-0.82)	(-0.89)	(-0.86)	(-0.86)
Capex	0.407***	0.410***	0.407***	0.408***	0.356***	0.358***	0.356***	0.357***	0.129	0.128	(0.127	0.128

	(4.24)	(4.26)	(4.25)	(4.25)	(4.08)	(4.16)	(4.12)	(4.13)	(1.44)	(1.44)	(1.42)	(1.43)
LEV	-0.150***	-0.152***	-0.152***	-0.151***	-0.128***	-0.129***	-0.128***	-0.129***	-0.094***	-0.096***	-0.094***	-0.095***
	(-2.62)	(-2.63)	(-2.61)	(-2.62)	(-4.21)	(-4.18)	(-4.24)	(-4.20)	(-3.35)	(-3.37)	(-3.31)	(-3.34)
IDNC	0.068**	0.300**	4.503***	1.446***	0.076**	0.306*	4.221**	1.457**	0.081**	0.234	5.238**	1.633**
	(2.24)	(2.06)	(3.33)	(2.78)	(1.97)	(1.69)	(2.21)	(2.02)	(2.23)	(1.43)	(2.19)	(1.98)
Obs.	8727	8727	8727	8727	7551	7551	7551	7551	6246	6246	6246	6246
Adj. R^2	0.142	0.142	0.142	0.142	0.073	0.072	0.072	0.073	0.072	0.071	0.071	0.072

4.2. The Interaction Effect of State Ownership Status and Interlocking Directorate Network

To test hypothesis H2, we add a new variable *SOE* and a interaction of SOE and centrality measures to Eq.(3):

$$Performance_{t+i}=\alpha_0+\alpha_1 IDNC_t+\alpha_2 SOE_t+\alpha_3 IDNC_t\times SOE_t+\alpha_k Controls_t,\ i=1,2\ or\ 3 \quad (6)$$

SOE is equal to one if a firm is a state-owned enterprise and equal to zero otherwise. We identify SOEs as those firms owned by state asset management bureaus or other SOEs controlled by the government. Based on the discussions and hypothesis H2 in Section 3.2, we expect a negative and significant coefficient on the interaction of *SOE* and *Network*. Table 4 reports the pooled regressions of such a specification.

Panel A of Table 4 shows that all the coefficient of *SOE* are positive and at last significant at the 10% level, indicating that SOEs outperform NSOEs. For the coefficients of the interaction of *SOE* and centrality proxies, nine coefficients of twelve are negative and significant, and columns (9), (11) and (12) show the negative value without significant. This reveals that the performance effect of interlocking directorates network is more pronounced in NSOEs than SOEs Panel B of Table 4 reports the effect of the interaction of *SOE* and centrality proxies on *ROS*; such a relationship between performance and the interaction of *SOE* and centrality proxies is still hold.

Table 4. The regression results on the effect of firms' centrality and state ownership status

Panel A and Panel B provide the results on the effect of firms' centrality and state ownership status. *DEGREE*, *EIGEN*, *BETWE* and *CENTR* are proxied by *IDNC* in column (1, 5 and 9), (2, 6 and 10), (3,7 and 11) and (4, 8 and 12), respectively. The *t*-values in parentheses are clustered at both year and firm levels. Year and industry fixed effect are controlled but not tabulated. *, **, ***Significant at 10%, 5% and 1%, respectively. See Appendix for definitions of variables.

Panel A: The interaction effect of state ownership status and interlocking directorates on ROA

	ROA_{t+1}				ROA_{t+2}				ROA_{t+3}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
_cons	-0.035	-0.034	-0.031	-0.035	-0.050	-0.048	-0.045	-0.050	-0.059	-0.055	-0.056	-0.059
	(-1.00)	(-0.99)	(-0.90)	(-0.99)	(-1.00)	(-0.97)	(-0.92)	(-1.00)	(-0.90)	(-0.86)	(-0.90)	(-0.90)
ROA	0.379***	0.381***	0.380***	0.379***	0.218***	0.220***	0.219***	0.218***	0.218***	0.219***	0.219***	0.218***
	(13.97)	(13.63)	(13.84)	(13.97)	(5.09)	(5.13)	(5.13)	(5.09)	(12.81)	(13.20)	(13.09)	(12.83)
Size	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(1.44)	(1.45)	(1.40)	(1.44)	(1.14)	(1.12)	(1.08)	(1.14)	(0.70)	(0.66)	(0.73)	(0.70)
Growth	0.010***	0.010***	0.010***	0.010***	0.004*	0.004*	0.004*	0.004*	0.001	0.001	0.001	0.001
	(4.37)	(4.38)	(4.34)	(4.38)	(1.71)	(1.68)	(1.70)	(1.71)	(0.22)	(0.18)	(0.17)	(0.22)
Capex	0.098***	0.098***	0.098***	0.083***	0.090***	0.090***	0.091***	0.077***	0.043***	0.043***	0.043***	0.029**
	(5.50)	(5.57)	(5.57)	(5.79)	(4.39)	(4.57)	(4.51)	(4.64)	(2.97)	(3.09)	(3.03)	(2.53)
LEV	-0.019**	-0.019***	-0.019***	-0.019**	-0.029***	-0.029***	-0.030***	-0.029***	-0.024***	-0.023***	-0.024***	-0.024***
	(-2.56)	(-2.58)	(-2.58)	(-2.55)	(-4.42)	(-4.42)	(-4.35)	(-4.43)	(-5.28)	(-5.22)	(-5.37)	(-5.25)
SOE	0.006*	0.005**	0.004**	0.006**	0.004*	0.005**	0.004*	0.004*	0.006	0.005*	0.006*	0.007*
	(1.75)	(1.85)	(1.97)	(1.96)	(1.72)	(2.02)	(1.76)	(1.85)	(1.30)	(1.84)	(1.73)	(1.79)
IDNC	0.014***	0.691***	0.936***	0.440***	0.014**	0.567*	0.811***	0.342**	0.014**	1.677	0.700*	0.340*
	(2.87)	(2.68)	(2.95)	(2.63)	(2.15)	(1.93)	(2.79)	(2.41)	(2.04)	(1.52)	(1.91)	(1.78)
IDNC × SOE	-0.002**	-0.242**	-0.337**	-0.010**	-0.002*	-0.559*	-0.289*	-0.006*	-0.001	-0.245*	-0.244	-0.004
	(2.20)	(-2.37)	(-2.06)	(-2.36)	(-1.72)	(-1.86)	(-1.68)	(-1.73)	(-1.01)	(-1.74)	(-1.31)	(-1.12)
Obs.	8727	8727	8727	8727	7551	7551	7551	7551	6246	6246	6246	6246
Adj. R^2	0.222	0.222	0.222	0.222	0.116	0.116	0.116	0.116	0.103	0.103	0.102	0.103

Panel B: The interaction effect of state ownership status and interlocking directorates on ROS

	ROS_{t+1}				ROS_{t+2}				ROS_{t+3}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
_cons	-0.376**	-0.378**	-0.362**	-0.373**	-0.493**	-0.491**	-0.480**	-0.490**	-0.679***	-0.675***	-0.678***	-0.674***
	(-2.29)	(-2.31)	(-2.29)	(-2.28)	(-2.36)	(-2.38)	(-2.32)	(-2.35)	(-3.00)	(-3.08)	(-3.08)	(-2.99)
ROS	0.264***	0.265***	0.265***	0.264***	0.138**	0.140**	0.139**	0.138**	0.161***	0.162***	0.162***	0.161***
	(6.54)	(6.48)	(6.55)	(6.54)	(2.26)	(2.27)	(2.27)	(2.26)	(3.14)	(3.16)	(3.14)	(3.14)
Size	0.019**	0.019**	0.019**	0.019**	0.019**	0.019**	0.019**	0.019**	0.019**	0.018**	0.019**	0.018**
	(2.57)	(2.50)	(2.55)	(2.58)	(2.31)	(2.31)	(2.25)	(2.31)	(2.34)	(2.37)	(2.40)	(2.34)
Growth	0.046***	0.045***	0.045***	0.046***	0.018**	0.017**	0.017**	0.018**	-0.009	-0.010	-0.010	-0.009
	(3.36)	(3.34)	(3.32)	(3.36)	(2.33)	(2.24)	(2.23)	(2.34)	(-0.81)	(-0.92)	(-0.92)	(-0.79)
Capex	0.406***	0.401***	0.407***	0.341***	0.356***	0.355***	0.355***	0.283***	0.125	0.125	0.122	0.050
	(4.26)	(4.27)	(4.30)	(4.58)	(4.15)	(4.26)	(4.22)	(4.49)	(1.39)	(1.37)	(1.35)	(0.48)
LEV	-0.149***	-0.150***	-0.151***	-0.149***	-0.126***	-0.127***	-0.128***	-0.126***	-0.093***	-0.093***	-0.095***	-0.093***
	(-2.60)	(-2.61)	(-2.61)	(-2.60)	(-4.25)	(-4.23)	(-4.18)	(-4.25)	(-3.26)	(-3.24)	(-3.34)	(-3.25)
SOE	0.053***	0.028***	0.026***	0.058***	0.048***	0.020*	0.023	0.054**	0.062**	0.024**	0.034**	0.073**
	(3.02)	(4.46)	(3.22)	(3.05)	(2.69)	(1.72)	(1.39)	(2.55)	(1.98)	(2.10)	(2.06)	(2.18)
IDNC	0.063**	0.306**	4.200***	1.107***	0.045*	0.452***	3.976**	1.132**	0.041**	0.397	3.443*	1.109*
	(2.20)	(2.36)	(3.06)	(3.18)	(1.75)	(3.08)	(2.34)	(2.17)	(1.99)	(1.05)	(1.85)	(1.80)
IDNC×SOE	-0.079*	-0.488**	-1.448**	-0.241**	-0.078**	-0.487*	-0.946**	-0.243**	-0.099*	-0.484*	-0.837*	-0.333*
	(-1.81)	(-2.37)	(-2.39)	(-1.99)	(-2.02)	(-1.72)	(-2.28)	(-2.10)	(-1.69)	(-1.71)	(-1.91)	(-1.94)
Obs.	8727	8727	8727	8727	7551	7551	7551	7551	6246	6246	6246	6246
Adj. R^2	0.143	0.143	0.143	0.143	0.074	0.073	0.073	0.074	0.074	0.073	0.072	0.074

In summary, we show that directors of companies sitting on each other's boards are a frequently observed characteristic in China's transition economy. In spite of this, busy boards are a relatively small incidence in China. We document that being central in the interlocking directorate network leads to better performance. Further, we also document that the performance effect of interlocking directorate network vary with state ownership status, and the benefits associated with a firm's network position is more pronounced in NSOEs relative to SOEs.

4.3. Robust Tests

To further understand the relationship between interlocking directorate networks and firm performance, we empirically examine the impact of first order changes in firms' position on the first order change in firm performance. We calculate Δ*CENTR* as firm's current value minus its value in prior year. Similarly, we also obtain the change dependent variable (Δ*ROA* and Δ*ROS*) by abstracting pervious value from current value. Table 5 shows the estimations from regressing Δ*ROA* and Δ*ROS* on Δ*CENTR*. As in earlier regression specifications, industry and year fixed effect are included and standard errors are calculated by clustering by both year and firm. The results shows a significant positive relationship between Δ*ROA* / Δ*ROS* and change in centrality proxy.

Table 5. The impact of change in firms' centrality and changes in performance

This provides the results on the impact of changes in firms' centrality on the changes in firm performance. The *t*-values in parentheses are clustered at both year and firm levels. Year and industry fixed effect are controlled by not tabulated. *, **, ***Significant at 10%, 5% and 1%, respectively. See Appendix for definitions of variables.

	ΔROA_{t+1}		ΔROS_{t+1}	
	(1)	(2)	(3)	(4)
_cons	0.110***	0.1117***	0.685***	0.6806***
	(2.81)	(2.82)	(3.90)	(3.86)
Δ*ROA*	-0.317***	-0.316***		
	(-15.10)	(-15.00)		
Δ*ROS*			-0.252***	-0.251***
			(-5.73)	(-5.73)
Size	-0.006***	-0.006***	-0.042***	-0.042***
	(-3.16)	(-3.20)	(-4.57)	(-4.51)
Growth	0.005***	0.005***	0.002	0.002
	(3.29)	(3.31)	(0.16)	(0.17)
CAPEX	0.020	0.020	-0.007	-0.006

	(1.32)	(1.31)	(-0.10)	(-0.10)
Leverage	0.070***	0.070***	0.428***	0.428***
	(4.52)	(4.54)	(5.10)	(5.07)
Δ*CENTR*	0.085***	0.019***	1.306***	1.914**
	(3.34)	(3.35)	(3.26)	(2.41)
SOE		0.007*		0.113**
		(1.94)		(2.42)
Δ*CENTR* × *SOE*		-0.004*		-0.090*
		(-1.78)		(-1.83)
Obs.	6246	6246	6246	6246
Adjust R^2	0.151	0.164	0.131	0.139

Additionally, prior research has argued that firm performance should be measured by economic value (i.e., the present value of future cash flow) rather than the accounting-based performance. Because accounting-based performance not only has little ability to capture the risks of interlocking directorates which is an important investment, but also involves bias due to the earnings management activities. To address this concern, we imply market-adjusted annual stock price return and Tobin's Q as alternative performance measures. An untabulated result reveals the three standard centrality measures and our aggregate proxy are significantly associated with one-year ahead market-adjusted stock price return and one-year ahead Tobin's Q. Further, such an effect is more pronounced in NSOEs than SOEs.

5. CONCLUSION

Interlocking directorate network provide a conduit of sharing resource and information flow that can affect the performance of firms in the network. In this paper, we seek to add to prior literature by theoretically analyzing and empirical testing the relationship between interlocking directorates and firm performance in a transition economy. To do this, on the one hand, besides the interlocking directorates' benefit argued by resource dependency hypothesis, we conceptualize interlocking directorate network as a solution of the institutional voids derived from Chinese economic reform from central planning to market-oriented economy. On the other hand, by focusing on network position, we come up the standard centralities to capture benefit and cost of being networking by interlocking directorates, which incorporates not only the interlocks held by a firm but also the importance of these interlocks.

We find that that central firms earn significantly higher future three-year performance than non-central firms; this association holds after controlling for the influence of current performance, firm size, sales growth, leverage and capital expenditure investment. Further, we document that the economic effect of interlocking directorate network is most pronounced in NSOEs, suggesting that interlocking directorate network may matter more for NSOEs. Our results in an additional test also indicate that the changes in centrality are significantly associated with the changes in one-year ahead performance.

Our results support our theoretical arguments on interlocking directorate network's role to fill some institutional voids. Our results are also consistent with the resource dependency hypothesis that companies being more networked have better access to information, human capital, financial capital, suppliers, etc., hence, resulting in an increased future profitability. The positive impact that our network centrality measures have on firm performance indicates that not only interlocks of a firm matter, but also the network position of a firm within an inter-connect world matter, which have theoretical and managerial implications. These findings suggest that a company should pay much closer attention to its position within networks when they invest in interlocking directorates.

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APPENDIX: Variable Definitions

Variables	Definitions
ROA	Ratio of net income tototal assets
ROS	Ratio of net income to Sales
Growth	Change in sales scaled by lagged sales
Capex	Ratio capital expenditures to total assets
LEV	Ratio of liabilities to total assets
Size	The log of total assets
DEGREE	The degree centrality of interlocking directorate networks
EIGEN	The eigenvector centrality of interlocking directorate networks
BETWE	The betweenness centrality of interlocking directorate networks
CENTR	Equal-weighted average of DEGREE, EIGEN and BETWE
SOE	An indicator which equal to one if the firm owned by government, and zero otherwise.