Making Relationships Matter: Director Interlocks and Fortune 500 Performance, 1996–2007

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Abstract Board memberships are critical to Fortune 500 performance, providing access to sectoral knowledge or resources, management expertise, and capital. How can companies strategically target new directorships to maximize financial returns? We explore how director interlocks impact Fortune 500 ranking performance from 1996 to 2007, combining traditional financial indicators with board membership composition through social network analysis. We benchmark how key business drivers influence Fortune ranking, and then employ social network metrics of centrality and structure to show how interlocking directorships affect outcomes. We then subsequently perform dynamic panel regression techniques to estimate financial impact across sectors. Strategically selecting board memberships has a large potential return on investment, different sectors and ranking level, which can impact firms' bottom lines by billions of dollars and tens of Fortune 500 ranking points.

Keyword Social network analysis · Fortune 500 · Board membership · Director interlocks · Corporate performance · Return on investment

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1   Introduction

Conventional business wisdom states that relationships matter, but exactly how do they matter? Board memberships are critical to large cap success, providing access to sectoral knowledge or resources, management expertise, oversight and capital. From 1996 to 2003, U.S. Airways Group expanded its board by 40 % while it's Fortune ranking drops 88 points due to dismal revenue performance. How can companies strategically target new directorships to maximize returns and hopefully avoid US Airways misfortune? How much impact does directorships have? The New York Times has 10 direct connections to other firms via board members since 1999, but its ranking remains below 450 consistently. Revenues or relationships; is it what you know or who you know? What, if any, are the actionable, targeted strategies for firms that maximize director returns? These are the questions we seek to address.

In business, interlocking directorships among corporations has spawned a vast amount of theory and research, ranging from how and why one individual sits on another company's board, to the causes and consequences of corporate practices and governance structures. From an agency perspective, directors shape corporate organizational behavior as well as impact market performance—creating strategic alliances [1, 2], supply chain management [3, 4], access to capital resources [4–6], and performing independent oversight functions to protect shareholder interests [7–10]. Starting with the seminal work [11] on the nature of US corporate elite, Useem [12] and Mintz and Schwartz [13] employed quantitative approaches based on networks of overlapping directorships to explore the decision making power of such networks. Tracing the development of corporate networks, Mirzuchi [14] finds US interlock networks consistently connected in under five steps, less than conventional 'six degrees of separation.' Davis et al. [8] also explore the 'small world' phenomena of corporate elites, showing how interlocks are resilient to macroeconomic and micro market changes. Another central question is the interlock-profit relationship, where researchers such as Baysinger and Butler [15] find a positive effect of interlocks on profitability while others such as Richardson [16] show the opposite. Mizruchi [14] provides an overview of interlocks research, focusing on director memberships from a cooptation, monitoring, legitimacy, and career advancement perspectives to interlocks as causal mechanisms for corporate control, M&A and investment activity or poison pill tactics.

Our goal is to explore how Fortune 500 ranking performance is impacted by director interlocks from 1996 to 2007. As traditional financial indicators are key corporate performance indicators, we seek to understand the additional impact that interlocks provide from an SNA perspective. We econometrically benchmark key business drivers such as revenues, profits, GPM, total assets and liabilities that influence Fortune ranking, and then employ social network metrics of centrality to show how interlocking directorships affect ranking outcomes over time. We then subsequently perform empirical assessments using panel regression techniques to

estimate the various impacts of business and network metrics on the Fortune 500 ranking over time.

We do this from two different perspectives: first, how connectivity for the entire network of board memberships has changed over time; and second, how firm board composition affects performance. Empirical result adds to insights toward formulating additional criteria, and the order of their importance, for developing a firm's interlock strategy. Our approach is different from various previous work studies in that we not only empirically assess overall Fortune 500 ranking performance, but we also look at how interlock strategy can vary depending on firm ranking level measured by quintiles, as well as cross sectoral effects. This approach helps to identify the conditions under which interlocking director networks either propel or impede a company's ranking performance over time to develop board selection criteria.

2   Past Work on Directorship Linkages

Boards are seen as an instrument for a firm to deal with its environment [17], as corporate governance bodies that provide access to information or capital resources. Directors possess expert knowledge and build up informal/formal connections between firms. Despite different rationales and effects for interlocking directorates, it is agreed that interlocks are associated with diverse corporate behavior.

Many scholars start with the assumption that access to resources simulates interlock formation. This approach points out that collusion, cooption, career development, legitimacy, and social cohesion are amongst the reasons that interlocks form. Davis et al. [8] focus on the sociology of corporate elite and point out social cohesion among 'power elites' as described by Mills [11] as a key factor in interlock formation. They examine the degree of stability in the structure of the corporate elite network in the US during the 1990s and find that the level of connectivity among the fortune 500 is remarkably consistent over time. Palmer [6] suggests that diversified boards are more likely than others to facilitate formal coordination, such as profitable strategic alliances or joint ventures. Kenis and Knoke [18] mention the importance of information flows among business and investigate how those flows may affect corporate strategy. Knoke, Yang and Granados [19] used network metrics to study the topic of strategic alliances in the global information sector and how changing ties among core firms generates a more differentiated strategic alliance network. Hillman and Dalziel [20] view interlocking corporate directorates as a gateway to accessing more and higher quality of information that flows through entire Fortune 500 network. Therefore, interlocking directorates can increase information quality, reduce uncertainty and implicitly drive profitability.

While these perspectives focus on the reasons for interlocking directorates, the consequences of interlocks are also widely debated. Board memberships are a means for corporate control through strategic alliances, merger and acquisition activity, or oversight [21] and dominant players in corporate control [22, 23]. Profitability of interlocks is another large area, although there is little consensus on

how profitable director interlocks are [15, 24, 25]. Richardson [16] shows that unprofitable firms are more likely to form interlocks whereas some other scholars show a nonlinear relationship between the two. Yermack [26] uses a sample of 452 large U.S. industrial corporations between 1984 and 1991, to show that small boards are more effective. However, it is argued that directors of firms with higher growth opportunities tend to hold a greater number of directorships despite the costs the firms may incur. According to their logic, a larger board implies the existence of greater opportunity for a company albeit at a cost which we will explore below. The emphasis on board memberships as a means of communication instead of a means of corporate control views interlocks as a type of social capital which is essentially an information channel that flows through the network [27].

We empirically test the results of director performance, exploring if and how board memberships impact business outcomes, as measured by Fortune 500 ranking. Below we provide a brief introduction to understanding board memberships in different relational contexts (proximity, density, and centrality) with social network metrics that can help explain and predict rankings.

3   Interlock Metrics and Hypotheses

As opposed to traditional statistical inference, in network analysis power and the resulting control over outcomes is relational. Thus, the attributes of individual firms, such as revenue or GPM, must also be combined within the structure of connections, via director interlocks, to fully vet performance. Firms are connected to each other according to different types of dependency such as trade, information, kinship, conflict, exchange, etc. The structure of the social network determines an individual's position and status within a network. In our study, nodes are fortune companies while the links show the strength of director interlocks due to sharing of the same board member(s). One reason for the proliferation of network techniques to studying directorate interlocks are that such network metrics can transfer into market power, alliance formation and the importance of, costs, benefits, of directorate interlocks. As traditional financial indicators are obvious key corporate performance indicators for the Fortune 500, we seek to understand how interlocks impact from a network perspective. Thus, we posit that relationships can matter, more formally as:

Hypothesis 1 Director interlocks as measured by various SNA metrics can impact fortune ranking as relationship matters affecting overall Fortune 500 performance.

Centrality measurements in network analysis quantify graph theoretic ideas about actor's prominence within a network by summarizing the structural relations among all nodes. We use two particular measures, defined by degree and harmonic

closeness metrics. Degree centrality measures the number of ties to other actors in the network. In our context, degree counts the number as well as strength of interlocks via board memberships between companies. If company A has nine directors, then that firm does not necessarily have a degree value of nine, if those directors do not sit on any other Fortune 500 boards, that company would have a degree value of zero and be isolated. If company A has nine directors and six of them sit on other fortune 500 boards, then Company A would have a degree value of six if those other directors did not sit on any other additional Fortune 500 boards.

We posit that companies with directors that have more connectivity to other Fortune 500 companies (high degree) should possess more firm specific options and opportunities, while being less dependent on other companies for access, that lead to better ranking performance. Moreover, we want to explore the change in degree, to see the additional costs or benefits for increasing director interlocks as well as the relative competitive performance of firms changing interlocks.

Hypothesis 2 The number of director interlocks (measured by degree) leads to better Fortune ranking.

Increasing degree (measured by change in degree) should have a positive impact on Fortune 500 ranking due to better firm specific information and knowledge acquisition relative to other competitors.

Closeness centrality measures the extent to which a firm is near other firms in the network. Firms that are able to reach others via shorter director interlocking paths should have better access to resources and knowledge than firms that do not. We use a specific metric of closeness centrality, Harmonic-closeness, which measures the extent to which a company is near other firms in a network, meaning how fast a company can interact with others via its interlocks. The calculation of harmonic-closeness is the inverse of the average geodesic distances between companies (geodesic distance is the length of the shortest path connecting two companies). Firms with higher harmonic-closeness scores should have faster rapid access to others within the Fortune 500, possessing comparatively more direct bargaining and exchange leverage. For example, in 2007 Apple Computer has low harmonic-closeness (123) since the company is not well connected to others. All of its 4 director interlocks, GM, Dana Corp., Google, and Walt Disney, also have low harmonic-closeness values. Thus, it takes a longer path for Apple to access everyone else within the Fortune network.

Hypothesis 3a Firms that are closer to others in the Fortune 500 (measured by harmonic-closeness) should have better ranking performance due to quicker directorate access to other firms.

Hypothesis 3b Firms that increase their closeness (measured by change in harmonic-closeness) should have better ranking performance relative to competitors due to quicker directorate access to other firms.

4   Research Design

We first collect Fortune company level business data from 1996 to 2007, then we code director interlocks to create network metrics on directors and then finally regress business variables, our director interlock metrics and the combined effects as independent variables on explaining Fortune 500 ranking. By looking at changes in ranking over time, we capture which relationships matter and identify firm specific strategies for targeting directors to increase success among America's top firms.

Our data includes all companies listed within the Fortune 500 from 1996 to 2007. These are U.S. incorporated companies including private companies and cooperatives that file 10-Ks, as well as mutual insurance companies that file with state regulators. The data spans nine business sectors: agriculture, mining, construction, transportation & utilities, wholesale, retail, finance and finally services. Since companies can enter or leave the list, our final sample includes 758 firms over 12 years, for a total N = 5078 observations due to missing data. Financial variables are collected from both assets and liability side in order to benchmark corporate performance-revenues, employees, Pretax GPM, and S&P Return—from various sources, including Mergent Online, Hoover's, and Wharton Research Data Services

To capture director interlocks, we first obtained the director names for each company. Then we coded a 500 × 500 adjacency matrix for 12 years that looked at how many common directors sat on other company's boards. For example, Company A and Company B do not share any director interlocks, so the value in the adjacency matrix is zero. However, for company C and company D, since they share 4 common directors, we coded a value of 4 for the adjacency matrix. Director interlocks indicate not only the presence, but also the strength of ties across companies if multiple members of one company sit on the board(s) of others. We then calculate four social network metrics based upon these data in three categories: centrality of a company in the network (degree and harmonic closeness), how dense director connections (clustering) and how well do companies act as a bridge to others through board remembers (brokerage). Our sample decreases to n = 2957 due to companies that are isolated with no direct connections to others in the Fortune 500 would not generate any useful network metrics.

Degree, or the number of director interlocks, shows that on average, companies have seven board members ties to other Fortune 500 members. The maximum degree value is 38 for Chase Manhattan in 1998, which of course is larger than the size the board, as this indicates that directors can sit on multiple boards and those who do bring multiple connections to a company. The change of degree between companies can be as much as 15 from the prior year, such as Citigroup which expanded its number of direct ties from eight to 23 in 1999, as well connected directors are invited on the board.

Harmonic-closeness measures the extent to which a company is near all other firms, indicating the speed a company can connect with others. Higher numbers are associated with companies connected to other companies by many short, direct interlocks without a lot of intermediaries. On average, companies in the Fortune

500 are close to 133 director paths. Harmonic-closeness is calculated relatively by year. For example, Sara Lee has the maximum harmonic-closeness (183) in 1996, but in 2007 the maximum value is 3M with the score 168. Year to year change in harmonic closeness indicates if companies are becoming closer to the rest of the Fortune 500. According to our sample, companies are actually becoming further apart by −0.59 director paths on average.

Clustering indicates the percentage extent to which companies cluster together via interlocks and how dense their direct connections are around them. A firm score of 100 % means that for all director interlocks to other companies, those other companies are also connected to each other, while a firm score of 0 % means that none of directors mutually sit on any other boards. In our sample, the density of companies' neighborhood connections is 24 % on average, such as IBM in 2004. However, clustering decreases by 1.1 % on average over time. Brokerage counts how many times this company serves as a bridge or broker between two other firms. Generally, a firm bridges 53.7 different relationships on average within the Fortune 500. The maximum value is 834 for Chase Manhattan in 1998 which is well situated as a broker via director interlocks. Average change in brokerage is −2.1, which indicates that firms are also becoming less of a broker over time.

We employ a fixed effects estimation approach as our data is for Fortune 500 companies over 12 years. The fixed effects approach allows us to capture company variations over time. We perform three econometric models, first benchmarking our business variables on Fortune ranking, then regressing our network metrics on ranking and finally looking at their combined effects, comparing and contrasting the explained variance and coefficients.

5 Results

Table 1 shows that average number of director interlocks measured by degree has decreased by a third from 1996 to 2007, indicating that companies are either less interconnected or perhaps companies are connecting to other companies outside of the Fortune 500. Similar changes can be seen for harmonic-closeness at a 9 % decrease. We also looked at a non-firm specific variable, density, as the overall measure of how dense the Fortune 500 is connected each year. Measured by the actual number of connections divided by all possible, the connectivity of the Fortune 500 is quite low, starting at 1.6 % and decreasing by 30 % over time to only 1.1 % in 2007. Likewise, both the clustering coefficient and brokerage also decrease dramatically at 38 and 54 % respectively.

One possible explanation for decreasing connectivity could be the flurry of merger and acquisition activity in the late 1990s. However, even with this con-solidation, the Fortune 500 is less interconnected to each other through director interlocks. Contrary to early arguments on the consolidation of elite corporate power, here our network metrics seem to show the opposite, increasing the diversity of corporate interlocks over time. Another possible explanation is that Fortune 500

Table 1 Fortune 500 interlock trends, 1996–2007

Year	Degree	Harmonic-closeness	Density (%)	Cluster coefficient (%)	Brokerage
1996	8.8	138	1.6	29.3	71
1997	8.6	139	1.6	28.1	67
1998	8.5	141	1.6	26.3	69
1999	8.5	139	1.6	26.8	69
2000	8.1	136	1.5	27.1	62
2001	7.6	134	1.4	25.9	54
2002	7.7	136	1.5	25.2	53
2003	7.3	132	1.4	25.0	49
2004	7.1	132	1.3	24.6	48
2005	6.4	126	1.2	21.5	39
2006	5.7	119	1.0	19.5	30
2007	5.9	126	1.1	18.3	33
96–07 change (%)	−33	−9	−30	−38	−54

firms are connecting more to international companies not listed on the Fortune 500, tracking increasing globalization.

Table 2 reports the fixed effects regression results on ranking, with lower scores indicating better ranking performance. Several variables are log transformed to correct for heteroskedasticity, nonlinearities and outliers.

Model 1 has financial variables only, including revenues, number of employees, pre-tax GPM and market return on increasing or decreasing Fortune 500 ranking. High revenue performance is significant and positively related to better ranking. Similarly, we see that size of the company also has a significant impact on ranking. Growth in GPM may improve ranking minimally, while pretax GPM can cause harm to companies. S&P return has the largest effect among all financial variables in the model, significantly impacting the ranking of companies. The within R^2 from the mean-deviated regression on the transformed data indicates 37.94 % of the variance is explained by Model 1, using financial variables only.

In Model 2, we regress only the network variables to see the impact of director interlocks on ranking alone. We focus on centrality measures including degree, harmonic closeness, and change of harmonic closeness. Those network variables are good indicators on how well directors are positioned in the network, in terms of the number of connections, and the shortest path to reach others. Overall we see that director interlocks, as measured through our various social network metrics do impact ranking performance as postulated in Hypothesis 1. Relationship alone explains 11.03 % of the ranking outcome, approximately 30 % as powerful as

Table 2 Fixed effects estimation results on Fortune 500 ranking

Ranking	Model 1	Model 2	Model 3
Revenue	−79.2235***		−71.8754***
	(2.3222)		(3.2710)
Employee	−25.4870***		−17.8760***
	(2.5712)		(3.6058)
GPM	0.4639***		0.2787*
	(0.0735)		(0.1233)
Return	−5480.2181***		−6239.0127***
	(1080.3409)		(1417.6193)
Degree		−1.6440***	−1.9717***
		(0.3572)	(0.3160)
Closeness		−39.2769***	0.5119
		(2.5485)	(2.7158)
d.Closeness		4.7150***	0.7825
		(0.9326)	(0.8113)
_cons	505.4674***	368.8998***	468.6806***
	(7.3871)	(9.1649)	(11.4571)
N	4471	2647	2221
Within R^2	0.3794	0.1103	0.4009
Between R^2	0.7892	0.0753	0.8417
Overall R^2	0.7643	0.0704	0.8074
F	583.7226	85.7524	165.9732

Standard errors in parentheses. $p < 0.05$, **$p < 0.01$, ***$p < 0.001$

financial variables alone. More specifically, degree is both negative and significant, indicating that for each director interlock, firms with higher connectivity have higher ranking. Harmonic closeness is also significant, with much larger impact than degree. Change in harmonic closeness is also significant, but interestingly positive, indicating that changes cost ranking points on average. This surprising finding shows that while efficiency within the Fortune 500 is beneficial, there may be a cost for increasing efficiency.

The last column shows regression result with both financial variables and social network variables in Model 3. The impact of all financial variables and degree centrality remain the same, with coefficients in the same direction and similar magnitude as Model 1 and 2. Closeness centrality measures become insignificant, as the effects are washed out by the combined impact of other variables. Model fit is superior compared to the first two models, with 40.09 % of variance explained by all variables. This result confirms that financial variables still significant impact Fortune 500 ranking even when director interlock taken into consideration. In addition, relationship between board members also matter, as more connections are likely to result in higher ranking. Ranking outcome is better explained with board member relationship considered than financial performance alone.

6 Conclusion

In exploring how board memberships matter, we looked at the Fortune 500 from two different perspectives: first, how connectivity for the entire network of board memberships has changed over time; and second, how firm board composition affects performance. Empirical result reveals insights toward formulating additional criteria, and the order of their importance, for developing a firm's interlock strategy.

Contrary to Davis et al. [8] and others, we find that the overall connectivity of the Fortune 500 actually declined between 1996 and 2007. The number of interlocks decreased by 33 %, the density of all interlocks reduced by 30 %, mutual interlocks declined by 38 % and the number of times firms serve as brokers by dropped by over 50 %. While the Fortune 500 could be increasing their connectivity to other companies outside our sample, perhaps more to independent directors, the Fortune 1000 or even global companies, our results suggest increasing corporate interlock diversity and de-concentration of past elite power networks.

Key business drivers are important to Fortune success, accounting for over 37 % of ranking performance. When exploring the effects of interlocks only, we found that our interlock metrics can significantly alter outcomes, for better or worse, accounting for approximately 11 % of performance success. The empirical results suggest that most of the time traditional performance metrics matter and at the same time of board member relationships impact business success. As shown by our results that degree is positively related to performance, but harmonic closeness does not matter as much. It is not how fast you can reach other people in the network, but the number of connections that produces results.

This work is just a start to increasing the explanatory power of contemporary directorate interlocks. As our results are for the Fortune 500 only, we are reluctant to generalize specific inferences to privately held companies, the Global 1000, and those outside the Fortune 500. However, we do know that interlocks can and do make a difference. Thus the challenge for today's Fortune 500 boards, shareholders and executives is to realize the costs and reap the benefits of how relationships can matter. Besides increasing the sample size, content and longer time series for companies, we would suggest additional analysis with other variables, such as macro-economic indicators, merger and acquisition activity, strategic alliances and corporate governance indicators to expand the interplay between business performance and board memberships. In addition, other network metrics including more centrality measures and clustering can potentially be tested in future models.

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