Do Well-Connected Directors Affect Firm Value?

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Results have been mixed regarding whether, and how much, board of director connectedness is beneficial to firm value. Some prior research shows that overly busy directors are ineffective monitors, but these same "busy" directors can be valuable sources of information and other resources. For example, directors who are centrally located within a network can obtain information faster and those who are connected to other highly connected directors can access larger quantities of information. The information can take many forms including market trends, business innovations, and effective corporate practices and is available through these director network channels. However, increased information transfer speed (network centrality) and quantity (connections to highly-connected others) may not always balance out the negative effects of overcommitted directors, information overload, and the propagation of poor business practices. Using social network analysis, we investigate whether well-connected directors increase firm value and find that firms with well-connected directors have higher market value, after controlling for their operating cycle, investment opportunity sets and market competition. We also find that well-connected outside (independent) directors have a bigger impact on increasing firm value than well-connected inside directors.

We are thankful for the helpful comments from Jasmin Bol and Kris Hoang and workshop participants at Texas A&M University, Tulane University, University of Nebraska, the 2013 Oklahoma State Accounting Research Conference, and the 2013 Annual Congress of the European Accounting Association. We also thank Mason Porter for his insights on social network analysis. Thomas Omer acknowledges funding from Delmar Lienemann Sr. Chair of Accounting at the University of Nebraska-Lincoln.

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■Early studies of board of director connectedness find that membership on multiple boards (often referred to as board interlocks) reduces monitoring effectiveness, and subsequently, the corporate governance literature has used multiple board memberships as a proxy for the "busyness" of outside directors that can lead to reduced monitoring (Core, Holthausen, and Larcker, 1999; Fich and Shivdasani, 2006). Multiple board interlocks also raise questions about the independence (and quality) of board decisions and several academic studies link board interlocks to the spread of poor corporate practices, such as option backdating (Bizjak, Lemmon, and Whitby, 2009) and accounting irregularities (Chiu, Teoh, and Tian, 2013). While these previous studies focus primarily on board interlocks, which consider only the local connection between boards of directors, social network theory allows us to evaluate the effect of different facets of board connectedness. Directors that maintain multiple directorships have better access to information, such as market trends, learn from other directors' experiences, and may transfer this knowledge through their interactions with other board members. As a result, better-networked (better connected) directors likely have larger information sets, which can facilitate their monitoring and advising. Consistent with this notion, more recent investigations of overall board connectedness document higher abnormal stock returns (Larcker, So, and Wang, 2013) and better financial reporting quality (Omer, Shelley, and Tice, 2014) when firms have better connected board of directors, suggesting that the costs of multiple directorates can be offset by the benefits of acquiring information, resources or learning from other firms. We contribute to this literature by further examining the conditions in which well-connected directors and boards affect firm value.

Social network analysis has been used to study information flow across networks (of which board of director networks are examples), as well as individuals' ability to access the information (e.g., Haythornthwaite, 1996; Borgatti and Halgin, 2011; Phelps, Heidl, and Wadhwa, 2012). This comprehensive approach to information exchange offers several "centrality" measures to evaluate the multi-dimensional construct of connectedness.[1] We use four of these measures including degree, closeness, eigenvector, and betweenness to investigate whether better-connected directors improve overall firm value. The simplest measure of connectedness, degree, is the number of direct connections between a given director and all the other directors in a network (Freeman, 1979). This is similar to, but more comprehensive than, board interlocks used in prior studies. The eigenvector measure builds on the degree measure by incorporating the strength of indirect links via weighting of direct connections by how well linked those members are themselves (Bonacich, 1972, 1987, and 1991). The closeness measure represents the shortest path between connected directors and, thus, reflects the speed at which information transfers can occur (Freeman, 1979). Our final measure, betweenness, reflects the importance of directors within the network; directors with higher betweenness scores have more information and resources that must flow through him/her to get to other boards or directors; being in that position presents an opportunity for the director to control the flow of information (Freeman 1979). Overall, directors with higher centrality scores potentially have better access to and control over information.

Each centrality measure can be calculated at either the individual director or the board level. We measure all four at the individual director level and aggregate the individual measures to the board level, which allows us to investigate director connectedness both within and across boards. We investigate the extent to which the overall connectedness of the board increases firm value and compare the individual effects of inside and outside director connectedness. We also control for several firm- and environment-level factors that may influence the effect of board connectedness on firm value, including firms' investment opportunity sets, market competition, industry expertise, and operating cycle.

Using data from the BoardEx database for the period 2004-2010, we map individual director networks annually based on current board memberships from a sample of 265,116 unique director-year observations. We build the annual networks using common board memberships at the director level to follow actual relational links that form the information transfer mechanism. We calculate our connectedness measures for each director and aggregate those measures to the board level. Because these centrality measures reflect different, but related, facets of social connectedness, we create a composite measure using principal components analysis to investigate the overall effect of connectedness on firm value following Omer et al. (2014). After controlling for a number of board and firm characteristics, we find that boards with better-connected directors have a positive impact on firm value as proxied by the market value of equity. We also find that while the connectedness of inside directors is important to firm value, the effect of outside (independent) directors on firm value is significantly greater. This finding suggests that outside directors provide information that is incremental to information transferred through a well-connected inside director and is inconsistent with Duchin, Matsusaka, and Ozbas' (2010) conclusion that outside directors may not benefit boards as expected because information about a firm may be more costly to process for outside than inside directors. We also find that boards with well-connected directors have incrementally higher value even after controlling for firms' investment opportunity sets, operating cycle, market competition and the board's industry expertise. We find similar results and inferences when using Tobin's Q to proxy for firm value.

This study makes several contributions to the corporate governance literature. First, we use social network theory to examine the benefits and costs of shared directorates. Prior studies of boards of directors consider connectedness using only the number of board memberships. We capture more subtle facets of connectedness that include the potential speed and quantity of information transfer. Instead of examining only first-degree connections, our analyses consider individual directors' positions within the networks relative to those of other directors and how well-connected the first-degree connections themselves are. Second, we contribute to the growing literature bridging corporate governance and social network theory by considering the connectedness of individual directors rather than just the connectedness of the boards. Prior studies employing social network analysis often construct networks using boards as the smallest unit of analysis; boards are connected through interlocked directors (e.g., Schonlau and Singh, 2009; Larcker et al., 2013). We instead build annual networks based on the individual directors in order to follow the mechanistic flow of unobserved information. This approach allows us to explore differential effects of inside versus outside director connectedness on firm value, which has not been examined previously. Third, we contribute to the investment opportunity literature by showing that director connectedness provides incremental firm value beyond firms' investment opportunity sets.

The remainder of the paper is organized as follows.

[1] Social network analysis studies the relational structure between network members, which can be individuals or groups. Conceptually, a network is made up of the members (points) that are connected by a common factor (link). For a general introduction to network theory, please see "Networks: An Introduction" by M.E.J. Newman (2010).

In Section I, we review prior literature on directorships and present our hypotheses and measurements used for connectedness. Section II describes the data sample and research design. Finally, we present our findings in Section III and discuss their implications in Section IV.

I. Background and Related Literature

A. Joint Effects of Director Connectedness and other Board Characteristics

Boards of directors advise top management on strategic decisions and monitor management in the interest of shareholders (Fama and Jensen, 1983). The advising role requires that the board have sufficient relevant expertise and knowledge for guiding strategic decisions, while effective monitoring requires that boards be sufficiently independent of management. Given the board's influence on critical firm decisions, considerable research has focused on ways in which firms structure boards to meet advising and monitoring responsibilities and on how board characteristics predict situations in which directors will be more or less effective. Prior research has found that directors who serve on multiple boards maybe less effective monitors because of time constraints, resulting in negative economic consequences for the firm (Beasley, 1996; Klein, 1998; Core et al., 1999; Fich and Shivdasani, 2006; Ahmed and Duellman, 2007). For example, Core et al. (1999) provide evidence that boards with a higher percentage of outside directors serving on three or more other boards also allow higher executive compensation on average. In addition, Fich and Shivdasani (2006) find that firms with a majority of outside directors holding three or more board memberships experience lower market-to-book ratios, less profitability, and lower chief executive officer (CEO) turnover sensitivity to firm performance. Together, these results suggest that although outside board members improve board independence, situations exist in which outside director influences can impair firm performance and firm value.

Nevertheless, directors who sit on multiple boards can provide beneficial knowledge and insight from an advising perspective. By sitting on multiple boards, directors have access to information and resources that are not easily observable by investors, such as effective corporate practices and lessons learned from other boards, and can transfer this knowledge between boards of directors. This enhanced access compounds when firms share multiple directors with other firms, forming a larger network of boards connected by the common directors (Scott, 1991). Several studies document a relation between shared board directors, called board interlocks, and the spread of value-adding corporate practices, such as business innovations (Haunschild, 1993), alliance formation (Gulati and Westphal, 1999), and organizational forms (Palmer, Friedland, and Singh, 1986; Palmer, Jennings, and Zhou, 1989). Thus, firms with well-connected directors may also learn from other firms' successes and avoid their critical mistakes (Mizruchi, 1996; Mol, 2001).

Despite the potential benefits of information exchange, board interlocks can also propagate value-reducing activities as evidenced by previous studies. For example, Chiu et al. (2013) find that firms sharing a director with a restating firm are more likely to also report an accounting irregularity, and Bizjak et al. (2009) find that interlocked directorates are associated with the spread of stock option backdating. Several management studies also report that ties between boards can facilitate collusion and reduce competition among firms (Dooley, 1969; Pennings, 1980). Together, these studies provide evidence that information may be transferred through direct links between two boards. However, the overall effect of being well-connected in the director network remains an empirical question.

Social network analysis allows us to examine the effect of director connectedness on a global level by examining both direct and indirect links between boards. In particular, social network literature often studies the flow of information in a social network (Mizruchi, 1996; Haythornthwaite, 1996) using techniques for modeling information diffusion and access to such information through the social ties (Wasserman and Faust, 1994; Newman, 2010). Recent studies in accounting and finance that use social network analysis approaches find that firms with well-connected directors are less likely to misstate their annual financial statements (Omer et al., 2014), have higher abnormal returns (Larcker et al., 2013), and report superior post-merger performance (Schonlau and Singh, 2009), that are beyond the effects of board interlocks. These findings that firms with better networked directors benefit from increased access to information through the director network, which in turn affects the monitoring and advising by the board. Because of the mixed nature of evidence on the benefits to firms of connected directors we state the following null hypothesis:

H1: Director connectedness is not associated with firm value.

B. Effects of Well-connectedness by Inside versus Outside Directors

The costs and benefits of director connectedness may differ between inside and outside directors. Firms reportedly allow their executives to sit on other firms' boards to benefit from additional information and resources (Schoorman, Bazerman, and Atkin, 1981; Feld, 2012). In addition to developing relationships, CEOs can gain a broader perspective from serving on more than one board, such as exposure to alternative management styles and business

strategies. However, these already busy executives may also incur significant costs because of time committed to other boards and committee meetings. For example, Perry and Peyer (2005) show that firms that allow their executives to serve on external boards benefit from the additional directorships only if the executives have strong incentives to increase shareholder value. Recent media and academic articles have also expressed concern about the extent of CEO service on outside directorships and have argued in favor of limiting this service because of potential over-commitment (Countryman, 2003; Jackson, 2009; Hodgson, 2012).

Alternatively, advocates of increased board independence argue that outside directors serve an important role in monitoring management to protect shareholders interests, but they also incur an additional information cost, relative to inside directors, of becoming informed about unfamiliar firms (Raheja, 2005; Adams and Ferreira, 2007; Duchin et al., 2010); this cost accrues to the firm and may not always be balanced out by the benefits of increased board independence. To investigate the impact of well-connected inside and outside directors we estimate an overall connectedness for inside directors and outside directors and separately compare their impact on firm value. We also compare their relative effects on firm value. Because prior research provides conflicting evidence regarding the impact of inside and outside directors we state the following two hypotheses in the null:

H2a: Neither inside nor outside director connectedness impacts firm value.

H2b: There is no difference between the impact of inside and outside director connectedness on firm value.

C. Connectedness Measures

While director networks can provide information that is either beneficial or detrimental to firm value, access to the information depends on the relative connectedness of individual directors and, by extension, the overall board. We use social network theory to examine the effects of director connectedness on firm value. Prior research models the network structure using measures developed specifically to reflect useful network characteristics, such as the most direct connections, the number of intermediaries between any two given members, and the directionality of connections. These measures differ from simple board interlock measures in that they allow us to better understand network interaction patterns and the relative level of influence among network members.

Following prior social network studies on directors (e.g., Omer et al., 2014) we use four centrality measures, which we refer to as our measures of connectedness, and form a composite measure using principal component analysis. The individual measures are more formally referred to in network theory as degree centrality (number of direct connections), closeness centrality (speed of information transfer), eigenvector centrality (quantity of information transferred), and betweenness centrality (key broker of information and resource transmission control). These measures capture distinct, but related, aspects of centrality; overall, the concept of network centrality is used in social network research to indicate the relative importance of an individual within a given network. Members with higher centrality scores are considered to have better access to the information or resources transferred within the network (Sparrow, Liden, Wayne, and Kraimer, 2001; Tsai, 2001; Newman, 2005; Newman, Barabasi, and Watts, 2006; Newman, 2010). Consistent with Omer et al. (2014) greater values of our composite measure represent greater director connectedness.

We use a composite measure in our tests because the four connectivity measures, when determined at the individual director level, are not independent. Because each director has facets of all four measures, any attempt to analyze the independent effects of each measure creates a substantial omitted variable problem in our model specifications. However, as the intuition underlying our composite measure may not be readily apparent, we outline the theoretical representations of each centrality measure to provide intuition for their individual effects on information transfer.

The four connectedness variables are defined as follows. Degree centrality is a simple count of a director's direct connections to other networked directors (Freeman, 1979). Directors with high degree scores have many connections and are potentially a busy directors. Building on the simple degree measure, eigenvector centrality (Bonacich, 1972, 1987, 1991) is measured as the number of direct links between a given network member and other network members, with the links then weighted based on how well connected the linked other members are. Connections to other well-connected members will increase an eigenvector score more than connections to less well-connected members. Conceptually, directors with higher eigenvector centrality have more power and access to more information because they can access more individuals.

Closeness centrality (Freeman, 1979) examines the position of an individual relative to others in a network and is calculated as the inverse of the sum of the shortest distances between one network member and the other network members with whom that member is connected. Thus, when members are closer, the measure is larger and the speed of information transfer is expected to be faster. Directors further from the network's center have smaller scores and, thus, directors with high closeness scores are have fast access to information when it is likely to be most valuable.

Betweenness centrality measures the extent to which a

Table I. Sample Selection

This table summarizes the construction of the sample used for mapping the annual director networks and the sample used in the main regressions.

Panel A. Sample for Director Network Construction

	Director-Years
Director-years with non-missing firm identifiers in BoardEx (2004-2010)	265,116
Less observations who are not in the largest connected group	(80,593)
Sample of director-years in the director network	184,523

Panel B. Sample for Main Regressions

	Firm-Years
Firm-years corresponding to director sample from Panel A	29,883
Less observations without required data from Compustat	(10,833)
Sample of firm-years for regressions	19,050
Number of unique firms	*4,255*

director lies on links between other directors, so the larger a director's betweenness measure, the more likely it is that transferred information must pass through that director to be available to other directors in the network. Thus, a director in this position could, in theory, derive power or influence from his/her position in the network, so the betweenness measure provides an approximate indication of network influence. Directors with high betweenness scores are sometimes referred to as key brokers within the network.

II. Data, Sample Selection, and Research Design

A. Sample Data

We obtain information on boards of directors of publicly held companies from the BoardEx database and firm characteristics data from the Compustat database. Our sample period ranges from 2004 to 2010 and includes a total of 19,050 firm-year observations after conditioning on data required to construct our variables. Our sample includes 4,255 unique firms. We focus primarily on publicly traded companies, which have different governance and stakeholder characteristics than privately held companies (e.g., percentage of family board members, obligation to stockholders); thus, we do not consider private firms in our director network examination. Our sample selection procedure is described in Table I.

Table II summarizes the overall director network in Panel A, and the largest and second largest connected groups of directors (components) in Panels B and C, respectively. Panel A shows that the director network for each year is composed of one large connected component followed by many significantly smaller components. The largest connected component of directors (Panel B) includes an average of 70% of all directors per year. The number of unique directors per component declines sharply between the largest connected component and the second largest (Panel C). The second largest connected component includes an average of 0.1% of all directors per year.

Average path length (Table II, Panels B and C) is the average number of links connecting any two directors in a completely connected network. Directors in the largest component of our network are separated by, on average, six steps (i.e., six degrees of separation). The maximum path length or number of steps separating any two directors in the largest connected component (i.e., the network diameter) varies from 16 to 20, depending on year. In comparison, directors in the second largest component are on average separated by only three degrees, and the maximum distance between any two directors ranges from one to six.

Because connectedness measures are not all comparable across unconnected networks (Newman, 2010), we restrict our analyses to sample firms with directors in the largest connected component of each annual network.[2]

Table III reports the summary statistics for our sample of 19,050 firm-year observations. From Panel A, the mean log market capitalization in year t + 1 is 6.34 with a median of 6.37. In addition, we find that, on average, boards have at least one member that sits on another board of directors

[2] In theory, the geodesic distance between any two directors in a network is infinite if the vertices fall in different components of the network, leading to non-comparable closeness centrality measures across components within a network. The most common work-around is to only use those directors in the same component when computing closeness centrality, which would give a finite measure. Liu (2010) employs a scaling procedure by Sabidussi (1966) to normalize measures in disconnected groups. However, the approach does not apply here because of the large difference in group size, which leads to significantly different distributions. In addition, firms not in the largest connected group would have centrality measures equal to zero when scaling because of the large differential in group size.

Table II. Network Characteristics

This table summarizes the network characteristics of director networks by year. The network summary statistics include all director observations (Panel A), the largest connected group (Panel B) in the network, and the second largest connected component (Panel C). The number of components indicates the number of connected groups in each annual network. Average path length is the average number of links connecting any two directors in the component or group. The maximum path length, also known as the diameter, is the highest number of links connecting any two directors in the group (i.e., degrees of separation).

Panel A. Entire Network by Year

	2004	2005	2006	2007	2008	2009	2010
Number of directors	32,043	34,394	36,037	41,701	41,847	40,127	38,967
Number of components	1,079	1,126	1,142	1,938	2,143	2,059	1,918
% of directors in largest component	72.0%	73.2%	74.1%	68.6%	66.9%	66.4%	67.6%
% of directors in 2nd largest component	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%

Panel B. Largest Component by Year

	2004	2005	2006	2007	2008	2009	2010
Number of directors	23,060	25,188	26,697	28,603	28,001	26,648	26,326
Number of links	130,337	140,822	148,820	158,563	154,033	147,246	146,771
Average path length	6.186	6.168	6.207	6.321	6.491	6.502	6.424
Maximum path length (diameter)	18	17	16	18	18	20	19

Panel C. 2nd Largest Component by Year

	2004	2005	2006	2007	2008	2009	2010
Number of directors	38	39	38	38	63	58	77
Number of links	451	233	221	319	1,776	1,653	439
Average path length	1.358	2.065	2.060	1.828	1.091	1.000	3.268
Maximum path length (diameter)	2	3	3	3	2	1	6

within the same industry (*INDEXPERTS*). The average percentage of independent directors on a board and average board size are 82% and 8.29 members, respectively. Panel B presents average firm characteristics by industry using the 17 Fama-French classifications (Fama and French, 1997). The number of firm-year observations in an industry range from 147 to 6,944, with the Machinery and Business Equipment and Other categories, having the highest number of firm-year observations in our sample. Fabricated Products has the lowest number of firm-year observations.

B. Research Design

For each year from 2004 to 2010, we map an undirected and unweighted director network linking individual directors through shared publicly traded company board memberships.[3] We use the directors' professional board connections rather than possible social connections but acknowledge that information transfer that potentially affects firm value is not restricted to directors' professional board connections. Both sources of information transfer as it relates to the firm are likely to be highly correlated. As mentioned previously, we restrict our subsequent analyses to sample firm-year observations with directors in the largest connected component of each annual network because of comparability issues across connected groups that are significantly different in size. For each director we calculate degree, eigenvector, closeness, and betweenness centrality scores for each sample year.[4] For our main analyses, we aggregate each of these centrality scores to the firm level by taking its average across all the directors serving on a given board in a given year. We then construct our composite connectedness measure using principal component analysis to investigate the overall effect of director connectedness on firm value.

We investigate the overall effect of connectedness on firm value using ordinary least squares (OLS) regression of future firm value (year t + 1) as a function of aggregate director

[3] In undirected networks, a link between two entities is non-directional. Examples include co-membership in groups and family relationships. In unweighted networks, each link is represented by a dichotomous variable; that is, a tie is either present or absent between the pair.

[4] We use iGraph (R package) to calculate the raw centrality measures.

Table III. Summary Statistics

Panel A reports the summary statistics for 19,050 firm-year observations from 2004 to 2010. Panel B reports the mean values for select variables by industry (Fama French 17 classifications). Only observations that have all required data are included. MVE_{t+1} is the natural log of market capitalization measured at year t + 1. The remaining variables are measured at year t and are further defined in the appendix.

Panel A. Sample Firm-year Descriptives (N = 19,050)

	Mean	St. Dev.	Q1	Median	Q3
CONNECTEDNESS	0.01	0.96	-0.69	-0.18	0.53
MVE_{t+1}	6.34	1.94	5.04	6.37	7.63
INDEXPERTS	1.31	1.31	0.00	1.00	2.00
OUTSIDECEOS	0.49	0.73	0.00	0.00	1.00
BRDINDEP	0.82	0.09	0.78	0.86	0.89
BRDSIZE	8.29	2.16	7.00	8.00	10.00
FIRMAGE	19.48	15.30	8.01	14.01	26.02
BUSSEG	6.71	4.82	3.00	3.00	9.00
LEVERAGE	0.22	0.23	0.01	0.17	0.34
ASSETS	6.36	2.01	4.95	6.36	7.72

Panel B. Sample Characteristics by Industry

	N	CONNECTEDNESS	MVE_{t+1}	ASSETS	BRDSIZE	BRDINDEP
Food	403	0.12	6.77	6.85	9.15	0.83
Mining and Minerals	208	-0.29	6.34	5.95	7.65	0.80
Oil and Petroleum Products	782	-0.23	6.91	7.00	7.83	0.80
Textiles, Apparel & Footwear	313	-0.07	6.01	6.10	8.18	0.80
Consumer Durables	353	-0.07	5.61	5.98	8.33	0.80
Chemicals	420	0.40	6.77	6.91	8.75	0.85
Drugs, Soap, Prfums, Tobacco	947	0.12	6.03	5.38	8.24	0.83
Construction and Construction Materials	510	0.11	6.46	6.73	8.67	0.83
Steel Works Etc	210	0.04	6.88	7.08	8.37	0.84
Fabricated Products	147	0.05	6.26	6.39	8.65	0.83
Machinery and Business Equipment	2,760	-0.06	6.19	5.96	7.78	0.82
Automobiles	261	0.16	6.64	6.98	8.72	0.83
Transportation	737	0.25	6.90	7.21	8.80	0.83
Utilities	618	0.48	7.85	8.47	10.39	0.87
Retail Stores	1,179	0.00	6.49	6.57	8.58	0.81
Banks, Insurance Companies, and Other Financials	2,258	-0.01	6.81	7.51	8.70	0.80
Other	6,944	-0.03	5.97	5.80	8.02	0.82

connectedness, controlling for board and firm characteristics that the prior literature indicates affect firm value. All explanatory variables are measured in year t.[5] We include the composite connectedness measure (*CONNECTEDNESS*) as the variable of interest in the following model:

$$MVE_{t+1} = \alpha + \beta_1 CONNECTEDNESS + \beta_2 INDEXPERTS + \beta_3 OUTSIDECEOS + \beta_4 BRDINDEP + \beta_5 BRDSIZE + \beta_6 FIRMAGE + \beta_7 BUSSEG + \beta_8 LEVERAGE + \beta_9 ASSETS + \text{Year fixed effects} + \text{Industry fixed effects} + \varepsilon . \quad (1)$$

We use the natural log of market capitalization (MVE_{t+1}) to measure firm value because it captures investor's assessment of the firm's equity. The board characteristics controls in Equation (1) include the percentage of outside directors on

[5] Similar to Larcker et al. (2013), we mitigate endogeneity concerns due to causality by examining the relation between connectedness and future firm value. Therefore firm value is measured one year after the point at which connectedness and other control variables are measured.

the board (*BRDINDEP*) and board size (*BRDSIZE*). We also control for two other board characteristics that may affect the need for information or the extent to which information is used by the board. The first measure, *INDEXPERTS*, is a measure of industry expertise of the board of directors. Directors are exposed to contemporaneous industry-specific information, such as consumer knowledge and market trends, that can be transferrable between firms in the same industry. Therefore, highly connected directors who serve on multiple boards in the same industry are likely to receive more easily applicable information than individuals who are board members for firms in different industries. The second board characteristic, *OUTSIDECEOS,* allows us to control for the effect of having outside CEOs serving on firms' board of directors. These directors may serve as a source of contemporary management information and are able to provide relevant and current advice given their position as CEO of another firm. On the other hand, the benefit to the board of another firm's CEO is that the firm's own CEO may have an "ally" in the boardroom, resulting in actions that could potentially lower firm value.

Firm-level control variables are leverage (*LEVERAGE*), firm age (*FIRMAGE*), the natural logarithm of assets (*ASSETS*), and the number of business segments (*BUSSEG*). These variables are further defined in the appendix. We estimate our regression model with year and industry fixed effects to account for heterogeneity across time and industries. We also cluster standard errors on firm to adjust for unobserved firm effects (Petersen, 2008). The data is winsorized at the 1st and 99th percentiles for all continuous variables.

To investigate whether inside and outside director connectedness affects firm value differently, we re-estimate Equation (1) using inside director connectedness and outside director connectedness through seemingly unrelated estimation methods (SUR). We use SUR instead of separate OLS regressions because the error terms for the two equations are likely correlated, resulting in inefficient OLS coefficients. In addition, SUR allows coefficients to vary by group, which is important for understanding the effect of each variable by group. We then compare the connectedness coefficients to evaluate whether there is a difference in the impact of inside and outside director connectedness on firm value. An inside director is defined as an individual who has a board affiliation of "employee" and an outside director is defined as an individual who has a board affiliation of "independent" in the BoardEx database.

We also examine the effect of director connectedness on firm value after controlling for heterogeneity in firms' business environments including market competitiveness, operating cycle, investment opportunity set and geographic aspects of information accessibility. To proxy for market competiveness, we calculate the Herfindahl-Hirschman Index in each two-digit standard industrial classification (SIC) industry per year. Lower values of the index indicate lower market concentration or higher competition. We define *HIGH_MKTCOMP* as an indicator variable equal to 1 when the firm operates in an industry that has a Herfindahl-Hirschman Index of sales in the lowest quartile of all industry scores and 0 otherwise. In addition, firms may have higher firm value because they have better operating efficiency as reflected by faster operating cycles than similar firms. Therefore, we also control for the length of the operating cycle following Biddle, Hilary, and Verdi (2009) based on receivables over sales and inventory over cost of goods sold.[6] We construct an indicator variable, HIGH_OPCYCLE, which is equal to 1 when the firm has a faster operating cycle than the median operating cycle length for its industry and 0 otherwise.

To control for differing investment choices available to firms, we calculate investment opportunity set (IOS) scores for each firm using the factor analysis approach developed in Baber, Janakiraman, and Kang (1996) and employed in previous IOS studies (e.g., Cahan, Godfrey, Hamilton, and Jeter, 2008; McGuire, Omer, and Wilde, 2014). The four variables used to construct IOS scores are (1) investment intensity, (2) the geometric mean annual growth of the market value of assets, (3) the market-to-book ratio, and (4) the ratio of research and development expenditure to total assets. Following Baber et al. (1996), we define investment intensity as the sum of acquisitions, research and development, and capital expenditures for years t – 2 through *t* divided by total depreciation expense over the same period.[7] The geometric mean annual growth in the market value of assets is calculated as the nth root of the ratio of the market value of assets for year *t* to the market value of assets for year t-n, where n is the maximum number of periods (1 to 3) for which data is available. We calculate the market-to-book ratio as the market value of assets divided by the book value of assets at the end of year *t*. Finally, the ratio of research and development expenditure to total assets is R&D expense scaled by the firm's book value of assets at the end of year *t*. This approach reduces the four variables to a single firm-level factor score representing the firm's IOS score for year *t*. For each firm, we classify the IOS score into low and high scores at the industry median and create an indicator variable, *HI_IOS,* equal to 1 when the firm's IOS score is above the median, and 0 otherwise.

Finally, we evaluate the relation between director connectedness and firm value while controlling for

[6] Operating cycle = log[(receivables/sales + inventory/cost of goods sold) × 360].

[7] Consistent with (Baber et al., 1996), missing values of research and development expense and acquisitions are set to zero.

Table IV. Firm Value as a Function of Connectedness

This table presents the results from a regression of firm value for 2004-2010 on aggregate board connectedness and control variables. The dependent variable (MVE_{t+1}) is the natural log of market capitalization measured in year t+1. The explanatory variables are measured in year *t*. The regression includes year and industry fixed effects. Robust standard errors are adjusted for clustering by firm. The *t*-statistics are presented in parentheses. The variables are described in the appendix.

VARIABLES	MVE_{t+1}
CONNECTEDNESS	0.095***
	(5.361)
INDEXPERTS	0.047***
	(4.749)
OUTSIDECEOS	0.044***
	(2.791)
BRDINDEP	-0.541***
	(-3.997)
BRDSIZE	0.013*
	(1.693)
FIRMAGE	-0.003***
	(-3.312)
BUSSEG	-0.009***
	(-3.074)
LEVERAGE	-1.278***
	(-17.515)
ASSETS	0.870***
	(86.001)
Constant	1.754***
	(11.673)
Observations	19,050
R^2	0.778

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

information accessibility. In particular, firms that are located in densely populated areas may have greater access to information because their information environment is more complete and thus would not necessarily benefit (or benefit as much) from well-connected directors as firms located in less densely populated areas. We create an indicator variable, *TOP10_MSA,* that is equal to 1 when a firm is headquartered in one of the top 10 most-populated metropolitan statistical areas (MSA) as measured by population and 0 otherwise.

III. Empirical Analysis

A. Main Results

Table IV reports our main results from estimating Equation (1). We find a positive and significant coefficient for *CONNECTEDNESS* (0.095, $p < 0.01$), suggesting that future firm value increases when the board and its directors are better connected and rejecting H1. This is consistent with the idea that well-connected directors have larger information sets, which can facilitate decision making that results in higher firm value. We find similar results when using Tobin's Q as the dependent variable. In addition, the positive and significant coefficients for *INDEXPERTS* (0.047, $p < 0.01$) and *OUTSIDECEOS* (0.044, $p < 0.01$) suggest that firm value also increases with more industry experts and CEOs on the board of directors. In terms of economic significance, moving from the 25th to the 75th percentile of connectedness in year *t* results in an 11.4% higher market capitalization in year t + 1.[8]

To evaluate whether the connectedness of inside directors or outside directors have different effects on firm value, we re-estimate Equation (1) using seemingly unrelated regression with the aggregate connectedness for

[8] We predict economic significance based on the estimated coefficient from our sample and the difference in connectedness across the interquartile range. Our estimate shows that connectedness is strongly associated with future firm value, but we do not claim that increasing connectedness over that range will necessarily cause this large level increase in firm value.

Table V. Firm Value as a Function of Connectedness of Outside and Inside Directors

This table presents the results from regressions of firm value for 2004-2010 on aggregate connectedness for inside directors and outside directors measured in year *t*. The dependent variable (MVE_{t+1}) is the natural log of market capitalization measured in year t+1. The explanatory variables are measured in year t. All regressions include year and industry fixed effects. Robust standard errors are adjusted for clustering by firm. The *t*-statistics are presented in parentheses. The variables are described in the appendix.

VARIABLES	(1) MVE_{t+1}	(2) MVE_{t+1}
INSIDE_CONNECT	0.067***	
	(4.175)	
OUTSIDE_CONNECT		0.109***
		(6.236)
INDEXPERTS	0.060***	0.042***
	(6.363)	(4.188)
OUTSIDECEOS	0.053***	0.042***
	(3.366)	(2.660)
BRDINDEP	-0.444***	-0.483***
	(-3.084)	(-3.576)
BRDSIZE	0.014	0.012
	(0.413)	(1.616)
FIRMAGE	-0.003***	-0.003***
	(-3.155)	(-3.339)
BUSSEG	-0.010***	-0.009***
	(-3.130)	(-3.008)
LEVERAGE	-1.275***	-1.275***
	(-17.192)	(-17.531)
ASSETS	0.877***	0.867***
	(86.902)	(85.846)
Constant	0.060***	1.722***
	(6.363)	(11.688)
Observations	19,050	19,050
R^2	0.777	0.778

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

inside directors in the first regression and the aggregate connectedness of outside directors in the second regression. The first column of Table V reports the results of regressing future firm value on the connectedness of inside directors. The coefficient for inside director connectedness (*INSIDE_CONNECT*) remains positive and significant (0.067, $p < 0.01$), suggesting that firms benefit from greater network ties when their executives serve on or are connected to other boards. Similarly, we also find that the coefficient for outside director connectedness (*OUTSIDE_CONNECT*) is positive and significant (0.109, $p < 0.01$). Therefore, both inside and outside director connectedness increase future firm value, and we reject H2a. When comparing the magnitudes of the two coefficients using a Wald test, we find that they are statistically different ($p < 0.01$), which suggests that the effect of the outside director connectedness on firm value is greater than that of inside directors and allows us to reject H2b. In terms of economic significance, moving from the 25th to the 75th percentile of outside director connectedness in year *t* results in 7% higher market capitalization in year t + 1 compared to moving from the 25th to the 75th percentile of inside director connectedness. We find similar results when using Tobin's Q to proxy for firm value (untabulated). This finding provides evidence that the costs of outside directors assimilating information about the firm are, on average, exceeded by the benefits of the information provided by the outside director.

B. Controlling for Business-related Factors

We further examine whether director connectedness improves firm value in varied business and information environments. Table VI reports results from estimating

Table VI. Firm Value as a Function of Connectedness with Additional Controls

This table presents the results from regressions of firm value for 2004-2010 on aggregate board connectedness, market competitiveness, operating cycle, geographic location, and growth opportunities. The dependent variable (MVE_{t+1}) is the natural log of market capitalization measured in year t+1. The explanatory variables are measured in year *t*. All regressions include year and industry fixed effects. Robust standard errors are adjusted for clustering by firm. The *t*-statistics are presented in parentheses. The variables are described in the appendix.

VARIABLES	(1)	(2)	(3)
	MVE_{t+1}	MVE_{t+1}	MVE_{t+1}
CONNECTEDNESS	0.095***	0.095***	0.078***
	(5.342)	(5.383)	(4.690)
HIGH_MKTCOMP	0.030		
	(0.845)		
HIGH_OPCYCLE		0.004	
		(0.155)	
TOP10_MSA			0.002
			(0.086)
HIGH_IOS			0.526***
			(23.507)
INDEXPERTS	0.047***	0.047***	0.013
	(4.818)	(4.742)	(1.363)
OUTSIDECEOS	0.044***	0.044***	0.038***
	(2.804)	(2.788)	(2.589)
BRDINDEP	-0.538***	-0.541***	-0.595***
	(-3.977)	(-3.990)	(-4.745)
BRDSIZE	0.012*	0.013*	0.016**
	(1.659)	(1.694)	(2.288)
FIRMAGE	-0.003***	-0.003***	-0.002**
	(-3.289)	(-3.306)	(-2.080)
BUSSEG	-0.009***	-0.009***	-0.005*
	(-3.089)	(-3.076)	(-1.687)
LEVERAGE	-1.279***	-1.277***	-1.184***
	(-17.516)	(-17.488)	(-17.215)
ASSETS	0.870***	0.870***	0.903***
	(85.968)	(85.906)	(95.786)
Constant	1.745***	1.752***	1.207***
	(11.618)	(11.526)	(8.807)
Observations	19,050	19,050	19,050
R^2	0.778	0.778	0.794

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

Equation (1) with additional controls for market competitiveness, operating cycle, investment opportunity set, and information accessibility as a result of geographic location. We find positive and significant coefficients for *CONNECTEDNESS* in all estimations, confirming that firms benefit from having well-connected directors even after controlling for differences in other business-related factors that may affect firm value. While the coefficients for market competitiveness (*HIGH_MKTCOMP*) and operating cycle (*HIGH_OPCYCLE*) are not significant in the first and second models, respectively, the coefficient for *HIGH_IOS* is positive and significant (0.519, $p < 0.01$), indicating that firms that have more investment opportunities have higher firm value.

C. Additional Tests

1. Change Analysis

To further control for unobservable determinants of firm value that are time-invariant, we examine the change in firm value between year *t* and year t-1 as a function of changes

Table VII. Change in Firm Value as a Function of Change in Connectedness

This table presents the results from regressions of change in firm value for 2004-2010 on change in aggregate board connectedness and control variables. The dependent variable (ΔMVE_{t+1}) is the change in the log market capitalization between in year *t* and year t+1. The explanatory variables measure changes between year t-1 and year *t*. Robust standard errors are adjusted for clustering by firm. The *t*-statistics are presented in parentheses. The variables are described in the appendix.

VARIABLES	ΔMVE_{t+1}
ΔCONNECTEDNESS	0.055***
	(4.486)
ΔINDEXPERTS	-0.023**
	(-2.231)
ΔOUTSIDECEOS	-0.010
	(-0.864)
ΔBRDINDEP	-0.192
	(-1.532)
ΔBRDSIZE	0.003
	(0.475)
ΔBUSSEG	0.012***
	(2.986)
ΔLEVERAGE	-0.047
	(-0.708)
ΔASSETS	-0.215***
	(-9.721)
Constant	0.009
	(0.190)
Observations	14,794
R^2	0.015

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

in explanatory variables used in Equation (1) between year t-1 and year *t*. Hence, similar to the results provided above, the dependent and explanatory change variables are not measured contemporaneously. We do not include industry fixed effects because industry membership is generally time-invariant.[9] We estimate the following change model using ordinary least squares (OLS):

$$\Delta MVE_{t+1} = \alpha + \beta_1 \Delta CONNECTEDNESS + \beta_2 \Delta INDEXPERTS + \beta_3 \Delta OUTSIDECEOS + \beta_4 \Delta BRDINDEP + \beta_5 \Delta BRDSIZE + \beta_6 \Delta BUSSEG + \beta_7 \Delta LEVERAGE + \beta_8 \Delta ASSETS + \varepsilon. \quad (2)$$

Table VII presents the results of estimating Equation (2). We find that the coefficient for change in connectedness (ΔCONNECTEDNESS) is positive and significant (0.055, $p < 0.01$), suggesting that an increase in aggregate director connectedness is associated with increases in future firm value.

[9] Our findings do not change when we include industry fixed effects.

2. Endogeneity

One potential concern of our empirical findings is endogeneity between firms' selection of directors and firm value. On one hand, firms may choose well-connected directors in order to improve firm value. However, another possible explanation is that well-connected directors may accept directorships for firms that are already highly valued. In addition, our results linking connectedness to firm value may be driven by an omitted variable correlated with our connectedness measure that also affects firm value. We address endogeneity using several methods. First, similar to Larcker et al. (2013), we measure our dependent variable after the point at which we measure connectedness and other control variables. In addition, we employ a change model with the dependent variable measured from year *t* to t+1 and explanatory variables measured in the prior period (year t–1 to *t*). Finally, we perform a Hausman test, which compares the OLS and instrumental variables (IV) estimates, to test for endogeneity (Hausman, 1978). A significant difference between the estimates would indicate that the OLS estimates are inconsistent and that the IV approach is more appropriate.

For the instrumental variable, we select the industry average connectedness because it is likely correlated to the firm's connectedness, but uncorrelated with the error term; the average connectedness in the industry may determine the extent to which the industry as a whole chooses well-connected directors, but the average connectedness in the industry should not affect individual firm value. To mitigate weak instrument concerns we estimate a reduced-form regression using *CONNECTEDNESS* as the dependent variable and the instrumental and exogenous variables on the right-hand side. The results from the reduced-form regression confirm that the industry average connectedness is a good instrumental variable. For the Hausman test itself, we find in untabulated results that the OLS and IV coefficients are not statistically different and we cannot reject the consistency of the OLS estimates. We report our main analysis using OLS because the OLS estimates are more efficient than the IV estimates and therefore preferred.

IV. Conclusion

Boards of directors are tasked with monitoring and advising management on corporate decisions that can have a critical impact on firms' value. This paper considers the potential benefits and costs of acquiring external information from other firms through shared directorates. Directors form relationships with each other by serving on the same corporate board, and these relationships link firms when individuals serve on multiple boards. However, the acquisition of external information can also impose costs on individual directors. These costs include the additional time and effort required to serve on multiple boards, which potentially impair oversight responsibilities, as well as imposing the risk to the firm of acquiring and spreading damaging information such as poor corporate practices. Our primary finding is that firms with higher aggregate connectedness, as proxied by our composite social network measure, are associated with higher firm value on average, even when controlling for other factors that have been found to affect firm value. This suggests that for our sample of firms the directors' cost of acquiring external information does not outweigh the potential benefits of greater and faster access to information from other firms. In addition, we find that while future firm value increases with connectedness of both inside and outside directors, well-connected outside directors have a larger impact on future firm value than well-connected inside directors. Overall we find positive benefits for connectedness even when we consider additional business and information environment differences.

This study makes several contributions to the corporate governance literature. First, we extend corporate governance research using social network theory and methods to examine the benefits and costs of shared directorates. Prior studies of boards of directors commonly consider connectedness only as the number of board memberships. We use an alternative approach that captures the more complex aspects of connectedness that extend beyond the number of board memberships to include the potential rate and amount of information transfer, as well as the effect of a board position as a key information broker. Second, we contribute to the emerging literature bridging corporate governance and social network theory by considering the connectedness of individual directors rather than boards. By studying connectedness at the director level, we are able to consider the effect of inside versus outside directors. Finally, we also contribute to the IOS literature by providing evidence that director connectedness has a positive effect on firm value even when investment opportunity sets are high.

A limitation of our director network analyses is that the results consider only the directors, and subsequently firms, that are part of the largest connected component in the network. As mentioned previously, we use this approach because the standard formula for calculating the closeness scores is limited in that the resulting measures are not comparable across disconnected groups or components in a network. The measures capture relative connectedness and centrality within a particular network and they cannot be meaningfully compared to analogous measures for directors in a completely separate, perhaps much smaller or larger, network. Thus, the general inferences about the effect of firm connectedness may not apply to the disconnected 30% of directors and corresponding firms if the smaller group of boards interacts in a significantly different manner than the larger connected component. Future studies will consider modified centrality measures that allow incorporation of the disconnected components.■

Appendix: Variable Definitions

ASSETS	Firm size measured by the log of total assets.
BRDINDEP	Board independence measured by the ratio of the number of outside directors to the total number of directors on the board.
BRDSIZE	Board size measured by the number of directors serving on the firm's board of directors.
BUSSEG	Number of business segments reported for the firm in Compustat.
CONNECTEDNESS	Composite measure of the board of directors' connectedness based on principal component analysis of the four centrality measures. This is measured at the firm level.
FIRMAGE	Age of the firm defined as the number of years since the firm first appeared in Compustat with valid assets data.
HIGH_IOS	Indicator variable equal to 1 when the firm's IOS score is above the industry median, and zero otherwise. IOS scores are calculated using factor analysis (Baber et al. 1996).
HIGH_MKTCOMP	Indicator variable equal to 1 when the firm operates in an industry that has a Herfindahl-Hirschman Index of sales in the lowest quartile of all industry scores and 0 otherwise.
HIGH_OPCYCLE	Indicator variable equal to 1 when the firm has a faster operating cycle than the median operating cycle length for its industry and 0 otherwise. The length of the operating cycle is calculated as the log of receivables/sale plus inventory/ cost of goods sold multiplied by 360.
INDEXPERTS	Number of directors that serves concurrently on another board of directors within the same industry.
INSIDE_CONNECT	Composite measure of inside directors' connectedness based on principal component analysis of the four centrality measures. This is measured at the firm level.
LEVERAGE	Leverage of the firm measured by the ratio of long-term debt and short-term debt over total assets.
MVE_{t+1}	Natural log of market capitalization measured in year t+1. Market capitalization is calculated as the number of common shares outstanding multiplied by the closing stock price at the end of the period.
OUTSIDE_CONNECT	Composite measure of outside directors' connectedness based on principal component analysis of the four centrality measures. This is measured at the firm level.
OUTSIDECEOS	Number of outside CEOs serving on the board of directors.
TOP10_MSA	Indicator variable equal to 1 when a firm is headquartered in the top 10 most populated metropolitan statistical areas (MSA) and 0 otherwise.

References

Adams, R. and D. Ferreira, 2007, "A Theory of Friendly Boards," *Journal of Finance* 62 (No. 1), 217-250.

Ahmed, A. and S. Duellman, 2007, "Accounting Conservatism and Board of Director Characteristics: An Empirical Analysis," *Journal of Accounting and Economics* 43 (No. 2-3), 411-437.

Baber, W.R., S.N. Janakiraman, and S.H. Kang, 1996, "Investment Opportunities and the Structure of Executive Compensation," *Journal of Accounting and Economics* 21 (No. 3), 297-318.

Beasley, M., 1996, "An Empirical Analysis of the Relation between the Board of Director Composition and Financial Statement Fraud," *Accounting Review* 71 (No. 4), 443-465.

Biddle, G.C., G. Hilary, and R.S. Verdi, 2009, "How Does Financial Reporting Quality Relate to Investment Efficiency?" *Journal of Accounting & Economics* 48 (No. 2-3), 112-131.

Bizjak, J., M. Lemmon, and R. Whitby, 2009, "Option Backdating and Board Interlocks," *Review of Financial Studies* 22 (No. 11), 4821-4847.

Bonacich, P., 1972, "Factoring and Weighting Approaches to Status Scores and Clique Identification," *Journal of Mathematical Sociology* 2 (No. 1), 113-120.

Bonacich, P., 1987, "Power and Centrality: A Family of Measures," *American Journal of Sociology* 92 (No. 5), 1170-1182.

Bonacich, P., 1991, "Simultaneous Group and Individual Centralities," *Social Networks* 13 (No. 2), 155-168.

Borgatti, S.P. and D.S. Halgin, 2011, "On Network Theory," *Organization Science* 22 (No. 5), 1168-1181.

Cahan, S.F., J.M. Godfrey, J. Hamilton, and D.C. Jeter, 2008, "Auditor Specialization, Auditor Dominance, and Audit Fees: The Role of Investment Opportunities," *Accounting Review* 83 (No. 6), 1393-1423.

Chiu, P.C., S.H. Teoh, and F. Tian, 2013, "Board Interlocks and Earnings Management Contagion," *Accounting Review* 88 (No. 3), 915-944.

Core, J., R. Holthausen, and D. Larcker, 1999, "Corporate Governance, Chief Executive Officer Compensation, and Firm Performance," *Journal of Financial Economics* 51 (No. 3), 371-406.

Countryman, A., 2003, "Region's CEOs Sit on Fewer Outside Boards, Review Finds," Chicago Tribune (May).

Dooley, P.C., 1969, "The Interlocking Directorate," *American Economic Review* 59 (No. 3), 314-323.

Duchin, R., J.G. Matsusaka, and O. Ozbas, 2010, "When are Outside Directors Effective?" *Journal of Financial Economics* 96 (No. 2), 195-214.

Fama, E.F., and K.R. French, 1997, "Industry Costs of Equity," *Journal of Financial Economics* 43 (No. 2), 153-193.

Fama, E.F., and M.C. Jensen, 1983, "Separation of Ownership and Control," *Journal of Law & Economics* 26 (No. 2), 301-325.

Feld, B., 2012, "All CEOs Should Sit on Another Company's Board," CNN Money (August).

Fich, E.M., and A. Shivdasani, 2006, "Are Busy Boards Effective Monitors?" *Journal of Finance* 61 (No. 2), 689-724.

Freeman, L.C., 1979, "Centrality in Social Networks: Conceptual Clarification," *Social Networks* 1 (No. 3), 215-239.

Gulati, R. and J. Westphal, 1999, "Cooperative or Controlling? The Effects of CEO-Board Relations and the Content of Interlocks on the Formation of Joint Ventures," *Administrative Science Quarterly* 44 (No. 3), 473-506.

Haunschild, P.R., 1993, "Interorganizational Imitation: The Impact of Interlocks on Corporate Acquisition Activity," *Administrative Science Quarterly* 38 (No. 4), 564-592.

Hausman, J.A., 1978, "Specification Tests in Econometrics," *Econometrica* 46 (No. 6), 1251-1271.

Haythornthwaite, C., 1996, "Social Network Analysis: An Approach and Technique for the Study of Information Exchange," *Library & Information Science Research* 18 (No. 4), 323-342.

Hodgson, P., 2012, "Should CEO Board Service be Limited?" Corporate Secretary (May).

Jackson, E., 2009, "Should CEOs Sit on Other Companies' Boards?" Seeking Alpha (April).

Klein, A., 1998, "Firm Performance and Board Committee Structure," *Journal of Law and Economics* 41 (No. 1), 275-299.

Larcker, D.F., E.C. So, and C.Y. Wang, 2013, "Boardroom Centrality and Firm Performance," *Journal of Accounting and Economics* 55 (No. 2-3), 225-250.

Liu, Y., 2010, "The Impact of Networks on CEO Turnover, Appointment, and Compensation," University of Maryland Working Paper.

McGuire, S.T., T.C. Omer, and J.H. Wilde, 2014, "Investment Opportunity Sets, Operating Uncertainty, and Capital Market Pressure: Determinants of Investments in Tax Shelter Activities?" Texas A&M University Working Paper.

Mizruchi, M., 1996, "What Do Interlocks Do? An Analysis, Critique, and Assessment of Research on Interlocking Directorates," *Annual Review of Sociology* 22, 271-298.

Mol, M., 2001, "Creating Wealth Through Working with Others: Interorganizational Relationships," *The Acadeour of Management Executive* 15 (No. 1), 150-152.

Newman, M.E.J., 2005, "A Measure of Betweenness Centrality Based on Random Walks," *Social Networks* 27 (No. 1), 39-54.

Newman, M.E.J., 2010, *Networks: An Introduction*, New York, NY, Oxford University Press.

Newman, M.E.J., A.-L.s. Barabási, and D.J. Watts, 2006, *The Structure and Dynamics of Networks* (*Princeton Studies in Complexity*), Princeton, NJ, Princeton University Press.

Omer, T., M. Shelley, and F. Tice, 2014, "Do Director Networks Matter for Financial Reporting Quality? Evidence from Restatements," University of Nebraska-Lincoln and Texas A&M University Working Paper.

Palmer, D., R. Friedland, and J. Singh, 1986, "The Ties that Bind: Organizational and Class Bases of Stability in a Corporate Interlock Network," *American Sociological Review* 51 (No. 6), 781-796.

Palmer, D., P.D. Jennings, and X. Zhou, 1989, "Late Adoption of the Multidivisional Form by Large US Corporations: Institutional, Political, and Economic Account," *Administrative Science Quarterly* 38 (No. 1), 100-131.

Pennings, J., 1980, *Interlocking Directorates*, San Francisco, CA, Josey-Bass Publishers.

Petersen, M.A., 2008, "Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches," *Review of Financial Studies* 22 (No. 1), 436-480.

Perry T. and Peyer U., 2005, "Board Seat Accumulation by Executives: A Shareholder's Perspective," *Journal of Finance* 60 (No. 4), 2083–2123.

Phelps, C., R. Heidl, and A. Wadhwa, 2012, "Knowledge, Networks, and Knowledge Networks: A Review and Research Agenda," *Journal of Management* 38 (No. 4), 1115-1166.

Raheja, C., 2005, "Determinants of Board Size and Composition: A Theory of Corporate Boards," *Journal of Financial and Quantitative Analysis* 40 (No. 2), 283-306.

Sabidussi, G., 1966, "Centrality Index of a Graph," *Psychometrika* 31 (No. 4), 581-581.

Schonlau, R. and P.V. Singh, 2009, "Board Networks and Merger Performance," Carnegie Mellon University Working Paper.

Schoorman, F., M. Bazerman, and R. Atkin, 1981, "Interlocking Directorates: A Strategy for Reducing Environmental Uncertainty," *Academy of Management Review* 6 (No. 2), 243-251.

Scott, J., 1991, "Networks of Corporate Power: A Comparative Assessment," *Annual Review of Sociology* 17, 181 -203.

Sparrow, R., R. Liden, S. Wayne, and M. Kraimer, 2001, "Social Networks and the Performance of Individuals and Groups," *Academy of Management Journal* 44 (No. 2), 316-325.

Tsai, W., 2001, "Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance," *Academy of Management Journal* 44 (No. 5), 996-1004.

Wasserman, S. and K. Faust, 1994, *Social Network Analysis: Methods and Applications* (*Structural Analysis in the Social Sciences*), New York, NY, Cambridge University Press.