MEASURING TRENDS IN CORPORATE BOARD INTERLOCKING AMONGST U.S. FIRMS

By

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Abstract

The notion of a circle of "elites" who exercise influence over politics, legislation, and public life has motivated both academic and public discussion. How can we verify the existence of such a circle of board directors of large corporations? Gerald F. Davis and Johan Chu's 2016 study "Who Killed the Inner Circle? The Decline of the American Corporate Interlock Network" finds that the degree of corporate board interlocking declined from 1997 to 2010. My thesis replicates and extends Chu and Davis' methods to trends in board interlocking after 2010: I find increases in the connectivity of female and non-American directors; strong declines in corporate interlocks in the early 2000s; and weaker declines after 2010, implying a fracturing in the network of American corporate elites contrary to perceptions of its resurgence made popular by recent political rhetoric. These results yield surprising evidence against rhetoric about a dense network of elites exercising influence over American public life, and fruitful questions for future discussions on how changes in this "inner circle" have manifested.

Introduction

The political rhetoric around "elites" in the United States has intensified in recent years—the Trump 2016 presidential campaign relied on messaging about the "swamp," an entrenched circle of wealthy, influential political and business insiders conspiring to manipulate politics in their favor (Przybyla 2016). This narrative has since been adopted and promoted by conspiracy platform QAnon and dominates political messaging (The Guardian 2019). The notion of the "elites" is a key component of public discourse on income inequality, housing crises, and the opioid epidemic, adding urgency to studying the existence and composition of such a circle of "elites."

Management Theory has studied business' ability to influence public affairs in various forms: C. Wright Mills' "The Power Elite" concluded that business interests exercised a documentable influence on public policy via influencing elected representatives at every level of government (Mills 1958). Michael Useem built on Mills' work, examining the existence of an "inner circle," a small network of individuals who hold tremendous power to influence political decision-making and corporate governance practices (Useem 1984)—with profound implications for studies across disciplines like Sociology, Economics and Political Science aiming to comment on the national, even global, forces that shape politics and the global economy (Mizruchi 1996). Subsequent research has aimed to study this through analyzing "board interlocking," a measure of the degree of connectivity between the directors serving on corporate boards of US firms (and between the firms themselves), to conclude whether a super connected network of high ranked corporate board directors exists in the United States.

A seminal study aiming to discover trends in the extent of board interlocking in the United States was conducted by Gerald F. Davis and Johan Chu in 2016, finding that the degree

of corporate board interlocking declined from 1997 to 2009 and presenting several reasons for this decline, including a decline in firms' preferences for highly connected board directors. Since Chu and Davis, however, there has been little conclusive research on subsequent trends in interlocking. How has board interlocking changed in the 2010s and do these results follow Chu and Davis' findings on the decline from 1997 to 2009? My study aims to answer these questions by replicating Chu and Davis' analytical methods and extending their study beyond 2010 to 2022.

This analysis takes on potent meaning in this time of heightened political rhetoric about the "swamp": the pronounced importance that discourse about "draining the swamp" has taken on is premised on the assumption that the "swamp" is stronger than ever. Politicians and voters who engage in this discourse do so imagining that the corporate elites who comprise the inner circle are deeply connected, whereas Chu and Davis' findings imply the very opposite—that the "inner circle" has gradually broken down over time (Chu and Davis 2016).

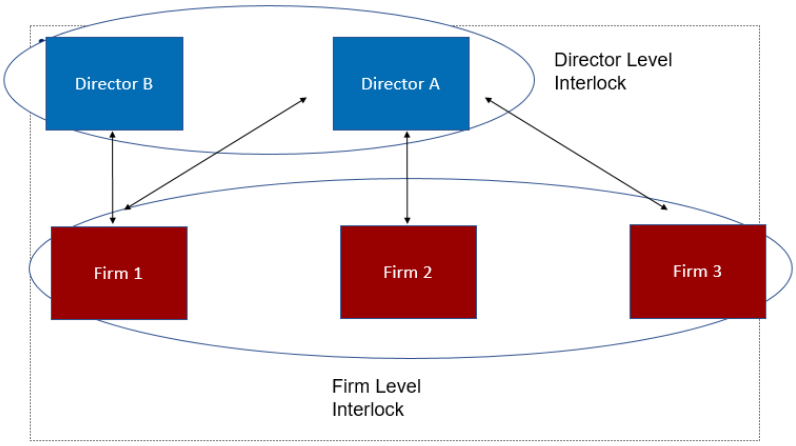
Does this fracturing continue, and to the extent discovered by Chu and Davis? If so, that would mean that public discourse, media commentary and political figures have profoundly mischaracterized the power systems in the United States, and that these theories veer closer to fake news than truth. If not, however, that means that concerns that a small group of individuals has enough power and capital to exercise disproportionate influence on the US government continue to manifest: this makes it especially timely to revisit Chu and Davis' findings and verify whether they hold true after 2010.

More importantly, a number of global macroeconomic trends since 2000 have shaped interlocks: the financial crisis of 2008 and the Dodd-Frank Act imposed additional regulation on boards of financial institutions by giving proxy rights to shareholders to nominate board directors

(Rezaee 2016); the Silicon Valley boom led to the emergence of tech startups whose corporate governance practices differ from the traditional blue-chip company (Fenwick et.al, 2019); The Sarbanes-Oxley Act of 2002 forced companies to implement new corporate governance standards encompassing board director selection and independence (Alkhafaji 2007). These past two decades have witnessed tremendous changes in business culture and practice in America, and their causal effect on interlock trends is yet to be studied. What is the state of the "inner circle" today? An empirical study that can answer this question can equip researchers across the disciplines of Management Science, Sociology and Economics with a foundation to extrapolate the influence the "inner circle" still exerts on legislation.

Background and Theory

Figure 1: Description of Board Interlocks



After Mill's analysis of the presence of businesses in the power structures of the United States (Mill 1956), the foundations of the study of board interlocks were laid by Professor Michael Useem who found evidence that directors and executives of top corporations in the United States who served on the boards of multiple corporations made up an elite "Inner Circle" of highly connected individuals who often succeeded in influencing regulation and policymaking to be favorable to corporate interests (Useem 1984).

Management theorists who have built on Useem's work, however, have been more focused on determining the causes of this "super-connectedness." Galaskiewicz, Wasserman, et al. (1985) aimed to determine the effect of the social standing of a director on the board of a corporation (measured by variables indicative of social privilege such as whether or not they attended an Ivy League University, whether they were a member of their local country club, or served on the board of cultural organizations) on the likelihood of that director being "interlocked" (that is, serving on the board of another corporation). They found significant correlation between social privilege and connectedness but used a relatively unsophisticated log-linear regression analysis to construct an adjacency matrix for interlocking. Subsequent papers attempted to evolve this methodology by using network analysis, while also attempting to determine the effects of corporate interlocking on Poison Pill Defenses (Davis 1991), Environmental Hazards (Lang and Lockhart 1990) and corporate charitable giving (Galaskiewicz 1997).

However, as Mark Mizruchi (1996) points out, Interlock research needs more detailed description of the processes that variables are being used to capture. Most research in the field in the 1980s and 1990s defined measured linkages between boards too ambiguously and without sufficient analytical rigor. Since then, network analysis has become the prominent mode of analyzing board interconnectivity and its determinants. Typically, this entails the construction of an "interlock" variable at both the firm and individual director level. The connected firms and directors are taken to be "nodes" and the distance between nodes for shared boards is measured for directors, while the distance between nodes of shared directors is measured for firms (Davis, Yoo and Baker 2003).

This approach is also used in Chu and Davis's (2016) paper measuring the decline of board interlocking from the 1980s to the 2000s: Chu and Davis argue that Board interconnectedness has declined since 1997, mainly explained by a decline in the number of "super-connected" board members, that is, board directors who serve on the boards of multiple firms. This has been motivated by two main factors: first, a decreased preference amongst firms for directors serving on multiple boards; and second, a decline in the value of interconnectedness for directors. Other studies have argued that declining board interlocks have made managers more short-sighted in their decision making by reducing the sharing of knowledge and experience across firms (Benton and Cobb 2019), supporting the view that board interlocks have declined over time, and this decline has had negative effects on the sharing of institutional knowledge and firm performance.

Despite the large amount of research that has already been done into the effect of interlocks on firm performance measures, there still appear to be grey areas where researchers have identified potential linkages with interlocking and financial decision-making. Some recent papers on the subject have analyzed the effect of interlocking on firm outcomes (Lamb and Roundy 2016) like firm performance (Withers et. al 2018), likelihood of being taken private (Stuart and Yim 2010), or engaging in strategic Mergers and Acquisitions (Cai and Sevilir 2012).

Today, there seem to be some common methods and themes among board interlocks scholarship. Smith and Sarabi (2020) argue that there are three main types of papers being published in interlock research: the first type, like the aforementioned studies, aim to measure the effect of board interlocks on individual level topics within firms like leadership, human capital management, and management practices. Secondly, there are papers aiming to connect board interlocking with global topics like political environments, legislation, spillovers into developing

countries, etc. These papers follow more closely in the vein of Useem's 1984 book by examining the "inner circle" of corporate elites and how they influence the world. Some, like Benton's study on the trends in female representation on corporate boards (Benton 2021), examine the effect of changes in broader social norms on board networks. Finally, the third type of paper aims to measure the effect of board interlocks on performance measures and corporate governance, like poison pill takeovers or golden parachutes (Smith and Sarabi 2020).

However, there has been no defining paper like Chu and Davis' that has been able to track trends in Board Interlocks since the 2000s. As a result, there is need for further analysis on how interlocks have changed in the United States since the 2000s that could potentially inform what Smith and Sarabi refer to as the "second type" of research: studies that aim to measure the broader global impacts of corporate connectedness and draw conclusions about how much power the connected elite are able to exert on politics and legislation. I believe there is significant potential to fill this gap and provide information about the most recent time-varying trends to support current board interlocks research and aim to do so in my study.

Design and Methods

Replicating the methods used by Chu and Davis, I study two main subjects: first, the change in "Board Interlocks" over time for firms in the S&P1500, and second, the association, over time, between certain determinant characteristics about individuals (age, sex, nationality) and the "connectivity" of that individual (Chu and Davis 2016).

I restrict my analysis to publicly traded US firms: whilst board composition and network association data is available for Europe as well as North America, the inclusion of non-US firms would require more sophisticated data merging and imputation. Furthermore, metrics of analysis

would have to be adjusted per local business norms; furthermore, network trends across nations may differ due to political and macroeconomic factors unique to nations' economic and regulatory climate.

A single board "Board Interlock" is formed between two firms when the same board director serves on the board of both firms. The two boards are considered "interlocked." The variable of interest at the director level is the director's "connectivity," that is, the number of boards that director is connected to. The variable of interest at the firm level is the firm's "number of interlocks," that is, the total number of other firms that the focal firm is connected to through a director serving on both boards. The measurement of these variables is a mechanical exercise— the main analysis in this study is about the association between directors' characteristics (like the demographic and social characteristics mentioned above) on connectivity. For each director, I use whether the director gained a new board seat in the subsequent year as the dependent variable, coded as 1 if yes and 0 if no. I use a random effects unbalanced panel logistic regression for this analysis— the dependent variable, the likelihood of a board director gaining a new seat in the subsequent year, is regressed against the determinant characteristics of the director.

In the first stage of my analysis, I analyzed characteristics of the larger network of board interlocks in the years 2000, 2010 and 2020 to determine large shifts over time. I created a dataset of board connections from the years 1996-2023 by merging ISS and Boardex Network Associations datasets on Company Ticker. Each row of Boardex Firm Associations data is a "dyad" of two interlocked firms who share a board director: the merged ISS/Boardex firm-year level dataset contained four columns: "year"-"focal firm"-"connected firm"-"shared board director". To construct a final dataset of only firm to firm connections, I then collapsed the dataset to get the number of

connections for each firm. If a firm shared multiple directors with another firm, those connections were collapsed into a single tie, resulting in a dataset containing three columns: "year"-"focal firm"-"number of direct ties". I used this dataset to compare how the number of direct ties for the most highly connected firms have changed over time. The final dataset contained a sample of 3,054 unique focal firms over 493,977 firm-years from 1996-2022. In comparison, the sample used by Chu and Davis as representative of the S&P1500 contained 2,454 unique focal firms over 151,135 firm-years from 1997-20010. My sample was larger due to the inclusion of more firms from the ISS dataset for years 2010-2022 that Chu and Davis did not include in their study.

Results

Table 1: Description of Centrality Measures Computed

Measure	Description
Degree	The number of companies the focal company is connected to
Degree Centrality	A recursive measure to rank the company in the larger network by its degree
Eigenvector Centrality	A recursive measure to rank the company in the larger network by not only its degree but the degree of the companies it is connected to

Changes in Firm Network Characteristics

To verify the firm networks data sample constructed, I looked at the degree centrality and network degree of the top 25 firms in years 2000, 2010 and 2020 similarly to Chu and Davis' rankings (see table 1 for description of centrality measures used). Results were directionally consistent with Chu and Davis' findings: the Degree table (see table 2) indicates that the number of direct ties for the most highly connected companies in the network have declined over time: in 2000, Bank of America Corp, the most highly connected firm, had direct interlocks with 48 other companies. In contrast, in 2010, the most highly connected firm in the network, Marimaca, had only 41 direct ties. And in 2020, the most highly connected company, Brookfield, had even fewer

direct ties to only 28 companies. The average degree for companies in the S&P1500 sample was 8.51 in 2000 (for 1843 companies), 7.78 in 2010 (for 2043 companies) and 8.15 in 2020 (for 1826 companies). The averages do not indicate significant movement in the number of direct ties.

Changes in Director Network Characteristics

To examine whether the number of "highly-connected" directors (serving on more than three board seats) has declined significantly over time I graphed the distribution of directors on boards of S&P500 firms by the number of board seats served on (see Figure 1). In 1996, 40.9% of directors held more than 3 board seats (that is, there were 397 directors out of a total of 970 holding seats on more than 3 companies' boards) however, by 2000, this number had declined to 36.6% (940 out of 2567) and in 2020 it was 32.4% (863 out of 2663). It is possible the analysis was affected by the limited data available for S&P500 firms in the year 2000 but given that the sample used was smallest in 2000 yet yielded the highest portion of directors holding more than 3 board seats, it is logical to assume that the share would only be bigger if a larger sample had been used. However, it is also possible that the result may be due to normalization by number of firms, not amount of assets: it is possible that "highly-connected" directors served on fewer boards but controlled larger amounts of firm assets, thereby still retaining significant power in the network. There was a similar decline in the number of directors holding more than 5 board seats. In 2000 461 directors sat on the boards of six or more distinct companies (see fig 1) and 60 sat on the boards of 5. In contrast, in 2010, 581 directors sat on more than 6 boards and only 51 sat on 5. These numbers further declined in 2020, where 509 directors sat on more than 6 boards and 52 sat on 5. While the number of directors serving on fewer board seats (1-5) shows an increase (likely due to the higher number of firms included in the sample in recent years), there was a consistent decline from 2010-2020 in the number of "highly connected" directors serving on 3 or more boards (see Figure 2).

Table 2: Top 25 Firms by Degree: 2000 (left), 2010 (right), 2020 (bottom)

Company	Degree
BANK OF AMERICA CORP	48
GENERAL ELECTRIC CO	44
MAY DEPARTMENT STORES CO	42
AT AND T INC	42
WELLS FARGO AND CO	42
XEROX HOLDINGS CORP	41
CONTINENTAL AIRLINES INC	40
ANIXTER INTERNATIONAL INC	38
EXXON MOBIL CORP	38
AVIS BUDGET GROUP INC	38
BANK ONE CORP	37
BELLSOUTH CORP	37
PEPSICO INC	37
GEORGIA PACIFIC GROUP	37
AMSOUTH BANCORP	36
LEXMARK INTERNATIONAL INC	36
CITIGROUP INC	36
SEAGATE TECHNOLOGY HOLDINGS PLC	36
KIMBERLY-CLARK CORP	36
VERIZON COMMUNICATIONS INC	35
FLEET BOSTON FINANCIAL CORP	35
HONEYWELL INTERNATIONAL INC	35
HILLSHIRE BRANDS CO	35
SUNOCO INC	34
E*TRADE FINANCIAL CORP	34

Company	Degree
MARIMACA COPPER CORP	41
CAPSTONE COPPER CORP	41
CANACCORD GENUITY GROUP INC	33
GUIDE EXPLORATION LTD	31
CATERPILLAR INC	31
CITIGROUP INC	30
STORM RESOURCES LTD	28
TMX GROUP LTD	28
YELLOW CORP	28
NYSE EURONEXT	27
AON PLC	27
COCA-COLA CO	27
GENERAL ELECTRIC CO	27
SURGE ENERGY INC	27
HOWMET AEROSPACE INC	27
TRANSALTA CORP	26
BAUSCH HEALTH COMPANIES INC	26
LOWE'S COS INC	25
QWEST COMMUNICATIONS INTERNATIONAL INC	25
BROOKFIELD CORP	25
CORNING INC	24
ADVANTAGE LITHIUM CORP	24
EAST WEST PETROLEUM CORP	24
RUSORO MINING LTD	24
FORD MOTOR CO	24

Company	Degree
BROOKFIELD CORP	30
METLIFE INC	28
EAST WEST PETROLEUM CORP	28
MARRIOTT INTERNATIONAL INC	27
TE CONNECTIVITY LTD	26
RAYTHEON TECHNOLOGIES CORP	26
CARDINAL HEALTH INC	26
NXP SEMICONDUCTORS NV	25
TARGET CORP	24
HEWLETT PACKARD ENTERPRISE CO	24
MARATHON PETROLEUM CORP	24
JAZZ PHARMACEUTICALS PLC	24
NEW FOUND GOLD CORP	23
ESTEE LAUDER COS INC	23
HANESBRANDS INC	23
BRISTOL-MYERS SQUIBB CO	23
COLLEGIUM PHARMACEUTICAL INC	23
NEWELL BRANDS INC	23
NEWMONT CORP	22
AT AND T INC	22
AKAMAI TECHNOLOGIES INC	22
NEUROCRINE BIOSCIENCES INC	22
HOWMET AEROSPACE INC	22
RESIDEO TECHNOLOGIES INC	22
CALIFORNIA RESOURCES CORP	22

Table 3: From Chu and Davis (2016); Top 25 Firms by Degree: 2000 (left), 2010 (right)

Rank	Degree	Company	Rank	Degree	Company
1	37	Sara Lee	1	21	Marathon Oil
1	37	Allstate	2	20	Northern Trust
3	35	Bank of America	2	20	Stanley Black & Decker
3	35	SBC Communications	2	20	H. J. Heinz Company
5	34	Bell Atlantic	2	20	Lowe's Companies
6	33	Chase Manhattan	6	19	The Progressive Corporation
6	33	Schering-Plough	7	18	Caterpillar
8	32	ExxonMobil	7	18	Aon
9	30	Xerox	7	18	Suntrust Banks
9	30	Equifax	10	17	Prudential Financial
9	30	Honeywell International	10	17	The PNC Financial Services Group
12	29	AMR	10	17	International Business Machines
12	29	Bank One	10	17	Keycorp
12	29	Suntrust Banks	10	17	United Technologies
12	29	Kroger	10	17	Chevron
16	28	Protective Life	10	17	Wells Fargo and Company
16	28	Kmart	10	17	McDonald's
16	28	Vulcan Materials	10	17	FMC Technologies
16	28	BellSouth	10	17	Pfizer
16	28	Minnesota Mining and Manufacturing	20	16	Sprint Nextel
21	27	Procter and Gamble	20	16	The Bank of New York Mellon
21	27	AT&T	20	16	Enpro Industries
21	27	Union Carbide	23	15	Eli Lilly and Company
21	27	Fleet Boston	23	15	MeadWestvaco
25	26	Pepsico	23	15	Northrop Grumman
25	26	Aon	23	15	Deere and Company
25	26	Springs Industries	23	15	3M
25	26	Sunoco	23	15	Qwest Communications International

I explored the possibility that this decline was due to age or retirement related attrition by examining the median age of directors in 2000, 2010 and 2020: the median ages for all directors were 73, 73 and 72. For "highly connected" directors (that is, directors serving on more than 5 board seats), the median ages were 74, 76 and 70. Higher median age in 2010 and lower age in 70 implies that it is possible that the decline may be partially due to age related attrition.

Changes in Firm Interlock Network Density

To further analyze the change in connectivity at the firm level, I visualized the denseness of the firm level interlock network by visualizing the main component of the network for S&P500 firms in 2000, 2010, and 2020 (see Figure 3). Due to limited data available from Boardex for years prior to 2010, the sample for 1996 contained only 266 firms. In contrast, the sample for 2010 contained 530 firms (since there are often slightly more than 500 firms listed on the S&P500) and the sample for 2020 contained 503 firms.

The graphs indicate a weak decline over time in the denseness of the firm level board interlock network, with the main component of the 2020 network being more spread out than the main component of the 2010 network. In other words, the 2010 graph demonstrates strong connectivity between a smaller set of firms.

Figure 2: Distribution of Directors by Number of Board Seats Held

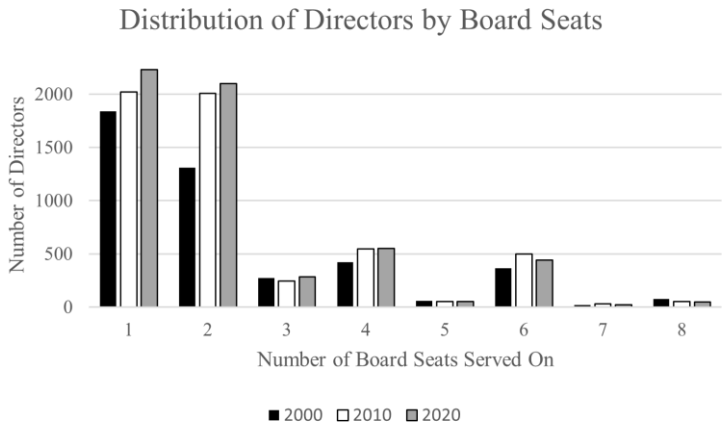


Figure 3: Number of Highly Connected Directors Over Time

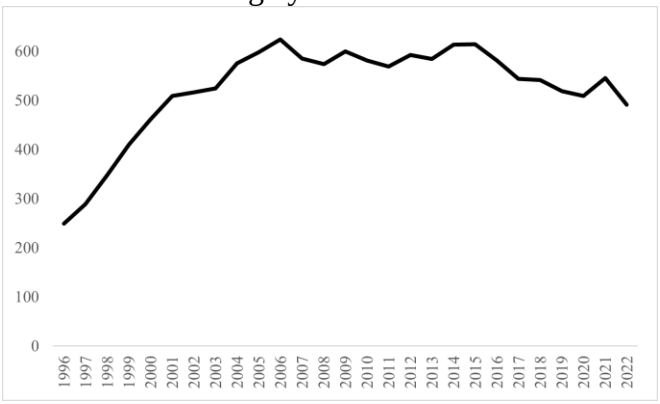
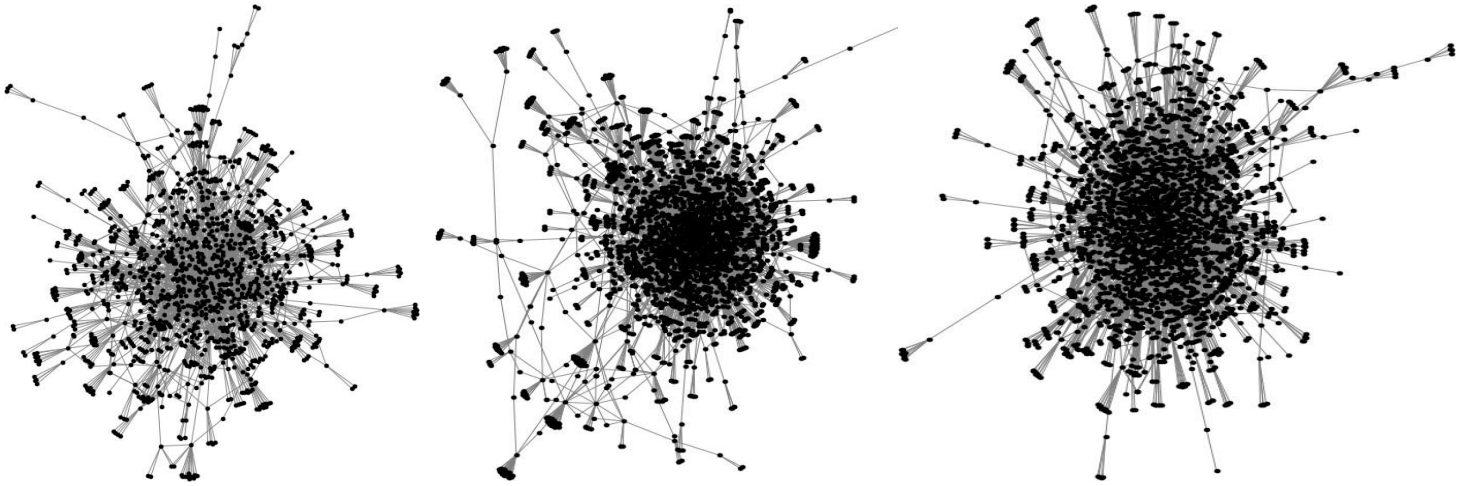


Figure 4: Main Component of SP500 Firm Network: 1996 (Left), 2010 (Center), 2020 (Right)



Regression Analysis to Predict Odds of Gaining New Seat in Subsequent Year

Chu and Davis (2016) find that odds of gaining a new board seat for highly connected directors have declined over time, indicating a broader decline in the interlock network. I similarly am interested in whether directors who are already highly connected gain the newest connections. Does this create a self-reinforcing board interlock network? What predicted the odds of a director gaining another board seat? To answer these questions, I regressed the odds of gaining a new board seat in the subsequent year for a director against a set of predictors (see table 3). Predictors were chosen based on key demographic characteristics, degree centrality measures, and company information.

A key point of interest in my study was identifying changes in not only the density, but also the composition of the "inner circle." Did historically underrepresented groups become more represented over the analysis period by gaining more connections? Since ethnicity data was unavailable, I used "gender" and "nationality" as predictors to identify these changes, with nationality coded as 1 if Not American, and 0 if American. I hypothesized that as the years became more recent the coefficients for gender and nationality would increase while the coefficients for company metrics would stay the same. I expected to see an increase in the effect of gender and nationality corresponding to social changes in the past 20 years for more inclusion of women and minority ethnicities in powerful corporate positions and boards.

Another key goal of the regression was to examine whether director interlocks had remained self-reinforcing, that is, if there was a consistent trend reflecting that a director's likelihood of gaining new board seats depended on how many board seats they already held. Chu and Davis (2016) attribute a decline in the connectivity of highly boarded directors to a decline in firms' preferences for such directors—it was important to my analysis to validate this finding,

and identify whether the effect of a directors' pre-existing network size on their likelihood of gaining new seats had declined. To do so, I used the variable "Network Size" available via Boardex (defined by Boardex as the total number of overlaps through serving on boards of firms, nonprofits, and educational institutions) as predictor, log transforming it to account for outliers. I also constructed the dummy variables "number of seats held =2" and "number of seats held > 2" to measure the specific effect of whether the director was already "well connected" (that is, held more than 2 board seats) on their likelihood of gaining a new board seat.

Similar to the effect of a director's pre-existing network size, it was possible that the size and power of the firms the directors served on significantly affected their likelihood of gaining new board seats. I conjectured that directors who served on boards of larger, more well-known firms may have higher likelihoods of gaining new board seats than those who served on boards of smaller, lesser-known firms. My analysis aimed to measure if this effect declined or increased over time—I measured the firms' sizes using their number of employees, log transforming the variable for use as a predictor in the regression to account for outliers.

Besides pre-existing network and size of firm, likelihood of gaining new board seats was likely to be influenced by the director's level of experience and the amount of time spent cultivating connections. I included directors' age as a predictor variable as proxy for years of experience and time spent in the corporate network. I also scaled the variable to account for outliers, using "Age/10" and "Age^2/1000" as predictors to capture "Age." Finally, I captured the time varying component of the regression using "Years since 1997" both as a predictor, and in interaction terms with other predictor variables to identify if effects of certain predictors had increased or decreased in the years from 1997 to 2010.

A limitation of my analysis was the absence of any predictor capturing social status: Chu

and Davis (2016) use "social status" as a predictor, measuring it as whether the board director graduated from Harvard, Yale, Princeton, or Stanford University. Educational qualification and graduation data was not available via Boardex or ISS and could not be used in my study.

In addition to the logistic regression, I ran a Value Weighted Least Squares (VWLS) regression to check whether the coefficients would be directionally similar. Had this not been the case there may have been some outliers or attributes of the data that meant that the regression results were simply a product of overfitting the logit curve and not reflective of any true underlying relationships. This was not the case, as the VWLS coefficients were all directionally similar to the coefficients resulting from the logistic regression.

The original sample contained 18,485 unique directors across 1995-2022. The highest number of seats held by any director in the sample in any year was 8. The director with the highest number of board seats was Sam Nunn (consistent with the findings of Chu and Davis (2016)).

As preliminary data visualization, I plotted the correlation matrix for the numeric variables age, log of number of employees, and network size (see Figure 4). The resulting plots show that the most highly connected directors are between the ages of 60-80 with a network size between 50-150. The graphs also indicate a collinear linear relationship between network size and number of employees. This implied that directors who served on the board seats of larger corporations had larger pre-existing networks.

Figure 4: Pairwise Collinearity between Numeric Variables 1997-2022

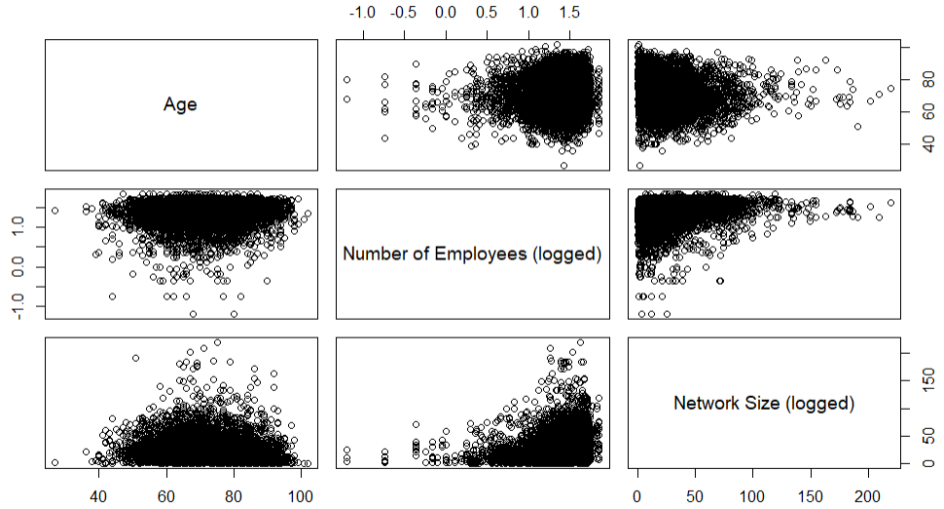


Table 3: Description of Variables Used in Regression

Variable	Description
Years since 1995	Difference between data year and 1995
Age	Director's Age
Number of Employees	Number of Employees of Largest firm Director is on Board of
Female Director	Dummy variable for gender (Female = 1)
Network Size	Measure provided by Boardex counting number of connections via corporate boards, nonprofit organizations and Educational Institutions
Non American Director	Dummy Variable for nationality (Non American = 1)
Number of Board Seats (n=2)	Dummy variable for if director holds exactly 2 board seats (2 board seats = 1)
Number of Board Seats (n¿2)	Dummy variable for if director holds more than 2 board seats (more than 2 board seats = 1)

Regression Results

The results of the regression show a weakly positive coefficient for the "Years since 1997" variable, implying that as the years get closer to 2022 and further away from 1997, the odds of gaining a new board seat increase (see table 4). This result is consistent with the findings of Chu and Davis (2016) (see table 9 in appendix) who also found a similarly weak positive coefficient. The coefficient indicates no considerable change in likelihood over time, but changes

in composition of the network are indicated by the coefficients of the interaction terms. Female and non-American director interaction terms with Years since 1997 have a positive coefficient, indicating that over time, the odds of gaining a new board seat for women and non-American directors have increased.

The results also indicate that experience carries a high premium, with the higher the age, the higher the odds of gaining a new board seat. Notably, network size also has a positive coefficient, indicating that directors with a pre-existing large network have higher odds of gaining an additional board seat over the entire analysis period. Network size and age are the most significant predictors, while the number of employees (logged) is least significant, indicating that the size of the company whose board the director serves on is far less important than the director's pre-existing network.

However, examination of the interaction terms reveals that the effect of network size and number of employees has weakly declined since 1997, with both coefficients being weakly negative. This implies that in the years since 1997, having a large pre-existing network or serving on the board of a larger firm has become less important in gaining new boards seats and developing a network. This would be consistent with the fracturing density of the interlock network, as the decline in the importance of being “highly connected” or serving on an influential board would imply an expansion of the network to less-connected directors from smaller firms, widening it beyond a closed circle of the most influential directors from the largest, most well-resourced firms.

To confirm whether such a trend could be validated and observed after 2010, I re-ran the regression models, this time for a sample that included the years 2010 to 2022 (see table 4). This time, I also included a variable "Years since 2010" and interacted the variable with the other

predictors to determine changes since 2010. The sample used for the second regression had 19,186 observations whereas the sample for the first regression (1997-2010) had 19,036 observations (see table 4).

Consistent with Benton's findings, the predictor variables for Female Director had a smaller but similarly positive coefficient, indicating increasing likelihood for female directors to gain board seats in the years 2010-2022 (Benton 2021). Interestingly, while coefficients for "Female Director" were positive in both analysis periods, the coefficients of the interaction terms with the "Years Since…" variables were negative in both periods: this indicates that while there has been an overall increase in the connectivity of female directors, this is not a linear trend.

Furthermore, the regression results showed a positive coefficient for "Years since 2010," implying that odds of gaining a new board seat increased overall in years since 2010. However, a potential problem with interpreting this result may be that due to limited availability of data, the sample contains more directors in recent years than it does in previous years. The positive coefficient may thus simply be because the skewed number of observations is pulling the coefficient in a positive direction in recent years.

Interestingly, the results of the post 2010 regression had a few interesting differences from the 1997-2010 analysis. Notably, the coefficient of the linearly transformed "Age/10" variable was negative, indicating that increasing age had a negative effect on likelihood of gaining a board seat. The same variable had a positive coefficient in the 1997-2010 analysis period, implying that the importance of age to likelihood of gaining a new board seat declined post 2010—this may be indicative of changes in the composition of the network, with younger directors becoming more interlocked in recent years. Also notably, the coefficient for network size was negative, implying that the likelihood of gaining a higher board seat declined for

directors with pre-existing highly connected networks post 2010. This also indicates that relatively important characteristics in 1997-2010 like high connectivity, age and experience became less important post 2010. However, it is unclear whether the coefficients are strong enough to decisively comment on this trend: the coefficient for number of employees (logged) was positive in both analysis periods, and the interaction terms with the “years since” variable also have weak coefficients, making it unclear if this represents a true trend. However, these results do indicate that characteristics like firm size, pre-existing network, and experience are weakly important or have declined in importance in the years after 2010. If representative of a true underlying relationship, this would support Chu and Davis’ argument that the likelihood of gaining newer board seats for super-connected directors has declined over time.

Conclusion

The analysis of the Board Network characteristics demonstrates findings consistent with Chu and Davis: the most highly connected firms in the interlock network have become less connected over time; the number of highly connected directors has also declined over time; and the interlock network has become less dense over time, although this decline has been weak over the years 2010-2022. The Regression Analysis also indicates a clear increase in the likelihood of non-American directors in gaining new board seats post 2010. The results suggest that women have a higher likelihood of gaining a new board seat than men, and that the likelihood of gaining a new board seat for women increased post 2010. Another consistent finding is that the likelihood of gaining new board seats for "well connected" directors (defined as directors holding more than 3 board seats) and directors with higher network sizes has declined over time, supporting Chu and Davis' findings about the decline in board preferences for highly connected directors.

Table 4: Logistic Regression Coefficients (Left: 1997-2010; Right: 2010-2022)

	Dependent variable:		*Dependent variable:*	
	Gained Additional Board Seat in Subsequent Year (=		Gained Additional Board Seat in Subsequent Year (=1)	
	normal Logistic Regression	*OLS* VWLS	*normal* Logistic Regression	*OLS* VWLS
	(1)	(2)	(1)	(2)
Years Since 1997	0.064**	0.480***	0.050	0.051***
	(0.026)	(0.017)	(0.040)	(0.014)
Age/10	0.232***	0.411***	−0.051*	−0.049***
	(0.053)	(0.043)	(0.028)	(0.009)
$Age^2/1000$	−0.137***	−0.255***	0.006*	0.005***
	(0.034)	(0.025)	(0.003)	(0.001)
Number of Employees (logged)	0.014***	0.027***	0.008	0.008*
	(0.004)	(0.004)	(0.007)	(0.005)
Female Director	0.009	0.026*	0.026***	0.025***
	(0.011)	(0.015)	(0.007)	(0.002)
Network Size (logged)	0.063***	0.075***	−0.020**	−0.019***
	(0.007)	(0.012)	(0.008)	(0.002)
Nationality (Non American = 1)	−0.022*	0.015**	−0.023***	−0.020***
	(0.013)	(0.007)	(0.006)	(0.002)
Number of Board Seats held (n = 2)	−0.011	−0.024***	−0.028***	−0.027***
	(0.007)	(0.003)	(0.009)	(0.002)
Number of Board Seats held (n > 2)	−0.015	−0.003	0.002	0.0001
	(0.010)	(0.009)	(0.005)	(0.001)
Years since 1997 (2010) X				
Age/10	−0.012*	−0.128***	−0.001	0.001
	(0.007)	(0.004)	(0.004)	(0.001)
Age 2/1000	0.006	0.084***	−0.0002	−0.0002***
	(0.004)	(0.002)	(0.0005)	(0.0001)
Number of Employees (logged)	−0.001**	−0.002***	0.0001	−0.0003
	(0.001)	(0.0004)	(0.001)	(0.0005)
Female Director	−0.0004	−0.0003	−0.001	−0.001***
	(0.001)	(0.003)	(0.001)	(0.0002)
Network Size (logged)	−0.003***	−0.004***	0.0003	0.001***
	(0.001)	(0.001)	(0.001)	(0.0002)
Non American Director	−0.001	0.006***	0.0005	0.001**
	(0.002)	(0.001)	(0.001)	(0.0002)
Number of Board Seats held (n = 2)	−0.001	0.006***	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.0005)
Number of Board Seats held (n > 2)	−0.002	0.001	−0.013	−0.006
	(0.001)	(0.001)	(0.017)	(0.005)
Constant	−1.014***	−1.719***	−0.091	−0.100**
	(0.206)	(0.184)	(0.141)	(0.050)
Observations	19,036	19,036	19,186	19,186
R^2		0.195		0.026
Adjusted R^2		0.195		0.025
Note:		*p<0.1; **p<0.05; ***p<0.		*p<0.1; **p<0.05; ***p<0.01

The decline in the importance of pre-existing networks towards gaining new seats and simultaneous increase in likelihood of gaining new seats for women and non-American directors poses an interesting causal question: has the increase in female representation been driven by broader social changes, and has in turn caused the decline in the importance of super connectivity? Or has there been a decline in firms' preferences for highly boarded directors, as Chu and Davis argue, that has in turn allowed lesser connected women to gain more seats? This is a complicated question that may require untangling of the factors that influence firms' preferences for directors: higher female representation may simply be primarily driven by higher scrutiny over firms' board compositions and an increase in the number of women in high level executive positions, not the breakdown of the inner circle. Changes in corporate network composition may only be evidence of the fact that the "inner circle" continues to exist, just with a different set of members.

My findings of a weak decline in network density after 2010 do not provide evidence about changes in the power structure or architecture of the corporate elite: however, they ask important questions about the speed of declining interlocking. If interlocking has only declined weakly post 2010, then has recent academic work presupposing the fragmentation of the inner circle exaggerated the extent of fragmentation? The composition of the "inner circle" may have changed, as may have the amount of existing corporate influence required to access it, but the key questions lie in the amount of power exercised by the most influential members of this network. Whether the most connected directors and firms successfully exercise influence over political and governmental decision makers is at the core of any discussion about the existence of the "inner circle," be it in academia or public discourse. My study did not set out to answer this question, but it should be the focal point of examination in future studies.

Appendix

Table 5: Descriptive Statistics 1997-2010

Statistic	N	Mean	St. Dev.	Min	Max
Years Since 1997	19,036	6.720	3.912	0	13
Age	19,036	77.871	8.034	41	102
Age/10	19,036	7.787	0.803	4.100	10.200
$Age^2/1000$	19,036	6.129	1.235	1.681	10.404
Number of Employees (logged)	19,036	4.156	0.800	0.000	6.362
Female Director	19,036	0.127	0.333	0	1
Network Size (logged)	19,036	2.586	1.078	−1.966	5.389
Non-American Director	19,036	0.074	0.262	0	1
Gained an additional Seat in Subsequent Year	19,036	0.052	0.222	0	1

Table 6: Descriptive Statistics 2010-2022

Statistic	N	Mean	St. Dev.	Min	Max
Years Since 2010	19,186	6.067	3.698	0	12
Age	19,186	68.930	8.001	27	99
Age/10	19,186	6.893	0.800	2.700	9.900
$Age^2/1000$	19,186	4.815	1.095	0.729	9.801
Number of Employees (logged)	19,186	4.059	0.870	0.000	6.362
Female Director	19,186	0.237	0.425	0	1
Network Size (logged)	19,186	1.240	0.399	−0.367	2.320
Non-American Director	19,186	0.133	0.339	0	1
Gained an additional Seat in Subsequent Year	19,186	0.037	0.188	0	1

Table 7: Correlation Table 1997-2010

	Years Since 1997	Age	Age/10	Age^2/1000	Number of Employees (logged)	Female Director	Network Size (logged)	Non American	Gained Seat in Next Year
Years Since 1997	1								
Age	-0.3	1							
Age/10	-0.3	1	1						
Age^2/1000	-0.31	1	1	1					
Number of Employees (logged)	-0.05	0.08	0.08	0.07	1				
Female Director	0.07	-0.16	-0.16	-0.16	0.11	1			
Network Size (logged)	0.05	-0.13	-0.13	-0.13	0.27	0.16	1		
Non American	0.05	-0.04	-0.04	-0.04	-0.04	-0.04	0	1	
Gained Seat in Next Year	-0.04	0	0	0	0.05	0.03	0.08	-0.03	1

Table 8: Correlation Table 2010-2022

	Years Since 2010	Age	Age/10	Age^2/1000	Number of Employees (logged)	Female Director	Network Size (logged)	Non American Director	Gained Seat in Next Year
Years Since 2010	1								
Age	-0.4	1							
Age/10	-0.4	1	1						
Age^2/1000	-0.4	1	1	1					
Number of Employees (logged)	-0.01	-0.02	-0.02	-0.02	1				
Female Director	0.16	-0.17	-0.17	-0.17	0.08	1			
Network Size (logged)	0.07	-0.13	-0.13	-0.14	0.28	0.18	1		
Non American Director	0.06	-0.15	-0.15	-0.14	-0.03	-0.01	-0.05	1	
Gained Seat in Next Year	-0.02	-0.04	-0.04	-0.04	0.02	0.03	0.06	-0.02	1

Table 9: Chu and Davis (2016) Results

Logistic Regression Coefficients (1997-2010)[1]

	Model 1	Model 2	Model 3
Years since 1997	−.19	.19	.17
	(−.92)	(1.01)	(.83)
Age/10	3.41***	4.28***	4.05***
	(7.37)	(9.95)	(8.79)
Age²/1,000	−3.28***	−3.96***	−3.76***
	(−8.15)	(−10.62)	(−9.39)
Maximum number of employees (logged)	.11*	.68***	.59***
	(2.01)	(16.73)	(13.54)
Maximum annual return	.07	.19***	.17***
	(1.30)	(3.97)	(3.35)
Female director	−.02		.08
	(−.26)		(.81)
Minority director	.38***		.50***
	(3.86)		(5.05)
Social elite director	.28***		.41***
	(4.01)		(5.84)
Corporate executive	−.18**		−.07
	(−2.75)		(−1.11)
Director degree centrality (logged)	−1.47***		
	(−5.09)		
Director eigenvector centrality	.28		
	(.12)		
Number of boards served by peer directors (logged)	1.47***		
	(11.67)		
Number of board seats held by director (n = 2)	.59***		
	(6.16)		
Number of board seats held by director (n = 3 or more)	.77***		
	(5.15)		
Years since 1997 ×:			
Age/10	.05	−.04	−.02
	(.77)	(−.60)	(−.22)
Age²/1,000	−.05	.03	.00
	(−.75)	(.48)	(.07)
Maximum number of employees (logged)	.01	−.03***	−.04***
	(.82)	(−5.29)	(−5.90)
Maximum annual return	−.00	−.01*	−.01*
	(−.28)	(−2.25)	(−2.11)
Female director	.01		.00
	(.94)		(.07)
Minority director	−.02		−.03*
	(−1.63)		(−2.54)
Social elite director	−.01		−.02*
	(−1.24)		(−2.23)

[1] Models 1, 2 and 3 represent logistic regressions run with different sets of predictors

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