

Board Homophily, Board Diversity and Network Centrality

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The relationships of multiple firms linked by interlocking directors are among classic subjects of studies within the social network approach in organizational research. Interlocking directorates enable exchange of information and resources between two or more firms that are linked by a director who participates in their boards. The phenomenon of interlocking directorates is a major area of research in management, sociology and political science, and has been investigated across different countries, cultures and governance systems. We present a study of interlocking directorates linking boards of firms that are listed on the Warsaw Stock Exchange. The main aim of this paper is to investigate if board diversity and board homophily are related to positions in an interlocking directorates network. We apply methods of social network analysis.

Keywords: board homophily, board diversity, board composition, interlocking directorates, social network analysis.

Homofilia, zróżnicowanie i centralność rady w sieci

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Relacje firm powiązanych przez dyrektorów zasiadających w wielu radach należą do klasycznych obszarów badań nurtu sieciowego w domenie nauk organizacji i zarządzania. Powiązania rad umożliwiają wymianę informacji i zasobów między dwoma lub więcej firmami powiązanymi ze względu na występowanie w ich organach zarządzających i/lub kontrolnych tych samych osób. Fenomen powiązań rad firm jest przedmiotem wielu badań w naukach o zarządzaniu, socjologii i naukach politycznych realizowanych w różnych krajach, kulturach o odmiennych systemach ładu korporacyjnego. Przedstawiamy w artykule badanie powiązań rad firm notowanych na warszawskiej Giełdzie Papierów Wartościowych. Głównym celem prezentowanych badań jest przedstawienie zależności między zróżnicowaniem składu rady, zjawiskiem hemofilii rad a centralnością ich pozycji w sieci relacji międzyorganizacyjnych tworzonych przez powiązania rad. W artykule wykorzystano metody analiz sieci społecznych.

Słowa kluczowe: homofilia rady, zróżnicowanie rady, kompozycja rady, powiązania rad, analiza sieci społecznych.

JEL: G30; G34; M14

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1. Introduction

Two types of distinct theoretical domains exist within the social network paradigm: the network theory and the theory of networks (Borgatti & Halgin, 2011). The network theory aims to explain the consequences of network variables, such as having many relationships or being constrained by certain position. An example of such theorizing can be found in the board capital construct that was recently proposed as the composite of human and social capital, and is used as proxy for the board ability to provide valuable resources and limit dependency (Hillman & Dalziel, 2003). Within this recent theoretical tradition ties in the form of interlocks are used to measure social capital which, as a component of board capital, should lead to privileged access to resources (Haynes & Hillman, 2010). A less frequent but equally important stream of theorizing is called the theory of networks. It refers to describing the properties of a network structure and explaining mechanisms and processes that determine why networks have the structures they do (Borgatti & Halgin, 2011). An example of this type of research is the study of small world structures of the interlocking directorate network among listed companies on Scandinavian stock exchanges in which national networks were compared with small-worldliness statistics which lead to theoretical propositions aiming to explain the observed variance of cross-country data (Sinani, Stafsudd, Thomsen, Edling & Randoy, 2008). We place our paper in this second stream of theorizing, as the main goal of our article is to inquire into relationships among board homophily, board diversity and positional patterns observed in an interlocking directorates network.

The current study makes several contributions to the interlocking directorates and board literature. We propose to extend current reasoning behind creation of interlocking directorates to include social homophily effects at the board level of analysis. We propose that alike boards will have a tendency to form ties through interlocking directors. We also inquire into the relationship between demographic heterogeneity and boards centrality in interlocking directorates networks. In particular, we focus on boards diverse due to women participation.

Although the constructs of board composition and demographics have been subject of extensive studies in board and governance literature, including the ones that use social network approaches, no study identified in the comprehensive review of literature by Johnson, Schnatterly and Hill (2013) follows the theory of network perspective that we decided to pursue.

We follow the calls to extend the underresearched areas of board demographics (Johnson, Schnatterly & Hill, 2013; Kołodkiewicz, 2014). With 14% of women participation in boards without enforced regulation on quotas, the Polish interlocking directorates network offers a good testing ground on the effects of gender diversity on corporate networks.

2. Interlocking directorates

The phenomenon of interlocking directorates has been studied more extensively since the early 20th century. In his review of research on interlocks Mizruchi (1996) tracks the academic interest in the phenomenon in the US back to an important political action against potential abuse of corporate power undertaken by the Pujo Commission of the American Congress. Senator Pujo led this commission in the 1920s to investigate the influence exerted by the industry and finance barons via their control of the boards of America's largest corporations. As a result of this work interlocking directorates regulations were introduced to anti-monopoly laws in the United States in Clayton Act. The regulation prohibited interlocks among competitors. The academic interest followed. Interlocking Directorates (ID) became a major area of research in management, sociology and political science, and were investigated across different countries, cultures and governance systems (e.g. Au, Peng & Wang, 2000; Barnes, 2015; Burt, 1979; Carroll et al., 2010; Chu & Davis, 2015; Comet & Pizzaro, 2011; Cronin and Popov, 2005; Davis, 1996; Heemskerk, 2007; Heemskerk & Schnyder, 2008; Heemskerk et al., 2016; Kono et al., 1998; Kogut & Walker, 2001; Mintz & Swartz, 1985; Pettigre, 1992; Pennings, 1980; Sankar et al., 2015; Siudak & Sankowska, 2015; Sankowska & Siudak, 2016; Scott, 1991; Stark & Vedres, 2012; Sinani et al., 2008; Useem, 1984; Zdziarski, 2012a, 2012b).

The main theoretical tradition of ID studies in the management science was the resource dependence theory (Pfeffer & Salancik, 1978; Mizruchi, 1996; Mizruchi & Stearns, 1988). The phenomenon of ID is regarded within this tradition as a legal instrument for co-optation of its stakeholders. The co-optation of stakeholders into the decision process of a firm is necessary to deal with the ever changing environment and lack of firms' control over critical resources. Information, money, support, legal advice, ideas, beliefs or sentiments may all flow through inter-organizational networks (Allee, 2003). In consequence, interlocking directorates serve as a proxy of a firm's access to valuable resources and information, and are the second most popular phenomenon used to study inter-organizational networks and relational advantage, after strategic alliances (Dyer & Singh, 1998; Mizruchi, 1996).

Access to external resources limits uncertainty, risk and power dependence of a company and thus should lead to better results. Despite the fact that this claim is relatively intuitive, research on the relationship among interlocks and results gives mixed results at best (Mizruchi, 1996). Theoretical motivation of this stream of inquiry included: reduced cost of information exchange, access to key resources, optimization of control processes, possibility of joint lobbying, increased legitimacy and faster adaptation of innovations. All of these consequences were expected to have positive effects on performance. Surprisingly these intuitive conclusions were confirmed only in a relatively small amount of prior research (Mizruchi,

1996). Several possible explanations of rather contradictory findings on the relationship between results and interlocks were proposed. The first one involves various motivations to form interlocks. Some serve as a means to establish monitoring and control over troubled firms in which investors hold shares. Another perspective is grounded in the behavioral approach that looks at busyness of directors serving in too many boards, resulting in lack of proper attention and misconduct (Ferris, Jagannathan & Pritchard, 2003). In summary, the casual ordering between interlocking and effects of corporate strategies remains an important question that needs to be researched further in specific contexts (Mizruchi & Stearns, 1988).

Studies aiming to check if broken interlocking directorate ties are replaced revealed that accidentally broken relationships were restored in a small percentage of cases (Mizruchi, 1996). This finding was also interpreted as the lack of evidence that interlocking directorates are formed for strategic motives of companies aiming to limit their power dependencies. However, some of the incidentally broken ties have been restored with other institutions in the same industry, which can be interpreted as evidence that resources limiting power dependency are available from different sources, and that limiting the power dependence matters (Mizruchi & Stearns, 1988).

Another stream of research on ID takes a different theoretical perspective of the elite theory (Michels & Paul, 1959). Proponents of it characterize directorate interlocking as a form of integration between elites of a given society (Useem, 1984). Elite theorists analyze network connections at the individual level rather than the firm level, which is more common in the resource dependence theory studies. Kono, Palmer, Friedland and Zafone (1998) studied how the presence of upper-class clubs influenced networks of interlocking directorates. They found that interlocks were formed by elite club members more often in cities where such clubs existed. This finding suggests that individual homophily effects can be present, and that interlocks are often formed due to social cohesion. The theory of class hegemony in political science was constructed based on the observation that personal connections are the result of strong social ties within the elite class (Koenig & Gogel, 1981).

Interlocking Directorates enable exchange of information and resources between two or more firms that are linked by a director who participates in their boards. IDs facilitate dissemination of knowledge and practices among related boards and corporations, also enhancing access to capital as well as the ability to take over other companies and to survive a crisis (Ratcliff, 1980; Singh & Harianto, 1989; Davis, 1991). Firms approving their directors as board members of other companies may wish to establish a relationship with those other firms to create a communication channel, monitor their plans and activities and get private industry insights.

Strategic information and cross-organizational knowledge flows allow influential companies to exercise a form of control, or influence other com-

panies (Seidel & Westphal, 2004). Personal relationships among directors of separate entities create a communication channel that potentially enables some form of coordination between two or more companies and joint action towards specific common goals. This can also lead to the development of mutual trust and commitment in the competitive corporate world which is related to a broader concept of social capital derived from relationships between executives and companies. In the contemporary knowledge economy, social capital is often recognized as an important intangible asset or a capability influencing competitive advantage and performance of companies (Nahapiet & Ghoshal, 1998; Newbert, 2007). Relationships forming social capital are of course not limited to interlocking directorates only, but can also be a result of other types of relationships such as friendships, club memberships, family ties, political or religious affiliations, joint education, industry or geographic proximity. Mizuchi (1996) claims that interlocking directorates are likely to be correlated to those other indicators of social integration and that no better indicator of relationships between companies than board interlocks has yet been proposed. The social capital literature points to two distinct types of social capital – bonding and bridging (Lin, 2002).

Among positive implications of possessing the bonding type of social capital, authors write about trust, good communication about complex tasks, pro-social group norms, and access to support in a crisis. The disadvantages may include redundant information, constrains on actors, and the potential to promote anti-social norms. Bridging social capital enables good access to new information and ideas, and provides strategic benefits from brokerage, while it may also make execution of more complex tasks difficult, communication more complex and requires willingness to learn and change (Prell & Skorovetz, 2008).

In summary, current interlocking directorates literature has not been successful in proving the direct relationship among this phenomenon and the variance in results at the firm level of analysis, but has shown that interlocks serve as conduits for information and resources exchange, adoption of new practices, and mutual influence of interconnected firms. Due to embeddedness, these effects are dependent on the position of a firm within a wider network of relationships created via interlocking directorates.

3. Board homophily and board diversity

Increasing complexity of the environment in which firms operate requires knowledge from different and divergent sources to gain better understanding of the context in which strategic options unfold. To assure that inter-organizational knowledge at least partly corresponds to the heterogeneity of external environment, some firms take advantage of the heterogeneity of their upper echelons (Hambrick & Mason, 1984). Heterogeneity changes

decision dynamics, as diverse groups with participation of minority directors bring divergent thinking and perspective, the group think becomes less likely, and consideration of decisions is more comprehensive (Hogg & They, 2000). Female directors on boards of S&P 1500 companies were associated with a reduction in the number of bids to take over other firms and also the bid premium paid, which may suggest a change in risk-taking by boards in which women participate (Levi, Li & Zhang, 2014). While this research suggests a conservative approach of heterogeneous boards towards mergers and acquisitions, in other aspects diverse boards have been at the forefront of adoption of new practices. For example, boards with females adopted new corporate governance practices earlier than homogenous boards composed of males only (Singh & Vinnicombe, 2004). The research by The Conference Board of Canada provides evidence on further behavioral differences related to board composition and female participation. Boards with 2 or more females as compared to male-only boards reviewed twice as many non-financial performance measures regularly, while boards with three or more women explicitly identified criteria for measuring the strategy in 74% of cases, as compared to only 45% cases with male-only homogenous boards (Brown, Brown & Anastasopoulos, 2002).

Studies aiming to present CEOs' and board members' opinion on key performance factors of an effective board reveal that board composition is believed to be critically important. In particular, the diversity of skills, knowledge, information, industry expertise, abilities, team spirit and time commitment are perceived as important factors of good governance (Sonnenfeld & Kusin, 2013; Kołodkiewicz, 2014). Yet a line of research on board composition proves that diverse boards are not so common, and more often directors on the same boards share similar attributes and demographical characteristic (Miler & Triana, 2009).

Women are generally disadvantaged in obtaining board positions at big firms (Hillman, Cannella & Harris, 2002). Yet women were proven to benefit more than men from the Matthew effect – the tendency for popular nodes to be grow new ties faster (Peterson & Philpot, 2007). These could be explained by a relatively small pool of competent, experienced female candidates to draw from in the selection process. A comparative analysis of directors' sample of 89 women and 99 men showed that females were more likely to join new boards at a faster rate than males (Hillman, Cannella, & Harris, 2002). In general, research indicates that the board selection process is not gender or demography neutral. On the contrary, despite the trend to make boards smaller, the participation of female directors increases, driven by external pressures to raise diversity in boardrooms (Farrell & Hersch, 2005).

The formation of interlocks depends on individual willingness to join a board, as well as on firms' intention to invite an individual to become a new director. In many instances, the acceptance to join a board of a second

or subsequent company is subject to approval in the firm in which a person has already committed to serve as its director (Davis, 1996). Decisions to join the board, to invite someone to sit on the board and to accept a board position are likely to be driven by strategic motives (Siudak & Sankowska, 2015). Firms are likely to invite trusted, experienced and well connected directors who are likely to offer valuable strategic advice and signal high governance standards to investors. Candidates would be more willing to join the board of a firm that is able to get access to external resources, enjoys high levels of legitimacy, and bears little reputational risks. Research that focuses on these strategic motives of board selection is described as the economic perspective, while another stream of research labeled as the “social perspective” acknowledges the social processes and biases that affect the selection process (Withers, Hillman & Cannella).

While strategic and professional motives undoubtedly explain a large portion of interlocks formation, research on behavioral and social factors indicates that they play a role in who forms links to whom among directors. The cohesion of business elite has been recognized as a driver of board nominations for a long time (Useem, 1984). Boards of companies have traditionally been small groups as typical examples of “old boys’ networks” sharing similar demographic attributes, educational background, social values and views on business priorities (Westphal & Milton, 2000). The archetypical all-white-men board was present in 2/7 of boards among the largest Canadian companies in 2001, which led The Conference Board of Canada to title a section of the report discussing the value of demographic diversity in a boardroom “Leadership and Stewardship: The 11th older white man” (Brown, Brown & Anastasopoulos, 2002, p. 3).

In addition to cohesion and social identity, behavioral aspects of a management job enhance likelihoods of nomination. Board candidates who engaged in the ingratiation behavior toward CEOs of their company such as flattery, conformity and favor-rendering were nominated to other boards by their CEOs more often, and were more likely to receive board appointments at firms where their CEOs served as directors and also at firms connected indirectly in an interlocking directorates network (Westphal & Stern, 2006). Ingratiation behaviors and behaviors enhancing professional reputation of a director, such as provision of valuable advice in strategic issues, are alternative paths enhancing the likelihood of board nominations. This likelihood diminishes if ingratiation or advice is exercised by female directors and directors with ethnic minority backgrounds (Westphal & Stern, 2007). This research confirms earlier findings that demographic factors are important drivers of nomination processes and interlocking directorates.

As economic processes are embedded in social structures, the observed distribution of interlocking directorates and the speed of new ties emergence can also be explained in part by homophily effects. Homophily is a preference of an individual to form a tie with similar others (McPherson,

Smith-Lovin & Cook, 2001). Directors have been shown in general to be more likely to join new boards if they already sit on multiple boards (Davis, 1993). Due to homophily we may expect that nominations, acceptance and approvals of new board positions will be more likely if individuals and groups involved share common demographic characteristics. It has been shown that the presence of women on a board is related to a larger number of female managers in general, women with high-ranking titles, and women participation in the highest-paid jobs in a company (Bilimoria, 2006). This may suggest evidence that high-ranked female directors promote other women to top positions. The majority of research relating to the presence of women on boards looked at intra-organizational effects such as a change it brings to board processes as well as career advance options for other women in the company. We are especially interested in investigating how women participation in boards is related to external, inter-organizational networks of interlocking directorates. Does the presence of women increase the probability of a more collaborative board culture, and does the participation of company directors in many other boards result in high degree centrality in a network of boards? Are the effects of higher participation of women in boards more visible in the observed ID network? Can we observe homophily effects for diverse boards? And if so, are they similar to homophily effects for homogenous, male-only boards?

	Degree Centrality	Betweenness Centrality
Presence of women on a board, controlled for board size	H1:+	H2:+
Ratio of women on a board	H3:+	H4:+

Tab.1. Hypothesized direction of relationship among the presence of women on a board, ratio of women on a board, and two measures of centrality in an interlocking directorates network. Source: authors' own work.

Four hypotheses were formulated at a nodal level to account for effects on board centrality depending on the presence of women in board composition.

We also expect individual homophily effects of directors to extend to the board level, so we would expect the board homophily – the tendency of alike boards to be linked by an interlock more frequently if the interlock formation process happens at random, with no homophily effects present in the network. The following two hypotheses are also empirically tested in our research:

H5: Homogenous boards composed of only men will have higher likelihood of the presence of an interlocking director connecting them to other male-only homogenous boards.

H6: Heterogenous boards having females in their composition will have higher likelihood of the presence of an interlocking director connec-

ting them to other heterogonous boards that include women in their composition.

4. Research methods

We use methods of social network analysis (Wasserman & Faust, 1994; Batorski & Zdziarski, 2009). Our initial dataset can be thought of as a 2-mode network in which two classes of nodes were present: directors and boards. Such networks, in which two different classes of nodes are analyzed jointly, are also called affiliation or bi-partite networks. Other examples of two-mode networks include: scientists citing the same papers, countries collaborating in international institutions, women attending the same parties, actors playing in the same films, musicians playing in the same bands, and graduates belonging to the same alumni networks. These social situations vary in nature: some are enduring while others more tentative. In some situations, actors are expected to interact very intensely, while in others participation is treated as an opportunity for interaction, with only minor probability that two actors will actually exchange some information or resources. Despite these differences, a common methodological approach was developed in studying bi-partite networks. The nature of the investigated relationship is such that it connects sets of actors rather than individual ones. Two-mode networks enable a direct presentation of a dual perspective of the social situation that can be investigated at alternative levels of inquiry (Faust, 2005). We present this dual perspective first in the introductory graphical display of the network using Kamada-Kawai algorithm, in which graph theoretic distances are proportional to geometric distances in the drawing (Kamada & Kawai, 1989). Since our research question was on the relationship among board composition, board homophily and centrality in an interlocking directorates network, we used a projection of this 2-mode network into a 1-mode network of boards for our analysis. We used this network to calculate an algebraic measure of board centrality that serves as a proxy for board access to valuable resources and information from its environment.

The empirical context of the presented research is a network constructed of boards of all non-financial firms registered under Polish corporate laws whose stocks were traded at the Warsaw Stock Exchange as of December 2006. The census approach was used, and due to the fact that the research from a single country is presented, it was possible to control for any confounding variables that may potentially bias structural properties of an observed phenomenon. The hypotheses were verified with linear regression models and logistic regression models. Since we are analyzing complete census data on the whole population of boards that were embedded in the interlocking directorates network of non-financial companies, there was no need to account for sampling errors with p-values (Nuzzo, 2014).

Polish corporate governance represents continental European governance arrangements in which dual boards (executive and supervisory boards) and concentrated block holders are more common. For the purpose of this study we have treated members of supervisory and executive boards jointly following an earlier approach to studies of interlocks in Poland (Zdziarski, 2012; Zdziarski, 2012; Siudak & Sankowska, 2015; Sankowska & Siudak, 2016). In total we have studied 191 boards of non-financial companies that were listed at the Stock Exchange. We used court registry data on 1729 individuals who were directors on either supervisory or executive boards as of January 2006. Based on PESEL numbers we were able to decode sex (a binary variable) and age (an interval variable) for all directors except foreign ones. The data also contains information about the tenure of board members (an interval variable). The foreign board members (without PESEL numbers) were given a subsequent number. However, we were not able to calculate their age or classify their gender, thus our analysis is limited to Polish citizens and residents on boards when we inquire into age and gender.

The affiliation between companies and board members was used to reconstruct an undirected interlock network. Board attribute data included size and the number of females. The variables representing the ratio of female board members to the board size were also created, in addition to binary variables in which the presence of minority directors was coded. Based on the interlocking directorates network we calculated two network centrality measures: the degree and betweenness scores for each board. Degree centrality measures the number of direct relationships for each node in the network, while betweenness centrality measures the frequency of each node being present on the shortest paths connecting all other pairs of nodes present in the network (Freeman, 1979).

The data analysis was managed with R 3.2.2. Packages: Igraph 1.0.1 (Csardi & Nepusz, 2006), and Statnet (Handcock et al., 2008). Two-mode network visualization of interlocking directorates at the Warsaw Stock Exchange was prepared with Pajek (Batagelj & Mrvar, 1998).

5. Results

191 boards in which 1729 positions were registered in court data give an average board size of slightly above 9 persons. Boards were plotted as black circles, and directors as white circles in Picture 1 below, which represents a 2-mode network of boards and directors of companies listed at the Warsaw Stock Exchange as of 1 December 2006. The sizes of circles differ proportionally to betweenness centrality scores calculated in the 2-mode network. The relationships among boards and directors in this graph are white lines which denote a situation in which at least one director participates in two connected boards.

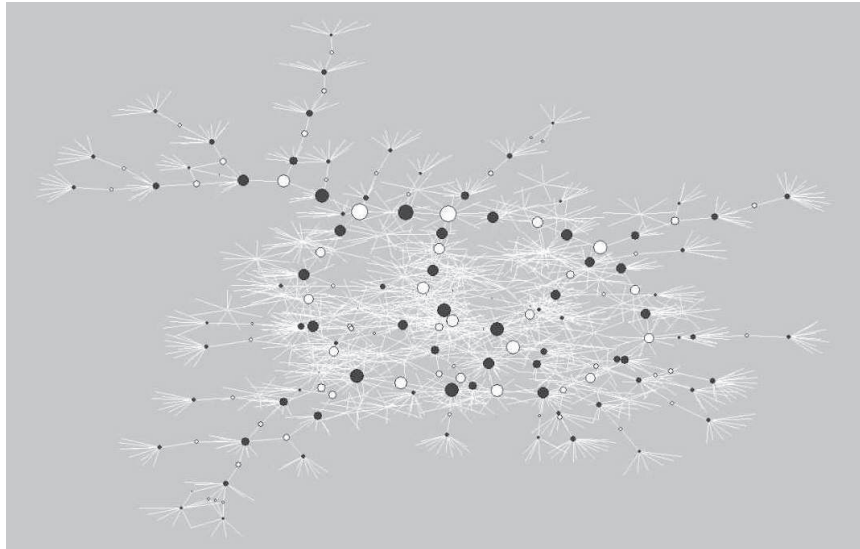


Fig. 1. 2-Mode Network of Boards and Directors. Produced in Pajek (Batagelj & Mrvar, 1998) with the application of Kamada-Kawai algorithm. Source: authors' own data.

We can observe in Picture 1 above that both boards and directors show a substantial variance in values of betweenness centrality scores, which is visible through a range of sizes of circles. The concentration of larger black nodes in the center of the graph indicates that boards having high betweenness centrality tend to be connected to other highly central boards. Some boards, placed a bit further from the center of the picture, also have high betweenness centrality scores, as they control long chains of interconnected boards that do not have alternative relation interconnected nodes in the center of the graph. The dense concentration of white lines towards the center of the graph suggests that boards and directors who are placed there have high degree centralities. This graphic representation of the 2-mode network offers introductory insights into the nature of the observed phenomenon. We further present the results of hypothesis testing, and briefly report the elements of models and the results of the statistical analysis of the interlocking directorates network.

With the first model we test hypothesis H1: "Presence of women on a board will be positively related to board degree centrality". To verify the hypothesis, the model of linear regression was built. Board degree centrality was calculated as a sum of degrees of board members. The board size was used as a control variable. Board degree centrality was linearly transformed with a logarithmic function.

The beta coefficient is negative, which means that when controlling for the board size, the presence of a female on a board has a negative impact on the degree. This is opposite to what we expected in H1. However, the adjusted R-square is small, which means that the model does not explain much of the observed degree centrality variance. Below are the results reported from Statnet.

Model 1:

lm(formula = log(degree + 1) ~ sex.1 + board.size, data = firms)

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.68616	0.20931	3.278	0.00124
sex.1	-0.21158	0.11945	-1.771	0.07814
board.size	0.01804	0.02123	0.850	0.39655
Multiple R-squared:	0.01894,		Adjusted R-squared: 0.008501	
F-statistic:	1.815 on 2 and 188 DF,		p-value: 0.1658	

The second model verifies hypothesis H2: “Presence of women on a board will be positively related to board betweenness centrality”. We used Model 2 with linearly transformed dependent variable of betweenness centrality and the presence of a female board member as the independent variable, and the board size as a control variable. The results indicate that the presence of a female on a board has a negative impact on the board’s betweenness centrality, when controlling for board size. Beta equals -0.59 . Again the direction of the relationship is opposite to what we expected in H2. Model 2¹ explains again a small portion of the variance in the population, with a relatively small value of the adjusted R-square 0.05.

Models 3–6 used to test hypotheses 3–6 were constructed based on the same logic. The details of statistical analysis of these models can be obtained from the authors.

Hypothesis 3 “Ratio of women on a board will be positively related to board degree centrality” and hypothesis 4 “Ratio of women on a board will be positively related to board betweenness centrality” were rejected due to a negative correlation we observed between the ratio of female board members to all board members versus board degree centrality (-0.13) and board betweenness centrality (-0.15). These negative effects are small and explain a small portion of variance as measured by adjusted R square.

In the last two models we tested dyadic hypotheses H5 and H6 aiming to verify the observed network homophily at the board level. Hypothesis H5: “Homogenous boards composed of only men will have higher likelihood of a presence of an interlocking director with other male-only homogenous boards” was verified with the logistic regression model. The dependent variable is a dichotomous variable: two companies share at least

one board member, and two companies do not share any board member. The independent variable represents homophily. Companies with heterophile boards are assigned 0 and the ones with male-only boards – 1. The likelihood of sharing board members increases by 0.57 if two boards have only male members. Therefore, there is a preference to build a tie based on homophily, which enabled us to confirm hypothesis H5.

In hypothesis H6 we expected a similar effect for alike heterogenous boards: “Boards with a female in their composition will have higher likelihood of a presence of an interlocking director with other heterogenous boards that include women in their composition”. To verify the homophile process in interlocking directors, the logistic regression model was again constructed. The dependent variable is a dichotomous variable: two companies share at least one board member, and two companies do not share any board member. The independent variable represents homophily. Companies with heterophile boards are assigned 1 and the ones with male-only boards – 0. The diversity within boards does not increase preferences to share board members with other companies having diverse boards. The beta coefficient is in fact negative and equals -0.3 . It means that boards with males and females are less likely to share a board member with other diverse boards in comparison to male-only boards, and we rejected hypothesis H6.

6. Discussion and Conclusion

Our results indicate that board demographics and board homophily are not neutral to centrality in a wider interlocking directorates network, but also that they explain a relatively small proportion of the observed centrality variances. The effects of having women on boards, as well as having higher ratios of female directors versus the overall board size, were opposite to what we had expected. With earlier findings that female director presence on a board changes behavioral aspects of governance to a large extent, we expected that diverse boards would strategically act to have larger exposure to different practices and perspectives from other boards through interlocking directorates. The opposite was true – diverse boards have fewer interlocks, which may suggest that interlocking directorates offering exposure to different practices and opinions on other boards are an alternative to being exposed to diverse opinions and practices internally as a result of board diversity. Negative effects for centrality in an inter-board network were also confirmed for boards with foreign directors. These findings confirmed the expected direction of relationship between variables, although effects were rather small, with the exception of betweenness centrality where a relatively strong negative relationship was present.

We expected that homophily effects would play a role in explaining the likelihoods of interlocking directorates among homogenous and heterogenous boards. The results were surprising to a certain extent. We found out

that male-only homogenous boards would more likely share interlocks with other male-only homogenous boards, but for boards with a female in their composition the likelihood to have interlocks with other diverse boards was negative. It looks as if conformity and cultural fit can be a driver of board selection in male homogenous boards, but heterogenous boards will be averse to linking with other boards of similar characteristics. This observation reinforces the explanation that internal diversity may to a certain extent substitute external exposure to diverse ideas and practices from other boards.

We were able to explain only a small variance in observed centralities, which needs to be accounted for as a major limitation of our research. We based our empirical verification on a single-country dataset measured at a single point of time; therefore, no comparative study or replication of the observed results was possible. We hope to overcome these limitations in future studies of interlocking directorates and board characteristics.

Endnote

- 1 Detailed results from testing models referring to hypotheses 2–6 and data for replication are available from the authors upon request.

References

- Allee, V. (2003). *The future of knowledge: Increasing prosperity through value networks*. New York: Routledge.
- Aluchna, M. (2009). Corporate governance a procesy globalizacji. *Studia i Prace Kolegium Zarządzania SGH*, 94, 97–114.
- Au, K., Peng, M.W. & Wang, D. (2000). Interlocking directorates, firm strategies, and performance in Hong Kong: Towards a research agenda. *Asia Pacific Journal of Management*, 17(1), 29–47, doi: 10.1023/A:1015432819596
- Batagelj, V. & Mrvar, A. (1998). Pajek – Program for Large Network Analysis. *Connections*, 47–57.
- Bilimoria, D. (2006). The relationship between women corporate directors and women corporate officers. *Journal of Managerial Issues*, 18(1), 47–61.
- Borgatti, S.P. & Foster, P. (2003). The Network Paradigm in Organizational Research: A Review of Typology. *Journal of Management*, 29, 991–1013, doi: 10.1016/S0149-2063_03_00087-4
- Borgatti, S. & Halgin, D. (2011). On network theory. *Organization Science*, 22(5), 1168–1181, doi: 10.1287/orsc.1100.0641
- Brown, D., Brown, D. & Anastasopoulos, V. (2002). *Women on Boards: Not Just the Right Thing . . . But the “Bright” Thing*. Ottawa: The Conference Board of Canada.
- Burt, R. (1992). *Structural Holes*. Cambridge, Massachusetts: Harvard University Press.
- Burt, R.S. (1979). A structural theory of interlocking corporate directorates. *Social Networks*, 1(4), 415–435.
- Carroll, W.K., Fennema, M. & Heemskerk, E.M. (2010). Constituting corporate Europe: A study of elite social organization. *Antipode*, 42(4), 811–843.
- Chu, J.S. & Davis, G.F. (2015). *Who Killed the Inner Circle? The Decline of the American Corporate Interlock Network*. Ross School of Business. Michigan: University of Michigan.

- Comet, C. & Pizarro, N. (2011). The cohesion of intercorporate networks in France. *Procedia-Social and Behavioral Sciences*, 10, 52–61, doi: 10.1016/j.sbspro.2011.01.008
- Cronin, B. & Popov, V. (2005). Director Networks and UK Corporate Performance. *International Journal of Knowledge, Culture and Change*, 4, 1195–1205, doi: MC04-0126-2004
- Csardi, G. & Nepusz, T. (2006). The igraph software package for complex network research. *InterJournal, Complex Systems*, 1695(5), 1–9.
- Davis, G.F. (1993). Who gets ahead in the market for corporate directors: the political economy of multiple board memberships. *Academy of Management Annual Meeting Proceedings*, 1, 202–206, doi: 10.5465/AMBPP.1993.103158
- Davis, G.F. (1996). The significance of board interlocks for corporate governance. *Corporate Governance: An International Review*, 4(3), 154–159.
- Dyer, J. & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23(4), 660–679.
- Elango, B. & Pattnaik, C. (2007). Building capabilities for international operations through networks: a study of Indian firms. *Journal of international Business Studies*, 38, 541–555.
- Farrell, K.A. & Hersch, P.L. (2005). Additions to corporate boards: the effect of gender. *Journal of Corporate Finance*, 11(1), 85–106, doi: 10.1016/j.jcorpfin.2003.12.001
- Faust, K. (2005). Using Correspondence Analysis for Joint Displays of Affiliation Networks. In: P.J. Carrington, J. Scott & S. Wasserman (Eds), *Models and methods in social network analysis* (pp. 117–147). Cambridge: Cambridge University Press.
- Ferris, S.P., Jagannathan, M. & Pritchard, A.C. (2003). Too busy to mind the business? Monitoring by directors with multiple board appointments. *The Journal of Finance*, 58(3), 1087–1111, doi:10.1111/1540-6261.00559
- Freeman, L. (1979). Centrality in social networks. Conceptual clarification. *Social Networks*, 1, 215–239.
- Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. *American Journal of Sociology*, 91, 481–510, doi: 10.1086/228311
- Hambrick, D. & Mason, P. (1984). Upper Echelons: The Organization as a Reflection of Its Top Managers. *Academy of Management Journal*, 9(2), 193–206.
- Handcock, M.S., Hunter, D.R., Butts, C.T., Goodreau, S.M. & Morris, M. (2008). statnet: Software Tools for the Representation, Visualization, Analysis and Simulation of Network Data. *Journal of Statistical Software*, 24(1), 1548–7660.
- Haynes, K. & Hillman, A. (2010). The effect of board capital and CEO power on strategic change. *Strategic Management Journal*, 31, 1145–1163, doi: 10.1002/smj.859
- Heemskerk, E. (2007). *Decline of the corporate community: Network dynamics of the Dutch business elite*. Amsterdam: Amsterdam University Press.
- Heemskerk, E. (2011). The social field of the European corporate elite: a network analysis of interlocking directorates among Europe's largest corporate boards. *Global Networks*, 11(4), 440–460.
- Heemskerk, E.M. & Schnyder, G. (2008). Small states, international pressures, and interlocking directorates: the cases of Switzerland and the Netherlands. *European Management Review*, 5(1), 41–54, doi: 10.1057/emr.2008.3
- Heemskerk, E.M., Fennema, M. & Carroll, W.K. (2016). The global corporate elite after the financial crisis: Evidence from the transnational network of interlocking directorates. *Global Networks*, 16(1), 68–88, doi: 10.1111/glob.12098
- Hillman, A.J. & Dalziel, T. (2003). Boards of Directors and Firm Performance: Integrating Agency and Resource Dependence Perspectives. *The Academy of Management Review*, 28(3), 383–396, doi: 10.2307/30040728
- Hillman, A.J., Cannella, A.A. & Harris, I.C. (2002). Women and racial minorities in the boardroom: How do directors differ? *Journal of Management*, 28(6), 747–763, doi: 10.1177/014920630202800603

- Hogg, M.A. & Terry, D.I. (2000). Social identity and self-categorization processes in organizational contexts. *Academy of Management Review*, 25(1), 121–140.
- Johnson, S., Schnatterly, K. & Hill, A. (2013). Board Composition Beyond Independence: Social Capital, Human Capital, and Demographics. *Journal of Management*, 39(1), 232–262, doi: 10.1177/0149206312463938
- Kamada, T. & Kawai, S. (1989). An algorithm for drawing general undirected graphs. *Information processing letters*, 31(1), 7–15.
- Kogut, B. & Walker, G. (2001). The small world of Germany and the durability of national networks. *American Sociological Review*, 317–355.
- Kołodkiewicz, I. (2014). Czynniki warunkujące skuteczność rad nadzorczych. *Problemy Zarządzania*, 12(2), 68–87.
- Kono, C., Palmer, D., Friedland, R. & Zafonte, M. (1998). Lost in space: the geography of corporate interlocking directorates. *American Journal of Sociology*, 103(4), 863–911, doi: 10.1086/231292
- Levi, M., Li, K. & Zhang, F. (2014). Director gender and mergers and acquisitions. *Journal of Corporate Finance*, 28, 185–200, doi: 10.1016/j.jcorpfin.2013.11.005
- Lin, N. (2001). *Social capital: A theory of social structure and action*. Cambridge, MA: Cambridge University Press, doi: 10.1017/CBO9780511815447
- McPherson, M., Smith-Lovin, L. & Cook, J. (2001, August). Birds of Feather: Homophily in Social Networks. *Annual Review of Sociology*, 27, 415–444.
- Miller, T. & Triana, M. (2009, July). Demographic Diversity in the Boardroom: Mediators of the Board Diversity–Firm Performance Relationship. *Journal of Management Studies*, 46(5), 755–786, doi: 10.1111/j.1467-6486.2009.00839.x
- Mintz, B.A. & Schwartz, M. (1985). *The power structure of American business*. Chicago: University of Chicago Press.
- Mizruchi, M. (1996). What do interlocks do? An Analysis, Critique, and Assessment of Research on Interlocking Directorates. *Annual Sociological Review*, 22, 271–298.
- Nahapiet, J. & Ghoshal, S. (1998). Social Capital, Intellectual Capital, and the Organizational Advantage. *Academy of Management Review*, 23(2), 242–266, doi: 10.2307/259373
- Newbert, S. (2009). Empirical research on the resource-based view of the firm: an assessment and suggestions for future research. *Strategic Management Journal*, 28(2), 121–146, doi: 10.1002/smj.573
- Nuzzo, R. (2014). Scientific method: statistical errors. *Nature*, 150, 150–152.
- Pennings, J. (1980). *Interlocking Directorates*. San Francisco: Jossey-Bass.
- Prell, C. & Skorovetz, J. (2008). Looking at social capital through triad structures. *Connections*, 28(2), 4–16.
- Ratcliff, R. (1980). Banks and corporate lending: an analysis of the impact of the internal structure of the capitalists class on the lending behavior of banks. *American Sociological Review*, 553–570.
- Sankar, C.P., Asokan, K. & Kumar, K.S. (2015). Exploratory social network analysis of affiliation networks of Indian listed companies. *Social Networks*, 43, 113–120, doi:10.1016/j.socnet.2015.03.008
- Sankowska, A. & Siudak, D. (2016). The small world phenomenon and assortative mixing in Polish corporate board and director networks. *Physica A: Statistical Mechanics and its Applications*, 443, 309–315, doi:10.1016/j.physa.2015.09.058
- Scott, J. (1991). Networks of Corporate Power: A Comparative Assessment. *Annual Review of Sociology*, 17, 181–203.
- Seidel, M.D. & Westphal, J.D. (2004). Research impact: How seemingly innocuous social cues in a CEO survey can lead to change in board of director network ties. *Strategic Organization*, 2(3), 227–270, doi:10.1177/1476127004045252
- Sinani, E., Stafsudd, A., Thomsen, S., Edling, Ch. & Randoy, T. (2008). Corporate governance in Scandinavia: comparing networks and formal institutions. (B.B. Kogut, Ed.) *European Management Review*, 5(1), 27–41.

- Singh, H. & Harianto, F. (1989). Management-Board Relationships, Takeover Risk, and the Adoption of Golden Parachutes. *Academy of Management Journal*, 32(1), 7–24.
- Singh, V. & Vinnicombe, S. (2004). Why so few women directors in top UK boardrooms? Evidence and theoretical explanations. *Corporate Governance: An International Review*, 12(4), 479–488.
- Siudak, D. & Sankowska, A. (2015). Miary analizy sieciowej w ocenie strategii interlockingu–powiązania rad dyrektorów. *Nauki o Finansach*, 1(22), 120–135.
- Sonnenfeld, J. & Kusin, M.W. (2013, April). What CEOs Really Think of Their Boards. *Harvard Business Review*, 98–108.
- Stark, D. & Vedres, B. (2012). Political Holes in the Economy The Business Network of Partisan Firms in Hungary. *American Sociological Review*, 77(5), 700–722, doi: 10.1177/0003122412453921
- Useem, M. (1984). *The inner circle*. New York: Oxford University Press.
- Wasserman, S. & Faust, K. (1994). *Social Network Analysis: Methods and Applications*. Cambridge: Cambridge University Press, doi: 10.1017/CBO9780511815478
- Westphal, J.D. & Milton, L.P. (2000). How experience and network ties affect the influence of demographic minorities on corporate boards. *Administrative Science Quarterly*, 45(2), 366–398, doi: 10.2307/2667075
- Westphal, J.D. & Stern, I. (2006). The other pathway to the boardroom: Interpersonal influence behavior as a substitute for elite credentials and majority status in obtaining board appointments. *Administrative Science Quarterly*, 51(2), 169–204, doi: 10.2189/asqu.51.2.169
- Westphal, J.D. & Stern, I. (2007). Flattery will get you everywhere (especially if you are a male Caucasian): How ingratiation, boardroom behavior, and demographic minority status affect additional board appointments at US companies. *Academy of Management Journal*, 50(2), 267–288, doi: 10.5465/AMJ.2007.24634434
- Withers, M., Hillman, A. & Cannella, A. (n.d.). A Multidisciplinary Review of the Director Selection Literature. *Journal of Management*, 38(1), 243–277, doi: 10.1177/0149206311428671
- Zdziarski, M. (2012). Elita Wewnętrznej Kregu i Centralne Firmy. Wyniki Badan Relacji Przez Rady Nadzorcze w Polskich Spolkach Gieldowych. *Organization and Management*, 150(1), 23–39.
- Zdziarski, M. (2012). Relacje w radach nadzorczych spółek publicznych. *Współczesne Zarządzanie*, 4, 213–223.

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