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Structure behind principles: Social selection mechanisms in corporate governance networks

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Abstract

Purpose – *The aim of this paper is to demonstrate that social relations at a corporate governance platform between members of supervisory boards, and between members of supervisory and executive board tiers can serve as an alternative viewpoint towards understanding mechanisms of social selection in corporate governance networks. The paper shows that through the lenses of social network analysis it is possible to identify and understand how the process of corporate governance member selection unfolds within companies, and how that selection process might have been potentially influenced by the cross-board relations, such as interlocking directorships.*

Design/methodology/approach – *To estimate network parameters and attribute effects of network tie emergence the paper utilizes exponential random graph models (ERGMs) on corporate governance data of Danish publicly listed companies. Econometric models are applied to estimate parameter statistics which serve further to explain tendencies of tie emergence.*

Findings – *The results of the study reveal that the process of selection of both supervisory boards and executive directors are interdependent. Also, the study showed that board members are more likely to select popular supervisory board members and top managers who have their expertise gained through multiple companies affiliated with multiple industries. However, these conditions for CEO selection apply only to the extent to which they have their experience gained from multiple companies but not multiple industries.*

Originality/value – *The study contributes both to practitioners and researchers. On one hand, it emphasizes that being a dynamic practitioner who is exposed to different companies affiliated with different companies and industries increases a visibility and attractiveness to companies' boards. On the other hand, the paper shows that the research on board assemblage nowadays requires observing boards through networks instead of boards in isolation while also integrating executive tier.*

Key words - *Corporate governance, Boards of directors, Management, Social network analysis, ERGMs, CEO*

Paper type – *Research paper*

1. Introduction

Corporate boardroom processes have long been of interest to organizational researchers and practitioners, and in order to understand boards we need to understand the people who sit on them (Adams, 2017). The importance of corporate governance structure has motivated numerous studies to discuss board compositions and board and executive member selection processes (Kesner *et al.*, 1986). Both researchers and practitioners, such as national institutes of company directors, emphasized that outcomes of governing corporations (e.g. company performance) depend on a combination of competences that board members possess (AICD, 2016; Darko *et al.*, 2016; Nordberg and Booth, 2019). In order to determine the combination of competences required by board representatives, companies are recommended to develop 'skill matrices' which will enable them to select those candidates that fit company demands (AICD, 2016). The skill matrices represent the

outline of mandatory skills that further set out the conditions under which the assessment processes, and ultimately the selection of candidates for the supervisory boards, are administered. Matrices imply that the selection criteria are indicative of the diversification of expertise among existing and new board representatives, through which the synergetic effect is generated, and which further condition successful governance.

A Cadbury report defines corporate governance as a system that enables directing and controlling business entities (Cadbury, 1992). The Organisation for Economic Co-operation and Development emphasizes that assimilation of the concept of 'relationship' is nowadays fundamental for understanding corporate governance, as it has the potential to supplement and extend knowledge of corporate business strategies and board structures. This assertion indicates that relational ties existing between representatives of corporate boards have the capacity to reveal more information about how corporate boards are assembled, than does inspecting further the selection mechanisms and methodologies that companies apply to assemble boards (Mizruchi and Stearns, 1988; Pfeffer, 1972; Allen, 1978, 1974; Stokman *et al.*, 1985; Zeitlin, 1974; Pfeffer and Salancik, 1978).

Following the argument by McPherson *et al.* (2001) and Freeman (2007) regarding the development of board selection processes, the requirement for diversification of skills at supervisory boards seems not to be sustainable under the following assertion. They argue that the homophily effect is the grounding principle under which corporate boards are established. Homophily indicates that social actors associate themselves with others similar to them (McPherson *et al.*, 2001; Freeman, 2007), implying that it is not skill diversification that drives the selection process of corporate board composition, but rather the similarities among team members.

Taking the into account that organizational research argues that similarities among the representatives of two-tier boards drive the selection process, this study aims to identify how social selection processes develop in the corporate governance context, and whether homophily represents one of the main effects that drives the selection processes. Additionally, this paper extends further the discussion about selection processes beyond the boundaries of supervisory boards, as it incorporates the selection of executive directors within the model to identify the logic that supervisory board members follow to select appropriate executive directors. Thus, both corporate governance tiers are simultaneously investigated through the methodology of social network analysis while taking into account the condition of interdependence (Lusher *et al.*, 2013). This condition assumes that both selection processes are mutually susceptible, and arguably, do not develop in isolation from each other. Thus,

this paper leads to further discussion on whether – and if so, how – tendencies towards homophily and preferences for particular corporate board representatives create an interplay of social selection mechanisms in the two tiers of corporate governance. Following this, the paper argues that corporate board social selection processes do not develop in isolation and at random, but that the selection depends both on the selection conducted by the other boards and on the personal characteristics of the actors.

2. Theoretical background and hypotheses

Corporate governance theory suggests that shareholders, as asset owners, represent those who are responsible for corporate decisions. In practice, companies employ agents (supervisory and executive directors) who will be responsible for both determining and executing companies' strategic decisions (Shleifer and Vishny, 1997). It is essential that supervisory boards' decisions are in compliance with shareholders' incentives in order to prevent principal-agent problems, as non-executive directors should prioritize shareholders' interests over their own (Forbes and Milliken, 1999). The literature suggests that one of the main responsibilities that boards have, besides safeguarding shareholders from management misappropriations (Minichilli *et al.*, 2012), is to decide on the composition of two-tier board systems.

2.1. Supervisory board member structures

Boards of directors represent a formal link between shareholders and top management (Mintzberg, 1983, Monks and Minow, 1998). They symbolize the apex of company's decision control system (Fama and Jensen, 1983: 311), which is interdependent and particularly vulnerable to process losses (Steiner, 1972).

Supervisory board members are selected according to their qualifications, experience and knowledge. It is fundamental that the experience and knowledge of newcomers correspond well with the company's business strategy and the overall structure of the corporate governance structure. Since boards of directors are not responsible for the execution of daily tasks (Forbes and Milliken, 1999), they are not expected to be experienced professionals who have the same level of understanding of the company as the executive directors (Treadwell, 2006; Kakabadse *et al.*, 2001). Supervisory board members have part-time engagement with the company they govern, which enables them, without

limitations, to hold multiple supervisory board affiliations (interlocking directorships), which gives them power to directly control the decision-making processes on each board they represent.

Forbes and Milliken (1999) observed the control and service tasks of boards of directors in the context of interpersonal conflict in US companies. They argue that the homophily effect (McPherson *et al.*, 2001) is a crucial driver of in-group coherence, which is particularly important for suppression of interpersonal conflicts during decision-making processes (Forbes and Milliken, 1999). Their findings show that cognitive conflicts may be expected to escalate if board members have disparate education levels, or different functional and industry backgrounds. Also, if group members exhibit homophily, increases in diversity can disrupt the functioning of the group (Adams, 2017; Giannetti and Zhao, 2016; Bernile *et al.*, 2018; O'Regan *et al.*, 2005). That is because individuals of different backgrounds tend to perceive, comprehend and respond to a particular situation differently, which may lead to difficulties during decision-making processes and in-group confrontations (Forbes and Milliken, 1999; Garlappi, *et al.*, 2016; Adams *et al.*, 2016; Ingley and van der Walt, 2003), which can be disruptive (Horstmeyer, 2017). Williams and O'Reilly (1998) emphasized that demographic diversity is associated with the lower level of interpersonal attraction within groups, which leads to the lower integration level.

Following Burt's (1992) theory of structural holes, it could be argued that exactly those actors who bridge two structures, e.g. teams, boards, etc., may have the most significant influence on both boards, as their brokering function enables the exchange of information between groups.

Based on the argument that interlocking directorships and homophily effects might drive the composition of supervisory boards, the following hypothesis is proposed:

H1: Non-executive directors tend to select and collaborate with those non-executive directors who are similar to them.

2.2. Executive directors' selection process and selection preferences

Supervisory boards are responsible of monitoring and scrutinizing executive directors on behalf of the shareholders (Hallman and Dalziel, 2003). Besides, members of the supervisory boards are accountable to shareholders for the selection of internal and/or hiring of external executive directors. Considering that boards meet few times per year, they are incentivized to engage credible and responsible executives in order to ensure the execution of corporate decisions. The selection of top

managers is a particularly sensitive topic for supervisory boards, as the appropriate selection of executive directors is vital to the performance and survival of organizations (Vinkenburg *et al.*, 2014), and should be different from the selection of lower hierarchical employee levels (Hollenbeck, 2009).

Following the stratified systems theory, the engagement of appropriate executives is a particularly delicate subject matter for supervisory board members because each consecutive level in the organizational hierarchy supports a higher level of complexity involved in decision-making processes (Jacques and Clement, 1991). Therefore, executive director levels bear a high level of complexity due to interaction with and dependency on various stakeholders, as making decisions at top management levels requires taking into account various economic, financial, political, sociocultural, and technological considerations, with respect to both short and long term (Carpenter and Frederickson, 2001; Hooijberg *et al.*, 1997).

Another important structural condition is high visibility of executive directors (Vinkenburg *et al.*, 2014), as this condition is highly linked to interaction and dependency on key stakeholders (Harrison *et al.*, 1988) who often control important resources (Pfeffer and Slancik, 1978). Such visibility makes the executive directors become a key target for symbolic gestures (Walsch, 1988). Supervisory boards, however, only intrinsically and mainly ambiguously formulate a set of expectations they have from executive directors, and thus the engagement of top managers still represents the black box of the theory of corporate governance. Therefore, executive directors tend to share unaligned perceptions of what behaviour is expected from them (Beatty *et al.*, 2001), and what expertise they should possess in order to be attractive enough for the boards. On the other hand, the arrangement of executive directors is a problem as the decision about the appointment may be risky for the top tier, and the engagement itself requires the executives to bear a high level of risk after the appointment of an executive director, as the latter becomes a member of the dominant elite (Hambrick and Mason, 1984). Finally, members of top management are considered powerful on account of their accumulated experience, reputation and access to internal and external networks (Zhang and Rajagopalan, 2004), allowing them to make realistic threats, such as leaving for the competition (Giambatista *et al.*, 2005).

Taking into account the previous considerations on which supervisory board members base their decisions on executive director selection, such as the high level of complexity, visibility, ambiguity, risk, and power, this paper assumes that it could be expected that board members are inclined to engage those executives who are both more experienced (by being engaged by multiple companies,

preferably across different industries) and, therefore, more popular (by having established multiple relations with relatively more shareholders than the others).

Following this, the paper employs the straightforward assertion to hypothesize the following:

H2a: A board of directors is likely to collaborate with more popular and multiple company- and industry-experienced executive directors.

Lastly, this paper distinguishes the CEO position in top management from the other executive directors in order to determine whether – and if so, how – boards of directors establish preferences towards particular individuals. Hermalin and Weisbach (2003) provided the evidence that boards play a significant role in few corporate decisions, where arguably the most important ones are those pertaining to the selection, monitoring and retention of the CEO.

The literature argues that the selection of chief executive officers may be both internal and external. On one hand, earlier studies demonstrated that preferences for the appointment of an internal candidate to the position of CEO guarantee a better understanding of a company's internal operations due to professional expertise (Westphal, 1998; Elloumi and Gueyié, 2001). On the other hand, recent literature acknowledges that supervisory boards are, in fact, more likely to prefer external candidates over the internal ones for the position of CEO (Hermalin, 2005). Boards of directors deliver knowledge to the company they represent, which is nourished by an extensive past experience acquired elsewhere (Roberts *et al.*, 2005). This is because those CEOs gained relatively more expertise by being engaged by different companies and industries (Roberts and Stiles, 1999). But at the same time, their tenure is shorter while receiving a higher remuneration (Muth and Donaldson, 1998).

Taking into account the fact that non-executive directors are expected to provide a different type of expertise to the company, this paper argues that supervisory boards are prone to engaging external rather than internal CEOs, as the former have had the opportunity to acquire professional expertise in more companies and industries. Therefore, the following hypotheses are proposed:

H2b: Boards of directors tend to select a CEO who has acquired experience from multiple companies and multiple industries.

3. Data and methodology

3.1. Sources of data

The hypotheses were tested through empirical analysis applied to a dataset of public listed companies in Denmark. The dataset includes the entire sample of all business entities whose shares were traded on the Danish Stock Exchange (Nasdaq OMX Copenhagen) during the period from 2010 to 2014. That period was selected because the two audit firm mergers in Denmark characterized the periods both before and after the time frame set for this study. This is because it was expected that the mergers might distort the corporate governance structure and the board composition due to audit partner defection, which could mean that a certain number of board representatives move to other boards or resign from current ones.

The list of companies was identified through interim reports on share trading on 31 December for each of the five years, published by the Stock Exchange. The interim reports were used as the guidelines for collection of annual statements from which the relational and attribute data related to both supervisory and executive directors were identified and extracted. Few data sources were used to collect the annual statements: (1) a registry of all Danish business entities – *Virk.dk*, (2) official company websites (section for investor relations), and if the data was unavailable from one of the previous two sources, the rest of the data was collected (3) through direct contact with the companies. Annual statements were used as, according to Danish regulations, publicly listed companies are required to disclose information on corporate governance structures, which includes both supervisory boards and executive directors.

The entire list of publicly traded companies was incorporated into the study in order to fulfil the requirement of completeness, as it is critical for research into social networks (Robins, 2015). This resulted in the sample of 774 business entities (165, 162, 153, 149, 145 respectively for each year). During the observed period, there were in total 1,236 unique supervisory board members and 501 unique executive directors who were affiliated with 191 unique business entities. The following Table 1 provides the details on the selected sample.

Table 1 – The sample of companies, supervisory board members and executive directors

	2010	2011	2012	2013	2014
Number of companies	165	162	153	149	145
Number of supervisory board members	969	962	922	897	894
Number of executive directors	382	385	357	348	352
Average number of supervisory board members per company	m=6.45 SD=2.62	m=6.63 SD=2.52	m=6.71 SD=2.61	m=6.71 SD=2.73	m=6.68 SD=2.61

Average number of executive directors per company	m=4.70 SD=1.40	m=4.73 SD= 1.52	m=4.75 SD=1.38	m=4.62 SD=1.46	m=4.65 SD=1.50
Average number of interlocks per board of directors	m=1.12 SD=0.42	m=1.16 SD=0.43	m=1.11 SD=0.44	m=1.11 SD=0.44	m=1.11 SD=0.43

3.2. The network

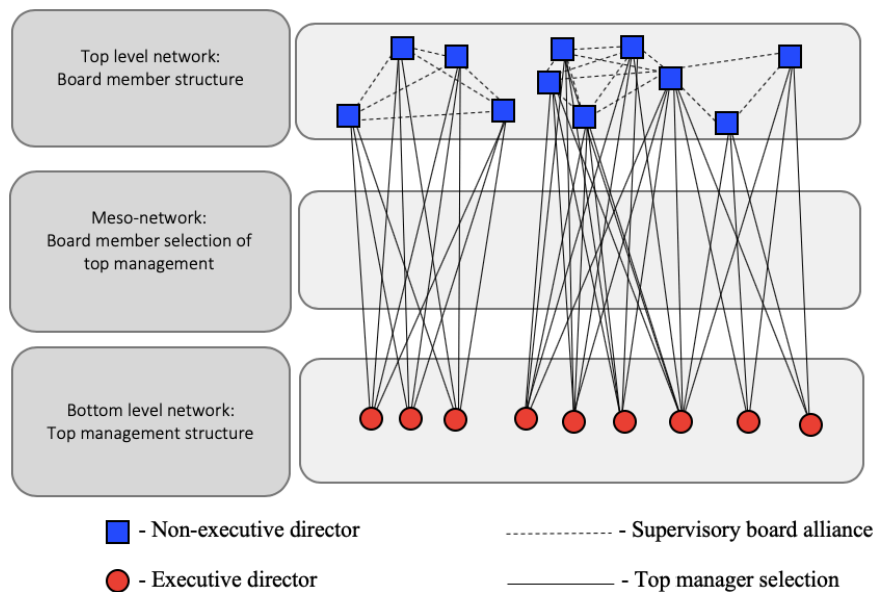
In order to investigate how two-tier collaborative relations develop in corporate governance networks and provide the answer to how social relations emerge in that context, network analysis is applied. To do so, the units of the analysis are determined; in this study they represent the relations within the corporate governance platform among supervisory board members and between supervisory board members and executive directors. In order to extract the information on relational ties, first the network nodes are defined. The nodes that assemble the network are the social actors (people) who represent each of the board tiers for each selected company, among whom relationships develop. Relationships represent collaborative ties that portray ‘who works with whom’ at the same corporate governance level of the company.

A simplified visualization of the collaboration network within and across two-tier board systems is presented in Figure 1. Supervisory board members are represented by blue squares and top managers are shown by red circles. In the network visualization, the dashed lines represent collaborations between supervisory board members. According to the visualization, members who sit on the same board of directors form a clique-based network configuration, which determines that everyone is connected to everyone else (Robins, 2015). Board members who share relationships with two cliques are the ones who sit on multiple boards at the same time, and thus occupy interlocking directorship positions. Solid lines represent collaboration between the two tiers, namely, between supervisory and executive members. Both groups of ties represent social selection processes that occur regarding board member selection by boards and top management member selection by supervisory boards. The bottom level of the network of the top management tier was excluded from the study, as top management is considered as it should not have a significant impact on either the supervisory board selection process or the top management selection process (Adams, 2017).

The network that is observed here is multilevel, and it is assembled from the two types of nodes and two types of relational ties (Robins, 2015; Wang *et al.*, 2013). This study includes information on social selection processes that develop over the five years, and therefore has a perennial (multi-year) character. Though a perennial sample was included in the model, many collaboration/selection ties

reappeared during data extraction. Those overlaps were excluded as the ties were not treated as weighted to refer to the strength of ties, which resulted in removing dyadic covariates from the model. This is because tenured positions and length of board members' contracts were not taken as explanatory variables to potentially influence social selection processes at both network levels.

Figure 1 - Simplified network visualization



Assuming that networks emerge either through self-organization or social selection, the focus of this paper is on the latter process, as the study observes the impact of exogenous attributes on tie formation propensity (Lusher *et al.*, 2013). For the first part of the model, in which supervisory board network parameters are estimated, the central focus is on the homophily effect (Robins, 2015). Homophily implies that relations between two actors tend to emerge if they hold the same attributes (McPherson *et al.*, 2001). The argument behind the idea of integrating the homophily parameter is that in-group coherences are essential to board representatives, and board composition based on similar cognitions enables board members to diminish the probability of escalation of conflicts that might emerge due to dissimilarities (Forbes and Milliken, 1999). In this study, the homophily effect is observed through the attribute match, particularly if the same attribute value (such as expertise gained through different companies and industries) is held by two board members who share the tie (sit on the same board).

In the second level of the network, the attributes of each representative on corporate boards and in corporate managements were also integrated into the model. The attributes represent the theoretical arguments outlined in the section on theoretical background and hypotheses development, and include information about the experience that individual board and executive members gained during

the observed period. Following the theory, information on previous experience on different boards and affiliations with different companies and industries was used as explanatory variables to provide a more detailed explanation of how social relations emerge. In particular, the aim of the attributes was to give further clarification on why particular attribute holders (e.g., those having more than one affiliation with different companies and/or industries over the observed period) tend to attract more attention, and therefore, become more popular nodes in the network (Vinkenburg *et al.*, 2014).

The outcome of a model estimation is a probability of the overall network structure in terms of parameters associated with a particular pattern. Patterns reflect the influence of personal characteristics on actors' embeddedness in the observed interpersonal network. Additionally, a major assumption of the method is that patterns are interdependent and serve as a control for network endogenous processes (Robins *et al.*, 2007).

3.3. Research methodology







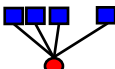








While accounting for the condition of interdependence, social network analysis (SNA) methodology has the capacity to identify network structuring principles (network configurations) that are capable of explaining the internal processes that occur within the observed network (Robins, 2015).

To apply SNA methodology in the study, this paper utilizes a recently developed cutting-edge statistical model called exponential random graph models (Wang *et al.*, 2018). ERGMs represent the state of the art for the analysis of interdependence structures, and operates as a pattern-recognition device concerned with explaining the patterns of ties in social networks (Frank and Strauss, 1986; Wassermann and Pattison, 1996; Lusher *et al.*, 2013). For the purpose of modelling the network structural parameters, the MPnet software was adopted (Wang *et al.*, 2013).

The underlying assumption of ERGMs is that stochastic (random) processes characterize the manner in which social relations between social actors are generated, and can explain the propensity of network tie emergence. In practice, this implies that ERGMs hold the premise that social networks are comprised of small mechanisms that lead to tie formation processes, and that through the estimation of dispositions, those mechanisms can be modelled and determined. What is specific for the network studies is that the patterns of network ties (some of them are presented in Table 2) delineate dependent variables whose presence in the network has the explanatory power to identify and describe the internal processes that characterize the emergence of the network (Wang *et al.*, 2018). On a single tie scale, this means that the emergence of a single tie is influenced by the presence

or the absence of the other ties in the network. Whereas on the network scale, this principle implies that the existence of a particular group of network mechanisms (configurations) is mutually

Table 2 - Summary of network effects included in the exponential random graph model

Pattern	Visualization	Interpretation
<i>Single-level structural parameters</i>		
Edge		An edge connecting two nodes (a baseline propensity of a tie formation).
Star parameter ASA*		Indicative of the presence of highly central supervisory board members within a network. Models the degree distribution.
One-mode level closure ATA		Within level closure parameter. Indicative of triadic clustering between board members.
One-mode level Indirect connectivity A2PA		Indirect connectivity. Indicative of actors being connected through multiple boards but not directly.
<i>Cross-level structural parameters</i>		
Edge – XEdge*		A baseline propensity to a meso-level tie formation (non-executive selecting an executive director).
Non-executive director popularity effect - XASA		Parameter indicates presence of highly central supervisory board members.
Executive director popularity effect - XASB		Parameter indicates presence of highly central top managers.
Non-executive director-centred clustering - XACB		Two non-executive directors selecting the same top managers.
Non-executive director closure - ATXAX		Between level closure parameter. Indicative of triadic clustering between executive and non-executive directors.
<i>Attribute effects</i>		
InteractionA*		Indicative of interaction between board members who have multiple board and/or industry affiliations
TwoPath111A		Star homophily parameter – indicative of transitive connection between board members holding for multiple board and/or industry affiliations
TwoPath101A		Transitive connection between board members holding attribute through the other who is not a holder of the attribute
SumA		Interaction with multiple summed number of companies and industries
X2StarB101		Tendency towards selection of multiple actors who hold the same attribute
X2StarB010		Popularity effect driven by a particular attribute (top manager was affiliated with multiple companies/industries)

*Indicates name/abbreviation for network parameters according to Wang et al., 2013

Squares indicate board members, and circles represent top managers.

dependent on the existence of the other ones, which signifies that structures in the network evolve because the other structures in the network evolve and exist as well. It is precisely those internal processes that represent the condition of interdependence on which this study relies (Wang *et al.*, 2018).

The selection of the structuring principles integrated into the model is theory driven and the visual appearances of these principles, outlined in Table 2, resemble the social reality of actions that occur in the observed context.

For multilevel networks, ERGMs could formally be expressed as:

$$Pr(X = x \ Y = y) = \left(\frac{1}{k}\right) \exp\left(\sum_Q \Theta_Q Z_Q(x, y)\right) \quad (1)$$

In the previous expression, X denotes the network variable for a network with n nodes, and x denotes the corresponding realization. While Y is an array of actor attribute variables with realizations y . $Z_Q(x, y)$ is a network statistic counting the number of network patterns of type Q for a particular network realization x and given the vector of attributes y . Θ_Q is the parameter corresponding to the statistics $Z_Q(x, y)$, and k is a normalizing constant included to ensure that the formula is a proper probability distribution. The summation is taken over all network patterns Q that are integrated in the model. The probability of observing any network x in this distribution is both dependent on statistics $Z_Q(x, y)$ and the corresponding parameter values Θ_Q for all patterns in the model (Brennecke and Rank, 2016). Building on criteria recommended by Wang *et al.* (2013), I tested the model for goodness of fit, and identified that, for all patterns introduced in the model, t -values were below the threshold of 0.1, while for the all the others, they were below 2.0 in their absolute value.

3.4. Limitations of the dataset

Previous research emphasized two limitations related to tracking the selection of CEOs, and categorization of those into the group of internal or external candidates that this paper also refers to. First, prior to making the final selection of candidates for the position of Chief Executive, firms tend to hire heir-apparents from outside for a few years before they become CEOs (Hermalin, 2005). In the recent study on the USA corporate governance case, it was reported that 22% of newly employed CEOs have less than five years of experience with the company they have been appointed to lead. Such an empirical practice muddies the distinction between internal and external candidates, and according to Hermalin (2005), creates data-definition problems for econometricians. The second

limitation is that companies sometimes tend to employ interim CEOs when the previous one unexpectedly departs. Thus, in order to fill in the temporary shortage of an appropriate duty officer, companies tend to engage insiders who will, by definition, have short tenures (Eldenburg *et al.*, 2004). This paper argues that the application of a further elaborated statistical method for network research omits the potential disadvantage of a statistical modelling issue.

4. Analysis and discussion of results

4.1. Descriptive statistics

Table 3 outlines the descriptive statistics of the corporate governance network by capturing the most relevant features of the multilevel supervisory board and non-executive directorship network. The table isolates only limited information on the sample related to a single year sampled, in order to provide information on the size of the sample that was used to develop the main network from each fragment. The average number of companies per year for the observed period is 154.8, governed by, on average, a total of 932.6 supervisory board members and 356.6 executive directors across the entire sample. An average size of supervisory board is 6.69 members with standard deviation of 2.62 members across the overall five-year sample. The ratio of top managers per board is 4.69 members

Table 3 - Descriptive statistics

	2010	2011	2012	2013	2014
Number of companies (average 154.8)	165	162	153	149	145
Number of board members (average 932.6)	970	963	922	898	899
Number of top managers (average 356.6)	378	375	356	342	332
Number of board members per board					m=6.69 SD=2.62
Number of top managers per board					m=4.69 SD=1.45
Number of unique representatives of board members in the sample (N_1)					1236
Number of unique representatives of top management members in the sample (N_2)					501
Board network density					0:00
Top management – board network density					0.00
<i>Board attributes - binary and continuous</i>					
Average number of companies board member was engaged by over the observed time					m=1.21 SD=1.34
Average number of industries board member was engaged by over the observed time					m=1.30 SD=0.68
<i>Top management attributes – binary</i>					
Number of executive board positions (0 – one; 1 – more than one)					0.59
Number of CEO positions occupied by top managers (0 – one; 1 – more than one)					0.41
Engagement of top manager across multiple industries (0 – one; 1 – more than one)					0.57

with a standard deviation of 1.45 top managers per executive team. After the elimination of duplicates and isolation of unique values, the complete sample ended up with a size of 1,236 unique board members and 501 executive directors. Despite a relatively large sample of network nodes, the network is characterized by a low-density level (Wassermann and Faust, 1994). The low network density level is conditioned by the number of positions on each corporate board, the number of mandatory top managers engaged in executive positions, and the number of interlocks that emerge across boards.

The average number of companies an individual supervisory board member is engaged by is 1.21 (with a standard deviation of 1.34). This indicates that establishing an interlocking directorship is common practice among supervisory board members in Denmark. Also, the average number of industries that a board member is engaged in is 1.30. The following Table 3 presents the descriptive statistics as ratios.

Approximately 59% of all executive directors in the observed sample have occupied an executive position in more than one company during the five-year period, which indicates a relatively higher executive director turnover rate. During the observed period, 41% of executives have also occupied at least two CEO positions in at least two different companies, which shows a possible tendency for selection of experienced executive directors, rather than internal ones. Lastly, more than half of the overall sampled top managers – around 57% – represented more than one executive board in companies affiliated to different industries.

4.2. Results of model estimations for multilevel networks

Table 4 represents results of the model estimation, incorporating five years' data, for a supervisory board and top management network. The results in the table are arranged in vertical and horizontal sections. The vertical sections represent three models regarding to the number of network effects that are incorporated into models. Model 1 observes parameters only for a top-level network, which integrates only structuring principles of the top-tier network. Model 2 presents parameter estimates only for main structuring principles, while model 3 additionally incorporates nodal attributes to enrich discussion of the results, and gives answers to the previously developed hypotheses. Such a presentation of the results helps to better understand how the exclusion of particular network configurations might distort the modelling of in-network processes. The horizontal sections represent network parameters in the form of top- and meso-level configurations together with the network effects that represent nodal attributes. Hence, the results of the model estimations reveal that the

network observed is characterized by a number of single-level and multilevel patterns that tend to emerge more or less often than what would be expected by their random occurrence. In the following, the structuring parameters are discussed together with the attribute effects in their logical order of occurrence.

4.2.1. Structuring principles of board membership networks

Table 4 displays the outcome of the network parameter estimations by including the network effects that capture structural parameters for both parts of the network related to supervisory boards, and supervisory boards and executive directors, together with the attribute effects. The presentation of the results from the model estimation follows the consecutive order of those network effects that are estimated as significant.

An edge parameter is usually included in modelling network structuring principles and functions as the control parameter that indicates a general propensity of network tie formation (Lusher *et al.*, 2013) and is usually not discussed. A negative significant value of the edge parameter only indicates that board members infrequently create ties outside the more complex structural patterns characterizing the network. The model also included the three-star popularity and activity network configuration Star3A, which is categorized as Markov and not as a social circuit dependence parameter (Robins *et al.*, 2007), as the other configurations included in the model are classified. That configuration was integrated to enable network convergence and improve the model fit, especially in those cases in which degree distributions are highly skewed (Robins *et al.*, 2007; Snijders *et al.*, 2006).

The star parameter *ASA* captures the popularity of certain nodes within the network. The effect mirrors the analytical notion of a degree centrality developed by Freeman (1979), which reflects the prominence of a social actor within the observed network (Lusher *et al.*, 2013) and indicates an intuitive notion of the activity of a single node (Robins, 2015). In the main model, the positive parameter value of the popularity effect shows that the network is characterized by the presence of those supervisory board members who tend to receive more nominations for selection as board members than the others would receive. The parameter indicates also that in the corporate governance network, some board members are more active than others, as they were involved in many board structures, and thus collaborated with relatively more board members than the others. Also, this parameter demonstrates that the network of supervisory board members is widely spread, which

implies that the network is characterized by tendencies to establish cross-board ties (interlocks). Such a result implies that some supervisory board representatives, while sitting on multiple boards, tend to

Table 4 - Results of the exponential random graph models for supervisory and executive director selection ties

Variable	Model 1	Model 2	Model 3 (main)
Network endogenous patterns – Board-level network			
Edge - Edge	-5.8815* (0.306)	-6.7607* (0.324)	-6.1215* (0.038)
Star3A	-0.0045** (0.001)	-0.0051 (0.004)	-0.0041 (0.003)
Star parameter - ASA	1.546* (0.078)	1.457* (0.082)	1.392* (0.091)
One-mode level closure - ATA	1.0033*** (0.007)	0.998*** (0.008)	1.012*** (0.01)
One-mode level Indirect connectivity - A2PA	-0.386 (0.204)	-0.412 (0.303)	-0.399 (0.204)
Network endogenous patterns – Board - top management level network			
Edge - Xedge		-6.684* (1.047)	-5.2351* (1.6638)
Non-executive director popularity effect - XASA		1.047* (0.036)	1.022* (0.042)
Executive director popularity effect - XASB		1.6638* (0.062)	1.2536* (0.71)
Executive director-centred clustering - XACA		1.0435 (0.654)	1.1202 (0.755)
Non-executive director centred clustering – XACB		-1.0918 (0.621)	-1.1213 (0.634)
Non-executive director closure – ATXAX		1.1043* (0.178)	1.0931* (0.055)
Attribute effects			
Homophily multiple board interaction – NUM_COMP_InteractionA			0.2391* (0.114)
Star homophily parameter – BOARD_MULTI_POS_TwoPath111A			0.3050* (0.015)
Homophily multiple industry interaction – NUM_IND_InteractionA			1.138* (0.026)
Star homophily parameter - BOARD_MULTY_BOARDS_TwoPath111A			0.1064* (0.026)
Boards select executives who were representatives in multiple companies - NUM_COMP_SumA			0.1412* (0.0184)
Boards select executives who were employed in more than one industry - NUM_IND_SumA			-1.1336* (0.0237)
Boards select CEOs who were representatives in multiple companies - MAN_MULTI_POS_X2StarB010			0.3391* (0.014)
Boards select CEOs who were employed in more than one industry MAN_MULTI_IND_X2StarB010			-1.121* (0.562)

Building on criteria recommended by Wang et al. (2013), all the models were for goodness of fit, and identified that, for all patterns introduced in the model, t-values were below the threshold of 0.1, while for the all the others, below 2.0 in their absolute value.

* Indicates significant effect at Lambda = 2 The value of $\lambda = 2$ has been used here as an initial value as it has been proven to be
 ** Indicates significant effect at Lambda = 4 reasonable for many ERGM estimations; however, higher values contribute
 *** Indicates significant effect at Lambda = 6 convergence in the case of highly skewed degree distributions (Koskinen & Daraganova,
 2013; Robins et al., 2007)

occupy a brokerage position; by filling in structural holes (Burt, 2004), they play a key role in spreading their expertise across the boards they represent. Additionally, these findings also indicate that the network is characterized by the presence of board members who might have better structural and positional embeddedness in the network than others (Gilsing et al., 2016). A possible explanation

for this might be that some board members have specialized knowledge or a better reputation in the network than others, resulting in a higher likelihood of preferential attachments; this could further lead to receiving more nominations for selections than others.

Two parameters that capture the closure effect (ATA) and indirect connectivity ($A2PA$) (Robins *et al.*, 2009) were integrated into the model to measure the tendency to cluster. This positive and significant parameter demonstrates the configuration in which two supervisory board representatives who, by sharing a collaborative relation, tend to be engaged with the same multiple other members of the same or different supervisory boards. According to the model estimation, the network is characterized by tendencies towards within-level closure, rather than by indirect connectivity. This result shows that cooperative ties tend to form triangles, rather than random ties, which captures the complexity of dynamics in corporate networks. Triangles illustrate that ties tend to emerge not only between the focal supervisory board representative and the two others, but between the two others as well. This shows that the propensity for closure tie emergence is indicative of possible similarities between the two disconnected ones, which afterwards establish the relational tie to form further collaboration. The attribute effect is further elaborated in order to take a closer look at the popularity and closure mechanisms.

Results from the model estimation show that members of supervisory boards tend to collaborate with those others who have interactions both with multiple companies and, preferably, across multiple industries. Both tie and transitive triangle homophily effects are positive and significant. The significant attribute parameters illustrate that expertise gained with a single company or multiple companies belonging to the same industry do not make board members potentially attractive to corporate boards. In contrast, the findings indicate that corporate boards tend to establish collaborative ties with those supervisory board members who have diversified knowledge and experience across multiple companies and industries rather than those who have more specialized expertise (AICD, 2016). Also, this tendency towards diversification is found to be a driving force for both popularity and closure effects, as those supervisory board members are both more popular in the network and also have a higher propensity to establish relationships with others who are similar to them. This means that what drives the closure is, in fact, the similarity of diversified knowledge and experience among those who establish closure. To this end, it could be argued that the homophily effect is an underlying process that captures the network structuring effect at the supervisory board level of the network. Thus, such an indication provides sufficient evidence to support *H1*.

4.2.2. Structuring principle of board-top management networks

Following the same structure, the findings from the model of the supervisory board and executive directorship network is presented in this section. The baseline propensity for meso-level network tie formation was accordingly included in the model (X_{Edge}), and indicates the general tendency towards the emergence of ties between board members and top management in regard to the collaboration and selection process. Similarly, serving as the control mechanism, the negative and significant parameter indicates that top managers and board members rarely establish collaborative relations outside more complex structural patterns characterizing the network. Along with that, two additional cross-level activity parameters were included in the model and both concern the popularity effects as measures of centralization of nodes (X_{ASA} and X_{ASB}) from two opposite perspectives. Both popularity effects refer to the tendency for significantly active board members and supervisory board representatives to be present in a cross-network collaboration process. Both activity network parameters are positive and significant, which indicates that a meso-level network tends to interbreed activity effects both among boards towards managers and among top managers towards board members. These effects indicate that, on one hand, supervisory boards tend to find a particular special group of executive directors more attractive to collaborate with. At the same time, executive directors tend also to establish collaborative relations with those supervisory board members who are more central in the network.

Also, the clustering and closure effects are integrated into the meso-level network to identify whether executive directors are prone to be selected by those supervisory board members who mutually collaborate both within and across boards (interlocks), or the top-level collaboration between supervisory board representatives does not condition the emergence of a tie with executive directors. Both cross-level clustering X_{ACB} and closure $ATXAX$ effects were included, as they were considered mutually exclusive parameters. Contrary to the clustering effect in the model, which is negative and insignificant, the closure effect holds both positive and significant parameter values. This finding demonstrates that top-level collaborations impact selection and collaboration with the same other executives.

In addition to that, the model also tested whether collaboration is conditioned by the level of experience gained with multiple companies and industries. Attribute parameters showed insignificant company-related parameter values, while for the attribute related to multiple directorships at different companies, the parameter estimation is positive and significant. The findings here indicate that boards

of directors have preferences towards those executives who have experience gained in more than one company but within the same industry. These results extend what we know about board member selection and collaboration with executives, as it highlights and augments the importance of professionalism and specialized knowledge in a particular industry. Because supervisory boards are not particularly interested in those executives who were engaged by companies in different industries, but only within the industry knowledge, the findings here only partially support *Hypothesis 2a*, but provide significant input to the theory.

Lastly, the model tested whether or not supervisory board members tend to select those CEOs who also have experience across multiple companies and/or industries. The results demonstrate a clear tendency towards the selection of those CEOs who acquired expertise through affiliation with more companies belonging to different industries. Interestingly, both effects are positive and significant, which means that board selection of CEOs is rather centralized around those popular CEOs who have expertise acquired through their engagements with multiple industries. This evidence fully supports *Hypothesis 2b*.

5. Conclusion

This study attempted to estimate the presence of particular types of network configurations in corporate governance networks in order to explain the unfolding of social selection mechanisms in that context. The combination of selected network parameters and attribute effects corresponds well with the theoretical arguments used to build the hypotheses, and provides a good fit for the relation between theory and data. [While responding to Pettigrew's \(1992\) appeal that future research on structures of corporate boardrooms should put more emphasis on board behaviour to explain the implications for demography and structures, the intention behind this paper was to translate this call into the study and observe the characteristics of network structuring processes \(Pfeffer, 1983; Adams, 2017\).](#) The paper extended the scope of observation of board selection processes from in-board to cross-board structures in order to account for the interdependency of tie emergence at the cross-board and two-tier level.

In general, results show that both the supervisory board and the network's supervisory board and management parts evolve under mutually interdependent structuring principles. These findings are in line with Forbes and Milliken's (1999) general claim that studying board selection mechanisms can help clarify the complexity of board designs. The findings here indicate that the structuring processes of two-tier boards are equally important for understanding of the evolution of corporate governance

networks and should not be observed exclusively. This study shows that, under cross-network observation, board members distribute equally incentives to selection and collaboration with appropriate representatives in both tiers.

More specifically, the results reveal that representatives of the supervisory board tier have a tendency to select both popular supervisory board members and popular executive directors. This implies that prominence for selection is subject to the actual position of individuals in the overall corporate governance network in both tiers. That finding also supports the claim that, from a demographic perspective, the evolution and composition of corporate boards are not simple and direct, but rather complex and indirect (Daily and Schwenk, 1996; Johnson *et al.*, 1996; Zahra and Pearce, 1989; Darko *et al.*, 2016; Nordberg and Booth, 2019). In addition, these findings are in line with Smith *et al.* (1994), who argued that the structure of boards both directly and indirectly impacts companies' performance, and explains why it was appropriate to observe the networks that lie behind the structures, instead of structures in isolation from the networks (Zahra and Pearce, 1989; Johnson *et al.*, 1996; Daily and Schwenk, 1996). The study also reveals that complexity behind demographic structures is not only a matter of the structures themselves (such as popularity and closure), but is also indicative of the attributes held by the representatives in both tiers of the boards (Vinkenburg *et al.*, 2014; Beaty *et al.*, 2001; Zhang and Rajagopalan, 2004). This is in line with Williams and O'Reilly's (1998) assertion that demographic diversities on corporate boards are associated with a lower level of interpersonal attractions, confirming that preferential attachments tend to be driven by similar attributes shared on both sides of relational ties. The attribute effects demonstrate that, in general, supervisory and executive directorship structures are highly impacted both by the match of attributes between the actors forming the tie (supervisory board network) and by the preferences for particular types of attributes (supervisory-executive directorship network). Following the assertion that the homophily effect (McPherson *et al.*, 2001) does not only play a fundamental role in suppression of interpersonal conflicts, but is also an important determinant of in-group coherence, the results here accordingly demonstrate that similarities, in fact, guide social selection mechanisms at corporate boards (Forbes and Milliken, 1999; Treadwell, 2006; Kakabadse *et al.*, 2001; Giannetti and Zhao, 2016; Bernile *et al.*, 2018; O'Regan *et al.*, 2005; Ingley and van der Walt, 2003). More specifically, a supervisory board network is primarily driven by the match of expertise gained through multiple companies and industries. On the other hand, a supervisory-executive directorship network is, for the most part, driven by preferences for those executive directors who gained experience through multiple companies belonging to multiple industries, whereas the same rule does not guide

the preferential attachment towards CEOs, despite the fact that they also represent the executive staff. In contrast, boards tend to prefer engagements with CEOs who have experience gained from multiple companies but not multiple industries, which signifies that higher and more specialized knowledge is expected of CEOs rather than of the other representatives of the executive tier (Westphal, 1998; Elloumi and Gueyié, 2001).

It is crucial to note that, aside from a number of limitations, this paper provides several important contributions for both practitioners and researchers. On one hand, practitioners should, first and foremost, be aware that pursuing careers in either corporate boards or management requires higher visibility, which is achieved through dynamism, turnover and continuous exposure to different corporate environments. However, though the dynamics are recognized at both CEO and other executive directorship positions, particular care should be taken over exposure to different corporate environments when it comes to CEOs, as corporate boards have no particular interest in experience across different industries. On the other hand, this study contributes to what we know about the composition of corporate governance in different ways. First, it observes the network behind the structure, thus emphasizing the importance of seeing relations as both a theoretical concept and an empirical tool for understanding the development of aggregations of social actors. Second, the paper utilizes social network analysis methodology, particularly exponential random graph models (ERGMs), to underpin the theoretical argument that emergence of relational ties depends on both the presence and the absence of other ties in the network. Third, the study fills the gap in the literature as it integrates discussion of board-management selection processes together with supervisory-board selection processes, which to the author's knowledge has not yet been done. Lastly, this study analyses social selection processes at the cross-board instead of single-board level, thus highlighting the importance of arguing for the condition of interdependence as the main component in network structuring mechanisms.

The main limitations that should be addressed in future research are the following. First, the empirical results are based only on a sample of Danish public companies, and by excluding private companies, it might raise concerns of generalizability. Second, this study has a cross-sectional character, which does not allow network parameters related to network dynamics to be specified. Thus, it is not possible to argue how the corporate governance collaboration network changes over time. Future research should take up these challenges to further inspect network dynamics in both public and private contexts from a longitudinal perspective.

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