CHAPTER 4

Networks in Ownership and Management Structures

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4.1 Introduction

In general, a network is a system consisting of many similar parts that are connected together to allow movement or communication between or along the parts, or between the parts and a control center (Cambridge Dictionary, n.d). Networks can develop at several levels: individual (social network), organizational, cross-organizational (a system between organizations), and international. According to Castells (1996), a network is "that specific form of enterprise whose system of means is constituted by the intersection of segments of autonomous systems of goals" (p. 171), a definition that applies to all networks. But what is, overall, the role of networks? We may consider the action or the process of interaction with

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others in the service of exchanging information and developing professional or social contacts as a network's main function which can thus be defined as the act of generating or establishing a group of organizations with the aim of exchange, action, or production between the organization's members (Alter & Hage, 1993).

For the purposes of this overview, a network may be defined as a set of autonomous organizations which come together to attain goals that they cannot attain separately (Chisholm, 1998). Chisholm (1996) explains that the organizations/members belong to networks in order to be able to handle the meta-problems that lie behind many problems and understanding which is essential to finding a solution. In terms of systems theory, an individual organization's commitment to a higher aim or goal, is considered to affect the entire system. The network is thought of as an organizational innovation apt to be quickly adopted because it offers a competitive advantage (Alter & Hage, 1993; Jarillo, 1993). Networks are not characterized by centralized power but, rather, they are by definition decentralized forms of organization (Chisholm, 1998), structured usually horizontally, and not vertically. At the same time, they contribute to the distribution of labor among the contracting parties (Alter & Hage, 1993), thus ensuring the valuable contribution of each member, as well as creating interdependent relationships.

The bibliography concerning the study of networks covers a wide range of scientific fields, including, among others, sociology, the political and administrative sciences, information and systems science, biology, et al. In this case, we look to the bibliography concerning the application of networks to the field of economics, i.e., corporate networks and, especially, those created and developed between companies through board and ownership interlocks.[1] Corporate networks of this kind are not a novel phenomenon. They appeared during the Second Industrial Revolution and the creation of modern corporations, and they were analyzed since the end of the nineteenth century, with the academic community and governments initially focusing on the danger implicit in the strength

[1] Corporate networks may assume many forms such as, for instance, the interconnections formed between organizations by means of trade (Wilhite, 2001), inter-organization loaning (Battiston et al., 2016), or the relationships with the suppliers (Choi &Wu, 2009).

and power corporations assumed due to their size (trusts) and the elimination of completion which this entailed (David & Westerhuis, 2014). At the center of such considerations was also the crucial role of financial institutions in the formation of corporate networks (Hilferding, 1910; Jeidels, 1905).

So, then, the present chapter initially focuses on corporate networks as smallworlds (Sect. 4.2). Next (Sect. 4.3), we focus on the bibliography relating to board interlocks as a crucial form of corporate networks. In Sect. 4.4, we look at the connection between companies that assumes the form of ownership interlocks, also known as ownership networks. In Sect. 4.5, reference is made to the institutional environment and how it affects the interlocking behavior of companies. In the sequel (Sect. 4.6), there is specific reference to the empirical studies concerning Greek enterprises. Finally, in Sect. 4.7, the challenges for future research are presented, which relate to ownership and board interlocks.

4.2 Corporate Networks as Small-Worlds

Since the 1960s, technical developments, particularly the development of graph theory,[2] have allowed for the better modeling and visual rendering of the relationships and bonds which develop in corporate networks. More recent developments in computer graphics have introduced new techniques for the exploration of networks with a complex structure. Corporate networks created through board- or ownership interlocks have been extensively treated in the bibliography as graphs comprised by a set of elements: nodes, otherwise known as vertices—usually the corporations—and the edges[3]—usually the directors or owners—which make for a link[4] connecting two nodes. Certainly, both directors and owners may be considered as a type of node, while a link may signify different types of relationships.

[2] In mathematics, graph theory is the study of graphs, i.e., mathematical structures used to produce models of the relationships between objects.

[3] A node's linked part is that part of the graph comprised by the node itself and all the other nodes that it may reach through paths delineated along the edges. The distance between two nodes is the number of edges connecting them, while the shortest path connecting two nodes (in the sense of crossing the fewest edges) is known as geodesic.

[4] When the links approach the maximum number of connections between the nodes, then the network is designated as thick, otherwise as sparse.

The analysis of social networks constitutes a crucial methodology for the analysis of the relationships between the actors (Burt, 1992). Inside the social network that is structured as a graph, certain nodes (companies or individuals) may exert a stronger influence or have higher status, data which can be measured by certain indicators of the centrality[5] of the node's position. This has attracted wide research interest (Larcker et al., 2013; Mariolis & Jones, 1982; Pfeffer & Salancik, 1978; Takes & Heemskerk, 2016) mostly in investigating the powerful or, at least, advantageous position of an organization inside the network or the correlation between the position of an organization inside the network and its performance, without, however, this being considered as always positive (Andres et al., 2013).

Corporate networks as graphs develop in formations and patterns (clique, pyramid, star, circle, et al.) that may differ from country to country, implying a different structure and relationship between the organizations inside the network (Windolf & Beyer, 1996). Due to the fact that cliques are subgraphs where every node is connected to every other node (full connectivity), it comes as no surprise that there are many approaches/methods of community detection in corporate networks, based on the investigation of cliques (Heemskerk & Takes, 2016; Piccardi et al., 2010; Vitali & Battiston, 2014), as more information is thus available at the topical level of connections.

In the research of boards and corporate interlocks, the network is mostly made up of one type of node, corporations, which are linked by one type of connection, the directors who sit on two or more boards (Bizjak et al., 2009; Davis, 1991; Edling & Sandell, 2001; Haunschild, 1993). The network consisting of one type of node (corporations, or their owners in the case of ownership interlocks) is called 1-mode network or unipartite graph. Insofar as the interlocks may be due to the corporations' strategy, this appears normal. However, this is not the only possible mapping of the interconnections. Another possible network transformation is if it is approached as a network of directors (or owners in the case

[5] Such indicators are, the degree of centrality, closeness of centrality, betweenness centrality, and eigen vector centrality. The first concerns the sum total of tips that are connected inside a node; the second, the average length of the smallest route between the node and all the other nodes in the graph; the third defines the times when a node operates as a bridge along the shortest route between two other nodes; and the last one measures a node's influence in the network, defined by the value of the nodes to which it is connected.

of ownership interlocks) who are linked via the organizations (Battiston & Catanzaro, 2004; Burris, 2005; Carroll, 2004; Davis et al., 2003). In all cases, however, the unipartite graph cannot fully account for the complex ties that develop simultaneously among the companies and those among the directors or owners.

Moreover, it is possible to analyze the network as a graph made up by both directors (or owners) and a company as nodes[6] (Newman et al., 2001; Robins & Alexander, 2004; Wang et al., 2009), with the connection between a director and a corporation meaning that the director is a board member of that particular company. A network with two different types of nodes is called a 2-mode network or bipartite graph.[7] A network's downgrade, in terms of the approach to it, from 2-mode to 1-mode, always implies a loss of information (Bohman, 2012). In this case also, the connections are generated between nodes of different types. The analysis of the three levels is more complex but provides additional information about the relationships that evolve within the network.

A particular type of mathematical graph is the small-world network which possesses certain attributes.[8] The small-world may be considered as a social network where many dense grids of actors are characterized by relationships that operate as conduits of control and information

[6] In the mathematical field of graph theory, this constitutes a bipartite graph whose vertices can be divided into two separate and independent sets so that each edge connects a summit of one set with a summit of the other.

[7] In this type of network, the connections are generated always between nodes of a different type, but it is also possible, through the analysis of two distinctive unipartite graphs, to more fully depict the ties that develop inside the network: between corporations, or between directors (or owners) but also between the two.

[8] The two main qualities that characterize a small-world, according to the Watts-Strogatz model (Watts & Strogatz, 1998), which is a specific category of small-world networks of random graphs, are the concepts of the mean path length—which is to say randomly selected pairs of nodes that turn out to be unexpectedly close to one another—and high clustering—the tendency for nodes of the network to be in the same "neighborhood". By contrast, according to the Erdős-Rényi model (Erdos & Renyi, 1959), the Poisson random graphs show a small index of clustering—inconsistent with the observed real social networks (Watts & Strogatz, 1998).

(Milgram, 1967; White, 1970).[9] As, for instance, from people's friendship relationships at the micro-level of a social system, we are able to observe a small-world structure at the (macro) level of a social system (Watts & Strogatz, 1998), so have corporate networks been extensively analyzed in the bibliography as small-world networks in relation to the sum total of the corporate large-world. In such a network, a relatively large number of organizations can be connected to others through a small number of ties. Many studies in the recent bibliography of board and ownership interlocks investigate whether corporate networks meet the small-world requirements (Davis et al., 2003; Heemskerk & Takes, 2016; Kogut &Walker, 2001; Robins & Alexander, 2004). These studies are usually empirical and their analysis covers specific geographical parameters. The study by Kogut and Walker (2001) of German corporations was the first to introduce a topological analysis of ownership networks.

4.3 Board Interlocks and Corporate Networks

Corporate networks assuming the form of board interlocks, otherwise known [as] interlocking directorate or overlapping directorships, have monopolized research interest on the networking of companies. At all events, interconnected directors in the United States (US) are an established practice of companies listed at the stock exchange, since the beginning of the twentieth century (Mizruchi, 1982), and globally, too, this is the rule rather than the exception among big companies (Davis & Greve, 1997). The bibliography on the use of corporate interconnections starts at the beginning of the past century, flourishes in the 1970s and 1980s and further intensifies in the 1990s (Mizruchi, 1996), and continues to the present with renewed impetus, provided by further developments in graph theory at the beginning of 2000s.

Alongside the increased interest, the criticism leveled at this research has also intensified. The main objections center on the inability of the analysis of corporate interconnections to predict corporate behavior

[9] Renowned psychologist Stanley Milgram (1933–1984) was the first to analyze the issue of the small-world (Milgram, 1967) through the mean number of connections between two individuals randomly selected from a population. From this research, the idea emerged that any two people (in the United States) could be connected through a chain of six contacts (at an average). An important offshoot of this work is the investigation of several sets of random graphs (Newman et al., 2001).

and correlate those ties with corporate performance, or even record the complexity and composition of the corporate interlock networks (Mizruchi, 1996; Zajac, 1988).

Nonetheless, despite such criticism, interlocks remain a powerful indicator of the interrelationships between companies (Mizruchi, 1996). Although in the United States, the anti-monopoly legislation of 1914 (Clayton Antitrust Act) forbids board interlocks between companies in the same sector (Fennema & Schijf, 1978)—as this would mean a potential alliance, especially among the larger organizations and, hence, a violation of anti-monopoly legislation—at least one in eight of overlapping directorships in the United States is between companies that are supposed to be in competition (Wardrip-Fruin & Montfort, 2003, p. 480).

Board interlocks can efficiently interconnect unconnected companies (Kang, 2008), leading to inter-corporate ties via the creation of social networks. Hallock (1997) points out that the prevalence of such ties is too pronounced to be accidental and probably reflects essential mechanisms of organization. One reason why interconnections between boards are so popular, is that they represent a reliable and low-cost conduit of information and communication between companies (Haunschild, 1993).

We have board interlocks when a member of a company's directorial board also sits on another board, or several (Mizruchi, 1996; Pennings, 1980). They are thus defined in their simplest form, as the relationship created between two boards when they share at least one member, with the network of those relationships (board interlocking network) comprising the total of the companies' boards, along with all the existing interconnections entailed therein (Mizruchi, 1996). Two companies have an immediate interconnection (direct interlock) if a member of the directorial board of one simultaneously sits on the directorial board of the other, and indirect interconnection (indirect interlock) if at least one member on the directorial board of each company sits on the board of a third (Green & Semple, 1981; Salinger, 2005). Although this distinction is not commonly made in the bibliography, indirect interconnection may be an even more important form of connection which, moreover, does not fall under the legal restrictions that apply to direct interconnection (Green & Semple, 1981).

What is it, however, that has caused the prevalence of board interlocks and what is their role? There have been a number of explanations as to the reasons for the emergence and spread of the phenomenon, as there have been attempts to analyze its implications beyond the economic realm, at a political and social level. Bibliography on board interlocks is now fragmented, as it draws from several scientific disciplines and uses a variety of theoretical perspectives without a unified understanding of how the finds of the bibliography fit together.

The first unified approach is by Mizruchi (1996) and, as he explains, a central issue in the research on the interconnections of corporations has been and continues to be, what interconnections do. Mizruchi (1996) distinguishes five basic determining factors which explain the formation of board interlocks: collusion, cooptation and monitoring, legitimacy, career advancement, and social cohesion. These factors (see below) have prevailed in the explanations offered in the bibliography on the emergence of the phenomenon. Additionally, a frequent distinction in the bibliography is between the factors responsible for the formation of board interlocks into those concerning the companies' activity or pursuit and those concerning the behavior or motives of the individuals-directors.

As an initial approach, the inaugural theories (Dooley, 1969; Hilferding, 1910; Jeidels, 1905) argued that it was the banks' pivotal position in the financial system that led to the creation of such ties between financial institutions and companies. Financial institutions exerted influence on non-financial institutions aiming to control them, which created relationships of power and interdependency. Besides, companies with great capital requirements tend to interconnect with banks (Mizruchi & Stearns, 1988; Pfeffer, 1972), while financial institutions try to get a representative on a company's board so as to better monitor the company's financial state of affairs (Eisenhardt, 1989; Mizruchi, 1982). Dooley (1969) ascertains that five distinct factors are responsible for the appearance of board interlocks: (1) the size of the company, (2) the extent of control by the management, (3) the company's financial connections, (4) the relationship with the competitors, and (5) the presence of topical financial interests.

A large part of the relevant bibliography interprets board interlocks as attempts at inter-corporate control and supervision (Allen, 1974, 1978; Burt, 1983; Gulati & Westphal, 1999; Kotz, 1978; Mizruchi, 1982; Zeitlin, 1974). The interconnections in this case result from companies wishing to gain control over others by accessing positions in their directorial boards, though with unsound corporate governance and collusion

as possible consequences. A more positive version of the control theory is that companies strive for control through collaboration, and interlocks are merely manifestations of the companies' interdependency (Pfeffer & Salancik, 1978). These are seen as non-competitive interactions, beneficial to all parties involved. Within this analytic framework, the corporate elite promotes cooptation, and interlocks represent companies' attempts to predict unexpected events in their environment and consolidate their relationship with other companies (Allen, 1974). Nevertheless, the inability to locate dense networks in many cases (Scott, 1997) weakened the argument for coordinated action, favoring alternative interpretations of the phenomenon of board interlocks (Useem, 1984).

Thus, through a wide range of analysis, it has been suggested in the bibliography that board interlocks are created because they contribute to a social structure that supports the cohesion of the corporate elite (Chu & Davis, 2016; Heemskerk & Takes, 2016; Palmer, 1983; Useem, 1982; Zeitlin, 1974). The directors frequently come from higher social classes, having similar educational backgrounds and shared channels of contacts, resulting in the creation of a social "inner circle". In this context, ties between companies may be interpreted in terms of the existence of a hegemonic class (Koenig & Gogel, 1981), the social class approach (Ornstein, 1984) or, also, the directors' social affinity (Yue, 2012) and the theory of social networks (Bohman, 2006, 2012).

Another frequently addressed matter concerning directors' motives that is thought to account for the interconnections of directorial boards, has to do with the prospects of professional advancement and the benefits (higher salary and status) these ties can offer to directors (Westphal & Stern, 2006) and managing directors (Kramarz & Thesmar, 2013). These interconnections work to signal the extensive networks of some directors, leading to higher social capital, and offering them greater flexibility and access (Johnson et al., 2011). This may be explained for by the fact that well-connected directors have a great many conduits for disseminating information and exercising control (Coleman, 1990), thus availing themselves of the opportunity to connect companies which could not otherwise be connected (Burt, 1992).

Thus, board interlocks are considered beneficial as the interconnected members carry their experience to other companies that are called on to make similar decisions (Davis, 1996), and provide valuable information for the consideration of other managing directors (Lorsch & Maclver, 1989; Useem, 1984). The motive for incorporating someone

who belongs to the directorial board of another company, may also have to do with the person's special traits and abilities (their human capital) which, however, does not have a direct bearing on the company itself. In general, a great part of the relevant bibliography argues that board interlocks help the interconnected companies overcome their dependency on resources (resource dependence theory) through formulating a set of strategies (Burt, 1978; Hillman et al., 2009; Ong et al., 2003; Shrader et al., 1991; Simoni & Caiazza, 2012). Those managing the company are motivated to ensure its survival and reinforce their own autonomy, while maintaining stability in the organization's transactions (Pfeffer & Salancik, 1978).

Moreover, board interlocks are useful as the company's quality signaling, highlighting its position in its environment (Certo, 2003; Connelly et al., 2011; Kang, 2008) and aiding in the better dissemination of the company's reputation, both positive (Certo, 2003) and negative (Kang, 2008). If a company becomes interconnected with another of "good" reputation, it sends out a signal of high quality to interested parties (such as stock holders and investors) who are assessing it, thus taking advantage of a spillover effect due to the board interlocks.

Beyond the companies' motives for connecting through board interlocks, research interest has also focused on the impact these ties have on companies. Many previous studies have shown that these actions help interconnected companies to manage the uncertainty in their environment (Martin et al., 2015; Mizruchi & Stearns, 1988; Ong et al., 2003; Shrader et al., 1991; Stearns & Mizruchi, 1986; Useem, 1984), while also making available information which would not otherwise be accessible (Haunschild & Beckman, 1998). When companies operate in conditions of high uncertainty, they often perform better if they have developed more board interlocks (Boyd, 1990). These ties reduce uncertainty because they improve access to higher up channels of information and communication (Hillman et al., 1999). Useem (1984) argues that the greater a company's centrality is in the network, the more access to information it has.

At the same time, board interlocks are thought to allow the dissemination of new practices of corporate governance (Davis, 1991; Larcker et al., 2013; Palmer et al., 1993; Shropshire, 2010; Tuschke et al., 2014), while they may also facilitate strategic choices such as alliances, merges and buy-outs or the listing of companies in the stock exchange (Gulati & Westphal, 1999; Moore et al., 2012; Rousseau & Stroup, 2015). Davis

(1991) has shown that the network of interconnections can contribute to the process of a company's strategic defense against threats of a buy-out (poison pills). At the same time, however, buy-outs and mergers can disseminate inside the network through mimetic practices (Haunschild, 1993). Mimetic behaviors inside the network are more likely to occur when there is a high level of uncertainty and ambiguity and there is a dearth of alternative sources of information (Haunschild & Beckman, 1998).

As a result of the above factors, board interlocks have real consequences and are capable of affecting the performance and behavior of the interconnected companies (Beckman & Haunschild, 2002; Cai & Sevilir, 2012; Haniffa & Hudaib, 2006; Harris & Shimizu, 2004). The acquisition of the necessary resources and information operates as a basis for this to occur (Davis & Cobb, 2010). Interconnections of this type, aided by the process of learning and dissemination (Davis & Cobb, 2010; Hillman et al., 2009), boost research and growth, thus improving the performance of companies (Davis, 1991; Gronum et al., 2012). Moreover, the interconnections of directorial boards facilitate access to capital (Stearns & Mizruchi, 1993) and a company's loaning (Mizruchi, 1996), as well as the formation of corporate alliances (Gulati & Westphal, 1999), aspects that bolster the company's position. Nevertheless, certain studies indicate that board interlocks may also be related to a decline in performance (Fligstein & Brantley, 1992; Stokman et al., 1985). The negative correlation between the ties of directorial boards and companies' performance may be explained by the fact that the connected members may be loyal to their social circle (elite) rather than their corporate boards, with the result that they are more interested in social cohesion rather than financial outcomes (Burris, 2005), or that occupying multiple positions on a number of directorial boards may adversely affect their efficacy in tending to the company's management (Andres et al., 2013; Harris & Shimizu, 2004).

4.4 Corporate Networks of Interlocking Ownership

A significant part of the bibliography has focused on the other type of interconnection between companies that we are looking at, namely, ownership interlocks, otherwise known as ownership networks. Ownership interrelatedness, in its simplest form, creates a network where two

companies are connected if one owns a certain percentage of the other (Vitali & Battiston, 2014; Vitali et al., 2011). This type of connection between companies has proven extremely important in, among others, understanding corporate control and flows of value globally (Glattfelder & Battiston, 2009; Vitali et al., 2011). Another possibility is the ownership bond due to the connection between two companies by means of the same owner (indirect connection) with, generally, companies also able to connect through more than one owner.

Stockholders in a company may be entities that cannot belong to others (e.g., natural persons, families, associations, and public agencies) or other companies. Thus, a distinction is made between primary owners (individuals) and secondary owners (companies). Direct ownership in a sector can be easily ascertained from the records of the distribution of shareholding, however, due to cross-shareholding,[10] the true ownership structure may be hidden behind a composite or not readily visible network of indirect relationships and interdependent owners. This scenario concerns forms of indirect ownership, i.e., ownership through another entity (company) which generate indirect interests among shareholders, whether these are individuals or companies.[11]

These composite structures of ownership form patterns of corporate networks (Almeida & Wolfenzon, 2006; Rungi et al., 2017; Wolfenzon, 1999) and their analysis bears on a wide range of issues, such as, for instance, patterns that relate to companies' tax evasion (Richardson et al., 2016). According to Levy and Szafarz (2016), there are four reasons which can motivate the existence of composite ownership systems: (1) the boosting of cooperation between companies which own one another, (2) a silent alliance and the increase of market power, (3) the attraction of external stock holders, and (4) corporate control which can be beneficial, although at the expense of the minority of stockholders (tunneling).

Although a great many studies exist of ownership structures, a comparatively small number focus on indirect ownership or issues to do with cross-partnerships. In the bibliography, indirect ownership has been

[10] These concerns ownership structures such as pyramid shareholding, one-sided shareholding, reciprocal shareholding, and cyclical shareholding.

[11] As a simple example of composite ownership structure, individual A owns part of the stocks of Company B, which is also the part owner of Company C. Even though A is not a shareholder of (so not directly interested in) Company C, he is an indirect "owner" and, thus, benefits from its revenue because of Company B.

linked to great benefit for the shareholders (Dietzenbacher et al., 2000; Flath, 1992, 1993). Nevertheless, the connection is not necessarily positive for the performance indices of the connected companies, with empirical outcomes being usually dubious or contradictory (Flath, 1993; Lichtenberg & Pushner, 1994; Morck et al., 2000; Yafeh & Yosha, 2003), which is also the case for the impact of composite ownership structures on the remunerations of managing directors (Allen, 1981).

Ownership networks have also been studied to ascertain the transmission of economic distress from one or more companies to the network (financial contagion effect) and the consequent ramifications (Bardoscia et al., 2017; Dastkhan & Gharneh, 2019; Elliott et al., 2014). In addition, ownership links have proven decisive in locating offshore fiscal hubs (Garcia-Bernardo et al., 2017; Rungi et al., 2017) or for the ability of multinational companies, due to the centrality of their place in the network, to affect public policy (Compston, 2013). More generally, the position of a crucial company in the network, is an indicator of the influence it may exert on restructuring practices (such as buy-outs and mergers) inside the network (Kogut & Walker, 2001).

Cross-shareholdings can potentially lead to silent collusions with the aim of increasing the power of companies (O'Brien & Salop, 2000). Companies may have reduced motives for competition due to ownership ties, resulting in high prices and low production (Azar et al., 2018). Research shows that this is dependent on the sector's structure and that, though such practices do exist in companies related by ownership, they are not necessarily the rational choice (Alley, 1997; Gilo et al., 2006; Reitman, 1994).

In studying the architecture of the global ownership network, Vitali et al. (2011) attempt to gather and process all the observable structures of ownership around the world, using the concepts of composite networks. The research shows that the main part of the existing ownership and (flows of) value in global markets is monopolized by a small group of shareholders, with the centralization of control resulting in the formation of many "hyper-entities" which control the largest part of companies worldwide, thus raising issues of financial stability and competition at a global level.

The fact that the control of companies is dispersed among many shareholders, particularly in Anglo-Saxon countries, makes it look like that there is a crowd of shareholders owning a small number of stocks in some companies. By contrast to this impression, however, Glattfelder and

Battiston (2009), looking at the stock markets of 48 countries, show that through composite ownership networks, a local distribution of control is linked to a global concentration of control and input—a fact which had not been systematically addressed previously. In a larger sample, Rungi et al. (2017) examine the patterns formed by ownership networks in 208 countries and come across a high concentration of corporate power, as less than 1% of the parent companies—which have over 100 subsidiary companies—are responsible for more than 50% of sales globally.

The ties of shared ownership are a particular kind of inter-corporate relationships and indubitably represent a vested interest in having a say in the control of company decisions. Nevertheless, only a small portion of the bibliography includes ownership networks in its study of areas relating to corporate control, its flow (Battiston, 2004; Chapelle & Szafarz, 2005; Davallou et al., 2015; Dorofeenko et al., 2007; Glattfelder & Battiston, 2009) and concentration (Brancaccio et al., 2018; Vitali et al., 2011). Games theory has been used as a method for analyzing the quantification of corporate control through voting systems, though this is a fairly heterogeneous body of research, differing in both their aims and their field of analysis (Aminadav et al., 2011; Karos & Peters, 2015; Levy, 2009; Levy & Szafarz, 2016; Rungi et al., 2017).

By contrast, the demarcation between ownership and company control is a frequent subject of analysis in the bibliography on composite ownership networks (Ben-Nasr et al., 2015, Claessens et al., 2000; Laeven & Levine, 2008; Lemma & Negash, 2016; Lingmin, 2016; Napoli, 2018; Paligorova & Xu, 2012). By and large, the above studies concern statistical approaches and their main contribution consists in the introduction of a rule aiming to demarcate ownership from rights to control (Claessens et al., 2000), the so-called weakest link principle[12] which, however, has disadvantages and limitations (Dietzenbacher & Temurshoev, 2008). Because of cross-shareholdings and the ownership patterns that emerge (such as pyramids) the rights to control (vote) many times exceed the rights of the dividends (Claessens et al., 2000; La Porta et al., 1999). More recently, problems relating to ownership networks and issues of control have been methodologically approached through some models of optimization (Di Giacomo & Cenci, 2018; Martins & Neves, 2017; Romei et al., 2015).

[12] This rule can be summed as follows: if company A owns 10% of company B's shares and company B owns 20% of company C, then, company A controls 2% of company C.

4.5 Institutional Environment and Comparative Study

Because research on ownership and board interlocks limits itself to the interconnections that develop at a national level and/or the analysis of a small time period, it enhances our understanding only partially, due to each country's particular characteristics, and the change occurring in networks over more long-term periods. Any comparative studies of corporate networks between countries only concern small time periods while studies concerning the long-term development of corporate networks focus at the national level.

The first full and systematic cross-country comparative study is by Stokman al. (1985). Their book focuses on corporate interconnections between the 200 largest companies in 10 Western European countries and explores company interconnections across countries and their effects on company performance, highlighting structural differences between countries. Scott (1991) was among the first to explain that differences in the countries' structural background that are due to cultural and historical factors that can lead to a different structure and development of corporate networks, making a distinction between Great Britain and the United States, and between mainland Europe and Asian countries.

Institutional divergence and differences in ideological and economic background influence the pattern and distribution of ownership ties among the largest companies, shaping different corporate bonds in different countries. For example, in the United States a negative attitude toward large companies has led to aggressive restrictions in the ability of financial institutions and organizations to control public companies (Fligstein, 1990), while, at the same time, as also happens in Great Britain, pension funds, mutual trusts and distinct individual shareholders are the main owners of large companies (Useem, 1996). By contrast, in Germany, banks and large companies have prevailed as owners of large enterprises (Jurgens et al., 2000).

The presence of powerful institutions affects corporate structuring. Rungi et al. (2017) correlate decisions of strategic inter-corporate control with the institutional environment. Among other things, they show that the pyramidal structures of ownership networks that operate as channels of control at a global level, are less likely to develop in countries with powerful economic institutions and a staunch adherence to contracts as these reinforce more transparent forms of corporate governance.

Franks and Mayer (1997) locate two ownership structures, internal and external systems, on the basis of which, US and British companies are distinguished from French and German ones. An internal system entails certain small companies listed in the stock market, which are characterized by a few interactions and represent a complex corporate ownership network. By contrast, an external system involves many large companies in the stock market, with more interaction between the companies but less ownership ties. The research outcomes indicate that French and German companies mainly follow the ownership structure of the internal system, while US and British ones, that of the external system.

Windolf and Beyer (1996), studying the corporate networks formed by ownership and board interlocks in the 623 largest companies of Germany and the 520 largest companies of Britain, conclude that Germany reflects a system of "cooperative capitalism", while Britain is an instance of "competitive capitalism". In Germany, by contrast to Britain: (1) ownership (stocks) is particularly concentrated, allowing owners to dominate the company; (2) the network of board interlocks is closely tied to the capital network, i.e., serves the reinforcement of the owners' power; and (3) both networks are amassed within the same sector (horizontal interconnections), i.e., connections between competitors are very likely.

Following the distinction between "varieties of capitalism" made byHall and Soskice (2001),[13] van Veen and Kratzer (2011) focus on the structural aspects of board interlocks between fifteen European countries (see Sect. 4.6). Their results show great quantitative differences in the network's denseness within the countries closely associated with the prevalent capitalist system in each country, whereas at the level of a European network, the countries occupy completely different positions. This happens because a country's international position depends significantly on the network's structure and the duration of the country's membership in the EU (van Veen & Kratzer, 2011).

[13] The distinction concerns liberal market economies (LME) versus the coordinated market economies (CME). In LME, companies plan their activities mainly based on markets and hierarchies, while in CME, they are more dependent on the relationships outside the market. Also, in LME, companies turn to financial markets for investment capital and, as a result, transparency is important and stock prices are a primary criterion of company performance. By contrast, in CME, companies are funded by debt and banks play an important role, while there are close-knit ties between banks and industrial companies. In this case, reputation and trust, rather the price of stocks, are important criteria of company performance.

Research into corporate networks has nevertheless shown that the categorization of countries isn't straightforward. Kogut (2012) has shown that the dichotomy between the free market and the coordinated market economies is rather blurred. By collecting data to do with ownership and board interlocks on 22 countries around the world, he found among others, that there are significant differences between the Anglo-Saxon countries (the United States, Great Britain, and Canada) while, behind these differences, certain continuities persist, such as the adherence of small-world attributes to corporate networks (Kogut, 2012).

Using data from 2005 on the corporate networks in 12 countries, Cardenas (2012) contributes another distinction to the one concerning the varieties of capitalism, one which is based on the joint influence of the financial system, state intervention, ownership structure, and the globalization of the creation of corporate networks in every country (Cardenas, 2012, pp. 315–316). Classifying the countries in two groups, corporate networks in the first group may be described as cohesive: the power structure is located in unity, concentration, and control. The cohesive network in Italy, France, Germany, and Spain is consistently explained by the combination of the economy structure which is centered around banks, the interventionist state, the concentrated ownership, and the small financial internationalization. The networks of the second group of countries (Canada, Australia, Switzerland, the United States, and Great Britain) are described as dispersed, as they are fragmented, decentralized, and with more unified ties due to the combination of non-interventionist state, the market-centered structure of the economy and decentralized ownership.

Collecting data from the largest companies in 208 countries, Heemskerk and Takes (2016) examine the topological attributes of a global corporate network—made of 968,409 companies interconnected through board interlocks—in which are included all personal interconnections, both at the level of tip management and directorial boards. The detection of community reveals that peripheral clusters play a fundamental part in the architecture of the network of global political economy. The article shows that transatlantic connections remain particularly powerful: Europe and North America remain interconnected through a dense network of members sitting on the same boards, while a separate Asian cluster—geographically isolated—is developing and gaining economic and political power, although Asia by and large remains outside the field of networks of the established global (i.e., Northern Atlantic) corporate elite.

4.6 Application to Greek Companies

As we conclude the survey of the bibliography, it is worth noting that research on the formation of corporate networks, structured by the ownership and board interlocks of Greek companies, is fairly limited, with the four cases identified below presented in chronological order of publication.

Using a historical approach to the analysis of social networks, Dritsas et al. (1996) compare three small economies of the interwar period, Austria, Greece, and Sweden and, specifically, the structure and defining factors of the formation of board interlocks and the place (centrality) of the banks in each country's corporate network. With 1938 as the reference year, they use data on Greece mainly available from the Bank of Greece on corporate unions, budgets, and the composition of directorial boards and, also, from the press of the Athens Stock Exchange, the government gazette, and the posts of the association of member companies, with the sample consisting of 52 companies (large companies in operation for at least 15 years) including nine banks and two insurance companies. Their findings on Greece show that the interconnections of the boards, though not as pronounced as in other European countries, concerned 38 companies which, in the interwar period, had developed ties with at least one other company. The ten more central companies in the network were connected to another nine, while the highest degree of centrality belonged to Chemical Products and Fertilizers Ltd. Three of the large banks, the Commercial Bank, the Ionian and Popular Bank, and the National Bank of Greece, were among the ten most central companies with their boards connected both with industrial companies as well as among themselves.

In a sample of the 27 richest economies (with high stock exchange values) on the basis of the per capita income for 1993, La Porta et al. (1999) utilize data (mainly from the World Scope database) on ownership structures aiming to define the ultimate stock owners of the companies with high capitalization. They find that, aside from the economies with very effective protection of the stock holders, relatively few companies in the sample possess a wide range of ownership. On the contrary, they are usually controlled by families or the state. The owners also

usually have control rights over the companies that significantly exceed cash flow rights, mainly through pyramidal structures and participation in management. The data for the Greek ownership structures (deriving primarily from Bloomberg Financial Systems) indicate that the large Greek companies are characterized by a very small dissemination of company control.

The most thorough approach to corporate networks which include Greek companies is found in the article by van Veen and Kratzer (2011). They investigate the structural aspects of board interconnections in the 15 countries that joined the European Union (EU) during the first four waves of accession (EU-15), showing the differences between the countries. The analysis is based on graph theory and in particular, the use of the degree of centrality and the concept of network density in order to highlight the companies' position in the network (at a local and global level) and the networking of board members. The sample selection, with a different number of companies in every country, refers to the year 2006 (January 1st) and was based on large and usually multinational companies in the stock exchange—362 in number, with 20 Greek ones among them—with financial capitalization as a basic choice criterion, while the data concerning the board members—6,115 positions in total, out of which 256 concern Greek companies—were mainly drawn from the annual corporate reports. The collection of additional data was made through other sources on the web, while complementary data was drawn from "Google Finance" (finance.google.com), "Zoom Info" (www.zoominfo.com), and "Top Management" (www.topmanagement.net).

The findings show great quantitative differences in network density outside the countries (van Veen & Kratzer, 2011). These differences are significantly related to the "variety of capitalism" (Hall & Soskice, 2001) prevalent in each country. Also, the cross-country analysis of corporate ties reveals a European network inside which the different countries occupy a completely different place while, as was mentioned, a country's international position closely correlates to the duration of its EU membership. Specifically, for the (20) Greek companies, the findings show a low network density, as they show the least number (after Portugal) of interconnections globally (14 out of a total of 1132, with 246 interconnections of the 38 French companies being the largest number) but also

locally, after Luxembourg and Portugal (12 connections out of a total of 688, with the greatest number, 145 connections, once more being to the 38 French companies). As a consequence, they are also characterized by a small degree of centrality in the European network (two connections with European companies out of a total of 444 connections, 101 of those by French companies). Another interesting finding is that the board members of Greek companies have positions on up to two boards simultaneously, with the largest percentage (93.8%) corresponding to only one.[14]

The study by Pastra et al. (2015) concerns another case where a more general analysis is made of the structure and characteristics of corporate boards in Greek shipping, without, however, focusing on the corporate networks that form in the industry, while emphasis is given to the (significantly low) percentage of women therein and the concomitant benefits of their presence. Nevertheless, drawing data from the Athens Stock Exchange for the shipping industry for the period 2002–2012, Pastra et al. (2015) found 305 board formations, with 84 of those numbering a total of 38 members with positions on two or more boards of listed companies. 30 out of those 38 (78.9%) held positions simultaneously on two different boards and eight (21.1%) respectively on three.

Finally, in the most recent research on networks that include Greek companies, Andrikopoulos et al. (2019), on the basis of data from Bloomberg's webpage on board members and key executives, use graph theory to find out the key nodes in the network of personal and corporate interconnections in a sample of 110 shipping companies, listed in the stock market, 10 of which were based in Greece. The study involves looking into the social networks that had formed—in a specified period—by means of the ties developed simultaneously by the leadership interlocks and the board interlocks in the shipping industry, the econometric appraisal of the factors determining those interconnections (company size, board size, profitability, and leverage), and the effects of the leadership interlocks on agent conflicts. The research findings indicate that the network of leaderships is denser than that of companies, that interconnections of directorial boards have a positive effect on profit and

[14] The most characteristic case of "big linker" is that of the German Cromme G. who has a position on the boards of nine companies simultaneously.

leadership interlocks have a negative effect on internal costs that occur due to the competitive interests of shareholders (agency costs).

4.7 Further Research

A literature review highlights the existence of a narrow research sample, as most of the published research on corporate networks of the form that concerns us is geographically focused on the United States. An even greater gap in the bibliography of board interlocks has to do with the investigation of international board interlocks, i.e., interconnected companies located in different countries. These types of interconnections have attracted next to no academic interest despite indications that they may actually be the most prevalent (Staples, 2007). For instance, Staples (2007) ascertained that in 2005, 75% of the 80 largest international companies had non-nationals sitting on their boards. Further study of international company interconnections is deemed important as it is able to highlight cross-country and intercultural consequences of the formation of such company ties.

Research on ownership and board interlocks as forms of company networks is extensive. Yet, only a few studies jointly analyze the two types of company interconnections (Bohman, 2012). In a study of the Japanese keiretsu networks, Lincoln et al. (1992) concluded that company link-ups through their directors is not a common phenomenon, yet the existing such links follow ownership links. Besides, broken ties between boards regenerate to a greater degree if the companies have simultaneously ownership ties (Ornstein, 1984). It has moreover been shown that in the United States, the participation of banks in non-financial companies is a powerful predictor of board interlocks (Kotz, 1978; Mizruchi, 1982). Thus, the high correlation between the two forms of corporate interconnection highlights the importance of including ownership structures in the bibliography on board interlocks, since the interests of shareholder-owners may significantly affect the real consequences of the interconnectedness of the boards.

Every type of tie that develops between two or more corporations, particularly if they belong to the same sector, is potentially a factor for collusion. This understandably incites interest in whether the ties investigated among competitors are motivated by attempts at collusion, whether they are effective in facilitating the collusion or, whether, ultimately, there

is no correlation. Although the possibility of collusion through ownership interlocks has indeed been investigated (Alley, 1997; Azar et al., 2018; Gilo et al., 2006; O'Brien & Salop, 2000; Reitman, 1994), the role of board interlocks in the promotion and dissemination of collusion has not. Nevertheless, the data on this issue is hard to locate because there is no systematic research on the motives of companies to form ties through joint directors. Also, whereas market power appears to be related to and facilitate ties between companies in the same sector, the few large companies in sectors of high concentration have no need of such ties in order to regulate prices (Mizruchi, 1996). There are, then, few indications that interconnections of this type are necessary in order to control competition. It is however not known whether, for instance, a company that improves its performance as a result of related illicit practices will promote such practices to other companies through board interlocks or whether collusions will be limited once a company forms ties with other companies which do not engage in such practices.

Moreover, as has been pointed out, many studies focus on the diffusion of corporate strategies through board interlocks (Davis, 1991; Palmer et al., 1993; Shropshire, 2010) and restructuring practices through ownership interlocks (Kogut & Walker, 2001) without, however, investigating whether these ties also contribute to a restraint on corporate behaviors. Thus, yet another extension in the research of corporate governance would be to investigate whether corporate interconnections also facilitate the withdrawal of strategic actions. One such example would be the strategic decision to withdraw investment in a company following its link up with another.

Finally, one other subject not covered in the bibliography and seems promising for future research, is the correlation of the corporate interconnections we are considering with entrepreneurship. Both large companies (Dooley, 1969) and small to middle ones (Gronum et al., 2012) develop corporate ties. However, research has not focused on understanding the ways in which corporate interconnections are likely to differ depending on a company's age or the extent to which companies at initial stages of their development form comparable bonds.

The review of the bibliography shows that the comparison of the structural characteristics of institutions in different countries can contribute to a fuller understanding of the causes and ramifications of corporate networks in the form of ownership and board interlocks (Cardenas, 2012; Fligstein, 1990; Franks & Mayer, 1997; Kogut, 2012; Scott, 1991; van Veen & Kratzer, 2011; Windolf & Beyer, 1996). Though it is known that institutions play a vital role in the formation of corporate bonds (Aguilera & Jackson, 2003), comparative institutional analysis (institutional changes and their great complexity) of corporate networks is consistently scarce. Thus, an important matter for further research is how the operation of interconnections differs in different parts of the globe. The perception that the global corporate elite operates in distinct peripheral communities (Heemskerk & Takes, 2016) and the fact that institutional robustness may effectively contribute to better corporate governance, may mean that it's necessary to take into account peripheral-topical aspects of the corporate environment, if we are to grasp the ways in which corporate power is generated and accumulated. This research need requires an approach of multiple methodologies where the methods of network analysis are complemented in depth by qualitative studies. In other words, the research on the global corporate elite needs to be "denser".

Appendix

Table 4.A1 Synopsis of empirical research articles on board* and ownership** interlock networks (*Source* Author's own creation)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Allen (1974) *	Sociometric analysis	United States	1935, 1970	Increasingly more widespread and full cooperation among large companies (cooptation) in which financial institutions are increasingly occupying central positions
Allen (1978) *	Sociometric analysis	United States	1935, 1970	The structure of the corporate elite is largely organized around a series of distinct and cohesive interconnected groups in which many companies jointly share a number of directors
Alley (1997) **	Econometric analysis	United States, Japan	1979–1994	Although collusion appears to prevail in the Japanese car industry, it is more competitive than in the American car industry
Andres et al. (2013) *	Social network & econometric analysis	Germany	2003–2006	Companies with closely interconnected boards show lower performance and pay their executive members significantly more
Andrikopoulos et al. (2019) *	Social network & econometric analysis	Global analysis	2006	Leadership interlocks are denser than the network of shipping companies, the interconnections of boards impact profit-making positively and leadership interlocks have a negative impact on costs due to the competing interests of shareholders

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Azar et al. (2018) **	Econometric analysis	United States	2016	Shared ownership interlocks (specifically in the US aerospace industry) generate powerful anti-competition motives while the high density of ownership interlocks entails higher costs
Bardoscia et al. (2017) **	Social network analysis	Global analysis	2013	Processes widely believed to stabilize the financial system i.e., market integration and diversification, can actually lead to instability as they contribute to the generation of cyclical structures that tend to reinforce economic hardship thus subverting systemic stability and increasing the likelihood of large crises
Battiston (2004) **	Social network analysis	United States, Italy	2002	The study of the topological structure in the relationships of the ownership interlocks in the Italian stock exchange and in two major US stock markets shows that the former is made up of different interest groups, while the US markets are characterized by very large owners who control the mutually overlapping subsets of reserves

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Battiston and Catanzaro (2004) *	Social network analysis	United States (Italy)	1999, (1982, 2002)	The extensive comparative analysis of the statistical attributes of board interlocks for the largest by revenue 1000 US companies and the companies of the Italian stock market, shows many common statistical attributes in the data groups, despite the fact that they refer to different countries and different years, thus implying an underlying mechanism not sufficiently accounted for by the existing network models
Beckman and Haunschild (2002) * **	Social network & Econometric analysis	United States	1986–1997	Findings show that companies connected to others possessing a related heterogeneous previous experience, tend to pay less for their buy-outs and have better performance. A company also pays less insurance fees when the companies linked to its network (1) have closed deals of differing sizes, (2) possess rare information (2), and (3) are of different size. In addition, in the corporate network, experience affects the quality of company decisions
Ben-Nasr et al. (2015) **	Econometric analysis	France	1998–2013	There are strong indications that companies with many large shareholders present less duration of debt

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Bizjak et al. (2009) *	Econometric analysis	United States	1996 –2002	Board interlocks facilitate the exchange of information and the diffusion of corporate policy in the network. Specifically, it appears that these ties are products of the dissemination of the dubious practice of backdating stock options
Bohman (2006) * **	Econometric analysis	Sweden	2000–2003	Share repurchases are not just related to specific economic features of the companies but also to social influence through board interlocks. The argument of social embeddedness holds even when ownership networks are taken into consideration
Bohman (2012) * **	Social network analysis	Sweden	1990–2005	The joint examination of owners' networks, companies and board members show that board interlocks depend to a large degree on ownership interlocks. The findings provide a new way of understanding the mechanisms behind the formation of board interlocks. Moreover, the correlation between types of interconnections suggests that the ownership network can potentially generate some of the phenomena attributed to the board interlocks

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Boyd (1990) *	Econometric analysis	United States	1980	Developing a structuring model to ascertain whether directorial boards respond to different types of environmental uncertainty, it was seen that in a more uncertain environment, these tend to be of a smaller size while they simultaneously develop an increased number of interactions. This correlation was higher in companies with a high performance
Brancaccio et al. (2018) **	Social network analysis	Global Analysis	2001–2016	The global network control is especially concentrated: the percentage of large owners who cumulatively own 80% of the global value of companies, is considered in the sample to always be below 2%. Also, investigating the phenomenon's dynamic, an increase is observed in the concentration of ownership: this tendency acquires a more systematic and general character as of the beginning of the economic crisis in 2007, with an increase of over 20%

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Burris (2005) *	Sociometric analysis	United States	1980	The social ties created through common participation in corporate boards contribute more to the cohesiveness of political behavior than to shared economic interests, such as those that relate to activity in the same sector or the same geographical location
Burt (1978) *	Input–Output analysis	United States	1967	The suggested theory explains where the board interlocks should appear between sectors of the economy, where they ought not to appear and what the profitability is of effective interconnection
Cai and Sevilir (2012) *	Econometric analysis	United States	1996 –2008	Examining the transactions of mergers and buy-outs in the presence of a board interlock between the buyer-company and the target companies, it is shown that buyers get an information advantage on the real value of the target companies, allowing them to acquire low performing companies at an attractive price
Cardenas (2012) **	Social network analysis & Fuzzy-set qualitative comparative analysis	Global Analysis	2005	This study analyzes national corporate networks with interlocks, defines two main types of corporate networks in twelve developed countries and traces the causal conditions (financial system, state intervention, ownership structures and globalization) that prevail in each country and influence the corresponding structure of corporate networks

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Chapelle and Szafarz (2005) **	Matrix methodology	Global Analysis	2003	On the basis of the rule of the majority, a model is provided designed to assess the ratio of the control (full control vs full ownership) by the ultimate owners of a group of companies. This ratio is determined per share, per company and per shareholder
Chu and Davis (2016) *	Social network & sociometric analysis	United States	1997– 2010	The findings show that the network of board interconnections in the US has changed in fundamental ways. What used to be the case for board interlocks for 100 years, changed within 10 years. The American corporate interconnection network suffered an impressive reduction of corporate ties among board members
Claessens et al. (2000) **	Weak-Link & Game Theory Approach	Inter-national Analysis	1996	Due to cross-shareholdings and to the ownership patterns that form (such as pyramids) the control rights (voting) often exceed those of dividends. More than two thirds of companies are controlled by only one shareholder, with older companies typically controlled by the family. Also, a significant portion of corporate wealth in Eastern Asia is concentrated in some families

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Dastkhan and Gharneh (2019) **	Simulation modeling	Iran	2010–2015	Results show that the suggested simulation model and the network of crossover participation are appropriate for the analysis of the systemic danger and its spread to financial systems. The structural characteristics of financial networks play an important part in the dissemination of shock and financial crisis
Davallou et al. (2015) **	Social network analysis	Iran	2014	The results of analysis of the ownership network of the Teheran stock market show that over 86% of all observable ownership relationships have formed through indirect ownership and with the presence of at least one intermediate owner. Also, the study of the degree of concentration shows that over 60% of the market's total value belongs to only 10% of shareholders

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Davis (1991) *	Econometric analysis	United States	1984–1989	The findings support a prospect of social structuring in the purchase of corporate control in which the network of interconnections provides a social framework which favors continued administrative dominance. The findings are also more consistent with models of structural cohesion rather than ones of structural equivalence (two nodes are considered structurally equivalent if they have the same adjacent areas) as responsible for the social, structural mechanism of diffusion
Davis and Greve (1997) *	Diffusion model	United States	1980, 1986	The authors compare the difference between two innovative practices of corporate governance that were adopted in response to the wave of buy-outs during the 1980s: poison pills (which spread quickly due to a process of diffusion from board to board) and golden parachutes (which spread slowly via geographical proximity)
Davis et al. (2003) *	Social network analysis	United States	1982, 1990, 1999	The level of connectedness among hundreds of large US companies and the thousands of board members is highly consistent with time's passage

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Di Giacomo and Cenci (2018) **	Optimization approach	Multi-national analysis (Europe)	2015	In this article, a linear model of programming is introduced, namely, the cheapest control problem, that contributes to both descriptive analysis and the optimization approach. The solutions to the problem allow the estimation of three indices that measure the ease with which a company can be controlled, on the basis of the ownership relationships
Dietzenbacher et al. (2000) **	Micro-economic analysis	Holland	1995	In every case, competition is reduced due to ownership interconnections. Comparing the case of shareholding with the no-shareholding case, the cost-price margins were found to be 2% higher in a Bertrand market and 13% higher in a Cournot market
Dietzenbacher and Temurshoev (2008) **	Input–output analysis	Czech Republic	1997	The methodology applied allowed for a picture to emerge of "secret ownership structures" in the banking sector. The complexity of the network of relationships between primary and secondary owners which was quantified, and the relevant ownership chains which were mapped, showed that indirect ownership relationships play a decisive role in the banking sector

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Dooley (1969) *	Descriptive analysis	United States	1935, 1965	Comparing the years 1935 and 1965, it seems that the frequency of board interlocks is pretty similar
Dorofeenko et al. (2007) **	Matrix methodology	Germany	2000	In cross-over forms of ownership, the rights of control and ownership can be completely separated and there may exist multiple balances in the economy
Dritsas et al. (1996) *	Social network analysis	Austria, Greece, Sweden	1938	The study shows that the three countries present similar patterns of board interconnections, the intensity and density of which accorded with the overall level in each country's economic development. Austria had the largest number of banks in a central position in the network, followed by Sweden and then Greece
Edling and Sandell (2001) **	Econometric analysis	Sweden	1997	The strategic choices of industrial and economic organization as corporate behaviors, such as the transfer from primary to secondary markets examined here, may be predicted by the social influence exerted by board interconnections

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Flath (1993) **	Econometric analysis	Japan	1981	Banks and insurance companies in Japan have the tendency to own, directly and indirectly, stocks in clients who borrow more intensively than themselves while some banks are also more inclined to keep stocks in companies with larger overall leverage
Fligstein and Brantley (1992) * **	Sociometric analysis	United States	1969, 1969–1979	The existing power relations within the company, the perception of control that prevails in the actions of the company and those of its competitors, play a part in the economic actions undertaken by large companies, despite differences in management, ownership, bank control or the presence in the banks of board interlocks
Franks and Mayer (1997) **	Descriptive analysis	France Germany, United Kingdom, United States	1990	French and German companies mainly follow the ownership structure of the internal system (small companies characterized by few interactions) while British and US ones follow ownership structure of the external system (a lot of large companies with interactions but fewer ownership ties amongst the companies)

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Garcia-Bernardo et al. (2017) **	Social network analysis	Multi-national analysis (global)	2015	In analyzing the ownership network across countries on the basis of global chains of corporate ownership, it becomes clear that there is a geographical specialization in the offshore network and the greatly significant role for global economy is revealed of Holland and the United Kingdom, as dominant country-channels in international chains of corporate ownership
Glattfelder and Battiston (2009) **	Social network analysis	Multi-national analysis (global)	2017	In Anglo-Saxon countries, corporate control tends to be diffused amongst many shareholders and is seen to be very concentrated at a global level, i.e., in the hands of very few important shareholders. The exact opposite is observed to be the case for European countries
Green and Semple (1981) *	Spatial analysis	United States	1978	The research shows that companies do indeed make use of the interconnections of directorial boards and that the network that has been created has topical differentiations and can affect peripheral stability

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Gronum et al. (2012) **	Econometric analysis	Australia	2005	Strong heterogeneous bonds improve innovation in small to middle-sized companies. However, the relationship between network ties and corporate performance is more complex, as the positive relationship is formed through the innovation
Gulati and Westphal (1999) *	Econometric analysis	United States	1995	This study shows that board interlocks can have qualitatively different ramifications for the creation of new strategic alliances between companies and alliances of companies, depending on the behavioral processes that make up the base for the companies' ties, while these outcomes of cohesion are in turn mitigated by ties developed with third parties
Hallock (1997) *	Econometric analysis	United States	1992	Interconnected board members enjoy at an average, significantly greater remunerations than not-interconnected ones
Haniffa and Hudaib (2006) * **	Econometric analysis	Malaysia	1996–2000	As regards board interlocks, which is a common phenomenon in Malaysian economy, the findings suggest that these ties do not add to corporate performance, with the market considering multiple ties as not healthy

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Harris and Shimizu (2004) *	Econometric analysis	United States	1981–1989	There is a positive relation between the percentage of overly taxed board members (sitting on multiple boards simultaneously) and excessive performances while there is no evidence that such individuals miss meetings. Moreover, the findings suggest that the "busy" members have not a detrimental but, rather, a favorable impact on the company's basic strategic decisions (such as buy-outs) as they are significant sources of knowledge
Haunschild (1993) *	Econometric analysis	United States	1981–1990	Corporate directors imitate the buy-out practices of those companies with which they are interconnected through board members
Haunschild and Beckman (1998) *	Social network & Econometric analysis	United States	1981–1990	We measured the effect of alternative sources of information on the relationship between board interlocks and corporate buy-outs. The findings show that most of the alternative sources reduce the impact of the ties between directorial boards except for one, the coverage of the company by the press, which increases it

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Heemskerk and Takes (2016) *	Social network analysis	Multi-national analysis (global)	2013	The transatlantic connections remain particularly strong: Europe and North America remain interconnected in a dense network of joint board members, while the separate Asian complex is developing and gaining financial and political power, although Asia, nevertheless, remains by and large outside the field of the established global (Northern Atlantic) corporate elite
Johnson et al. (2011) *	Econometric analysis	United States	1993–2000, 2000–2007	The hypothesis that higher remunerations relate to the admission of board members with high status or multiple ties does not appear to hold. However, the company's complexity relates to the ability to add members with a strong social fund and the prestige of the current directorial board is connected with the ability to bring on new members of high prestige
Kang (2008) *	Econometric analysis	United States	1998–2002	Important penalties to do with corporate reputation were found in 45 (out of 244) companies linked through board interlocks with 30 companies accused of financial fraud in the United States. Also, companies had greater chances of experiencing important reputational penalties when the interconnected members occupied supervisory or government positions

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Kogut and Walker (2001) **	Social network analysis	United States	2007–2010	A network's small-world attributes have an impact on innovative performance of the company complex
Kramarz and Thesmar (2013) *	Econometric analysis	France	1992–2003	There is a strong interconnection between the network of chief executive officers and that of directors. Social networks are associated with multiple benefits for the executive directors but have detrimental effects on corporate governance
La Porta et al. (1999) **	Econometric analysis	Multi-national analysis (27 rich countries)	1995, 1996	Apart from economies where the shareholders are well protected, comparatively few companies in the sample have a wide range of ownership. On the contrary, they are primarily controlled by families or by the state. Also, the owners usually have control rights which significantly exceed cash flow rights, mainly through using pyramidal structures and their participation in management

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Laeven and Levine (2008) **	Econometric analysis	Multi-national analysis (13 European countries)	1996–1999	It is ascertained that (1) one third of the companies introduced into Europe have more than one big owner, (2) the market value of companies with many big owners differs to that of other companies, and (3) the relationship between the evaluation of companies and the distribution of rights over dividends to many big owners, are in accordance with the predictions of recent theoretical models
Larcker et al. (2013) *	Social network & Econometric analysis	United States	2000–2007	In total, the findings suggest that corporate networks formed out of board interlocks provide financial benefits that are not directly reflected in the stock prices
Lemma and Nevash (2016) **	Econometric analysis	Multi-national analysis (deve-loping countries)	1996–2010	In the countries of the sample, the concentration of ownership and/or the existence of big stockholders in non-financial companies increases with the structuring of debt at corporate level, the levels of the industry's regulation, a country's level of corruption and the real per capita gross national product, while it diminishes with the basic capital structure, the size of the company and the orientation of a country's financial system

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Levy (2009) **	Social network analysis, Weak-Link Approach, Matrix Methodology & Game Theory Approach	Beligum	2005	The article compares existing methods for ascertaining a company's owners in a pyramidal structure without crossover ownership. These are applied to the Colruyt company, citing the different results in the corporate inspection which each method generates
Levy and Szafarz (2016) **	Game Theory Approach	Germany	1998	Taking into consideration ownership interlocks, it appears that managers can obtain indirect voting rights and thus insulate their companies from external control
Lichtenberg and Pushner (1994) **	Econometric analysis	Japan	1976–1989	Ownership by financial institutions of their own funds in Japan can effectively replace the defunct foreign market of buy-outs, resulting in the surveillance and intervention which minimize the risk of loss of productivity. At the same time, high levels of inter-corporate ownership, distance companies from the management of their problems, at the expense of their performance

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Lincoln et al. (1992) * **	Econometric analysis	Japan	1980	Studying the Japanese keiretsu networks, researchers conclude that corporate connections through the directors are not commonplace, but the existing such ties follow the ties of ownership
Lingmin (2016) *	Econometric analysis	China	2003–2012	Companies with the widest divergence between final control rights and rights over dividends have a significantly higher level of leverage of capital structuring. Also, leverage is an increasing motive for owners as, with the risk of confiscation that is prevalent in Chinese economy, debt increase is a tool for them to maintain control over funds and corporate decisions
Mariolis and Jones (1982) *	Social network analysis	United States	1962, 1964, 1966	Examining the reliability and stability of centrality in corporate interlock networks, it is ascertained that measurements of centrality are highly reliable and stable. Moreover, out of three measurements that were investigated (number of interlocks, non-directional centrality, and directional centrality), the number of board interlocks is slightly more reliable or stable than the other two. Lastly, the findings indicate that the central position of banks is more stable in relation to that of companies

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Martin et al. (2015) *	Econometric analysis	United States	2001–2009	Companies are likely not to form board interlocks necessarily in order to reduce uncertainty but in order facilitate adaptability and improve performance when they are faced with uncertainty
Martins and Neves (2017) **	Social network analysis & Optimization approach	Multi-national analysis (20 European countries)	2015	A series of solutions is examined which reveals alternative strategies of corporate control, using a wide range of companies in the European stock exchange. Strategies for control usually differ in whether they allow mutual cross-shareholding structures or not
Mizruchi and Stearns (1988) *	Econometric analysis	United States	1956 –1983	Decreasing solvency, reduced profit margin, increased demand for capitals at diminishing interests, and the matching of increased demand for capital with the stages of shrinkage of the business cycle, correlate with the existence of board interlocks
Moore et al. (2012) *	Econometric analysis	United States, United Kingdom	2002–2006	Characteristics of the external network, such as board interlocks, are important factors for predicting the external capital market choice from a foreign market, by a company of initial public offering

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Morck et al. (2000) **	Econometric analysis	Japan	1985, 1986, 1987	Ownership of its capital by a bank and corporate value are negatively associated in Japan. Also, middle levels of ownership significantly increase a bank's power to appropriate surplus funds of client-companies. Ownership ties with banks also appear to affect the company's value through influence on the investment policies of client-companies while introducing loose economic restrictions which allow companies to take up more marginally acceptable investment opportunities
Napoli (2018) **	Econometric analysis	Italy	2017	A more favorable framework is created for strategic change and innovation when a company extends membership to the directorial board or the top management team, to individuals outside the dominant families, in order to gain access to funds controlled by associates
Ong et al. (2003) *	Econometric analysis	Singapore	1997	Market capitalization, board size, total assets, return on assets, return on sales, profit before tax and nature of the company (financial or non-financial) are significantly correlated with board interlocks

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Ornstein (1984) *	Econometric analysis	Canada		Approximately half the interlocking directorates reflected corporate imperatives and half reflected class solidarity. Interlocks involving executives or between corporations with two or more interlocking directors were more likely to be reconstituted in cases of the retirement of directors, but the effects of location, industry, and foreign ownership were more likely to be reconstituted in cases of the retirement of directors, but the effects of location, industry, and foreign ownership were weak
Paligorova and Xu (2012) **	Econometric analysis	Multi-national analysis (G7 countries)	2003–2006	Companies in networks of a pyramidal form have significantly higher leverage and the use of debt in pyramids is associated with the risk of expropriation. Findings indicate that the capital structure of pyramids is affected by the expropriation activities of ultimate owners that have excess control rights

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Palmer (1983) *	Econometric analysis	United States	1962, 1964, 1966	This article presents evidence regarding the continuity of board interlocks that have been accidentally disrupted by such events as death or retirement, a fact which reveals something of the extent and manner in which different types of ties facilitate formal coordination
Pastra et al. (2015) *	Descriptive analysis	Greece	2001–2012	Drawing data on the Greek shipping industry from the Athens Stock Exchange, 305 board formations were found, out of which 84 included a total of 38 members who, during their term, occupied positions on two or more boards of listed companies. 30 out of the 38 (78,9%) held positions on two boards, and 8 (21.1%) on three boards simultaneously
Piccardi et al. (2010) * **	Social network analysis & Optimization approach	Italy	2008	The main finding is that both the board and ownership networks of the Italian companies examined exhibit a strong community structure and, moreover, the two structures overlap significantly. This is due to several factors such as pyramidal groups and members on multiple boards. Overall, this means that the small-world of listed companies is actually split into well identifiable communities

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Richardson et al. (2016) **	Econometric analysis	China	2005–2010	There is an important, non-linear relationship between ownership concentration and tax avoidance. Also, a significantly positive association is found between pyramidal ownership structure and tax avoidance due to the entrenchment effect, i.e., the managers' use of the company to promote their own interests rather than those of the shareholders
Robins and Alexander (2004) *	Social network analysis	United States, Australia	2006	Empirical bipartite graphs are compared to simulated random graph distributions conditional on constraints implicit in the observed datasets. It is concluded that the corporate networks compared have many similarities and some differences. Notably, both tend to be influenced by the clustering of directors on boards, while shared multiple board memberships (multiple interlocks) are an important feature of both infrastructures, and company structural power may be relatively more diffuse in the US structure than in Australia

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Romei et al. (2015) **	Social network analysis & Optimization approach	Italy	2012	The main contribution of this article concerns the emergence of interaction in cases of model-building of ownership networks as graphs (through algorithms who take effective advantage of such structures) and the empirical study of an important case, thus recommending a framework for analyzing issues of corporate governance through applying network analysis and graph theory on ownership networks
Rousseau and Stroup (2015) *	Econometric analysis	United States	1996–2006	Prospective buyers-companies are almost five times more likely to acquire firms in which their board members have served in the past. Buy-outs are also more likely when there is better corporate governance and the interconnected members have a higher share of ownership in the buyer company

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Rungi et al. (2017) **	Social network & Econometric analysis	Multi-national analysis (208 countries)	2015	Among others, a strong concentration of corporate power is ascertained, with less than 1% of the parent companies expanding to more than 100 subsidiaries and being responsible for over 50% of sales internationally. Also, the strategies of indirect control of the subsidiaries by the parent companies correlate with the quality of the institutional environment in every country
Shrader et al. (1991) *	Econometric analysis	United States	-	The study's results indicate that strategic relations of board interlocks constitute significant indicators of the organizational measure of centrality. They are closely related to the central position of companies in the exchange of resources. Thus, board interconnections are used strategically to connect organizations with their environment
Simoni and Caiazza (2012) *	Social network & Econometric analysis	Italy	1998–2006	Board interlocks between companies in the same sector were proven to be mechanisms of cooperation as long as they facilitate deeper connections among competitors, such as their integration through mergers and buy-outs

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Staples (2007) *	Descriptive analysis	Multi-national analysis	2005	In 2005, 75% of the 80 largest international companies had non-nationals on their boards, but only in 10% of those companies, were non-nationals the majority
Stearns and Mizruchi (1986) *	Econometric analysis	United States	1955–1984	Only when a company exerts power over another will the dissolution of board interlocks be reconstituted with the same firm. Otherwise, if the company interconnects with another, this means the absence of relations of corporate control
Stearns and Mizruchi (1993) *	Econometric analysis	United States	1956 – 1983	Through a time-series analysis of 22 large US manufacturing companies from 1956 to 1983, it was found that the types of financial institutions represented on companies' directorial boards correlated with the amounts and types of loans which companies sought

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Takes and Heemskerk (2016) *	Social network analysis	Multi-national analysis	2013	Investigating the concept of centrality in the global corporate board interlock, as well as in different national networks, it is seen that degrees of centrality are correlated and that there are important differences between countries. Also, the importance and centrality of companies don't always go together. Moreover, the article provides additional indications for the peripheral outcomes based on the network's topology
Tuschke et al. (2014) *	Econometric analysis	Germany	1990 –2003	Board interlocks contribute to the companies' learning practices with some types of interconnections having greater importance. In the article, the relevant advantages are seen of the various types such as experience, power and the reliability implicit in the ties among the network's companies, and it is argued that these markers may lead to measurable differences in the companies' learning outcomes

Article	*Methodology*	*Country*	*Period*	*Main Findings*
van Veen and Kratzer (2011) **	Social network analysis	Multi-national analysis (15 European countries)	2006	The results show great quantitative differences in network density in the countries that are closely allied with the capitalist system of each country, while at the level of the European network, the different countries assume completely different positions. This occurs because a country's international position depends significantly on the network's structure and the length of the country's membership in the EU
Vitali and Battiston (2014) **	Social network analysis	Multi-national analysis	2007	The analysis for the detection of community at a global level, showed that a global corporate network is intensely organized and concentrated in communities where geography is the main lever of formation
Vitali et al. (2011) **	Social network analysis	Multi-national analysis	2007	The study shows that the main part of the existing ownership and (flows of) value in international markets is monopolized by a small group of shareholders
Wang et al. (2009) *	Econometric analysis	United States	2000	Overall, findings support the view that it is possible for managers without social and educational credentials to gain access to corporate boards

(continued)

Table 4.A1 (continued)

Article	*Methodology*	*Country*	*Period*	*Main Findings*
Windolf and Beyer (1996) * **	Descriptive analysis & Social network analysis	Germany, United Kingdom	1992–1993	Germany represents a system of "cooperative capitalism" while Britain is an instance of "competitive capitalism"
Yafeh and Yosha (2003) **	Econometric analysis	Japan	1990	The concentrated stock capital correlates with lower expenditure activities, in favor of executive members
Yue (2012) *	Econometric analysis	United States	1996–2002	In the study of the evolution of conventional corporate interactions between internet companies during the period of the dot-com bubble, it was seen that there were asymmetric consequences for the formation and dissolution of corporate networks

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