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Shades of Power: Network Links with Gender Quotas and Corporate Governance Codes

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This study analyses the impact of political and regulatory pressures to increase the influence of women within the European board of directors' network. To accomplish this, we used a longitudinal approach, tracking two centrality measures of a European directors' network from 1999 to 2014. The network comprised publicly listed firms in 37 European countries, resulting in an extensive sample of 71,300 directors, of which around 10% were women. Governments promoting gender diversity in leadership positions have focused on two solutions: a slow track using voluntary approaches versus a fast track pushing for binding legislation. The panel data analysis shows how voluntary approaches to promote gender diversity, as implemented through corporate governance codes, have a positive and significant relationship with the 'closeness' of women to other directors in the network (i.e. their access to information). In contrast, binding legislation, such as gender quotas, increases women's role as unique 'bridges' between sub-networks – a result that serves to heighten their 'betweenness' centrality (i.e. their control over information).

Introduction

Men presently outnumber women in business leadership positions. In 2015, women occupied, on average, just one-fifth of all company directorships in the EU-28 (EIGE, 2017); however, there are important institutional country differences. Eleven European countries (Norway, Spain, Iceland, France, Italy, Finland, the Netherlands, Belgium, Germany, Portugal and Austria) have implemented quota laws to balance gender board diversity. In these countries, women account for at least a quarter of board members (EIGE, 2017). Other countries have chosen a non-binding approach and recommended targets in their corporate governance codes – for example, the UK and Sweden (Gabaldon, Mensi-Klarbach and

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Seierstad, 2017) – while others, such as Eastern European countries and Russia, have not implemented any measures at all.

Recently, research into women on boards (WoB) has become very popular (Gabaldon *et al*., 2016; Kirsch, 2017; Terjesen, Sealy and Singh, 2009). Several studies (e.g. Grosvold and Brammer, 2011; Mateos de Cabo, Gimeno and Nieto, 2012; Smith and Parrotta, 2018; Terjesen, Aguilera and Lorenz, 2015) have focused on the factors behind the low proportion of WoB, and many have mentioned women's limited networks as one factor driving this paltry number (Perrault, 2015). Indeed, lack of social capital is one of the elements that prevent women from breaking the glass ceiling (Gabaldon *et al*., 2016), since directors' goals can be greatly facilitated by their direct and indirect links to other actors in their social network (Adler and Kwon, 2002). In fact, women have limited access to the close environment within which relationships with CEOs and other directors are developed (Mateos de Cabo, Gimeno and Escot, 2011). Our goal is to study how both quotas and corporate codes are related to changes in the social capital of WoB through their positions within the director network. We do so by looking at the two main benefits of social capital: access to and control over the flow of information among the business elite (Burt, 1997).

A director network is a type of social network wherein two directors are connected if they sit on the board of the same company (Davis, Yoo and Baker, 2003). The literature on social networks (Battiston and Catanzaro, 2004; Conyon and Muldoon, 2006; Daolio, Tomassini and Bitkov, 2011; Davis, Yoo and Baker, 2003; Huang *et al*., 2011; Robins and Alexander, 2004; van Veen and Kratzer, 2011) covers the research on the topological characteristics of director networks. These topological properties describe how nodes and edges (i.e. directors and relationships) are arranged, allowing identification of relevant structures in the network, and can be applied to the whole network or to groups of individuals. There are numerous studies on how director networks affect diverse actions and outcomes: for example, remuneration and recruitment (Geletkanycz, Boyd and Finkelstein, 2001; Liu, 2014; Renneboog and Zhao, 2011), mergers and acquisitions (Cai and Sevilir, 2012; El-Khatib, Fogel and Jandik, 2015; Ishii and Xuan, 2014; Mazzola, Perrone and Kamuriwo, 2016; Renneboog and Zhao, 2014) or firm performance (Geletkanycz and Boyd, 2011; Larcker, So and Wang, 2013).

Nevertheless, only a few investigations combine the gender perspective with social network analysis. For example, Seierstad and Opsahl (2011) explore the effects of the Norwegian gender quota on women directors' social capital; Hawarden and Marsland (2011) study the locations of WoB in the New Zealand network; Hodigere and Bilimoria (2015) study how the human capital and professional networks of non-executive directors in the S&P index firms contribute to new appointments; while Strøm (2019) finds that the Norwegian quota law has driven women to more central positions, replacing the so-called 'old boys' network'. Unfortunately, these investigations covered few years and/or focused on one specific country or index, thereby failing to compare the effectiveness of different regulatory measures on WoB professional networks. This study fills this gap regarding the intersection between WoB and director networks. In particular, we look at the different effects of two types of affirmative action policies implemented by various European countries (mandatory quotas versus mentions of gender diversity on boards in corporate governance codes) on the centrality of women directors in the director network, and as a consequence, on the role played by women in the board network.

Our study answers the call by Terjesen and Sealy (2016) for understanding the consequences of gender quota laws and other affirmative-action policies and contributes to the stream of research on WoB that looks how affirmative action policies affect board gender diversity. Specifically, there is a need to 'use social network approaches to examine how individual actors (nodes) have relationships (ties) with others (Scott, 2012) and build these over time, within and across firms and stakeholders' (Terjesen and Sealy, 2016, p. 28). We also address the call by Hillman, Shropshire and Cannella (2007, p. 35) to offer a 'richer understanding of the specific resources individual directors bring to a board, as well as their motivations to contribute to them'. Understanding interlocking directorates may provide new insights into the diverse forms of board interdependencies and interactions. Additionally, van Veen and Kratzer (2011) assert the need to study cross-border interlocking directorates, given the integration of the European Union and the rapid development of economic globalization. Indeed, Carroll and

Fennema (2002) and, more recently, González (2019) find a developing European business community that points to the emergence of an international business elite that should be studied in a multi-country context. Thus, this study uses network analysis to examine the access to and control of information among directors, since information flows are key contributors to a director's human (or 'social') capital, influencing their productivity and ultimately their employability and remuneration.

We used a longitudinal approach to analyse the impact of gender quotas and corporate governance codes on women directors' influence in the European directors' network. We followed the evolution of the main topological and connectivity measures of a European global directors' network, constructed of listed firms from 37 countries in Europe from 1999 to 2014, obtained from Boardex. This resulted in a dataset of 505,169 observations of board-of-director positions, corresponding to 71,300 different directors. With this data we were able to compose a European-wide network matrix for each year, the largest directors' network studied to date, with 4,601,407 connections among directors.

This study provides several contributions. First, we observe the effects of different types of affirmative action policies on women directors' influence and power within the directors' network (Kumra and Vinnicombe, 2010; Stevenson and Radin, 2009), especially the changes in the roles played by WoB within the network. Therefore, we extend the WoB literature to the effects of institutional mechanisms for improving not only the number of WoB but also their influence within the European business elite. Second, our results indicate that network power depends on the policies implemented. Extending the research on WoB and affirmative action (Mateos de Cabo *et al*., 2019; Seierstad *et al*., 2017; Terjesen, Aguilera and Lorenz, 2015), we stress the role of regulatory pressures in breaking the homophilic selection paths to boards (Ibarra, 1992, 1997), which, according to our results, is greater when quota legislation is implemented than when softer measures (i.e. recommendations in corporate governance codes) are introduced.

Therefore, this study answers the following research questions: (a) What does the gendered European directors' network look like and how has it evolved over time? (b) To what extent do the instruments used to increase WoB have an impact, not only on numbers, but also on where WoB are located in the network? (c) Are there differences in the type of social capital benefit (centrality measure) affected depending on the type of regulation applied? Finally, if so: (d) Can these differences be translated into different aspects of women's influence within the European economic power elite?

Theoretical background

Directors' network research

Social network analysis aids in understanding how humans organize into communities (Newman and Park, 2003). One such social network is the network of directors. Directors frequently occupy positions on more than one board (Conyon and Muldoon, 2006). Well-established techniques in complex network theory (Caldarelli, 2007; Newman, 2010) make it possible to quantitatively delineate networks of interlocking directorates (Ong, Wan and Ong, 2003; Shropshire, 2010).

A type of network that is quite pervasive in different areas is a 'small world': a network characterized by a very short average distance between directors and firms. Examples of this structure are present everywhere in the corporate world (Battiston and Catanzaro, 2004; Caldarelli and Catanzaro, 2004; Davis, Yoo and Baker, 2003; Durbach and Parker, 2009; Grau *et al*., 2020; Heemskerk and Schnyder, 2008; Piccardi, Calatroni and Bertoni, 2010; Robins and Alexander, 2004; Sankowska and Siudak, 2016). Further research has examined the small-world model in management, demonstrating its growing empirical relevance for corporate governance (Baum, Shipilov and Rowley, 2003; Conyon and Muldoon, 2006; Kogut and Walke, 2001; Schilling and Phelps, 2007; Uzzi, Amaral and Reed-Tsochas, 2007; Verspagen and Duysters, 2004). Other investigations focus on the structural changes of corporate networks (Heinze, 2004), how 'clubby' they are (Conyon and Muldoon, 2006) and the speed of information propagation through them (Daolio, Tomassini and Bitkov, 2011). There are also interesting studies on directors' power (Huang *et al*., 2011) and the link between a country's economic system and the density of its national corporate network (van Veen and Kratzer, 2011).

In previous research on directors' interlocking, gender has rarely been studied. The first investigation on gendered director networks by Hawarden and Marsland (2011) compares director networks on a global (Fortune Global-200) and national network scale (New Zealand Stock Exchange) and finds that WoB are more likely to be in the network's largest connected component. The second study, by Seierstad and Opsahl (2011), documents the emergence of a small elite of women directors in Norway who are on the top in a number of proxies of influence (i.e. betweenness and number of directorships), giving rise to the 'golden skirts' phenomenon. Hodigere and Bilimoria (2015) find that network ties and cohesion are good predictors of appointments of women. More recently, Strøm (2019) finds that after the Norwegian quota, women directors became more central in the network than men. Nevertheless, these studies examine short time periods and/or focus on one specific country. Furthermore, these studies all tend to focus on networks' structural aspects. However, in addition to structural aspects, one can distinguish social capital's cognitive and relational dimensions (Nahapiet and Ghoshal, 1998). Through this lens, social capital comprises both the network and assets (e.g. information, innovation, mobility and trust) that may be mobilized through the network. Additionally, their methodological approach tends to be a descriptive analysis of the network's topological properties and their centrality measures, omitting a more complete multivariate analysis that would help properly analyse and make inferences about the potential relationships of diversity-affirmative action and women's power and influence on directors' networks. Lately, two studies have been published that focused on differences between men and women as interlocking directors. Markoczy, Sun and Zhu (2020) analyse the differences in directors' experiences, finding that interlocking men directors with women ties reduces such (re-)appointments while interlocking women directors with women ties facilitates such (re-)appointments. Grau *et al*. (2020) study gender differences in the power laws for a European directors' network and find higher exponents for women than for men, implying that there are fewer women than men hubs. This result, contrary to Seierstad and Opsahl (2011), points to the absence of a European 'golden skirts' phenomenon.

Regarding the scope of network analysis, previous research on corporate governance and networks indicates the existence of a new transnational network, where directors are highly interconnected (van Veen and Kratzer, 2011) beyond country limits (Fennema and Schijf, 1978). These interlocking directorates have been found mainly in European countries, indicating the existence of an 'integrated European business elite' (Carroll and Fennema, 2002; González, 2019; Sklair, 2001), stable even during the recent financial recession (Heemskerk, Fennema and Carroll, 2016). The expansion of transnational-board connections has come hand-in-hand with the economic integration of the European Union (Heemskerk and Fennema, 2009). Therefore, the corporate elite is broader, less restricted to within countries' borders and less dense in terms of connections (Heemskerk, Fennema and Carroll, 2016). The emergence of this international elite points to the need to analyse the cross-border interlocking directorates that constitute the European network.

Hypotheses on the effects of regulatory pressure on women's economic influence

Board gender quotas and corporate governance codes. There are many studies on the reasons why women are under-represented on corporate boards (e.g. Grosvold and Brammer, 2011; Mateos de Cabo, Gimeno and Nieto, 2012; Smith and Parrotta, 2018; Terjesen, Aguilera and Lorenz, 2015). A useful framework for classifying these factors is proposed by Gabaldon *et al*. (2016) and distinguishes between the supply (i.e. pool of qualified candidates) and demand side (i.e. company) perspectives. Although these authors considered both gender quotas and recommendations in corporate governance codes as demand-side instruments, in a closer look at the different frameworks for increasing the presence of WoB, Piscopo and Muntean (2018) argue that countries that enact quotas emphasize structural barriers on the demand side (i.e. systematic discrimination) as the main cause of the dearth of WoB, while when emphasis is placed on the insufficient number of women in the pipeline (supply-side argument), only voluntary approaches (non-binding measures in corporate governance codes) or no measures at all are used. We use this framework to distinguish the emphasis placed when approaching the problem: the confidence in market competition to solve the problem versus the recognition of structural

gender discrimination as a market failure to be eliminated.

Voluntary measures: Confidence in market competition. Discourses behind this approach emphasize market competition and individual merit. Therefore, women's slower career progress is attributed to a reduced pool of qualified women who are job-ready for board positions. Under this approach, an increase in the number of women with the required qualifications and career experience is expected to lead to more gender-equal representation on boards (McDonald and Westphal, 2013).

These self-regulatory strategies rely on companies' voluntary goodwill to induce change by favouring equal opportunity over equal results. Voluntary measures are usually instrumented by including recommendations in corporate governance codes urging companies to promote women to leadership positions (Fagan, González Menéndez and Gómez Ansón, 2012; Terjesen, Aguilera and Lorenz, 2015). Corporate governance codes are responsible for setting the reporting requirements regarding board gender diversity. These corporate codes have been widely used in European countries (Bohren and Staubo, 2014) in an attempt to disrupt the entrenched informal power structures (e.g. informal board selection processes) that keep women out of board positions while avoiding meddling with selection processes. This strategy is similar to that followed with political gender quotas that pursue disruption of longstanding informal norms of exclusion as the only means of augmenting women's representation in leadership positions (Dahlerup and Freidenvall, 2005; Htun and Jones, 2002). In the board gender context, Iceland is an example of how a general shift in the attitudes of existing informal institutions and processes can produce change (Arnardottir and Sigurjonsson, 2017). Nevertheless, recommendations in corporate governance codes are largely general; moreover, while some of them reflect specific gender balance targets, others leave it to the companies to set their own targets. Therefore, the efficacy of these measures is limited since their role is to recommend; nobody is responsible for requiring explanations for non-compliance, generally leading to only symbolic acceptance of women's equality (Gabaldon, Mensi-Klarbach and Seierstad, 2017).

As good corporate governance codes are issued by national stock exchange commissions, they are addressed to all publicly listed companies. However, the largest companies seem to be the ones that most often react to meeting recommendations on gender diversity, largely due to greater public scrutiny and pressures from external constituencies. Nevertheless, the lack of sanctions for non-compliance could lead to low implicit quotas to allow satisfaction of gender diversity requirements, as has been shown for senior management positions (Dezsö and Ross, 2012; Sojo *et al.*, 2016). Dezsö, Ross and Uribe (2016) argue that this implicit quota (usually one woman) comes from the decreasing marginal returns in terms of the organizational legitimacy of having more women in top management and the increasing perceived costs from the perspective of the male majority in top management.

In this context, women directors are expected to be located in central positions as the companies appointing them (the largest listed ones) tend to be well placed in the companies' network, and so relatively close (in terms of the number of links that must be crossed to reach other directors in the network) to all other directors in the network. Being close to other directors facilitates access to a broader pool of information at lower cost, improving its timeliness, quality and relevance, and resulting in few message transmissions and losses (Adler and Kwon, 2002; Freeman, 1979). This aspect of centrality in a directors' network is operationalized using their 'closeness' – you either know someone, or know someone that knows someone – formally, this is quantified in network analysis as the inverse of the shortest path between an individual and all other individuals in the network. To sum up, closeness can be considered a measure of a director's access to the information in the network (although not necessarily exclusive access to this information), so directors with the greatest closeness are the ones best placed to contact the entire network most quickly and effectively.

However, given the slow pace of the increase in the number of WoB, finding women with multiple directorships is less likely, and the 'bridges' (i.e. connections) they build between other subnetworks of directors tend to be non-essential; being in a position where everyone is highly interconnected, a woman's links might be redundant. For example, if a director knows several colleagues of a key director with relevant information for him/her, then none of those colleagues are really indispensable sources of information. This lowers the potential efficacy of those ties since they can

easily be bypassed (Burt, 2005). Therefore, women tend to be visible and connected in the network rather than powerful.

Based on the above, we hypothesize that:

H1: Including recommendations for board gender diversity in corporate governance codes is related to improvements in the closeness of women directors within the directors' network compared to that of men directors in the same network.

Board gender quotas: Structural discrimination theory. Gender quota discourses emphasize structural gender discrimination as the reason women directors are under-represented (Mateos de Cabo and Gimeno, 2017; Terjesen, Aguilera and Lorenz, 2015). In this regard, there are different explanations behind biases in recruiting women as board members. Taste-based discrimination (Becker, 1957) originates from preferences and cultural beliefs about gender that create a preference for not hiring women. In contrast, statistical discrimination (Phelps, 1972) is the manifestation of a lack of information that leads to applying the average characteristics of their gender group to specific women directors. In other cases, biases are unconscious, as in implicit discrimination (Bertrand, Chugh and Mullainathan, 2005). In all these cases, gender biases and male-dominated recruitment networks prevent women from obtaining promotions even if there is a well-nourished pipeline of highly skilled women ready to hold board positions. In this context, voluntary mechanisms are usually considered insufficient for transcending tokenism and moving beyond a 'critical mass' (Kanter, 1977). Therefore, this approach considers that a commitment to move gender diversity in the boardroom forward requires a stronger enforcement mechanism. As Piscopo and Muntean (2018) point out, countries tend to adopt statutory board quotas and abandon the 'slow track' approach when there are quota advocates that can convince governments that structural factors are preventing women from reaching top corporate positions. Since quotas are effective targets with enforcement strategies or sanctions/incentives for failure/compliance to achieve the goals (Sojo *et al*., 2016), they could be more effective in terms of power than corporate governance codes.

Indeed, statutory board quotas signal a commitment to gender equality that is often accompanied by increased penalties for non-compliance (Franceschet and Piscopo, 2013), compelling companies to adopt fast-track measures so that 'quota women' can gain authority and exert real power through a potent network. Mandatory quotas are usually greater in practical scope than corporate governance codes since all companies targeted generally react to reach their goals (Mateos de Cabo *et al*., 2019). Moreover, gender quotas mandate specific percentages of representation of each gender in boards (usually 30−40%) and a deadline for compliance. Finally, most quotas include enforcement mechanisms or sanctions (incentives) in case of non-(compliance) and regulations that clarify procedures for nominating and/or shortlisting women.

Thus, mandatory quotas compel companies to add a substantial number of women to their boards to reach the target. This puts women in positions of power (Wang and Kelan, 2013) and creates a strong demand for women and more intense appointment of WoB that could lead to an increase in the number of women with multiple directorships (Seierstad and Opsahl, 2011). Adding women with multiple directorships throughout the network, but especially in smaller and more peripheral companies, probably makes them unique bridges between sub-networks of directors in otherwise isolated peripheral companies and/or between those companies and the more central ones. As a consequence, there is an increase in the number of times women occupy positions as unique 'bridges' between two directors.

Information circulates more within than between groups, so a key source of social capital for an individual is being the broker between groups not otherwise connected (Burt, 1997). Thus, playing a role as a 'unique' bridge is very important in social networks, since directors connect previously unconnected areas of the network from this position, and thus are in a beneficial brokerage location in terms of flows of information, innovation, mobility and trust between network subsets (Granovetter, 1973). This places women in direct control over information diffusion in the network (Arranz, Arroyabe and Fernandez de Arroyabe, 2020). In other words, betweenness (i.e. the number of times a director is in a path connecting other directors in the network) measures how much information flows through a director and thus the degree to which that director serves as an 'exclusive' broker between pairs of directors. This

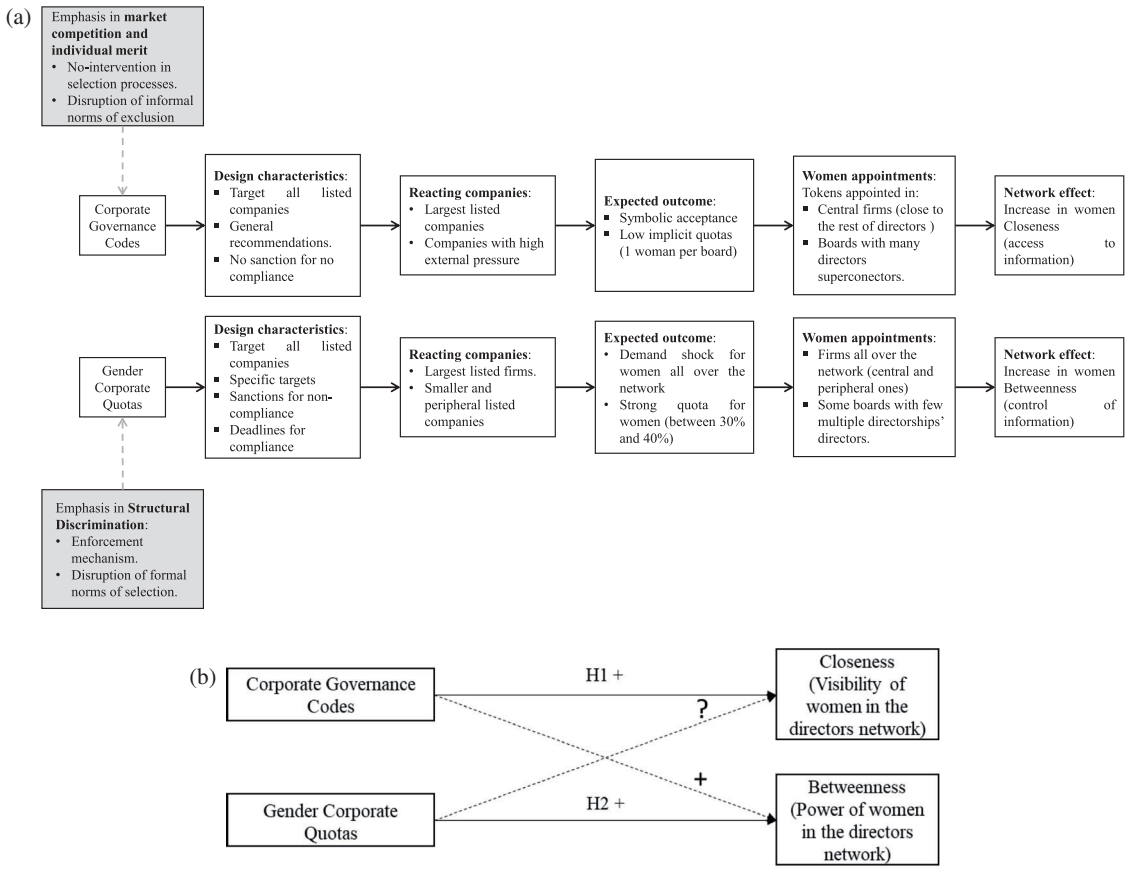


Figure 1. Theoretical framework: (a) our conceptual framework; (b) how interventions to improve the presence of WoB influence their position in the network

position gives a woman director an information advantage over her neighbours (Horton, Millo and Serafeim, 2012) that confers power because she can opt or threaten to stop transmitting information between the two sub-networks joined through her (Borgatti, Everett and Johnson, 2018). By contrast, closeness might not be affected, since women directors are appointed to boards of all sizes and companies with different locations in the network (central as well as peripheral firms).

Based on the above, we hypothesize that:

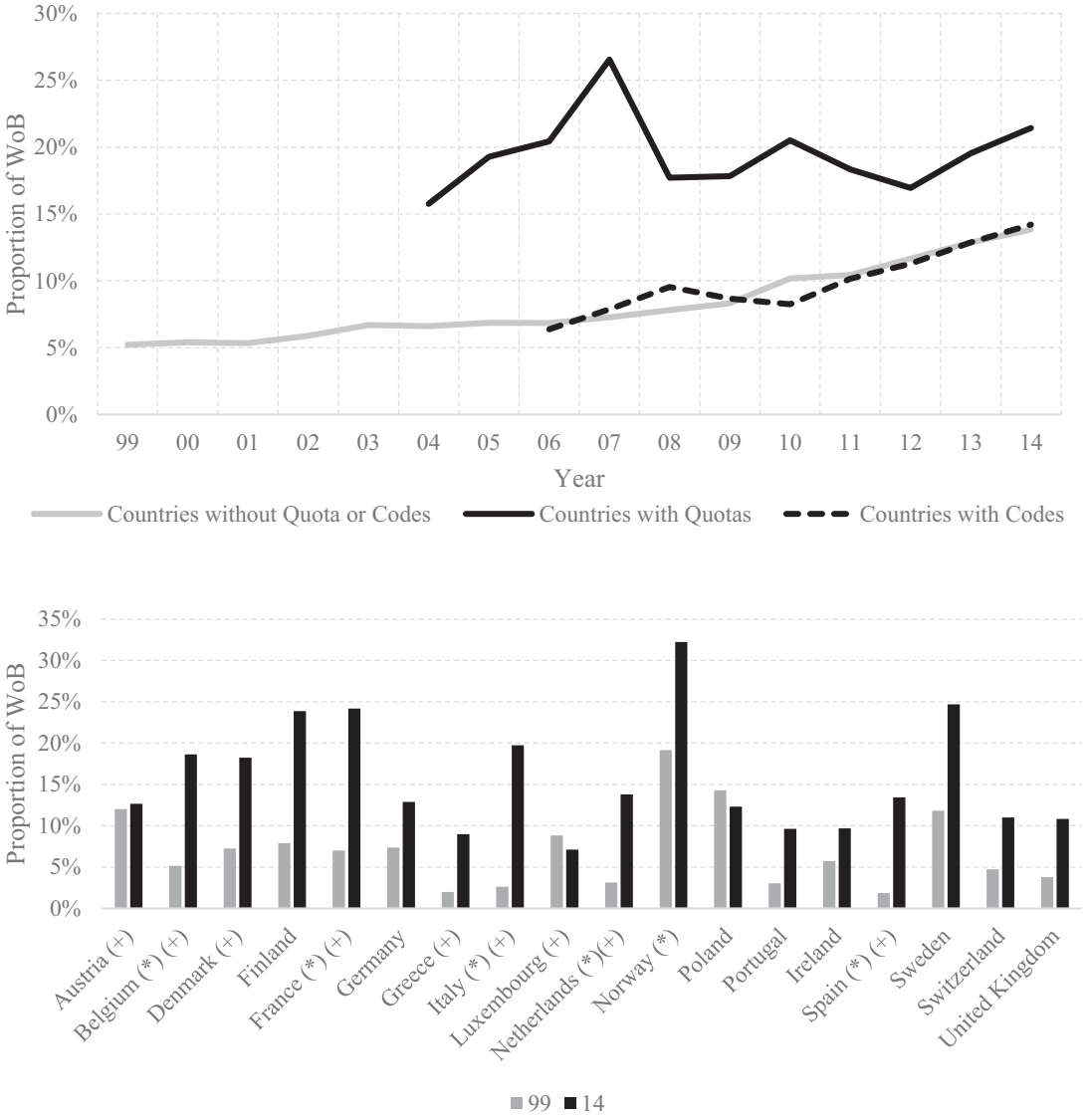
H2: Enacting statutory board quota legislation is related to improvements in the betweenness of women directors within the directors' network compared to men directors in the same network.

A summary of the theoretical framework used for each hypothesis is better visualized through a graph. Figure 1 depicts our conceptual framework (panel a) and how interventions to improve the presence of WoB influence their position in the network (panel b).

Data and methodology

Data collection

Board composition data were obtained from the Boardex database, where we collected the name of each director (of both supervisory and management boards) of publicly traded firms from 1999 to 2014. This database includes the gender of each director, although a manual search was required to clean and complete the information for approximately 10% of the directors with missing gender values. Countries included in the analysis are Austria, Belgium, Bosnia, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania,



* Countries with Quota + Countries with Corporate Governance Code

Figure 2. Evolution of the proportion of WoB between 1999 and 2014 in Europe

Luxembourg, Malta, Monaco, the Netherlands, Norway, Poland, Portugal, Ireland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the UK.

We identified 505,169 board positions, corresponding to a panel of 71,300 different directors. Gender was determined in a two-step process: first, by using the gender variable from Boardex, which left around 10% of the sample without gender identification; second, to complete the sample, we performed a manual search, taking into account the gender of the names and performing Internet searches when in doubt (as in Mateos de Cabo, Gimeno and Nieto, 2012 or Tyrowicz *et al*., 2020), identifying 7,778 women (10.9%). Figure 2 shows that the proportion of WoB has regularly increased each year among countries without a quota, from 5% in 1999 to 15% in 2014, and a shift to around 20% on average for countries with a quota.

Table 1. Network topology

Year	Nodes	Links	Diameter	Average path length	Density	Transitivity	N. Comps	Giant Comps
1999	8,263	159,823	17	5.6632	0.0047	0.6668	192	6,548
2000	11,316	268,132	16	5.8241	0.0042	0.6414	293	8,755
2001	13,041	225,190	15	5.8782	0.0026	0.6288	356	10,140
2002	14,562	263,743	16	5.9253	0.0025	0.6336	426	11,159
2003	16,550	248,723	19	6.1556	0.0018	0.6349	527	12,342
2004	17,888	251,167	19	6.3594	0.0016	0.6282	573	13,463
2005	20,545	352,238	23	6.5217	0.0017	0.6350	662	15,686
2006	22,239	353,950	21	6.7487	0.0014	0.6509	693	17,200
2007	24,442	294,497	21	6.7468	0.0010	0.6613	847	18,062
2008	24,754	286,105	22	6.6578	0.0009	0.6717	889	18,210
2009	23,695	275,163	24	6.6755	0.0010	0.6847	904	16,958
2010	23,534	275,187	20	6.5614	0.0010	0.6811	904	16,977
2011	25,731	337,861	20	6.4212	0.0010	0.6847	985	18,460
2012	27,612	342,987	24	6.5157	0.0009	0.6917	1,052	20,002
2013	29,141	303,526	17	6.5811	0.0007	0.6974	1,177	20,667
2014	31,629	363,115	19	6.7216	0.0007	0.7012	1,323	22,497

Nodes are the number of directors in the net and links are the connections between them. Average path length is the average of the shortest path between all pairs of directors. Diameter is the maximum path required to link two directors. Density is the frequency of the realized connections among directors relative to the potential connections. Transitivity is the transitivity coefficient, referring to the extent to which the relation that relates two nodes in a network that are connected by an edge is transitive; the coefficient ranges from 1 if there is perfect transitivity to 0 for perfect random networks. N. Comps is the number of isolated components of the network and Giant Comps is the number of nodes that belong to the greatest component of the network.

European directors' network properties

For each year from 1999 to 2014, we build a separate network using Newman, Watts and Strogatz's (2002) methodology for affiliation networks. Each network is constructed as follows: each director is a node and, if two directors sit on the same board, they are linked by an edge. In many cases, a director belongs to more than one board and thus happens to function as a connector to other directors. In this network, all members of the same board are connected to each other, creating a network clique (i.e. a group of people connected directly to everyone else). This method of constructing the network allows large networks to be obtained, eliminating the risk of subjective bias in the data collection (Newman, Watts and Strogatz, 2002).

Appendix A provides a graphic illustration of the actual directors' network in 2000 with different shades of grey indicating the node's (director's) gender. Table 1 presents the evolution of the main topological measures of each network from 1999 to 2014, displaying the number of directors (nodes) and connections between them (links). The 2014 network is the largest, with more than 30,000 directors and more than 350,000 direct connections between them.

The topological measures of the network show that its diameter (i.e. the maximum path required to link two directors) is quite small, ranging from 15 to 20. The average path link in the network, that is, the average of the shortest path between all pairs of directors, is around six degrees of separation (typical of the most famous social networks). The network density (i.e. proportion of actual links relative to potential links) is also very low, indicating that a large number of board directors are not directly connected. However, the transitivity coefficient, measuring the mean probability that two directors with a common connected director are themselves connected, is relatively high, ranging from 63% to 71%.

The network is not fully connected, meaning that not every node is reachable from any other node, as seen in Table 1 (the number of isolated components ranges from 192 in 1999 to 1,323 in 2014); however, one giant connected component dominates the network, including the majority of nodes (from 79% in 1999 to 71% in 2014). This implies that, even though the network was built with boards from different countries, there is a connecting path between most directors.

Finally, Table 2 summarizes the evolution of the gender distribution for each year. The number of

Table 2. Summary of the difference between men and women in the network

Year	# Men full network	# Women full network	% Women full network	# Men giant cluster	# Women giant cluster	% Women giant cluster
1999	7,832	431	5.2%	6,213	335	5.1%
2000	10,705	611	5.4%	8,272	483	5.5%
2001	12,345	696	5.3%	9,570	570	5.6%
2002	13,704	858	5.9%	10,468	691	6.2%
2003	15,442	1,108	6.7%	11,475	867	7.0%
2004	16,647	1,241	6.9%	12,471	992	7.4%
2005	19,054	1,491	7.3%	14,514	1,172	7.5%
2006	20,607	1,632	7.3%	15,902	1,298	7.5%
2007	22,514	1,928	7.9%	16,593	1,469	8.1%
2008	22,661	2,093	8.5%	16,604	1,606	8.8%
2009	21,591	2,104	8.9%	15,374	1,584	9.3%
2010	21,255	2,279	9.7%	15,283	1,694	10.0%
2011	22,946	2,785	10.8%	16,345	2,115	11.5%
2012	24,330	3,282	11.9%	17,452	2,550	12.7%
2013	25,268	3,873	13.3%	17,713	2,954	14.3%
2014	27,081	4,548	14.4%	18,941	3,556	15.8%

Distribution of men and women in the networks, both for the full network and for the giant component.

both women and men increased almost every year. Moreover, the percentage of WoB almost tripled in the period under study. Interestingly, the proportion of WoB in the giant component is slightly higher than that in the full network.

Operationalizations

For our analyses, we use two centrality measurements: *closeness* and *betweenness* – the common centrality measures in social network analyses (see Arranz, Arroyabe and Fernandez de Arroyabe, 2020; El-Khatib, Fogel and Jandik, 2015; Freeman, 1979; Sabidussi, 1966). Closeness measures the inverse of the distance from each director to every other director in the network – the links that must be crossed to reach each other. Higher closeness implies that the director is 'closer' to all other directors in the network, so it takes into account the distance of a director to the rest of the network. The higher the closeness, the greater the amount of information they receive from other directors in the network quickly. More precisely, the closeness of node i is given by

$$C_c(i) = \frac{1}{\sum_j^N d\,(i,\, j)}$$

where $d(i,\, j)$ is the shortest (geodesic) distance of director i to all other directors j. In the case of unconnected directors, we considered the distance equal to N, where N is the number of directors in the network. We normalized the measure for each year (dividing the measure by the maximum possible closeness: 1/N−1) to be able to compare the relative centrality for different years and took logarithms to take into account the heterogeneity found in the variable.

The second measure, betweenness (Freeman, 1979), shows the extent to which a director is 'between' pairs of directors in the network (i.e. the number of times the director acts as a bridge between any other pair of directors). A director with high betweenness implies that many directors need him/her to reach other directors via efficient paths. Thus, high betweenness implies a more influential and powerful director, as she/he would connect other directors and influence the flows (of knowledge or information) around a system, acting as a 'knowledge broker' (Seierstad and Opsahl, 2011). The mathematical formula for betweenness is

$$C_B\,(i) = \sum_{j<k} \frac{g_{jk}\,(i)}{g_{jk}}$$

whereg_{jk} is the number of binary shortest paths (geodesics) between two directors j and k, and $g_{jk}(i)$ is the number of those paths that go through director i. Once more, we normalized the measure for each year (dividing by $(n-1)(n-2)/2$, where n is the size of the component to which director i belongs) to compare the relative centrality for

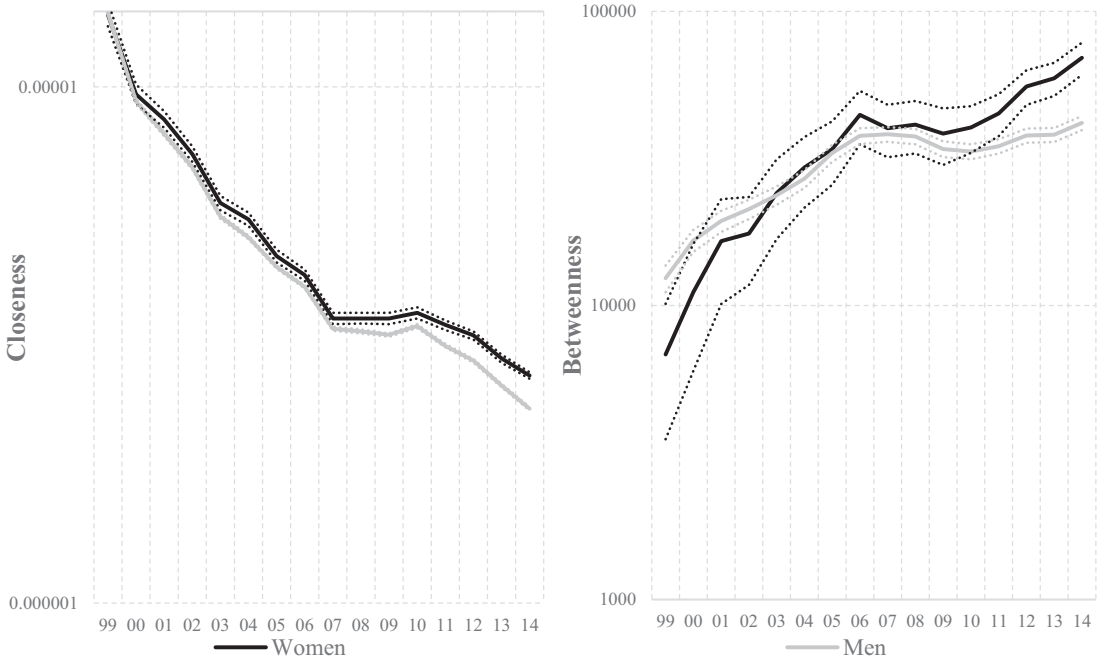


Figure 3. Evolution of the mean network centrality measures for both women and men. Closeness *is the average distance of each director to the other directors in the network (left).* Betweenness *is a measure of the number of times that a director is in the shortest path between two other directors in the network (right). Solid lines represent the average for each year for women (dark grey) and men (light grey), while the dotted lines represent the 95% confidence intervals*

different years and took logarithms to take into account the heterogeneity found in the variable. Figure 3 shows the evolution of both centrality measures for women and men, and Appendix B provides an example of the calculations and how different directors have different values of closeness and betweenness.

Gender quota laws and corporate governance codes have been operationalized as dummy variables and equal 1 for countries and years in which there is a gender quota law or governance code that includes a recommendation for board gender diversity, respectively, and 0 otherwise. For gender quota laws, we used information from European Women Shareholders Demand Gender Equality (EWDSGE, 2016) by the European Women Lawyers Association (www.ewla.org), completed with public statements for the later cases of Austria and Portugal in 2017. For the 10 countries identified with a board gender quota (Norway, Spain, Italy, Belgium, France, Iceland, the Netherlands, Germany, Portugal and Austria), the quota ranged from 30% to 40% (Figure 4). This group includes countries with either soft – without sanctions – or hard – with strong sanctions – quota regulations.

For corporate governance codes, we used the 220 codes available in the European Corporate Governance Institute database and NVivo qualitative data analysis software to identify those sections with a reference to 'gender' or 'diversity'. Finally, we manually analysed the 70 codes identified to establish which ones recommended a policy of board gender diversity. The results of this analysis are the codes identified in Figure 4.

The UK Corporate Governance Code of 2012 included broad references to gender, influenced by the Lord Davies Report of 2011 that set the voluntary target of 25% women on the boards of FTSE 100 companies by the end of 2015. It is remarkable that several countries have both codes and quota laws: the Netherlands, Belgium, Germany and Portugal first approved codes (2008, 2009, 2010 and 2016) and then quota laws (2011, 2011, 2015 and 2017), while France and Italy approved both the same year (2011). Spain and Iceland are special cases, where codes (2006 and 2009) were followed by quotas (2007 and 2010) and then new codes (2015 and 2012). This is possible as quota laws and references to gender on corporate governance codes follow different channels: quotas are usually

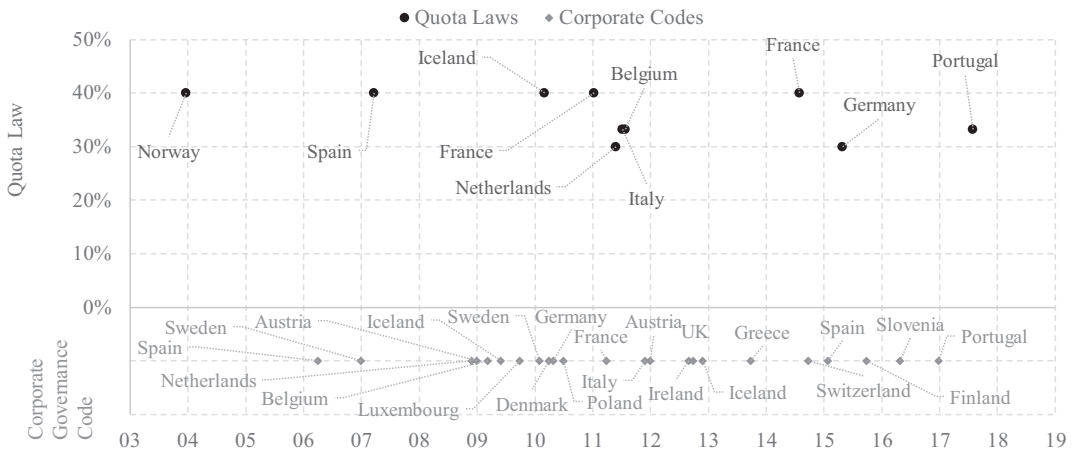


Figure 4. Adoption of quota laws and inclusion of recommendations for board gender diversity on corporate governance codes in Europe

passed as national laws and corporate governance codes are merely recommendations for listed firms in those countries.

Econometric models

To empirically confirm the effects of regulatory pressures on directors' influence centrality measures, we estimate a panel data model:

$$\begin{aligned} \mathrm{Y_{it}} = {} & \beta_{\mathrm{w}} \cdot \mathrm{Woman}_i + \beta_q \cdot \mathrm{Quota_{it}} \\ & + \beta_c \cdot \mathrm{Code_{it}} + \beta_{\mathrm{wq}} \cdot \mathrm{Woman_i} \cdot \mathrm{Quota_{it}} \\ & + \beta_{\mathrm{wc}} \cdot \mathrm{Woman_i} \cdot \mathrm{Code_{it}} + \alpha_{\mathrm{t}} + \omega_{\mathrm{i}} + \varepsilon_{\mathrm{it}} \end{aligned} \quad (1)$$

where Y_{it} represents the centrality measurement used (i.e. *Closeness*, *Betweenness*); $Woman_i$ is a dummy variable equal to 1 if the director is a woman; $Quota_{it}$ is a dummy variable that equals 1 if the director is in a country and year where a board gender quota is in place (those directors sitting on boards in more than one country were assigned to the country where they had more seats and, in case of an equal number of seats, by their nationality); $Code_{it}$ is a dummy variable equal to 1 if the director is in a country and year where there was a code of corporate governance that includes a recommendation for board gender diversity; $Woman_i \cdot Quota_{it}$ and $Woman_i \cdot Code_{it}$ are the interaction variables that allow assessing the impact of both gender quota laws and corporate governance codes; α_t are year constants controlling for the network's time evolution, as well as changing economic, political and/or sociological conditions; ω_i is a fixed-effects variable with different values for each director, which takes into account unobserved characteristics (e.g. age, education, experience, family); and finally, $\varepsilon_{it} \sim N(0, \sigma_\varepsilon)$ is the noise variable and takes different values for each director and year. Since the model has time and director fixed effects, we avoid potential endogeneity problems that could be caused by unobserved characteristics of each director and year.

Results

In Table 3, we present the estimations obtained from applying Model (1) to closeness, while Table 4 shows the estimations for betweenness. In both cases, we estimated fixed and random-effects specifications, and the Hausman test indicates that the only consistent indicator is the fixed-effects model.

Women tended to have higher closeness (access) in the directors' network (Table 3, column 1 and Figure 3, left). This higher access could be due to the fact that women tended to have greater presence in the largest listed companies, which occupy central positions in the network. On the contrary, women directors' power in terms of betweenness was lower (Table 4, column 1 and Figure 3, right); as they were usually surrounded by very well-connected men directors, their positions as bridges between two directors in the network might be redundant.

Corporate governance codes with recommendations for board gender diversity coincide with a clear increase in women's closeness in the directors' network (Table 3), confirming H1. By

Table 3. Panel regression on directors' network Closeness *(log)*

	(1) *Closeness*	(2) *Closeness*
Woman	0.281***	
	(0.033)	
Quota	0.018	0.058**
	(0.024)	(0.027)
*Woman * Quota*	−0.191***	−0.117
	(0.064)	(0.078)
Code	−0.145***	−0.404***
	(0.023)	(0.025)
*Woman * Code*	0.306***	0.220***
	(0.065)	(0.079)
# Directors	71,300	71,300
# Observations	334,856	334,856
Director random effects	Random	Fixed
Year fixed effects	Yes	Yes
Wald chi^2	286,801.6***	10,755.9***
Hausman test		2,158.3***

*** Coefficient statistically different from 0 with 1% level of significance; ** 5% level. *Closeness* is the inverse of the distance of each director to the other directors in the network (normalized and in logarithms). *Woman* is a dummy variable equal to 1 if the director is a woman; *Quota* is a dummy variable equal to 1 for the countries and years where a gender quota is in place; *Code* is a dummy variable equal to 1 for countries and years where there is a code of corporate governance that includes recommendations for board gender diversity. Each model includes *Director* random effects to take into account unobserved characteristics of each director (e.g. age, education, experience) and *Year* fixed effects to take into account the time evolution of the network.

Table 4. Panel regression on directors' network Betweenness *(log)*

	(1) *Betweenness*	(2) *Betweenness*
Woman	−0.111***	
	(0.032)	
Quota	−0.238***	−0.318***
	(0.034)	(0.043)
*Woman * Quota*	0.434***	0.897***
	(0.083)	(0.125)
Code	0.309***	0.155***
	(0.032)	(0.040)
*Woman * Code*	0.040	0.660***
	(0.085)	(0.127)
# Directors	71,300	71,300
# Observations	334,856	334,856
Director effects	Random	Fixed
Year fixed effects	Yes	Yes
Wald chi^2	1,828.1***	261.2***
Hausman test		4,971.3***

*** Coefficient statistically different from 0 with 1% level of significance. *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network (normalized and in logarithms). *Woman* is a dummy variable equal to 1 if the director is a woman; *Quota* is a dummy variable equal to 1 for the countries and years where a gender quota is in place; *Code* is a dummy variable equal to 1 for countries and years where there is a code of corporate governance that includes recommendations for board gender diversity. Each model includes *Director* either random or fixed effects to take into account unobserved characteristics of each director (e.g. age, education, experience) and *Year* fixed effects to take into account the time evolution of the network.

contrast, there is a negative, although statistically non-significant, relationship between gender quota laws and closeness (Table 3, column 2). References in corporate governance codes are also positively related to women's betweenness, but to a lesser extent than gender quota laws (Table 4). Indeed, gender quota laws are associated with a considerable increase in women's betweenness, confirming H2.

We performed several robustness tests that confirm these findings. In Table 5, we show the results if only hard quota laws are considered, and exclude the soft quota laws of Spain and the Netherlands (see Mateos de Cabo *et al.*, 2019). Both hypotheses are also supported in this case (Table 5). We also used country subsamples, excluding small countries from the network (Table 6), which resulted in outcomes similar to those in the main estimations.

Finally, we consider the different roles that executive and non-executive (i.e. independent) directors may play in the network. It is not possible to separate the network into two different ones since some directors (12% of the network) work as an executive director on one board and as an independent director on another board. However, we can consider that the potential effects on closeness and betweenness might vary between these roles. To check this, we present the regression results in Table 7 for directors who are executive directors on at least one board (columns 1 and 2) and for those who are independent directors on at least one board (columns 3 and 4). For executive directors, neither quota laws nor corporate codes influence closeness, but there is an increase in betweenness, while for independent directors, the results of corporate governance codes and quota laws are clearer in terms of betweenness and closeness.

Discussion and conclusions

An abundance of studies examine how quotas and recommendations in corporate governance

Table 5. Robustness panel regression on directors' network Closeness *(log) and* Betweenness *(log), without soft quota laws*

	(1) *Closeness*	(2) *Betweenness*
Hard Quota	0.199***	−0.191***
	(0.029)	(0.045)
*Woman * Hard Quota*	−0.147*	0.812***
	(0.084)	(0.129)
Code	−0.476***	0.063
	(0.024)	(0.039)
*Woman * Code*	0.222***	0.757***
	(0.078)	(0.125)
# Directors	3,348,562	334,856
# Observations	71,300	71,300
Director fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Wald chi^2	10,760.1***	259.32***

*** Coefficient statistically different from 0 with 1% level of significance; * 10% level. *Closeness* is the inverse of the distance of each director to the other directors in the network (normalized and in logarithms). *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network (normalized and in logarithms). *Woman* is a dummy variable equal to 1 if the director is a woman; *Hard Quota* is a dummy variable equal to 1 for the countries and years where a hard gender quota is in place; *Code* is a dummy variable equal to 1 for countries and years where there is a code of corporate governance that includes recommendations for board gender diversity. Each model includes *Director* fixed effects to take into account unobserved characteristics of each director (e.g. age, education, experience) and *Year* fixed effects to take into account the time evolution of the network.

codes increase the number of WoB (e.g. Ahern and Dittmar, 2012; Bohren and Staubo, 2014; Mateos de Cabo *et al*., 2019; Matsa and Miller, 2013; Terjesen and Sealy, 2016; Terjesen, Aguilera and Lorenz, 2015), as well as on the tendency of women directors to hold more multiple directorships (Hawarden and Marsland, 2011; Terjesen, Sealy and Singh, 2009). However, few studies investigate the consequences of regulatory pressures on the economic empowerment of women, since being known (i.e. high closeness) is not the same as being a controller of the information flow (i.e. high betweenness). In this study, we follow Sealy *et al*.'s (2017) recommendation to focus on change mechanisms (quotas versus codes) by surveying their impact on women's empowerment in directors' networks.

Affirmative action policies and efforts to comply with quotas and/or corporate governance codes force companies to appoint women, but the question arising in every debate is whether these appointments are symbolic moves or true opportunities for empowering women. This is an important issue, as women are sometimes included on boards as a token to comply with social demands for diversity (e.g. Elstad and Ladegard, 2012; Torchia, Calabrò and Huse, 2011). If this is the case, although regulations are complied with, there would be small changes in the decision-making status quo and the de facto power of these women would remain very limited, if not null. In this study, we move away from just counting heads and study how affirmative action policies in different countries have affected WoB in terms of their access to influential connections, networks and, at the end of the day, power.

The present study analyses whether political and regulatory pressures in Europe to promote women's access to boards have led WoB to obtain greater influence within the directors' network or whether, on the contrary, it has led to merely symbolic compliance, failing to improve the roles and positions of women in these networks. In the latter case, regulatory pressures would not be completely effective, remaining compensatory measures that affect only the numbers of WoB but not increasing women's real power.

In our theoretical approach, we show that the theory used to explain the scarcity of WoB (market competition and individual merit versus structural gender discrimination) justifies the adoption of measures with different degrees of pressure as remedies (gender diversity recommendations in corporate governance codes versus corporate gender quotas). Each instrument drives a different degree of compliance by companies that act to avoid eventual public intervention and which have diverse network locations.

Companies that comply with gender diversity recommendations in corporate governance codes tend to be the most central companies and are subject to high public scrutiny. Therefore, their commitment to those recommendations seems to be limited, creating a small demand of (initially token) women for their boards, highly interconnected but with redundant ties. Thus, the effect of recommendations in corporate governance codes is to enhance the visibility of WoB in the network. Indeed, women's closeness to other directors increases significantly when a corporate governance code includes a board gender diversity recommendation.

Table 6. Robustness panel regression on directors' network Closeness *(log) and* Betweenness *(log), for subsamples*

	EU+EFTA countries		Big countries	
	(1) *Closeness*	(2) *Betweenness*	(3) *Closeness*	(4) *Betweenness*
Quota	0.064**	−0.312***	0.562	−0.020
*Woman * Quota*	−0.116	0.906***	−0.308***	0.828***
	(0.078)	(0.125)	(0.109)	(0.166)
Code	−0.397***	0.153***	−0.906***	−0.188***
	(0.025)	(0.040)	(0.036)	(0.058)
*Woman * Code*	0.220***	0.659***	0.413***	0.744***
	(0.079)	(0.127)	(0.116)	(0.186)
# Directors	328,808	328,808	284,293	284,293
# Observations	69,449	69,449	60,291	60,291
Director fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Wald chi^2	10,729.3***	256.22***	9,539.99***	209.27***

*** Coefficient statistically different from 0 with 1% level of significance; ** at 5% level. Columns 1 and 2 are a subsample of EU countries in 2014 plus Switzerland, Norway, Iceland and Liechtenstein). Columns 3 and 4 are a subsample for those countries with bigger samples: UK, Germany, France, Italy, Spain, Netherlands, Sweden, Switzerland and Norway. *Closeness* is the inverse of the distance of each director to the other directors in the network (normalized and in logarithms). *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network (normalized and in logarithms). *Woman* is a dummy variable equal to 1 if the director is a woman; *Hard Quota* is a dummy variable equal to 1 for the countries and years where a hard gender quota is in place; *Code* is a dummy variable equal to 1 for countries and years where there is a code of corporate governance that includes recommendations for board gender diversity. Each model includes *Director* fixed effects to take into account unobserved characteristics of each director (e.g. age, education, experience) and *Year* fixed effects to take into account the time evolution of the network.

In contrast, when a mandatory quota is enacted, all targeted companies must comply. This creates an intense demand for WoB throughout the network, which contributes to increasing the number of directorships women hold and locating them between pairs of directors from more peripheral companies (that otherwise would be disconnected), as well as between such companies and more central ones. Our results show that board quotas are linked to a significant boost in women's betweenness in the network, making them 'bridges' with advantages over their peers as intermediaries of information between the network's centre and periphery. Therefore, quotas tend to increase women directors' power as unique bridges to allow information in the directors' network to flow or stop, while codes are useful for promoting their access to information in the network.

According to these results, we infer that quotas lead companies to look for women and locate them in strong positions in the network, which could be a potential sign of elite co-optation (Heemskerk and Fennema, 2014). Indeed, the most thought-provoking contribution of the study is that to challenge the confidence of some stakeholders (fundamentally business leaders), voluntary (rather than legislative) measures are best suited to address the issue of under-representation of women on boards. We do this by moving beyond the 'counting heads' approach and offering more nuanced results about the poor consequences for women's empowerment in the European business elite, using different shades of power measures borrowed from social network theory. If practitioners are truly looking for the benefits that potentially can come from improved board decision-making processes and more inclusive organizational cultures (Terjesen, Sealy and Singh, 2009), our results show that they are unlikely to reach it based only on voluntarism. This approach seems to lead to appointed women playing in a secondary league, a consequence of holding fewer directorships and being easily bypassed in the directors' network, which makes them weaker in terms of the exchange of information, knowledge and power.

We acknowledge some limitations in our analysis. There was a global financial crisis within the period analysed that, according to the glass cliff theory (Ryan and Haslam, 2005), might open previously unavailable opportunities for women in leadership positions. Nevertheless, Ryan *et al.* (2016) pointed out that the precariousness of the

Table 7. Robustness panel regression on the directors' network Closeness *(log) and* Betweenness *(log), for executive and independent directors*

	Executive directors		Independent directors	
	(1) *Closeness*	(2) *Betweenness*	(3) *Closeness*	(4) *Betweenness*
Quota	0.068	−0.402***	0.014	−0.361***
	(0.054)	(0.092)	(0.032)	(0.056)
*Woman * Quota*	−0.083	1.269***	−0.024	1.001***
	(0.152)	(0.266)	(0.092)	(0.164)
Code	−0.448***	0.207**	−0.355***	0.173***
	(0.049)	(0.086)	(0.030)	(0.052)
*Woman * Code*	0.198	1.023***	0.190**	0.704***
	(0.157)	(0.274)	(0.093)	(0.165)
# Directors	133,307	133,307	242,475	242,475
# Observations	52,060	52,060	64,090	64,090
Director fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Wald chi^2	3,810.2***	144.22***	8,460.5***	174.33***

*** Coefficient statistically different from 0 with 1% level of significance; ** at 5% level. A director is considered *Executive* if she/he is an executive director for at least one board in the network. A director is considered *Independent* if she/he is an independent director for at least one board in the network. *Closeness* is the inverse of the distance of each director to the other directors in the network (normalized and in logarithms). *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network (normalized and in logarithms). *Woman* is a dummy variable equal to 1 if the director is a woman; *Quota* is a dummy variable equal to 1 for the countries and years where a gender quota is in place; *Code* is a dummy variable equal to 1 for countries and years where there is a code of corporate governance that includes recommendations for board gender diversity. Each model includes *Director* fixed effects to take into account unobserved characteristics of each director (e.g. age, education, experience) and *Year* fixed effects to take into account the time evolution of the network.

glass cliff may also help explain the stagnation in rates of change: if women are less likely to succeed and thrive in such positions, they are also less likely to be appointed to leadership positions in the future. Therefore, the phenomenon has opposing effects on the presence of WoB that may be cancelling each other out with no significant final result. What is clear is that the glass cliff has had a significant impact on public discourse about women and leadership (Ryan *et al*., 2016). This public discourse has led to the enactment of corporate governance codes and mandatory gender quotas in many countries, the authentic drivers of the increase in the number of women in leadership positions, which are precisely the measures that we analyse in this study.

Another potential drawback might be that some directors from country i might also be members of a board in another country j that has a code or quota law. Thus, our model would not capture these possible cross-country effects. However, we consider this a minor issue in terms of the hypotheses we test, since not capturing these cross-country appointments driven by codes or quota laws would only shadow the relationships between the policy intervention and closeness/betweenness measures, resulting in estimated coefficients that are the lower bounds of the real (larger) ones.

We propose additional, rather straightforward ways to further improve this line of research. First, as we collected board-composition data from Boardex (which only includes listed firms), it is possible that our sample is biased towards larger, often more interconnected corporations, with the result that the centrality measures used to assess director power in the network were somewhat overvalued. However, this is not a strong limitation in the majority of the countries in our sample, given that most quota laws (with the exception of the Spanish and French quota laws) and corporate governance codes are aimed only at the largest listed companies of each country.

Second, we only observed connections between directors in terms of board membership, but there are other potential network-like ties, such as those through business networks, family relationships, attendance at the same schools and universities (Burt, Hogarth and Michau, 2000), elite organizations (such as golf club memberships, religious activities, political affiliations), business associations

or alternative boards (such as non-profit boards). These could be interesting for exploring the specific origins of women director networks, as opposed to men director networks. This would imply the use of multilayer network analysis, where boards are just one layer of the multiple networks that constitute people's community lives (see Kivelä *et al*., 2014). This knowledge, in turn, could help us better understand how women get appointed to boards and, as a consequence, their role and influence in a traditional directors' network. In this regard, Zenou, Allemand and Brullebaut (2012) find that compared to French men directors' networks, French women directors' networks more often originate through business ties rather than interlocking directorates. Nevertheless, these social or grey ties add noise to our network, potentially biasing the network effects we found (Horton, Millo and Serafeim, 2012). Network structure analysis requires, first, attention to the quality of the constituent ties, including their frequency and intensity (Adler and Kwon, 2002), something that can be ensured by focusing on a formal network like the one created by boards of directors.

Finally, to offer insight into a future research agenda, it would be useful to study variations in the design of affirmative action on the power and influence of women in the European directors' network. Elements such as the percentage and types of companies targeted, the length of the implementation period, or whether sanctions for non-compliance have an effect would need to be considered. There are also critical differences within corporate governance codes' approaches to gender equality, which should be accounted for. Another promising field of research would be a dynamic study of the network's topological and structural properties, which could allow us to see differences in the probability of leaving or entering a board, given the actual location(s) of the women directors within it. The centrality definitions that come from network theory would also allow testing with more rigour and nuance if the 'golden skirt' phenomenon observed in Norway (Seierstad and Opsahl, 2011; Strøm, 2019) holds in other countries, or even at European level. The different roles that independent/executive directors play in the network, how they are connected and their persistence is another promising line of research. Additionally, future research could look for meaningful firm outcomes associated with women's influence. Such outcomes could include performance measures, such as returns, risk or fraud (e.g. Cumming, Leung and Rui, 2015). In this regard, if real power and visibility are meaningful, these or other outcomes should show a measurable benefit. Furthermore, future analysis could delve deeper into the profiles of the network's main hubs/superconnectors. Understanding their educational and professional backgrounds would shed light on how networks are formed. Finally, the social network analysis field is growing rapidly and new measures, techniques and methodologies are increasingly available, allowing new research in the future (Jaspersen and Stein, 2019).

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix A: Graphing the network of the European Board of Directors
Appendix B: Social network centrality: Definitions and a simple example