Title: **There is something about networks:**

Effects of political and regulatory pressure on women's board networks

Author(/s): **Ruth Mateos de Cabo; Pilar Grau; Patricia Gabaldon; Ricardo Gimeno**

Date: **October-2018**

WORKING PAPER SERIES: 3/2018

CÁTEDRA CEU-MM
Madrid (Spain)
ISSN online: 2530-0237

There is something about networks:

Effects of political and regulatory pressure on women's board networks *

Ruth Mateos de Cabo; Pilar Grau; Patricia Gabaldon; Ricardo Gimeno

Abstract

This paper analyzes the impact of the political and regulatory pressure to increase the presence of women on boards by various European countries on female directors' centrality on the European board member's network. We use a longitudinal approach, following the evolution of the main topological measures of a European global director network (that is made up of listed firms of 39 countries and 4 territories in Europe obtained from Boardex) from 1999 to 2014. This results in an extensive sample of 425,322 observations of board of director positions, corresponding to 41,107 different directors of which 11.9% are women.

The results of the panel data models show that although affirmative action has accelerated the representation of women on boards, it has had different effects on their location on the network. This way, Corporate Governance Codes recommendations to promote gender diversity on boards have a positive direct effect on those centrality measures that are more related with visibility (degree) and closeness in the network (what we interpret as measures of 'soft' influence), whereas Board Gender Quotas produces a clear increase in those other measures that denote real power (betweenness as meaning control of flows, and eigencentrality measuring how well connected a director is).

Key words: Boards of Directors; Women on Boards; Social Networks; Gender Quotas; Governance Codes

JEL Codes: D85; G34, G38; J16; J71

(*) Ruth Mateos de Cabo (matcab@ceu.es) Universidad CEU San Pablo, Madrid (Spain); Pilar Grau (pgrau@urjc.es) Universidad Rey Juan Carlos, Madrid (Spain); Patricia Gabaldon (patricia.gabaldon@ie.edu) IE Business School, Madrid (Spain); Ricardo Gimeno (ricardo.gimeno@bde.es) Banco de España, Madrid (Spain).

We are thankful to Ruth Sealy, Diana Bilimoria and those attending EURAM 2018, and AoM 2018 for their comments and suggestions. This research has received financial support by the Spanish Government (Ministerio de Economía, Industria y Competitividad –Agencia Estatal de Investigación) and the European Union (FEDER) for their financial support (FEM2017-83006-R); Banco Santander (XIV Call for research mobility grants CEU-Banco Santander), and from Cátedra Universidad CEU San Pablo – Mutua Madrileña.

I. INTRODUCTION

The purpose of this paper is to analyze the position of women in the directors' network, and how different types of affirmative actions (i.e., gender quotas and corporate governance codes) modify this position.

Presently, men outnumber women in business leadership positions in the EU-28 countries. In 2015, women are just one in five of all directors in the EU-28 (EIGE, 2017). In this environment, eight European countries have implemented quota laws for the representation of women on boards. It is relevant to acknowledge that each of these countries have implemented different quota strategies (Gabaldon *et al*., 2017). There are only ten countries - France, Sweden, Italy, Finland, the Netherlands, Latvia, Germany, the United Kingdom, Denmark, and Belgium - in which women account for at least a quarter of board members (EIGE, 2017). Each one of these countries has applied a different strategy for promoting board diversity.

Over the last decades, women on boards (WoB) has become an intensive field of research, with a magnitude that can be understood comparing the literature reviews in Terjesen *et al*. (2009) and Kirsch (2018). There are a lot of studies on factors driving the low proportion of WoB (e.g., Grosvold and Brammer, 2011; Mateos de Cabo *et al*., 2012; Terjesen *et al*., 2015; Smith and Parrota, 2018), and many of them mention as one of those factors leading to this situation the old boy's club (Perrault, 2014), the closed environment (network) where relationships/acquaintance with CEO's and other directors are key for director appointments (e.g., Mateos de Cabo *et al*., 2011). However the lack of this type of social capital among many women prevents them from breaking the glass ceiling (Gabaldon *et al*., 2016). Thus, the study of social networks in the context of board of directors is a key element in this field that requires a close scrutiny.

On the other hand, regarding the literature on social networks, there is also considerable quantitative research on the study of director networks topological characteristics (Davis *et al*., 2003; Battiston and Catanzaro, 2004; Robins and Alexander, 2004; Conyon and Muldoon, 2006; Daolio *et al*., 2011; Huang *et al*., 2011; van Veen and Kratzer, 2011). There are also numerous studies on the effects of directors networks on diverse actions and outcomes: board room issues such as directors remuneration and recruitment

(Geletkanycz *et al*., 2001; Renneboog and Zhao, 2011; Liu 2014; Mergers and Acquisitions (M&A) activity and outcomes (Renneboog and Zhao, 2014; Cai and Sevilir, 2012; El-Khatib *et al*., 2015; Ishii and Xuan, 2014); or firm performance (Geletkanycz and Boyd, 2011; Larcker *et al*., 2013).

Nevertheless, research into director networks suffers from a scarcity of studies that consider the issue of gender. As far as we know, the only two studies that use this gender perspective are Seiestard and Opshal (2011) and Hawarden and Marsland (2011), the former to explore the effects of the Norwegian gender quota on female directors' social capital and the latest to study the location of women directors in the network components at a global (Fortune Global 200) and national level (New Zealand Stock Exchange).

Similarly, in the WoB research, director networks has not been considered as we have seen previously. In this paper we bridge this gap through the use of social network to analyze if political and regulatory pressure by various European countries leads to a change on women's influence in the board member's network and therefore to a change in the in Europe board networks system.

In this regard, when explaining the scenario for gender quotas on boards all over the globe, Terjesen and Sealy (2016) point towards the importance of understanding, not only the reasons but also the consequences, of gender quota laws and other affirmative action's policies. Specifically, there is a need to "use social network approaches to examine how individual actors (nodes) have relationships (ties) with others (see 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 *et al*. (2007) of offering a "richer understanding of the specific resources individual directors bring to a board, as well as their motivations to contribute to them" (p.35). Understanding the interlocks differentiated between male and female directors may provide new insights on the diverse forms of board interdependencies and interactions.

To do this, we use a longitudinal approach, following the evolution of the main topological measures of a European global director network that is made up of listed firms of 39 countries and 4 territories in Europe obtained from Boardex from 1999 to 2014.

This results in an extensive sample of 425,322 observations of board of director positions, corresponding to 41,107 different directors of which 11.9% are women.

This study provides several contributions. First, to our knowledge, this is the first try to understand the effects of affirmative action policies on the principal measures of women directors' influence on the directors' network (Kumra and Vinnicombe, 2010; Stevenson and Radin, 2009) on a European scale, especially the changes on the role played by women directors on the network. This work extends the women on boards' literature by shedding light on the institutional mechanisms for improving female participation on boards' networks. Second, our results indicate the degree of opportunities democratization for women depends on the type of affirmative action policies that are being implemented. Extending works related to women on boards and affirmative actions (Seierstad, *et al*., 2017; Terjesen, *et al*., 2015), we stress the role of the regulatory pressure degree in breaking the homophilic selection paths to boards (Ibarra, 1992, 1997), which according to our results is higher when quota legislation is implemented than when soft measures (Corporate Governance Codes) are introduced.

The rest of the paper is organized as follows. Next section offers a review of the literature on director networks and propose the hypotheses. Section 3 exposes the methodology, presenting the sample, the directors' networks constructed and the measures of centrality used in the analysis. Section 4 presents the results of the panel regressions and principal components. Finally, Section 5 concludes the paper.

II. THEORY DEVELOPMENT AND HYPOTHESIS

Social networks are fundamentally different from other types of networked systems. According to Newman and Park (2003), social networks present two important differences with regard to non-social networks: i) they show distinctly different patterns of correlation between the degrees of adjacent vertices, with degrees being positively correlated (assortative mixing) in most social networks.; ii) they show high levels of clustering or network transitivity. Both of these differences can be explained by the same

hypothesis: social networks are divided into communities, and non-social networks are not.

One important social network, especially in the fields of economics, finance and management, is the board of directors. It is well known that directors frequently occupy more than one board position (Conyon and Muldoon, 2006). Indeed, there is considerable research that through the use of well-established techniques in complex network theory (Caldarelli, 2007; Newman, 2010) study quantitatively (topological properties and characteristics) national networks of interlocking directorates.

In this regard, Davis *et al*. (2003) examined the stability of the structure (connective) of the US Fortune 1000 network of corporate directors, finding that the corporate elite is a small world (the average distance between directors and between firms is very short) and that this property is highly resilient despite the massive turnover of companies and directors. The authors argue that the small word organization of the corporate elite it is an endemic property of social (emergent property) and other networks and requires no without intentional design by any central planning authority.

Similarly, Battiston and Catanzaro (2003) and Caldarelli and Catanzaro (2004) apply network theory to characterized director networks for the US Fortune 1000 and the Italian Stock Market corporations. They found that the common features in the network of the major entities of a country are: small world networks; assortative, (directors with high (low) degree tend to be connected to directors with high (low) degree); highly clustered (they have a remarkable tendency towards clicquishness); and dominated by a giant component (the largest group of connected actors), implying a high level of exchange of information and influences conveyed by interlocks between boards.

Robins and Alexander (2004) looked at directors in the US and Australia. Comparing the network to simulated random graph distributions, they found that the small-world structure was not due to highly connected individuals working on lots of teams but on teams with many individuals that shared multiple interlocks (superconnectors).

Heinze (2004), in a longitudinal study of large German corporations, concludes that the institutional change in the German system of corporate governance has not lead to major structural changes on the network of interlocking directorates.

Conyon and Muldoon (2006) study the boards of director network of UK, US and German firms. They found that that the small world traits in the networks are no more pronounced than to what would be expected in a random network of the same size. In short, boards of directors, especially in the United States, are no more 'clubby' than would be expected by chance.

Daolio *et al*. (2011) studying the networks of top Swiss companies, found out that the topological structure of the director networks has evolved in such a way that special actors and links between actors strongly influences the flow of information among distant parts of the network, indeed the authors find that average propagation speed is notably slower in the real network than in randomized versions of it and that the many cluster structures present in the directors network are responsible for the slowing down.

Huang *et al*. (2011) analyze the power of directors in the US corporate governance network, and found that the directors that are most influential in the network are not necessarily those that serve in the board of the biggest companies.

In an European context, van Veen and Kratzer (2011) using data collected concerning 362 large publicly listed European corporations in fifteen European countries find a link between a country's economic system and the density of its national corporate network.

Other empirical studies have focused on the effects of directors networks on board room issues such as decision making on managerial compensation, hiring and firing of top management, the recruiting of non-executive directors, and corporate restructuring (Renneboog and Zhao, 2014).

For instance, Geletkanycz *et al*. (2001) using a sample of Fortune 1000 firms, find that when firms are more diversified a substantial premium is levied on CEOs' external directorate ties. Renneboog and Zhao (2011) for a large panel a large data panel consisting of all listed UK companies demonstrate that CEO's direct and indirect connections affect

his power and his information-collection value, which is reflected in a higher remuneration. Liu (2014) shows that a CEO's connections enhance his opportunities to leave his firm for another challenge.

In the context of mergers and acquisitions (M&A) results are inconclusive. Renneboog and Zhao (2014) show that the degree of connectedness between bidder and acquirer firms listed on the London Stock Exchange (proxied by centrality measures) increases the number of M&A transactions, increases the successful completion rate, reduces the negotiation time, and enables the bidder to offer equity. Cai and Sevilir (2012) demonstrate that informational asymmetries are lower when the bidder and the target have a common director. El-Khatib *et al*. (2015) show that higher-centrality acquirer CEOs are more likely to pursue acquisitions of U.S. public targets and that these deals are more likely to generate value losses. On the other hand, Ishii and Xuan (2014) argue that acquirer–target social ties lead to poorer decision-making and value destruction: connected deals are more likely to occur, deals are more likely to be subsequently divested due to poor performance, bidder CEOs are more likely to receive bonuses and higher compensation for completing mergers, and there is a significant value loss for shareholders of both the acquirer and the combined entity.

Other studies of directors' networks effects have focused on measures of performance. For example, Geletkanycz and Boyd (2011) have documented a positive link between networks and firm performance. In a similar vein, Larcker *et al*. (2013) show that firms with central boards earn superior risk-adjusted stock returns that can be attributed to greater information access.

There are other papers different than the ones on boards of directors that have examined too, the small-world model in management. Uzzi *et al*. (2007) make a review of the research on small world networks in management science. In this regard, Kogut and Walker (2001) study the small world of ownership in Germany as the German economy internationalized. Baum *et al*. (2003) examine the small-world of Canadian investment banks and their membership of underwriting syndicates rather than shared directors. Verspagen and Duysters (2004) study the small world properties of network of strategic alliances among firms in the chemical and food and electrical industries. Schilling and Phelps (2007) study the longitudinal patent performance of U.S. firms in 11 industry-

level alliance networks. These papers demonstrate the growing empirical relevance of small-world models for understanding corporate governance phenomena (Conyon and Mundon, 2006).

As we have seen, in earlier director interlock research director gender has been ignored. Similarly, in the women on board research director networks has not been considered. The first investigation of gendered director network is the one by Hawarden and Marsland (2011) that introduces social network analysis as a useful tool for women on boards' research thus bridging the gap between these two research streams. The authors using a longitudinal approach, comparing director networks on a global network scale (Fortune Global 200) and a national one (New Zealand Stock Exchange) with the 1999 Fortune US 1000 dataset find that female directors are more likely to be found in the largest connected component of the mixed gender network, indicating that they are not marginalized in director networks. However, the authors highlight that this result could be explained by the presence of affective affirmative action that enhance women directors tendency to be located in the largest component of the network.

The other research in this field is the paper by Seiestard and Opshal (2011) that found that a small elite of women directors in Norway rank among the top on a number of proxies of influence (i.e., betweenness and number of directorships), given rise to the "Golden Skirts" phenomenon.

In this regard, Hawarden (2010) proposes what she call "Glass Network theory" (GNT) to track the effectiveness of diversity interventions. GNT suggests that, where there is pressure for affirmative action, boards will respond by appointing more female directors who already have a substantive board appointment. Therefore, GNT predicts that a class of elite women directors, the beneficiaries of the network forces of preferential attachment (women directors with multiple directorships) will arise where there is pressure to increase WOB (Hawarden, 2010; Hawarden and Marsland, 2011).

A straightforward consequence of this, is that in those countries where a quota law or a corporate governance code has been enacted, we could expect that networks centrality measures for women directors will be enhanced. From this perspective, we present here four hypotheses which we examine in this paper:

To investigate whether political and regulatory pressure by various member States in the European Union has led to an improvement in the four common measures of centrality of female directors in the European board network, we hypothesize the following:

Regarding the degree measure of centrality:

> *H1a: The enactment of board quota legislation increases the number of connections/ties of the female director in the board network with respect her male counterpart.*
> *H1b: The inclusion in corporate governance codes on female board requirements increases the number of connections/ties of a female director in the board network with respect her male counterpart.*

Regarding betweenness:

> *H2a: The enactment of board quota legislation increases the number of times the female director is located as 'broker/bridge' between two other directors in the board network with respect a male counterpart.*
> *H2b: The inclusion in corporate governance codes on female board requirements increases the number of times the female director is located as 'broker/bridge' between two other directors in the board network with respect a male counterpart.*

Regarding closeness:

> *H3a: The enactment of board quota legislation decreases the distance of female directors to all other directors within the board network with respect those of a male director.*
> *H3b: The inclusion in corporate governance codes on female board requirements decreases the distance of female directors to all other directors within the board network with respect those of a male director.*

Regarding eigenvector centrality:

> *H4a: The enactment of board quota legislation increases the number of connections of female directors to highly connected individuals within the board network with respect those of a male director.*
> *H4b: The inclusion in corporate governance codes on female board requirements increases the number of connections of female directors to highly connected individuals within the board network with respect those of a male director.*

III. METHODOLOGY

Data

Board composition data comes from Boardex database, where we have obtained the name of each director of listed firms from 1999 to 2014. Boardex database includes gender of each director, although we have had to run a manual search for the around 5% of missing gender values in Boardex. Countries included in the analysis are Austria, Belgium, Bosnia, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, Norway, Poland, Portugal, Republic Of Ireland, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and Ukraine plus territories of Gibraltar, Guernsey, Isle of Man, Jersey. We have obtained 425,322 observations of board of director positions, corresponding to 41,107 different directors, of which 11.9% are women. As can be seen in Figure 1, there has been a regular increase in the proportion of female directors by year, from the 4.4% in 1999 to the 15.8% of 2014, and this increase has happen across almost all countries in our sample.

For the Gender quota laws we have used the information in the EWDSGE (2016) of 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 that we have identified with a quota, this range from 30% to 40% (see Figure 2).

In the case of the Corporate Governance Codes, we have downloaded the 220 Codes available in the European Corporate Governance Institute database (www.ecgi.org), and used Nvivo qualitative data analysis software to identify those sections with a reference to "Gender" or "Diversity". Finally we have run a manual analysis of the 66 codes identified to establish which ones of them recommend a policy of gender equilibrium on boards as well as publicity of the way companies are looking to fulfill those targets. Final results for this analysis are the identified codes in Figure 2, panel b.

Directors' Network

For each year, from 1999 to 2014, we have created a separate social network where each director is a node and we have considered that there is a links between two directors if they share a board. Figure 3 presents the results of each network and year with a different color depending on the gender of the node (director). Table 1 shows the evolution of the main topological measures of the network since 1999 to 2014. As can be seen, the biggest network is at the end of the observed period (2014), where we have more than 20,000 directors, and almost 115,000 direct connections between them. The average path to link two directors in the network is around 6 links (in line with the 6 degrees of separations typical of the most famous social networks). The diameter of the network (maximum path required to link two directors) is also quite small, moving between 16 and 21. However, although the values are lower enough to consider the network to be a small world (given the size of the network, the average path should be below 8-9), the biggest cluster in the network only account for an 8.5% of the total network.

Once we have created the 16 different networks (one per year), we have computed four different measures of network centrality for each director and year (190,868 director-year observations). The measures computed (see figure 4 for their evolution for both women and men) are the following,

Degree

Degree centrality (Nieminen, 1974) is the most straightforward measure of a node relevance. It shows the number of other individuals connected to the node (i.e., director). This measure can be formalized for each director *i* as:

$$C_d(i) = \sum_{j}^{N} x_{ij} \ ,$$

where *j* represents all other directors, *N* is the total number of directors in the network, and x_{ij} is defined as 1 if director *i* is in the same board (is connected) than director *j*, and 0 otherwise. Thus, the *Degree* is the number of directors known by each director for seating in the same board. In this sense, we can consider that the higher the Degree centrality level, the better connected is the director. The person that has more links will be in a better position than the rest, as they have higher connectivity and are more visible, tending to be seen as prominent for the net.

We have normalized the measure for each year (dividing the measure by the maximum possible number of connections: *N*-1) in order to be able to compare the relative centrality for different years, and we have also taken logarithms to take into account the heterogeneity found in the variable.

Closeness:

Closeness measures the inverse of the distance that each director has to every other director in the network (in terms of links needed to cross to reach each other). Higher closeness centrality implies that the director is "closer" to all other directors in the network, so it takes into account the distance of a director to all the rest of the network. Closeness centrality relies on the identification of the length of the path from a director to all the rest of the directors and is defined as the inverse of the total length (i.e., the inverse of the measure of decentrality proposed by Sabidussi, 1966):

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

where $d(i,j)$ is the shortest distance of director *i* to all other directors *j*. For unconnected directors we have considered an infinite distance. The higher the closeness, the greater the information about the other directors, because any information originated in any part of the net arrives to them very quickly. In this regard, directors with the highest closeness measures are the ones who are best placed to contact the entire network most quickly and effectively (i.e., good 'broadcasters'). Also, as Leavitt (1951) suggested, the higher the closeness the higher the independence of others given that they do not dependent upon others to contact or influence other directors.

We have normalized the measure for each year (dividing the measure by the maximum possible closeness: *N*-1) in order to be able to compare the relative centrality for different years, and we have also taken logarithms to take into account the heterogeneity found in the variable.

Betweenness:

Betweenness (Freeman, 1977) quantifies the number of times that a node (a director in our network) operates as a bridge, that is, as the shortest path between other two nodes (directors). This measure shows the extent that a director is "between" pairs of directors in the network. *Betweenness* centrality is computed as:

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

where g_{jk} is the number of binary shortest paths (geodesics) between two directors *j* and *k*, and $g_{jk}(i)$ the number of those paths that go through director *i*. A director with high betweeness is important because is in a position to influence and controlling the flow of information in the network. A high level of betweenness centrality implies a more influential director, as he/she would be the connection among other directors, and would be influencing the flows (of knowledge or information) around a system, this way acting as a 'knowledge broker' (Seierstad and Opshal, 2011).

Once more, we have normalized the measure for each year (dividing by $(n-1)\cdot(n-2)/2$) in order to be able to compare the relative centrality for different

years, and we have also taken logarithms to take into account the heterogeneity found in the variable.

Eigencentrality

Eigencentrality is a measure of the importance of the director in the network. It is derived from the number of connections that a director has, but weighted by the centrality of those directors in the network. Thus, a higher eigencentrality implies that the director is connected to other well connected directors. *Eigencentrality* is computed as:

$$C_e(i) = \frac{1}{\lambda}\sum_{j}^{N} x_{ij} \cdot C_e(j)$$

where x_{ij} was equal to 1 if director *i* is in the same board (is connected) than director *j*, and 0 otherwise, and λ is a constant. This can be rearrange in matrix notation to $\lambda C = XC$, where λ is now the eigenvalue, while *C* are the eigenvector of the matrix of the adjacency matrix *X* (a matrix where element *ij* is equal to one if directors *i* and *j* are linked and zero otherwise). If we restrict the eigenvector to have all elements higher than zero, then λ will be the maximum eigenvalue, and *C* will be a vector with the eigencentrality of each of the directors in the network. Thus, we can consider that the *eigencentrality* is a measure of how well connected a director is.

Econometric models

In order to empirically confirm the effects of political and regulatory pressures on the appointment of woman on boards, we have proceeded to estimate a series of panel data models,

$$Y_{it} = \beta_w \cdot Women_i + \beta_q \cdot Quota_{it} + \beta_c \cdot Code_{it} + \beta_{wq} \cdot Women_i \cdot Quota_{it} + \beta_{wc} \cdot Women_i \cdot Code_{it} + \alpha_t + \omega_i + \varepsilon_{it} \quad (1)$$

where Y_{it} represents the measurement of network centrality used (i.e., *Degree*, *Closeness*, *Betweenness*, *Eigencentrality*); $Women_i$ is a dummy variable equal to 1 if the director is a women; $Quota_{it}$ is a dummy variable equal to 1 if the director is in a country and year where a Gender Quota is in place (for those directors sitting in boards on more than one country, we have assigned them to the country where they had more seats and, in case of 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 is a Code of Corporate Governance that establish a recommendation regarding the presence of women on Boards ; $Women_i \cdot Qouta_{it}$ and $Women_i \cdot Code_{it}$ are the interaction variables that allow to assess the impact of both Gender Quota Laws and Corporate Governance Codes; α_t are year constants that allow us to take into account the time evolution of the network, as well as changing economic, political and/or sociological conditions; $\omega_i \sim N(0, \sigma_\omega)$ is a random variable that takes different values for each director, allowing us to take into account unobserved characteristics of each director (e.g., age, education, experience, family); finally $\varepsilon_{it} \sim N(0, \sigma_\varepsilon)$ is the noise variable that takes different values for each director and year.

Since the model has time fixed effects and director random effects (we have more than 40.000 directors, making not feasible to estimate a director fixed effect model), we are avoiding potential problems of endogeneity that could be caused by unobserved characteristics of each director and year.

IV. RESULTS

Network Degree

Table 4 shows the results of model 1, applied to the directors' network *Degree* (the number of other directors with whom each director is connected in the network). As can be seen, women in the network are not more (nor less) likely to have a higher (or lower) degree than men. The adoption of a Gender Quota Law or a mention to promote/foster gender board equity in a Corporate Governance Code tends to produce a higher degree both on men or women. This increase in the degree can be a consequence of either an increase in the size of boards (thus producing the increase in the number of links in the

members of the board) and/or a higher number of multiple directorships. Obviously, as we would expect, the effect is higher for women in the network, and interestingly, the size of the effect is higher for the Codes of Corporate Governance than for the Gender Quota Laws.

Network Closeness

Table 5 reports the estimation of model (1) on the directors' network *Closeness* (the average distance of each director to the other directors in the network). Women tends to have a higher closeness than men, possibly as a consequence of been generally in the board of companies closer to the center of the network. In this case, Gender Quota Laws and Corporate Governance Codes produce opposite effects on the position of women on the network. In the former case (Gender Quotas), their introduction produce a reduction on the closeness of the network, especially for women. By contrast, Corporate Governance Codes with approaches to board gender diversity produces an increase in the mean closeness of the network, especially for women. A possible explanation for the disparity in the effects of both measures could be a consequence of which type of companies react to their introduction. It looks like Corporate Governance tends to be apply by bigger companies with a higher centrality in the network, thus when women are included in their board because of the Comply or Explain directives, their closeness increase. By contrast, quota laws tends to be more broadly apply to all companies in the country that are targeted by them, not only the central ones, but also the ones in the periphery of the network, producing, in fact, a decline in the closeness of the women that enter into their board.

Network betweenness

Table 6 shows the estimations of model (1) applied to the directors' network *betweenness* (the number of times that a director is in the shortest path between two other directors in the network). Women tends to have a considerable lower betweenness than men (more

than 30% lower). This could indicate that women are not in a position to act as a bridge between other directors, occupying positions that could be considered redundant in the network since they are not able to control flows of resources. However, the introduction of Gender Quota Laws allows to overcome the gap between men and women in this aspect of the network. In the case of Corporate Governance Codes, the gender diversity approach also increase the betweenness of women although to a lesser degree than Gender Quotas and is not able to fully fill the gap between men and women.

Network Eigencentrality

In table 7, we present the estimations of model (1) on the directors' network eigencentralities (a measure of the proximity of a director to other central directors). In this case we are not able to observe any statistically significant difference between female and male directors. Furthermore, both Gender Quota Laws and the Corporate Governance Codes seems to reduce the eigencentralities of the network, although, once more, without differences between women and men.

Principal Component Analysis

Given the multiplicity of measures of network centrality, with a relative correlation (although each of them provide information on a very singular feature of the network), we have opted to conduct a Principal Component Analysis (PCA), in order to group and summarize the information.

This way, the PCA was conducted on the four centrality measures (*Degree*, *Closeness*, *Betweenness*, *Eigencentrality*) with orthogonal rotation (varimax). The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .5643, and all KMO values for individual items were > .5343, which is well above the acceptable limit of .5. Bartlett's test of sphericity χ^2 (6) = 207354.4, $p < .001$. An initial analysis was run to obtain eigenvalues for each component in the data. Two components in combination explained 74.4% of the variance. Given the large sample size, this is the number of

components that were retained in the final analysis. Table 8 shows the factor loadings after rotation. The centrality measures that cluster on components 1 are *Degree* and *Closeness* so this suggest that that component 1 represent the *Visitibility* of the director in the network (since it is an approximation to how many people know and how close is to other directors *in the network*), On the other hand, Component 2 clusters *Betweenness* and *Eigencentrality*. We interpret this second component as *Real Power* of the director, since it is related to measures that denote control of flows in the network (the director acts as bridge between two others directors) and how well-connected the director is.

In table 9 we present the estimations obtained from applying model (1) to both factors. As can be seen, women tends to have a higher *Visibility* in the directors network, but a lower *Real Power* than men. The effects of the Gender Quota Laws and the Corporate Governance Codes moves both factor in different directions. In the case of the later (Corporate Governance Codes), the appearance of recommendations of gender diversity on boards produces a clear increase in Women's *Visibility*, but only slightly (statistically marginally significant) increase in their *Real Power*. By contrast, Gender Quota Laws reduce the *Visibility* of women but increase considerably their *Real Power*. In fact, the size of the effect of the Gender Quota Laws on the *Real Power* factor is triple the size of the effect of the Corporate Governance Codes.

V. CONCLUSIONS

There are is an abundance of studies regarding how quotas and gender diversity measures on corporate governance codes do increase the number of women on boards (e.g., Ahern and Dittmar, 2012; Matsa and Miller, 2013; Bøhren and Staubo, 2014; Terjesen *et al*., 2015; Terjesen and Sealy, 2016). However, little has been shown about the consequences of political and regulatory pressure on the influence and location of women on the social network that comes from director interlocks.

The affirmative action measures and the efforts to comply with the quota and/or corporate governance code's make companies appoint more women, but are these appointments mere testimonials or are they seen as an opportunity to improve the real influence of women within the economic power of the private sector? This is an important matter as

it is well known (e.g., Elstad and Ladegard, 2012; Torchia *et al.*, 2011) that sometimes the incorporation of women to the board is done as mere tokens in an attempt to satisfy the demands for diversity from institutional investors, social advocators for gender diversity or political pressures, but real capacity of influence on the decision-making process of these women are indeed very small if not null.

In this regard, the present paper attempts to analyze if political and regulatory pressure in the European area to promote women's access to business leadership positions in the private sector, has lead women on boards to show higher influence on directors networks, or if, on the contrary, it has only led to appoint low relevant women, as a sign of symbolic compliance, that have not helped to improve the role that women play in these directors networks. In this last case, political and regulatory pressure would not be completely effective, remaining in make-up measures by affecting only the raw numbers of women directors on listed stock exchanges companies in a superficial level and not getting into the heart of the matter that is the women's real power and influence they can exert in the private economic sector and to explain the dynamic and interrelated nature of director interactions under a gendered perspective.

Using as dependent variables the main centrality measures of a European global gendered director networks from 1999 to 2014, the results of or panel models show the expected positive effect of affirmative action in improving the influence and location of women of women directors in director networks at a global. However, our results show important nuances indicating that after-quota or after- corporate governance codes has had different effects on women location on the network depending on the type of centrality measure being analyzed. This way, gender quotas and corporate governance codes recommendations to promote gender diversity on boards both influence positively the number of connections women directors have (degree) and therefore their connectivity and visibility in the network, as well as the number of times they connect two other directors (betweenness) which enhance their control over the flow of resources (knowledge and information) on the network. However, the effects over how close they are from the rest of director of the network (closeness) are mixed (negative for the quota, whereas positive for the governance codes) and nule in the case of the connections with other well-connected directors (eigencentrality).

More clarifying are the results on the regression over the factors resulting from a CPA that help us to interpret in the field of Women on Boards the different centrality measures. The results of these panel models, show the limited effect of recommendations on corporate governance codes for improving real power of women directors in the network constructed from director links or interlocks, since they only have a positive effect on these measures more related with visibility/connectivity and closeness from the resto of the directors (what we interpret as measures of 'soft' influence). Whereas, Board Gender Quotas produces a clear increase in those other measures that denote real power in the directors network as they improve women directors' role as "brokers" or controllers of flows (information, knowledge, etc.) within the network and how well-contacted they are. To sum up, it seems quotas tend to increase the real power and influence of women within their interactions with other directors and Codes are only useful to promote their visibility in the network.

Overall, the analysis shows that the shock created by different kinds of affirmative action's policies on women location on the director's network boards has led to a two-track approach. On one hand there is a fast track, when quota legislation is implemented, the slow track comes into action when Corporate Governance Codes appeal to self-regulation and corporate social responsibility without any binding measure for non-compliance.

Nevertheless, although quotas and other affirmative actions have been introduced in the analyzed countries, we can also see great variations in the design and regulations. For future research, the effect of these variations should be researched. Elements such as the percentage of the companies targeted and types of companies, the length of the implementation period, or whether sanctions for non-compliance will have an effect, need to be considered. There are also critical differences within corporate governance codes' approaches to gender equality, which need to be accounted for.

References

Ahern, K., & Dittmar, A. (2012). The changing of the boards: The impact on firm valuation of mandated female board representation. *Quarterly Journal of Economics*, 127, 137-197.

Battiston, S., & Catanzaro, M. (2004). Statistical properties of corporate board and director networks. *The European Physical Journal B, 38*(2), 345-352.

Baum, J. A. C., Shipilov, A. V. & Rowley, T. J. (2003). Where do small worlds come from. *Industrial and Corporate Change*, 12, 697–725.

Bøhren, Ø., & Staubo, S. (2014). Does mandatory gender balance work? Changing organizational form to avoid board upheaval. *Journal of Corporate Finance*, 28, 152-168.

Cai, Y., & Sevilir, M. (2012). Board connections and M&A transactions. *Journal of Financial Economics*, 103(2), 327-349.

Caldarelli, G. (2007). *Scale-free networks: complex webs in nature and technology*. Oxford: Oxford University Press.

Caldarelli, G., & Catanzaro, M. (2004). The corporate boards networks. *Physica A: Statistical Mechanics and its Applications, 338*(1-2), 98-106.

Conyon, M. J., & Muldoon, M. R. (2006). The small world of corporate boards. *Journal of Business Finance & Accounting*, 33(910), 1321-1343.

Daolio, F., Tomassini, M., & Bitkov, K. (2011). The Swiss board directors network in 2009. *The European Physical Journal B, 82*(3-4), 349-359.

Davis, G. F., Yoo, M., & Baker, W. E. (2003). The small world of the American corporate elite, 1982-2001. *Strategic organization*, 1(3), 301-326.

El-Khatib, R., Fogel, K., & Jandik, T. (2015). CEO network centrality and merger performance. *Journal of Financial Economics*, 116(2), 349-382.

Elstad, B., & Ladegard, G. (2012). Women on corporate boards: key influencers or tokens? *Journal of Management & Governance*, 16(4), 595-615.

EIGE (2017). *Gender Equality Index 2017: Measuring gender equality in the European Union 2005-2015.* European Institute for Gender Equality, Vilnius (Lithuania).

EWDSGE (2016). Gender balanced leadership European women shareholders pave the way. Project Documentation 2014-2016.

Gabaldon, P., de Anca, C., Mateos de Cabo, R., & Gimeno, R. (2016). Searching for Women on Boards: An Analysis from the Supply and Demand Perspective. *Corporate Governance: An International Review*, 24(3), 371–385.

Gabaldon, P., Mensi-Klarbach, H., & Seierstad, C. (2017). Gender diversity in the boardroom: The multiple versions of quota laws in Europe. *Gender Diversity in the Boardroom*, 1, 233–254.

Geletkanycz, M., & Boyd, B. (2011). CEO outside directorships and firm performance: a reconciliation of agency and embeddedness views. *Academy of Managament Journal* 54(2), 335.

Geletkanycz, M. A., Boyd, B. K., & Finkelstein, S. (2001). The strategic value of CEO external directorate networks: Implications for CEO compensation. *Strategic Management Journal*, 22(9), 889-898.

Grosvold, J. & Brammer, S. (2011). National institutional systems as antecedents of female board representation: An empirical study. *Corporate Governance: An International Review*, 19(2), 116-135.

Freeman L. C. (1977). A set of measures of centrality based on betweenness. *Sociometry*, 40, 35-41.

Hawarden, R. J. (2010). *Glass networks: the network structure of women directors on corporate boards*. Massey University, Palmerston North, New Zealand.

Hawarden, R. J., & Marsland, S. (2011). Locating women board members in gendered director networks. *Gender in Management: An International Journal*, 26(8), 532-549.

Heinze, T. (2004). Dynamics in the German system of corporate governance? Empirical findings regarding interlocking directorates. *Economy and Society*, 33(2), 218-38

Hillman, A. J., Shropshire, C., & Cannella, A. A. (2007). Organizational predictors of women on corporate boards. *Academy of Management Journal*, 50, 941–952.

Huang, X., Vodenska, I., Wang, F., Havlin, S., & Stanley, H. E. (2011). Identifying influential directors in the United States corporate governance network. *Physical Review E, 84*(4), 046101.

Ibarra, H. (1992). Homophily and differential returns: Sex differences in network structure and access in an advertising firm. *Administrative Science Quarterly*, 37, 422–447.

Ibarra, H. (1997). Paving an Alternative Route: Gender Differences in Managerial Networks. *Social Psychology Quarterly*, 60, 91–102.

Ishii, J., & Xuan, Y. (2014). Acquirer-target social ties and merger outcomes. *Journal of Financial Economics* 112, 344–363

Kirsch, A. (2018) The gender composition of corporate boards: A review and research agenda, *The Leadership Quarterly*, 29(2), 346-364.

Kogut, B. & Walker, G. (2001). The small world of German corporate networks in the global economy. *American Sociological Review*, 66, 317–335.

Kumra, S., & Vinnicombe, S. (2010). Impressing for success: A gendered analysis of a key social capital accumulation strategy. *Gender, Work and Organization*, 17, 521–546.

Lang, I. H. (2011). 'Co-opt the Old Boys' Club: Make it work for women'. *Harvard Business Review*.

Larcker, D., So, E., & Wang, C. (2013). Boardroom centrality and firm performance. *Journal of Accounting and Economics* 55(2–3), 225–250.

Leavitt, H. J. (1951). Some effects of communication patterns on group performance. *Journal of Abnormal and Social Psychology*, 46, 38-50.

Liu, Y., 2014. Outside options and CEO turnover: The network effect. *Journal of Corporate Finance*, 28, 201–217.

Mateos de Cabo, R., Gimeno, R., & Escot, L. (2011). Disentangling discrimination on Spanish boards of directors. *Corporate Governance: An International Review*, 19(1), 77-95.

Mateos de Cabo, R., Gimeno, R., & Nieto, M. J. (2012). Gender diversity on European banks' boards of directors. *Journal of Business Ethics*, 109(2), 145-162.

Matsa, D. A., & Miller, A. R. (2013). A female style in corporate leadership? Evidence from quotas. *American Economic Journal: Applied Economics*, 5, 136-169.

Newman, M. (2010). *Networks: an introduction*. Oxford: Oxford university press.

Newman, M. E., & Park, J. (2003). Why social networks are different from other types of networks. *Physical Review E*, 68(3), 036122.

Nieminen, J. (1974). On centrality in a graph. *Scandinavian Journal of Psychology* 15:322-336.

Perrault, E. (2015). Why Does Board Gender Diversity Matter and How Do We Get There? The Role of Shareholder Activism in Deinstitutionalizing Old Boys' Networks. *Journal of Business Ethics*, 128(1), 149–165.

Renneboog, L., & Zhao, Y. (2011). Us knows us in the UK: On director networks and CEO compensation. *Journal of Corporate Finance*, 17(4), 1132-1157.

Renneboog, L., & Zhao, Y. (2014). Director networks and takeovers. *Journal of Corporate Finance*, 28, 218-234.

Robins, G., & Alexander, M. (2004). Small worlds among interlocking directors: Network structure and distance in bipartite graphs. *Computational & Mathematical Organization Theory*, 10(1), 69-94.

Sabidussi, G. (1966). The centrality index of a graph. *Psychomatrika* 31, S81-603.

Schilling, M. A., & Phelps, C. C. (2007). Interfirm collaboration networks: The impact of large-scale network structure on firm innovation. *Management science*, 53(7), 1113-1126.

Seierstad, C., & Opsahl, T. (2011). For the few not the many? The effects of affirmative

action on presence, prominence, and social capital of women directors in Norway. *Scandinavian Journal of Management*, 27, 44–54.

Seierstad, C., Torchia, M., Warner-Søderholm, G., & Huse, M. (2017). Increasing the Number of Women on Boards : The Role of Actors and Processes. *Journal of Business Ethics*, 141, 289–315.

Smith, N., & Parrotta, P. (2018). Why so few women on boards of directors? Empirical evidence from Danish companies in 1998–2010. *Journal of Business Ethics*, 147(2), 445-467.

Stevenson, W. B., & Radin, R. F. (2009). Social capital and social influence on the board of directors. *Journal of Management Studies*, 46, 16–44.

Terjesen, S., Sealy, R., & Singh, V. (2009). Women directors on corporate boards: A review and research agenda. *Corporate Governance: An International Review*, 17(3), 320–337.

Terjesen, S., Aguilera, R. V., & Lorenz, R. (2015). Legislating a Woman's Seat on the Board: Institutional Factors Driving Gender Quotas for Boards of Directors. *Journal of Business Ethics*, 128, 233–251.

Terjesen, S., & Sealy, R. (2016). Board gender quotas: Exploring ethical tensions from a multi-theoretical perspective. *Business Ethics Quarterly*, 26(1), 23–65.

Torchia, M., Calabrò, A., & Huse, M. (2011). Women directors on corporate boards: From tokenism to critical mass. *Journal of Business Ethics*, 102(2), 299-317.

Uzzi, B., Amaral, L. A., & Reed-Tsochas, F. (2007). Small-world networks and management science research: A review. *European Management Review*, *4*(2), 77-91.

van Veen, K., & Kratzer, J. (2011). National and international interlocking directorates within Europe: corporate networks within and among fifteen European countries. *Economy and Society*, *40*(1), 1-25.

Verspagen, B. & Duysters, G. (2004). The small worlds of strategic technology alliances. *Technovation*, 24, 563–571.

Figure 1: Evolution of the proportion of female directors between 1999 and 2014 in Europe.

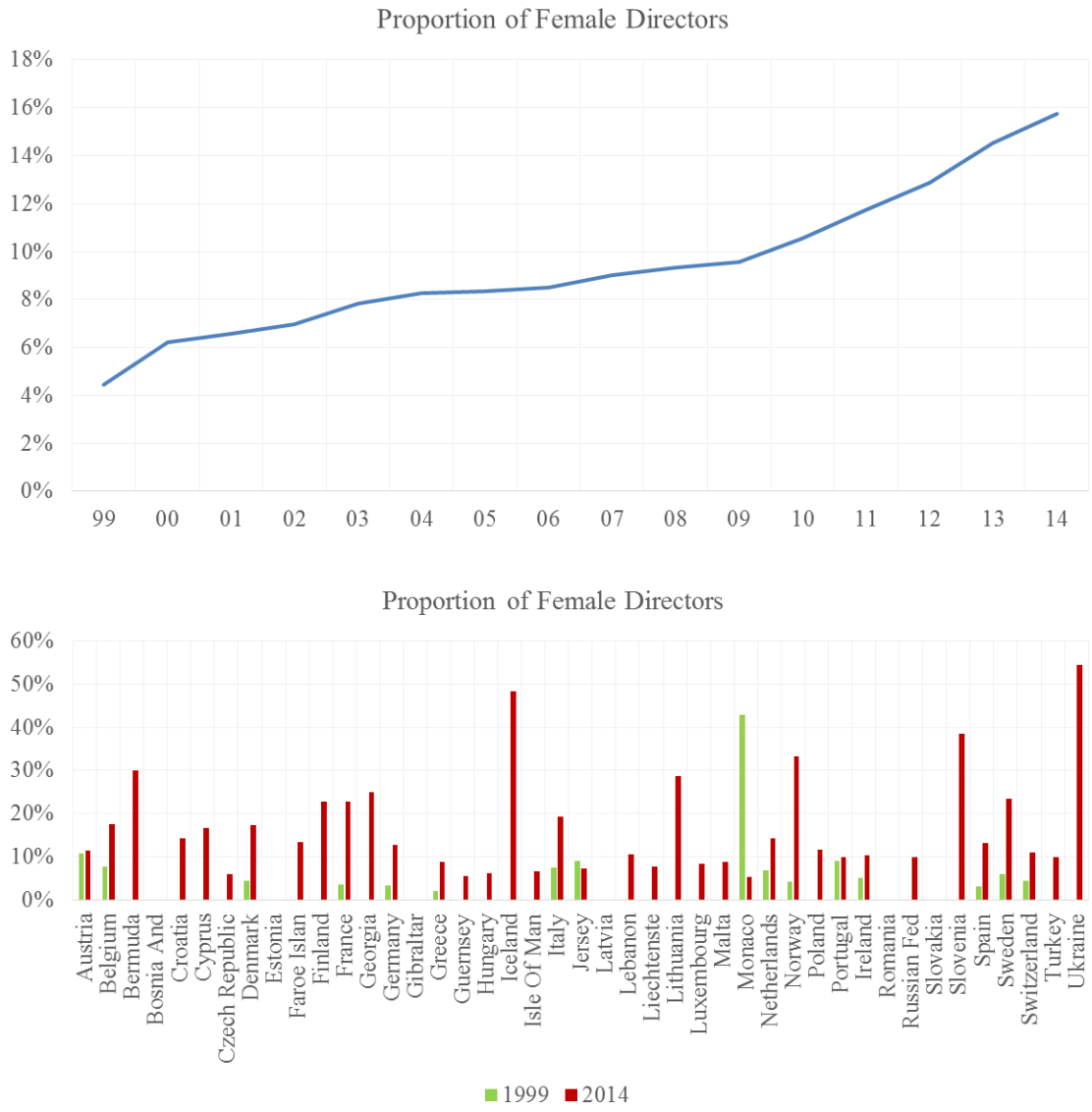


Figure 2: Adoption of Quota Laws and Comply or Explain principle in Corporate Governance Codes in Europe

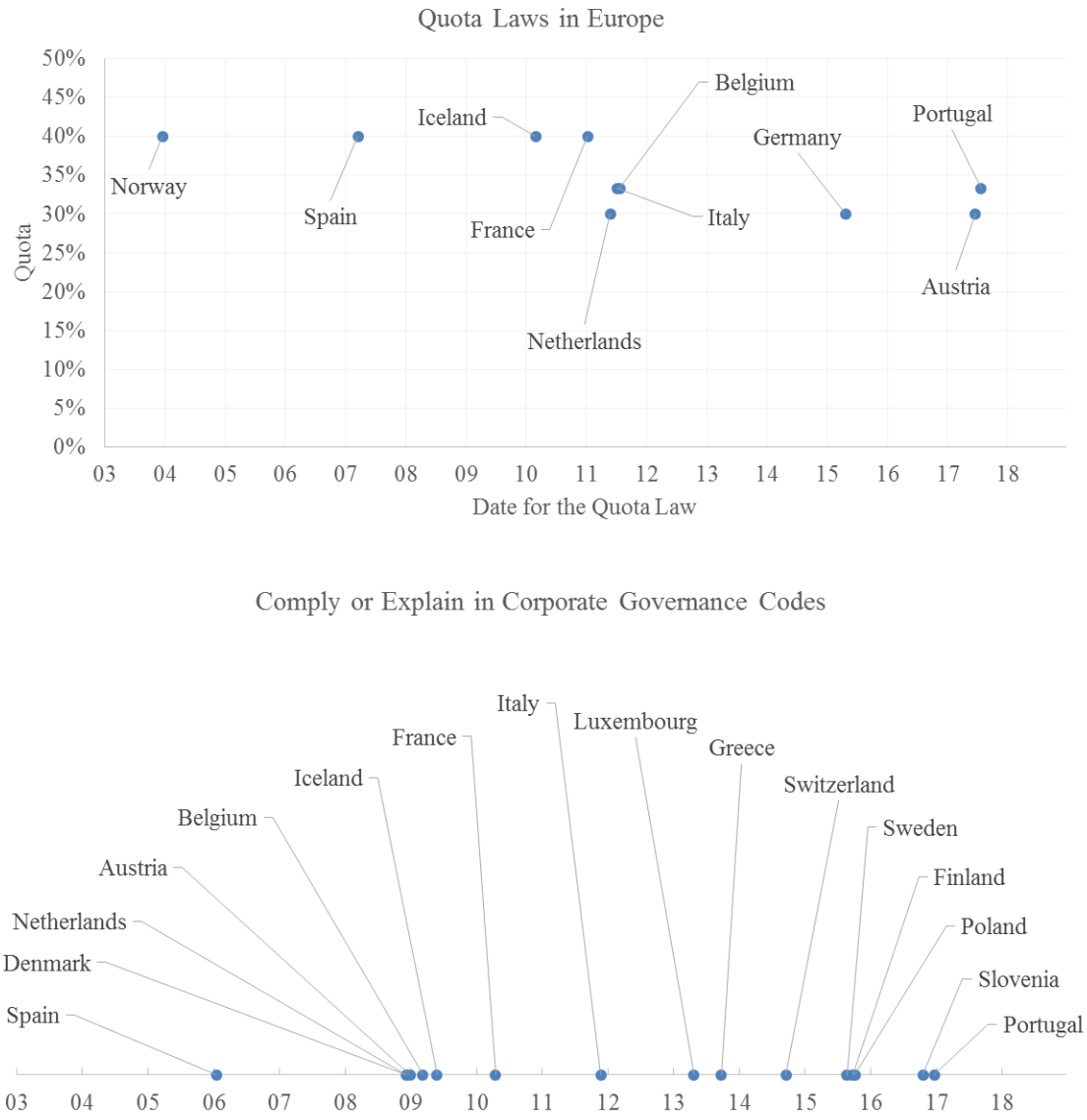
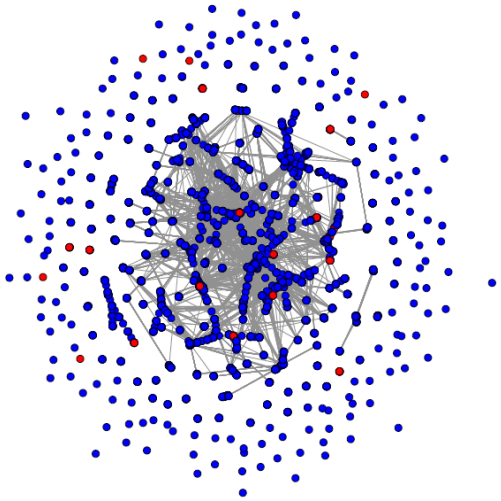
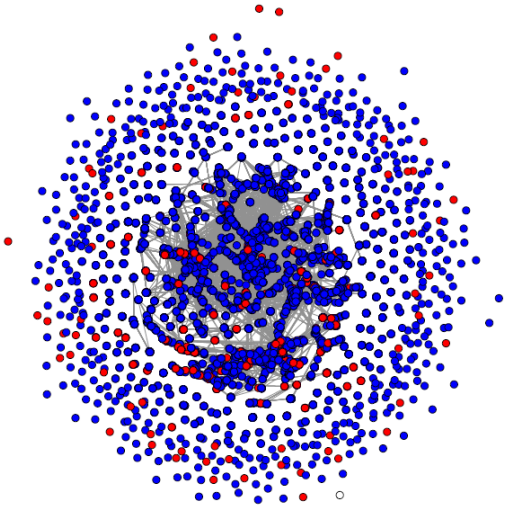


Figure 3: Social Networks of European Board of Directors. Red (blue) dots represent women (men).

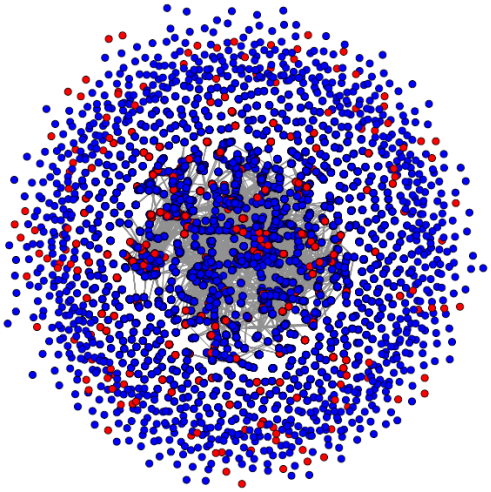
1999



2004



2009



2014

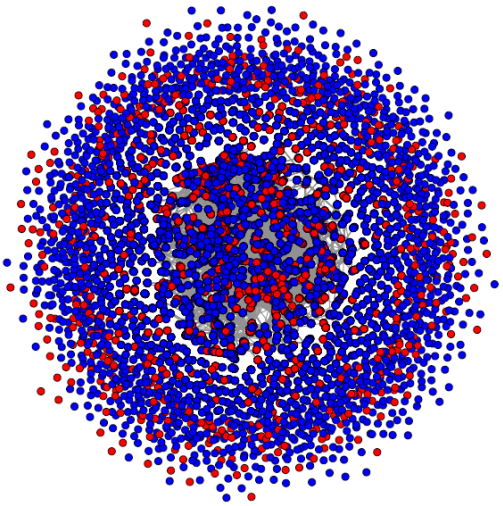
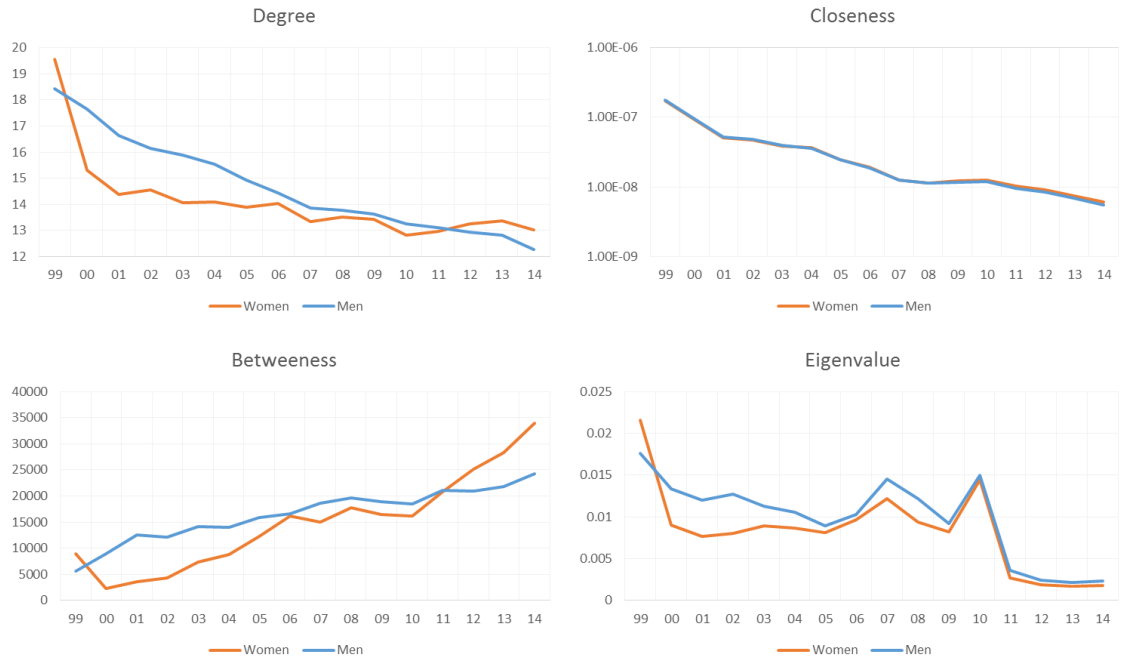


Figure 4: Evolution of the mean network centrality measures for both Women and Men



Degree is the number of other directors with whom each director is connected in the network. *Closeness* is the average distance of each director to the other directors in the network. *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network. *Eigencentrality* is a measure of the proximity of a director to other central directors.

Table 1: Network topology

year	nodes	links	av. path length	diameter
1999	4954	44345	4.631	12
2000	6615	55695	5.031	15
2001	8502	66891	5.413	18
2002	8994	68650	5.204	16
2003	9664	72210	5.491	16
2004	9942	72800	5.465	16
2005	11590	81319	5.595	16
2006	12445	84540	5.807	19
2007	14382	93066	6.001	19
2008	14919	96087	6.129	20
2009	14421	92031	6.167	21
2010	14522	89684	6.035	18
2011	16438	100012	6.097	17
2012	17625	105838	6.025	16
2013	18537	110200	6.271	21
2014	20235	114848	6.513	19

Nodes is the number of unique directors in the network each year. *Links* is the number of occasions in which two directors in the network share a board. *Av. path length* is the mean number of steps required to go from one director to other. *Diameter* is the longest path required to go from one director to other.

Table 2: Descriptive statistics of the network centrality measures

	Mean	St. Dev.	Skewness	Kurtosis	Min.	Max.
Degree	14.125	11.335	3.716	30.614	1	238
Closeness	2.43E-08	3.51E-08	3.662	18.712	2.91E-09	2.26E-07
Betweenness	18097.940	92000.590	11.925	230.580	0	4116544
Eigencentrality	0.009	0.040	10.509	167.315	0	1
log (Degree)	-7.018	0.778	0.132	3.256	-9.827	-3.139
log (Closeness)	-8.644	0.725	0.286	2.431	-9.827	-6.826
log (1+Betweenness)	1.464	3.756	2.245	6.197	0.000	15.231
log (1+Eigencentrality)	0.008	0.033	8.479	104.958	0.000	0.693

Degree is the number of other directors with whom each director is connected in the network. *Closeness* is the average distance of each director to the other directors in the network. *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network. *Eigencentrality* is a measure of the proximity of a director to other central directors. In the second half of the table, variables have been normalized and transformed using logarithms.

Table 3: Correlation matrix of the network centrality measures

	Degree (log)	Closeness (log)	Betweenness (log)	Eigencentrality (log)
Degree (log)	1			
Closeness (log)	0.7026	1		
Betweenness (log)	0.4457	0.1964	1	
Eigencentrality (log)	0.3662	0.2232	0.2186	1

Degree is the number of other directors with whom each director is connected in the network. *Closeness* is the average distance of each director to the other directors in the network. *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network. *Eigencentrality* is a measure of the proximity of a director to other central directors. All variables have been normalized and transformed using logarithms.

Table 4: Panel regression on the directors' network *Degree*.

	(1) Degree (log)		(2) Degree (log)		(3) Degree (log)	
Women	0.0039		0.0020		-0.0018	
	[.0082]		[.0082]		[.0082]	
Quota	0.0195	***			0.0117	***
	[.0036]				[.0044]	
Women * Quota	0.1169	***			0.0321	***
	[.0103]				[.0122]	
Code			0.0206	***	0.0145	***
			[.0033]		[.0033]	
Women * Code			0.1359	***	0.0916	***
			[.0103]		[.0119]	
number of directors	41107		41107		41107	
number of observations	190868		190868		190868	
Director random effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Wald chi2	108743.6	***	108841.3	***	108869.4	***

(***) implies that a coefficient is statistically different from zero with a 1% level of significance; (**) at 5%, and (*) at 10%. *Degree* is the number of other directors with whom each director is connected in the network (normalized and in logarithms). *Women* is a dummy variable equal to 1 if the director is a women; *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 establish a principle of Comply or Explain regarding the presence of women on Boards. Each model includes *Director* random effects to take into account unobserved characteristics of each director (e.g., age, education, experience, and so on), and *Year* fixed effects to take into account the time evolution of the network.

Table 5: Panel regression on the directors' network *Closeness*.

	(4) Closeness (log)		(5) Closeness (log)		(6) Closeness (log)	
Women	0.0432	***	0.0341	***	0.0393	***
	[.0068]		[.0068]		[.0068]	
Quota	-0.0107	***			-0.0177	***
	[.0032]				[.0039]	
Women * Quota	0.0015				-0.0388	***
	[.0080]				[.0106]	
Code			0.0364		0.0129	***
			[.0029]		[.0036]	
Women * Code			0.0346	***	0.0609	***
			[.0078]		[.0105]	
number of directors	41107		41107		41107	
number of observations	190868		190868		190868	
Director random effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Wald chi2	241437.4	***	241320.1	***	241409.9	***

(***) implies that a coefficient is statistically different from zero with a 1% level of significance; (**) at 5%, and (*) at 10%. *Closeness* is the average distance of each director to the other directors in the network (normalized and in logarithms). *Women* is a dummy variable equal to 1 if the director is a women; *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 establish a principle of Comply or Explain regarding the presence of women on Boards. Each model includes *Director* random effects to take into account unobserved characteristics of each director (e.g., age, education, experience, and so on), and *Year* fixed effects to take into account the time evolution of the network.

Table 6: Panel regression on the directors' network *Betweenness (log)*.

	(7) Betweenness		(8) Betweenness		(9) Betweenness	
Women	-0.2980	***	-0.2614	***	-0.3155	***
	[.0380]		[.0376]		[.0387]	
Quota	-0.0589	**			-0.1930	***
	[.0266]				[.0328]	
Women * Quota	0.6854				0.5719	***
	[.0632]				[.0808]	
Code			0.1175		0.2243	***
			[.0248]		[.0305]	
Women * Code			0.5640	***	0.2166	***
			[.0624]		[.0798]	
number of directors	41107		41107		41107	
number of observations	190868		190868		190868	
Director random effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Wald chi2	990.5	***	1011.8	***	1074.2	***

(***) implies that a coefficient is statistically different from zero with a 1% level of significance; (**) at 5%, and (*) at 10%. *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). *Women* is a dummy variable equal to 1 if the director is a women; *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 establish a principle of Comply or Explain regarding the presence of women on Boards. Each model includes *Director* random effects to take into account unobserved characteristics of each director (e.g., age, education, experience, and so on), and *Year* fixed effects to take into account the time evolution of the network.

Table 7: Panel regression on the directors' network *Eigencentrality* (log)

	(10) Eigencentrality		(11) Eigencentrality		(12) Eigencentrality	
Women	-0.0001		-0.0005		-0.0002	
	[.0004]		[.0004]		[.0004]	
Quota	0.0040	***			-0.0034	***
	[.0002]				[.0003]	
Women * Quota	0.0006				-0.0001	
	[.0006]				[.0007]	
Code			-0.0029	***	-0.0011	***
			[.0002]		[.0003]	
			0.0008		0.0010	
Women * Code			[.0006]		[.0007]	
number of directors	41107		41107		41107	
number of observations	190868		190868		190868	
Director random effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Wald chi2	5104.0	***	4955.5	***	5119.6	***

(***) implies that a coefficient is statistically different from zero with a 1% level of significance; (**) at 5%, and (*) at 10%. *Eigencentrality* is a measure of the proximity of a director to other central directors (normalized and in logarithms). *Women* is a dummy variable equal to 1 if the director is a women; *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 establish a principle of Comply or Explain regarding the presence of women on Boards. Each model includes *Director* random effects to take into account unobserved characteristics of each director (e.g., age, education, experience, and so on), and *Year* fixed effects to take into account the time evolution of the network.

Table 8: Factor Analysis. Loading Factors

	Factor 1	Factor 2
Degree (log)	0.4728	0.0773
Closeness (log)	0.6778	-0.3039
Betweenness (log)	-0.1247	0.6522
Eigencentrality (log)	-0.1383	0.6405

Loading factors for each of the two factors extracted from a Factor Analysis using Principal Components, and a Varimax orthogonal rotation. *Degree* is the number of other directors with whom each director is connected in the network. *Closeness* is the average distance of each director to the other directors in the network. *Betweenness* is a measure of the number of times that a director is in the shortest path between two other directors in the network. *Eigencentrality* is a measure of the proximity of a director to other central directors. All variables have been normalized and transformed using logarithms.

Table 9: Panel regression on the directors' network *centrality factors*

	(13) Factor 1 *Visibility*		(14) Factor 2 *Real power*	
Women	0.0460	***	-0.0811	***
	[.0090]		[.0103]	
Quota	0.0192	***	-0.0844	***
	[.0047]		[.0085]	
Women * Quota	-0.0402	***	0.1190	***
	[.0131]		[.0212]	
Code	0.0103	**	-0.0143	*
	[.0043]		[.0008]	
Women * Code	0.0859	***	0.0397	*
	[.0127]		[.0209]	
number of directors	41107		41107	
number of observations	190868		190868	
Director random effects	Yes		Yes	
Year fixed effects	Yes		Yes	
Wald chi2	334650.2	***	8720.0	***

(***) implies that a coefficient is statistically different from zero with a 1% level of significance; (**) at 5%, and (*) at 10%. Dependent variables are the factors obtained from a Factor analysis of different network centrality measures. *Factor 1 (Visibility)* is a measure of the number of connections and proximity of a director to other directors. *Factor 2 (Real Power)* is a measure of the relevance of the director to the whole structure of the network. *Women* is a dummy variable equal to 1 if the director is a women; *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 establish a principle of Comply or Explain regarding the presence of women on Boards. Each model includes *Director* random effects to take into account unobserved characteristics of each director (e.g., age, education, experience, and so on), and *Year* fixed effects to take into account the time evolution of the network.