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WHAT IS WOMEN'S POSITION IN BRAZIL'S BOARD INTERLOCKING NETWORK? AN ANALYSIS COVERING THE PERIOD FROM 1997 TO 2015

Qual a posição das mulheres na rede de board interlocking do Brasil? Uma análise para o período de 1997 a 2015

¿Cuál es la posición de las mujeres en la red de board interlocking de Brasil? Análisis del período de 1997 a 2015

Thiago de Sousa Barros[1] | thiago.barros@ufop.edu.br | ORCID: 0000-0001-7739-9150
Charles Kirschbaum[2] | charlesk1@insper.edu.br | ORCID: 0000-0003-2618-2597

[1]Universidade Federal de Ouro Preto, Departamento de Economia, Ouro Preto, MG, Brazil
[2]Insper Instituto de Ensino e Pesquisa, Núcleo de Empreendedorismo, Design e Estratégia, São Paulo, SP, Brazil

ABSTRACT

Until recently, the companies' boards of directors have shown a strong male predominance, while controversial results regarding the insertion of women in these bodies have prevailed. Given this context, this research aimed to investigate the evolution of women's participation in the boards of directors of Brazilian companies listed on B3 and the position of these directors in the corporate board interlock network, between 1997 and 2015. To understand this phenomenon, the Social Network Analysis (SNA) methodology was adopted and several indicators were. The results indicate that women's participations have increased top management positions of the Brazilian corporate environment and women have begun to integrate the boards of directors, a scenario still far from the reality observed in developed countries. Nonetheless, by analyzing the members connected in the corporate network, we have concluded that women reach high proximity, since they have a high degree of centrality in the network, but they also lack the potential for intermediation. Such results signal the need to increase gender diversity at the top level of companies, which could raise the quality of debate on boards of directors and improve levels of corporate governance.

Keywords: corporate governance, board interlocking, gender diversity, inequality of opportunities, social network analysis.

RESUMO

Até recentemente, os conselhos de administração das empresas apresentavam forte predominância masculina, imperando resultados controversos quanto à inserção das mulheres nesses órgãos. Em face disso, esta pesquisa teve como objetivo investigar a evolução da participação feminina nos conselhos de administração das empresas brasileiras listadas na B3 e a posição dessas conselheiras na rede corporativa de board interlocking, entre 1997 e 2015. Para entender esse fenômeno, foi adotada a metodologia Análise de Redes Sociais (ARS) e diversos indicadores foram calculados. Os resultados indicam que as mulheres aumentaram sua participação na alta administração do ambiente corporativo brasileiro e começam a integrar os conselhos de administração, cenário ainda distante da realidade observada em países desenvolvidos. No entanto, quando foram analisados os membros conectados na rede corporativa, concluímos que as mulheres alcançam alta proximidade, uma vez que têm alto grau de centralidade na rede, mas também carecem de potencial de intermediação. Tais resultados sinalizam a necessidade de aumentar a diversidade de gênero no alto escalão das empresas, o que poderia elevar a qualidade do debate nos conselhos de administração e melhorar os níveis de governança corporativa.

Palavras-chave: governança corporativa, board interlocking, diversidade de gênero, desigualdade de oportunidades, análise de redes sociais.

RESUMEN

Los consejos de administración de las empresas presentaban, hasta muy poco tiempo, un fuerte predominio masculino, prevaleciendo resultados controvertidos en cuanto a la inserción de la mujer en estos órganos. En vista de eso, esta investigación tuvo como objetivo investigar la evolución de la participación de las mujeres en los consejos de administración de empresas brasileñas que cotizan en B3 y la posición de estos directores en la red corporativa de board interlocking, entre 1997 y 2015. Para ello, la metodología de Análisis de Redes Sociales (ARS) fue utilizada y se calcularon varios indicadores para comprender este fenómeno. Los resultados indican que las mujeres han aumentado su participación en la alta dirección del ambiente corporativo brasileño y comienzan a integrar los consejos de administración, un escenario aún alejado de la realidad observada en los países desarrollados. A pesar de esto, cuando se analizan los miembros conectados en la red de empresas, es posible concluir que las mujeres alcanzan una alta proximidad, ya que tienen un alto grado de centralidad en la red, pero sin potencial de intermediación. Tales resultados señalan la necesidad de aumentar la diversidad de género en el nivel superior de las empresas, lo que podría elevar la calidad del debate en consejos y mejorar los niveles de gobernanza corporativa.

Palabras-clave: gobierno corporativo, board interlocking, diversidad de género, desigualdad de oportunidades, análisis de redes sociales..

INTRODUCTION

Board interlocking occurs when a board member of a given firm holds a position on the board of directors of yet another one (Uddin, 2012). With the evolution of capital markets, especially in emerging countries, corporate boards have attracted considerable research interest, especially through the lens of network sociology (Young, Goldman, O'Connor, & Chuluun, 2020). Several studies have shown that corporate behaviors and practices are disseminated through these networks (Barros, Cárdenas, & Mendes-da-Silva, 2021; Kopoboru, Cuevas-Rodríguez, & Pérez-Calero, 2020).

In this scenario, the literature has investigated the insertion of women on corporate boards (Sun & Zhang, 2021). However, research efforts focusing on the internal aspects of companies have prevailed by shedding light on the leadership style of women or their intrinsic behavioral characteristics, observing the potential impacts of such attributes on the decision-making process of boards s and, consequently, the performance of companies (Prudêncio, Forte, Crisóstomo, & Vasconcelos, 2021; Shi, Yiu, Ricafrente, Unite, & Sullivan, 2021; Zuchi, Brugni, Nossa, & Beiruth, 2021).

Therefore, few studies have addressed how women have joined board interlocks and what position they hold in the Brazilian corporate network since, in the context of other countries, evidence has shown that although women have been able to access boards of directors, they have remained isolated or occupied marginal positions within the corporate network (Benton & Cobb, 2019; Young et al., 2020).

The main objective of this paper is to design annual networks of board members to identify women's position in the national business elite and their evolution over time. To this end, information on board members covering the period from 1997 to 2015 was collected from all B3 companies, which resulted in a database of 59,004 men and 5,548 women. This allowed the extraction of Social Network Analysis (SNA) metrics.

As the Brazilian corporate environment is predominantly composed of men (Zuchi et al., 2021) and no legislation is targeted at mitigating gender inequality on boards of directors, there are flagrant entry barriers for women in this segment of the workforce (Costa, Sampaio, & Flores, 2019; Prudêncio et al., 2021). In this context, this article may also contribute to improving the understanding of the current scenario through network analysis, which primarily favors the development of gender equality in the country.

LITERATURE REVIEW

The disparities in the labor market insertion of male and female workers in contemporary societies are notorious. The scenario is no different in Brazil, given the gaps in women's incorporation, performance, and remuneration in the labor market (Cirino, 2018). Moreover, severe distortions have persisted in the distribution of opportunities by occupation and economic sector (Tonelli, 2018).

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Despite progress in women's education indicators and the increased presence of this gender in the formal workforce, the degree of access to managerial positions in emerging countries, as is the case of Brazil, is still incipient compared to men, and the male gender predominates in corporate elites (Prudêncio et al., 2021; Zuchi et al., 2021).

Due to the need to explore the obstacles and implications of women's participation in corporate boards of directors, some studies have addressed this topic, especially in developed countries (Maida & Weber, 2019). Not coincidentally, the Code of Best Practice on Corporate Governance instituted by the Brazilian Institute of Corporate Governance (IBGC, 2015) includes measures to foster diversity on corporate boards.

As the board is one of the primary components of the governance system – whose role is to be the link between ownership and management by deciding the direction of the business and fulfilling monitoring functions – its core characteristics of impartiality and independence contribute to the improvement of corporate governance (Shi et al., 2021; Simionescu, Gherghina, Tawil, & Sheikha, 2021; Sun & Zhang, 2021).

Throughout this paper, we will focus on the social ties between directors of different firms, which according to Westphal and Khanna (2003), can affect the flow of information between firms, generate trust between partners, and reduce transaction costs. According to this view, ongoing social relationships via board interlocking could be a means to strengthen direct ties and disseminate behaviors, as well as operate as channels of trust and create identity-based networks (Barros et al., 2021; Kopoboru et al., 2020; Zona, Gomez-Meija, & Withers, 2018). Moreover, board interlocking shapes a mechanism used to maintain the social cohesion of corporate elites; that is, a resource that helps corporate elites preserve their autonomy and control in the long run (Benton & Cobb, 2019; Knoke, 2018).

One of the central questions of board interlocking research is how marginalized groups are included in the network. Young et al. (2020) demonstrated that as nonwhites and women reach elite positions, they remain marginalized at the periphery of networks. Despite the constant debate about gender diversity issues in the corporate sphere, focusing the analysis on board composition has ultimately neglected a crucial issue: How is the power of board members impacted by their representation on other boards, considering the female presence in this corporate network?

Therefore, the primary interest lies in analyzing the existing network through network analysis metrics (Young et al., 2020). Thus, this paper emphasizes the need to understand the insertion of women in board interlocking networks, not only in terms of their absolute percentage values but also in their network centrality. Only then will it be possible to understand the position of women board members in the national corporate elite.

The international context and the Brazilian case

Several countries, especially in Europe, have enacted laws on quotas aimed at increasing women's representation on boards, such as Germany, Italy, Spain, France, Sweden, and Iceland (Maida

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& Weber, 2019), as well as Israel and Norway, which are at the forefront in this regard (Bøhren & Staubo, 2014; IBGC, 2013).

To strengthen this evolution, the Alliance for Board Diversity (2008) highlights that the share of Fortune 1000 companies with at least one woman on their boards increased from 11% in 1973 to 97% in 2006. In this scenario, according to Heemskerk and Fennema (2014), women have come to occupy 16% of seats on boards in the US, followed by South Africa (15.8%), Israel and the UK (15%) and the Netherlands (14%), whereas Scandinavian countries such as Sweden (27%) and Finland (24.4%) had a higher degree of female participation.

In Brazil, the female presence on corporate boards is still incipient, and the age bracket of directors and executive officers is high. Indeed, such homogeneity does not contribute to diversity in this environment (Silveira & Donaggio, 2019). In 43.3% of the companies, women have no seats on the board, and the average female participation is small (1.02), a figure way too low compared to the average of 10.25 male members per board (Prudêncio et al., 2021).

In addition, Brazil has no legislation providing in this regard, and a culture of exclusion persists in informal relationship networks, which are crucial to advance executive careers and induction to boards. This, in turn, reveals a barrier to women entering this segment of the workforce (Silveira & Donaggio, 2019).

However, the minute presence of female workers on the boards of directors of Brazilian companies has fostered the creation of Senate Bill No. 112/2010, which defines a minimum quota of women participation on the boards of public and mixed-economy companies, as well as Senate Bill No. 398/2016, which determines that a minimum percentage of seats must be allocated to each gender in the corporate boards of all publicly traded companies in the country (Silva & Margem, 2015).

METHODOLOGY

Data and sampling

We collected information on the members of the boards of directors of all Brazilian companies listed on B3 between 1997 and 2015 from the Brazilian Securities and Exchange Commission (CVM). The total number of companies represents a sample of 680 medium and large-sized firms comprising all economic sectors. However, some companies have ceased to exist, and others were created during this timeframe. For example, 418 companies are currently listed on B3.

The data collection resulted in a database of 59,004 men and 5,548 women. Many individuals belonged to a single board of directors, including internal members of the firm (e.g., directors), who by definition would not participate in more than one board. To keep this bias in perspective, we also produced analyses for a subset of this population that belonged to two or more boards, which makes them "connectors." The second sample resulted in 18,051 male and 1,089 female board members.

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The database consists of two entities: firms and directors (board members). Firms are linked to other firms through shared directors. Similarly, directors are linked to each other through co-affiliation to the same boards. We arranged the directors in rows and the boards in columns for each year of the comprised period. By doing so, we obtained an "affiliation" network for each year and analyzed the affiliation networks directly to avoid losing information (Borgatti & Everett, 1997).

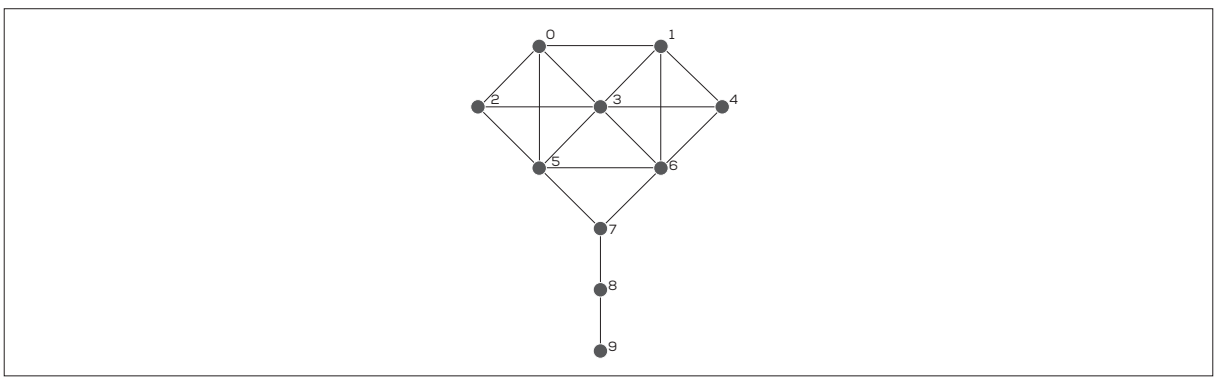
Social Network Analysis (SNA) Variables

To characterize the evolution of the interlock network between directors and firms, three metrics were selected. First, we obtained the density of the corporate network for each year. This metric measures overall network cohesion, where the number of ties is divided by the product of the number of directors and firms in the matrix. While the density metric is popular among SNA users, it is sensitive to the number of actors in the network, making it difficult to draw a comparison when the number of actors varies. Therefore, we also measured the local transitivity index, operationalized by the number of transitive quadruplets (Borgatti, 2009), and the average distance among all actors for each year. The mean distance refers to how quickly information and resources are transported in the network and establishing bridges between groups can considerably decrease the average path length.

Centrality indices

There is an extensive range of network centralities developed by the community of SNA researchers. In this paper, we have chosen to operationalize four popular and available centrality measurements for affiliation networks: degree, betweenness, closeness, and eigenvector (Borgatti & Everett, 1997). Next, we will explain these centralities and refer to Figure 1 to illustrate their calculation.

Figure 1. Illustration of a network



Source: Gundlach (2015) and Krackhardt (1990).

Degree centrality

Shaw (1954) proposed that the number of connections an individual has is directly related to their importance in the network. In many contexts, degree centrality expresses an individual's popularity and success in their professional field (Dahlander & McFarland, 2013). Similarly, the fundamental premise of this research is that a board member can be well connected if he or she has a relatively high volume of communication channels or resource exchanges. This, in turn, provides more opportunities, access, or alternatives to the board he or she is affiliated with compared to other boards (Mendes-da-Silva, Rossoni, Martin, & Martelanc, 2008; Zona et al., 2018).

This concept is measured by degree centrality, which represents the number of boards an individual participates in (Freeman, Borgatti, & White, 1991). In this paper, we check the centrality of female directors compared to male ones, and the number of director vertices corresponds to the number of boards to which they belong. In Figure 1, node 3 corresponds to the individual with the highest degree centrality.

Closeness centrality

Closeness centrality was originally proposed by Bavelas (1950) from experiments that identified that individuals with a low mean distance from other individuals in the network had faster access to information. Therefore, we propose that a female director may be well-connected if her mean distance from other directors is smaller, allowing for a faster exchange of information or resources (Larcker, So, & Wang, 2013).

This concept is measured by closeness centrality, which is operationalized from the mean distance between one board and another (Freeman, 1979). The average distance is calculated from the mean distance of the shortest path (geodesic path) between two nodes. In an "affiliation" network, the paths between directors are necessarily mediated by corporate boards. Thus, the normalization of this metric is adjusted to account for the "zig-zagging" between boards and directors (Borgatti & Everett, 1997). In Figure 1, we observe that nodes 5 and 6 have the highest closeness centrality, as they have, on average, the shortest paths relative to all other nodes in the network.

Betweenness centrality

Betweenness centrality, originally proposed by Bavelas (1950), represents the extent to which the critical paths in a network pass through an individual. Hence, individuals with higher betweenness centrality have greater control over the flow of information from one sector to another and exert power by being gatekeepers among their peers (Krackhardt, 1990). Therefore, the third understanding is that a female director may be well-connected if she is situated on critical paths between multiple boards, becoming an intermediary between firms and a key agent

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of information or resource exchange (Stovel & Shaw, 2012). Indeed, this concept is measured by betweenness centrality (Freeman, 1977) and allows one to observe whether women are central in terms of betweenness (Larcker et al., 2013). In terms of interlocking, the paths connecting directors are necessarily mediated by boards (Borgatti & Everett, 1997).

In contrast to closeness centrality, betweenness centrality brings about the notion of exclusivity because it denotes those directors who centralize a higher number of critical paths and, therefore, obtain information and resources that other directors cannot access. For example, in Figure 1, the individual with the highest middle centrality is node 7 since it concentrates the largest number of critical paths.

Eigenvector centrality

Bonacich (1972) proposed that the prominence of an individual occurs through their direct and indirect ties. To allow for the measurement of this "cascade" of contacts, Bonacich suggested the adoption of the first eigenvalue (eigenvector) of the matrix that corresponds to the network. Thus, the fourth variable addressed in the model was eigenvector centrality, which expresses the main eigenvalue of the matrix corresponding to the graph and can be perceived as a composite measure in which the degree centrality is adjusted. A given director is central if he or she is connected to boards in which they are central. We can observe that this measure is recursive: the centrality of a director depends on the centrality of the boards to which he or she is connected and vice versa (Borgatti & Everett, 1997).

Since a director's connectedness depends on direct and indirect connections, eigenvector centrality captures notions of power and prestige, assigning a special advantage in obtaining resources, information, and favors (Sauder, Lynn, & Podolny, 2012). Since eigenvalue centrality is based on degree centrality, these two measures tend to correlate but are not equivalent. For example, in Figure 1, although nodes 4 and 7 have equivalent degree centrality (three ties), node 4 has a higher eigenvalue centrality than node 7 (0.6 and 0.4, respectively). This is because node 4 is connected to more popular individuals in the network than node 7.

These network analysis metrics were calculated using Ucinet 6 software (Borgatti, Everett, & Freeman, 2002), and the results were interpreted for the 1997-2015 series, allowing us to understand the insertion of women on B3 Brazilian corporate boards and their centrality in the board interlock network. These metrics were applied over two profiles. In the first, we included all board members in the study population. In the second, we excluded directors affiliated with a single board. By doing so, we aimed to eliminate biases associated with appointing internal firm executives to boards.

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ANALYSIS AND RESULTS

Sample characteristics

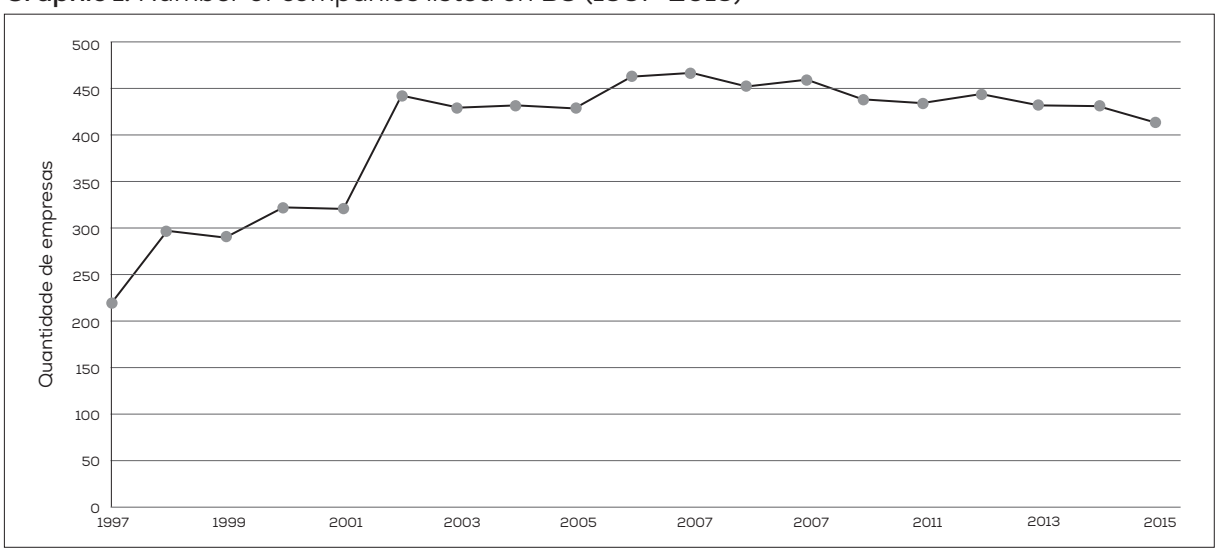
On average, the directors in the sample for this period were 48.8 years old. On average, men were slightly older (49.1 years) than women (45.1 years), with a similar standard deviation of approximately 11 years. Women and men show equivalent tenure at the company (seven years on average).

Among men, most are engineers (31.6%), followed by managers (27.3%), economists (16.8%), and lawyers (5.5%). Among women, the majority are managers (30.7%), economists (16.1%), lawyers (12.9%), and engineers (9.7%).

General network characteristics

The first analysis reveals that the number of Brazilian firms listed on the stock exchange was approximately 220 in 1997, and this figure had practically doubled by the last year of the series. By 2015, many firms were trading shares on the stock exchange (approximately 405). In addition, a considerable number of Initial Public Offerings (IPO) took place in that period, especially from 2002 onwards, due to the improved economic scenario.

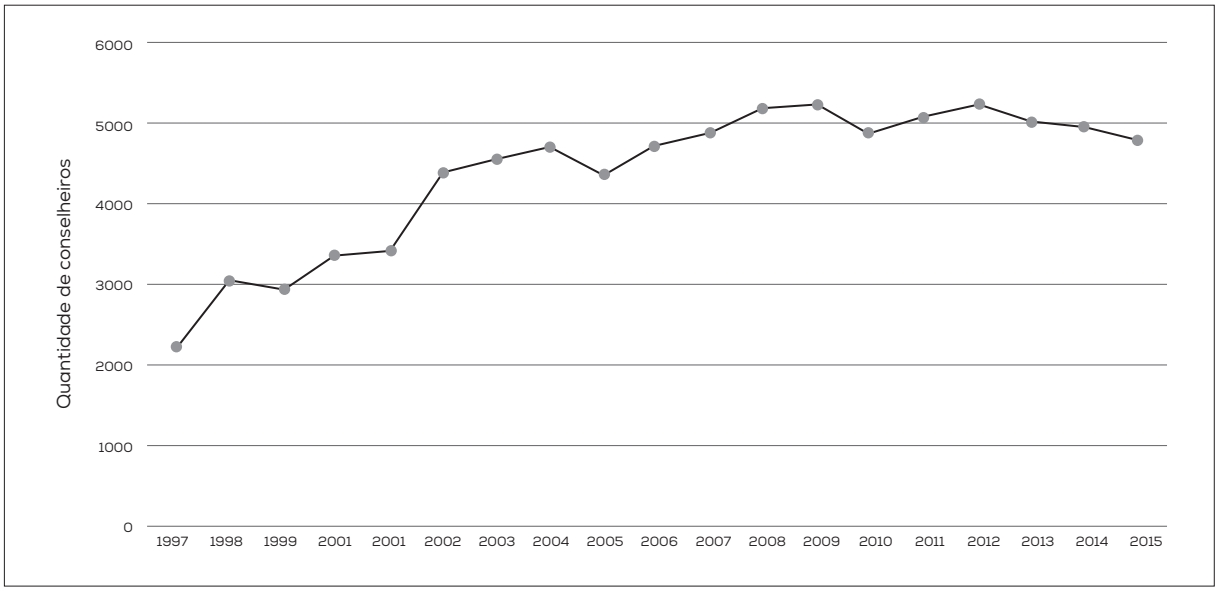
Graphic 1. Number of companies listed on B3 (1997-2015)



Source: Research results.

Similarly, the number of male and female directors also showed accelerated growth. It is worth noting that the average number of members on Brazilian corporate boards in the last year of the series is 10.0, within the bracket proposed by IBGC (2015), which ranges between five and 11 members. Prudêncio et al. (2021), when investigating the period 2016-2017, found an average number of 10.2 directors with seats in the firms, which shows that the data did not change significantly in the following years.

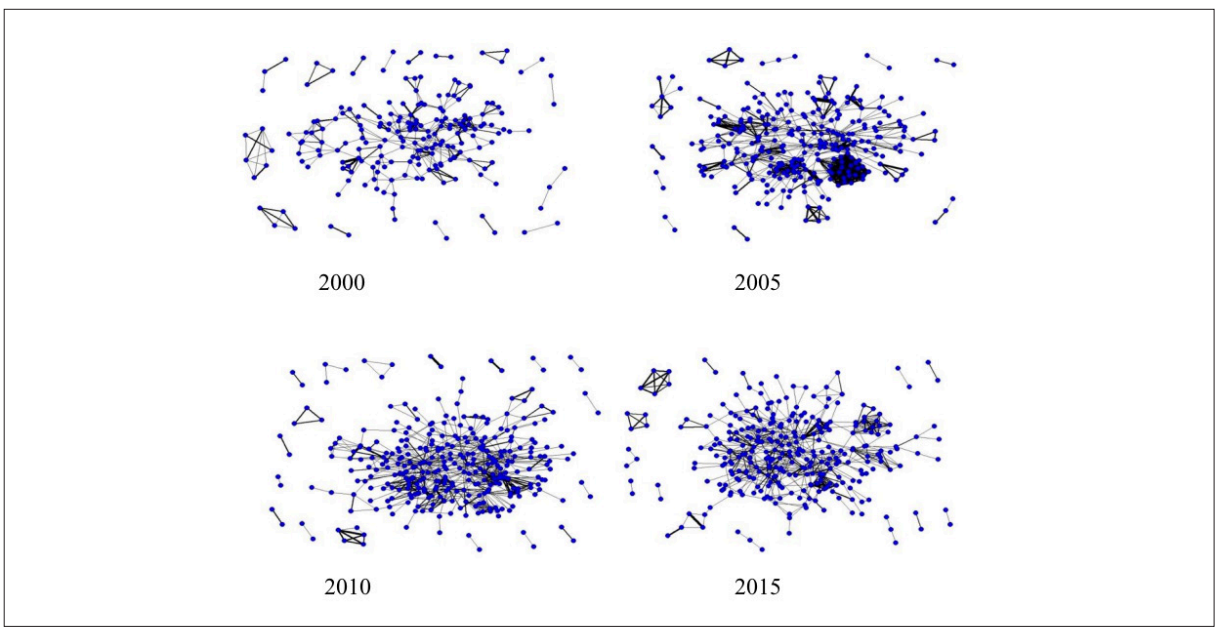
Graphic 2. Number of directors (1997-2015)



Fonte: Resultados da pesquisa.

Figure 2 below plots the networks every five years, starting in 2000. A visual inspection suggests an increase in the number of directors and larger connections between them.

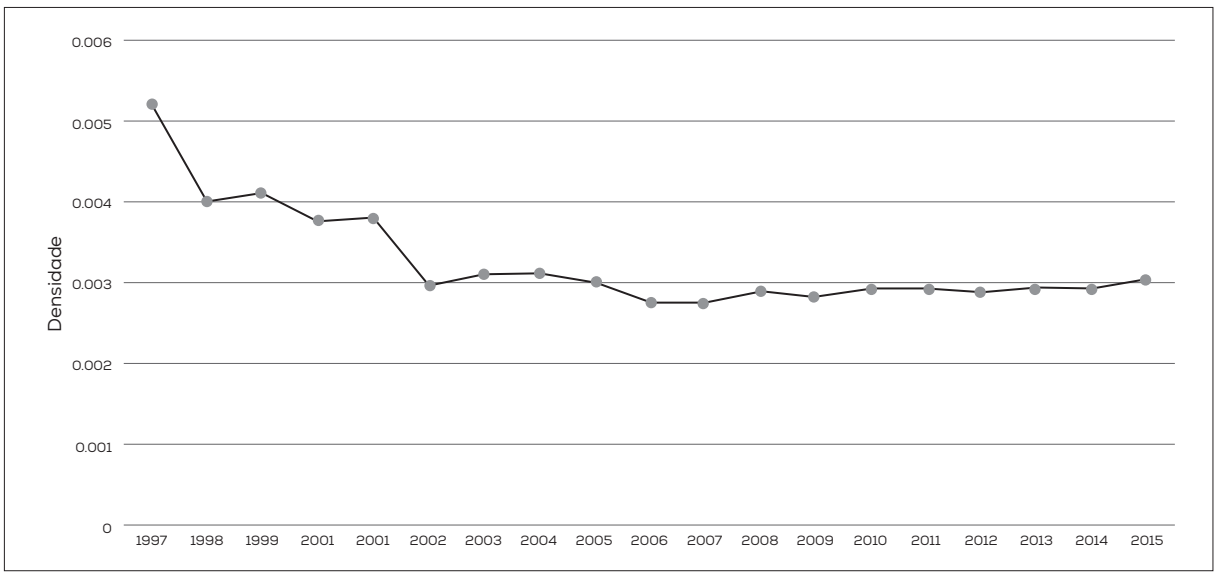
Figure 2. Evolution of Brazilian corporate networks (2000, 2005, 2010, 2015)



Source: Research results.

Over time, the network density evolution (Chart 3) reveals a decrease in overall cohesion. However, this decrease is strongly influenced by the increase in directors (Chart 2).

Graphic 3. Evolution of the density of director and corporate networks



Source: Research results.

The inspection of the evolution of transitivity (Chart 4) reveals a drop in local transitivity, which in turn demonstrates a decrease in the propensity of board members and firms to form closed groups. The presence of closed groups has been recorded in the literature associated with board interlocks in Brazil (Brookfield et al., 2012) and may be associated with the difficulty of women joining boards. In many contexts, it is common for homogeneous and cohesive groups to emerge, where these two dimensions reinforce each other. For example, in a network where individual A is a friend of B, and the latter is a friend of C, there is a tendency of closure by transitivity: if A invests time and resources in their relationship with B, and the same occurs between B and C, then A and C are expected to establish a relationship as well (Granovetter, 1973).

At the same time, the longer the coexistence between A, B, and C, the greater the propensity for these individuals to share attitudes and beliefs (Christakis & Fowler, 2007). However, the greater the similarity of attitudes and beliefs, the greater the propensity to form ties due to the homophily phenomenon (Kossinets & Watts, 2009). Among the multiple dimensions that can lead to the establishment of homophilic ties, the dimensions shared in cohesive groups are reinforced, leading to the salience of some characteristics over others (Kossinets & Watts, 2009).

Similarly, minority groups within firms may face various obstacles to inserting themselves into the organizational network. One important obstacle is the reduced sharing of beliefs and attitudes (which often correlate with gender) that would lead them to be included. In the case of women, this leads to being cut off from critical information flows (Singh, Hansen, & Podolny, 2010). In contrast, in more open groups, there is more room for a multiplicity of ideas, beliefs, and attitudes and, in an associated manner, for groups to put forward these distinct points of view. Similarly, the mean distance between directors and firms has remained stable over the years, suggesting that decreasing local cohesion has not resulted in creating more bridges with a global effect in the network.

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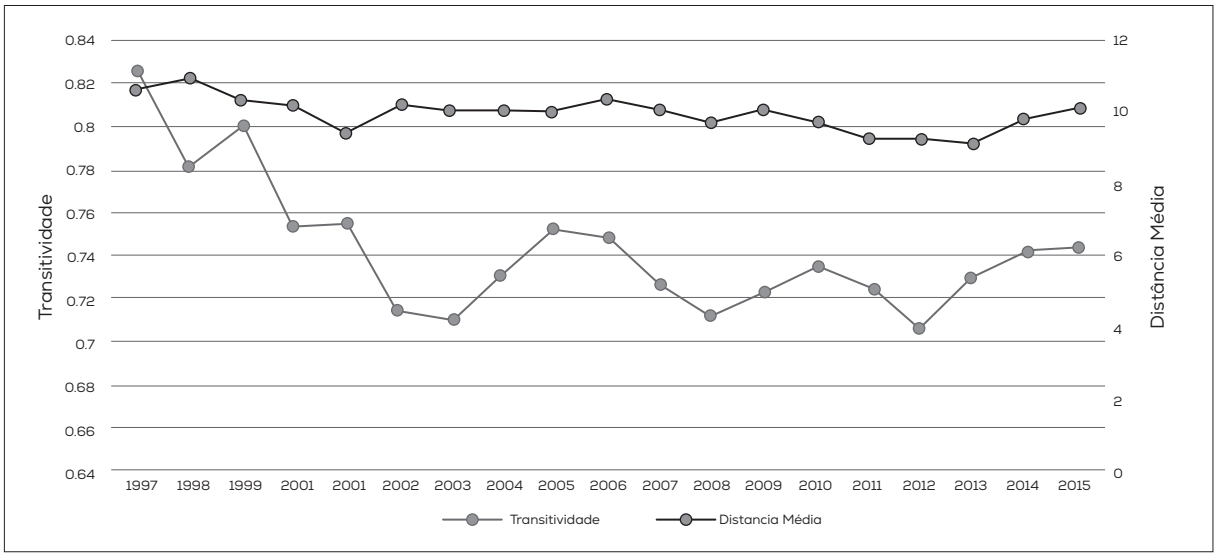
Graphic 4. Evolution of local transitivity and mean distance between directors and firms

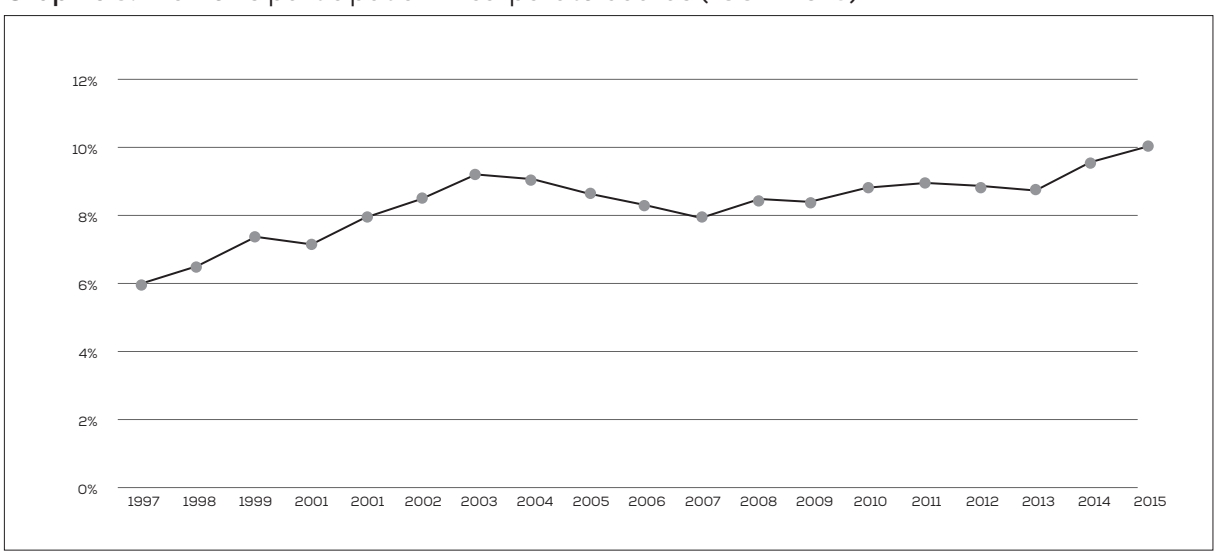


Source: Research results.

Female directors: participation and position in networks

To achieve the primary objective of this study, it is crucial to evaluate the evolution of the percentage of women holding seats on boards of directors. In 43% of the companies, women do not even have board seats, which denotes low representation. In 1997, women's participation was only 6%, and by 2015, it had reached 10% (Graph 5). Therefore, the average female participation is indeed low (1.01) compared to the average of ten board members, and these results corroborate other studies (Prudêncio et al., 2021).

Graphic 5. Women's participation in corporate boards (1997-2015)



Source: Research results.

Despite the increase in gender diversity on corporate boards, the number of women in Brazil is still relatively low compared to developed countries, especially those that already have enacted laws on this topic. For comparison: in 2019, publicly traded companies in Organization for Economic Cooperation and Development (OCDE) countries had 26% women on their boards, on average (OECD, 2019).

Given that the minimum quota of women on boards established by law varies between 30% and 40%, Brazil, which reached 10% of female participation in the last and best year of the series (1997-2015), has ample room for growth to absorb women in this segment of the labor market, which has crucial strategic importance for companies. However, there is a huge inequality gap in the corporate environment to be repaired through affirmative actions.

Based on the data on the centrality of male and female board members, we drew comparisons between the two samples. In the first sample profile, we included all board members in the population (Table 1) and, in the second, only the board members affiliated with two or more boards (Table 2).

When calculating the network measurements for the entire sample, we find that women have lower degree centrality (-4%), and when the calculation is performed only for connectors, women have a higher average degree than men (19%). Degree centrality corresponds to the mean number of boards that directors participate in, and when only connector directors are included, women keep showing higher average participation than men. This may indicate that women effectively accepted by the interlock community are more sought-after on average than their male counterparts.

The comparison of the average eigenvector centrality of men and women follows the pattern observed for degree centrality. This is expected since eigenvector centrality can be interpreted as a variation of degree centrality. When the entire population of directors is analyzed (Table 1), women present a lower eigenvector centrality than men (-18%). This trend reverses when only connector directors are analyzed since women have an average 59% higher centrality of this type. Women connectors present a higher degree of influence than men. However, when female non-connectors are inserted into the network, the relationship is inverted, suggesting that female non-connectors do not belong to the boards in which other members are influential.

Table 1 shows that women display higher levels of proximity centrality than men (+25), and in Table 2, this pattern disappears. Although men show higher closeness centrality in the connector profile, the samples are marginally distinct (p-value = 0.106). The average closeness centrality of men decreases when we include male non-connectors; this possibly occurs because many male non-connectors are affiliated with more peripheral boards. In contrast, non-connector women are relatively more affiliated with central boards.

Analyses of networks with all board members reveal that women have lower middle centrality (-50%) (Table 1), and this disparity is maintained for the network formed only by connector board members (Table 2). Women's average betweenness centrality is 20% lower than men's, and this evidence suggests that women hold relatively fewer critical paths between distinct groups in the board interlock network, which, in turn, decreases the chance that they will become global intermediary actors in the network.

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Table 1. Network variables for the entire sample

Amostra completa					
		Homens	**Mulheres**	**Mulheres/Homens**	**P-valor***
Grau	Média	0,0032	0,0030	-4%	.000128
	Des.pad.	0,0021	0,0030		
	N	59004	5548		
Proximidade	Média	143,66	179,55	25%	< .00001
	Des.pad.	284,61	336,62		
Centralidade-Meio	Média	0,0005	0,0003	-50%	< .00001
	Des.pad.	0,0031	0,0020		
Autovetor	Média	0,0028	0,0023	-18%	0.0169
	Des.pad.	0,0169	0,0174		
Clusterabilidade	Média	0,9280	0,9516	3%	< .00001
	Des.pad.	0,1709	0,1337		

Source: Research results.

Table 2. Network variables for connected members

Apenas Conectores (indivíduos em 2 ou mais conselhos)					
		Homens	**Mulheres**	**Mulheres/Homens**	**P-valor***
Grau	Média	0,0046	0,0055	19%	< .00001
	Des.pad.	0,0033	0,0062		
	N	18051	1089		
Proximidade	Média	64,35	56,77	-12%	.10628
	Des.pad.	194,98	196,19		
Centralidade-Meio	Média	0,0017	0,0014	-20%	.013195
	Des.pad.	0,0050	0,0044		
Autovetor	Média	0,0025	0,0039	59%	.003773
	Des.pad.	0,0167	0,0279		
Clusterabilidade	Média	0,8071	0,8154	1%	.124873
	Des.pad.	0,2343	0,2079		

Source: Research results.

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Development over time

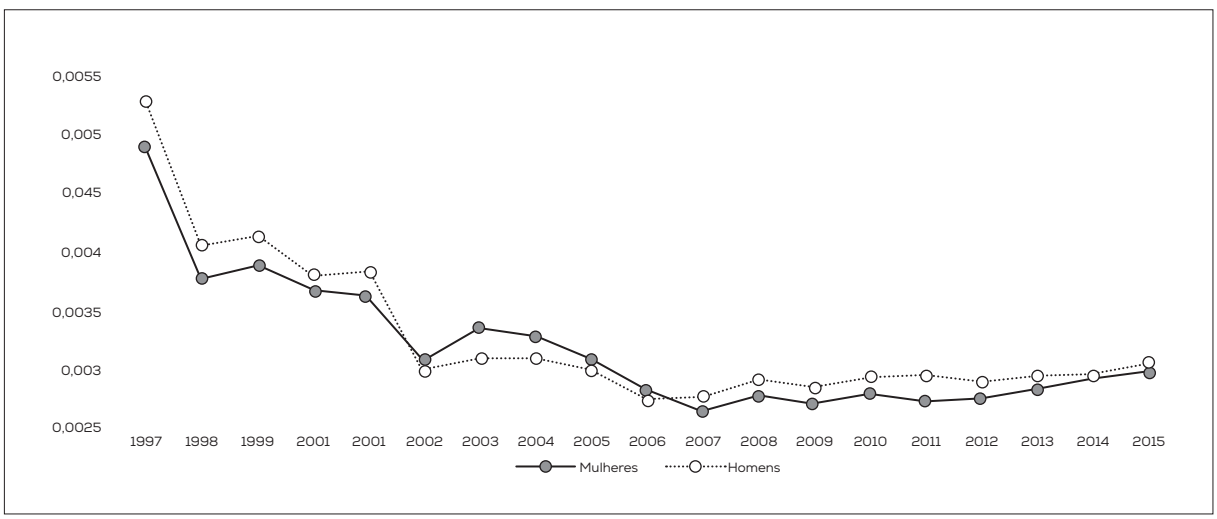
This section presents the centrality data broken down by year. Therefore, it will be possible to identify the development trend over time when comparing women and men. Centrality has decreased, regardless of gender, as shown in Chart 4. Except for the period between 2002 and 2006, men have always had a higher degree of centrality than women.

In 2002, the Ibovespa hit 11,268 points; in 2006, it reached 44,473 points (294.68% of appreciation). The market value of companies also grew 543% in this period, driven by the reduction in basic interest rates, the country risk classification, and a favorable international economic conjuncture. Indeed, this scenario paved the way for strengthening the capital market and expanding firms. Meanwhile, the Special Corporate Governance Stock Index (IGC) appreciated most among the various B3 indexes, with a 37.9% hike in 2004 alone, the peak of the series. However, from 2007 onwards, this trend reversed, mainly due to the subprime mortgage crisis's uncertainties.

Following the positive change between 2002 and 2006, several companies went public on B3. In 2006 alone, the last year of this prosperous period, 26 companies listed their shares on the stock exchange for the first time. As a result, women who already held a few seats on the board of directors began to join other boards as well. Data shows that starting in 2002, some women became members of more than five boards of relevant firms in the network. In specific cases (outliers), women occupy seats on up to 12 boards.

Even so, although these cases of female board interlocks do not foment the degree of corporate governance and board independence levels, we must highlight the favorable scenario for women directors in this series period, especially because these are leading companies in the country's corporate network. Moreover, such events may explain the reversal observed in degree centrality between 2002 and 2006, which is not repeated throughout the series.

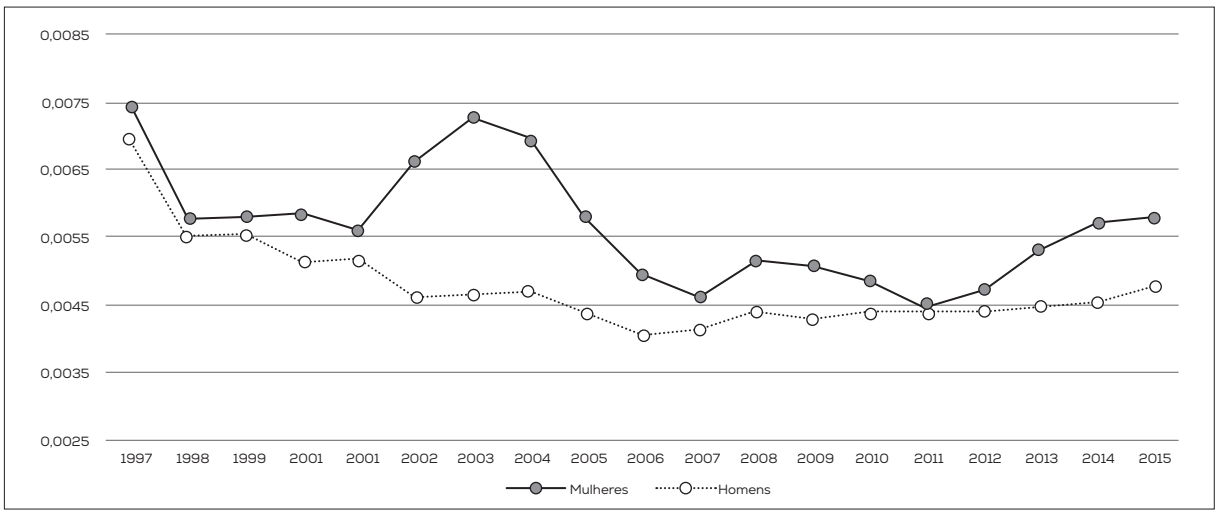
Graphic 6. Degree centrality for the entire sample



Source: Research results.

In line with the aggregate analysis (Table 2) for connecting members, women's degree centrality is typically higher (Chart 7). This difference is especially significant between 2001 and 2006. From 2011 onwards, the difference between men and women resumed its growth trend:

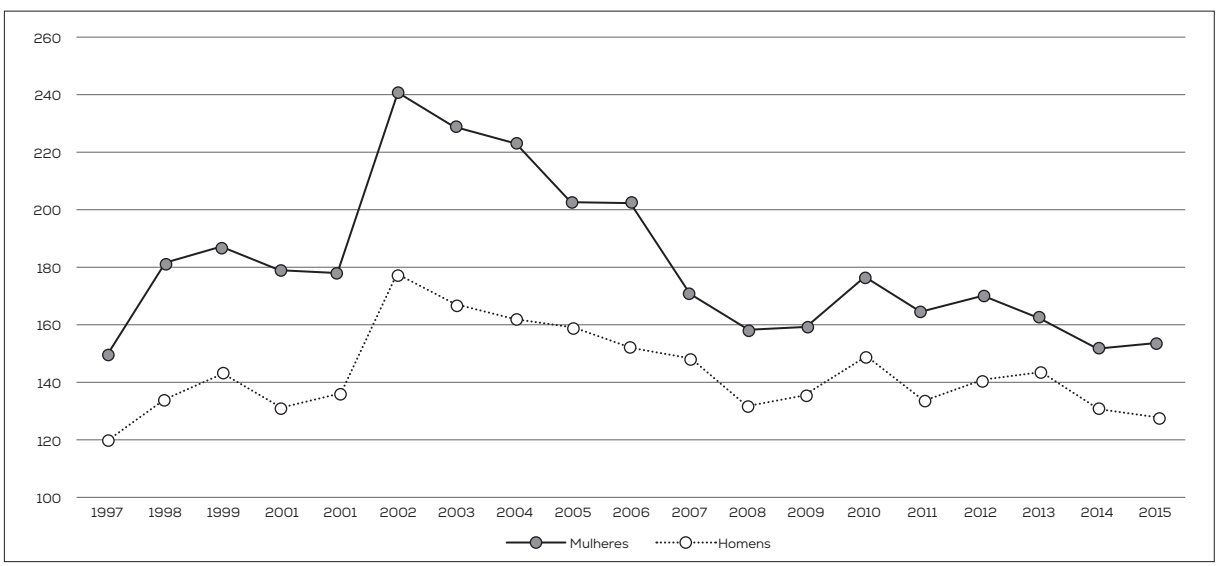
Graphic 7. Degree centrality for connected members



Fonte: Resultados da pesquisa.

When networks are analyzed with all directors, we notice that the closeness centrality is consistently higher for women (Chart 8). This measurement represents the mean of the shortest paths and defines how close each vertex is to the others.

Graphic 8. Closeness centrality for the entire sample



Source: Research results.

However, when analyzing only the connected directors, women generally show lower closeness centrality than men (Chart 9), and this pattern reversed between 2002 and 2005.

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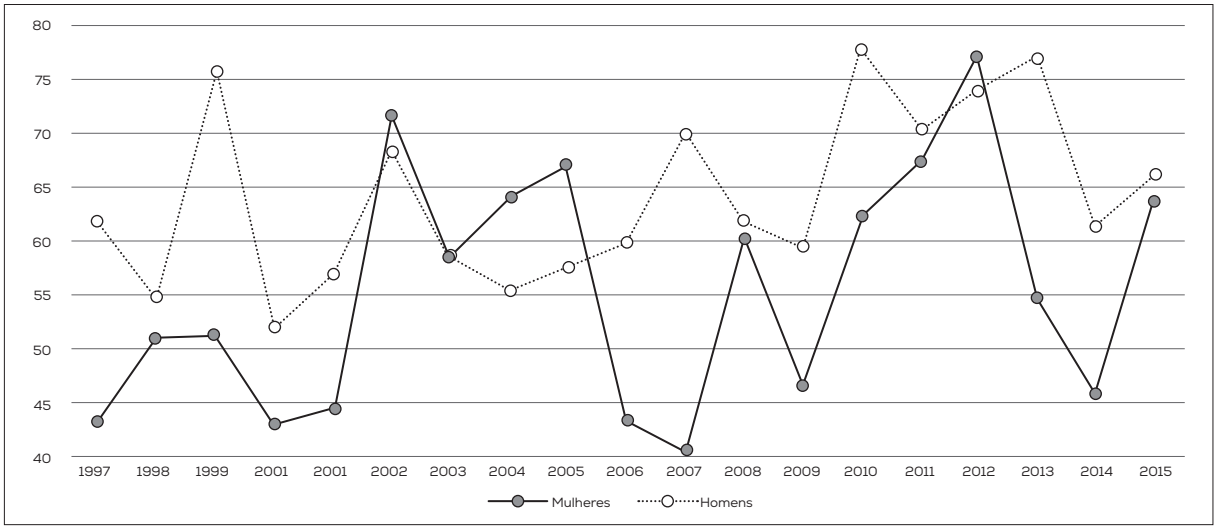
Fluctuations in men's and women's closeness centralities over the period suggest the lack of a consistent pattern and explain why the averages are not significantly different (Table 2):

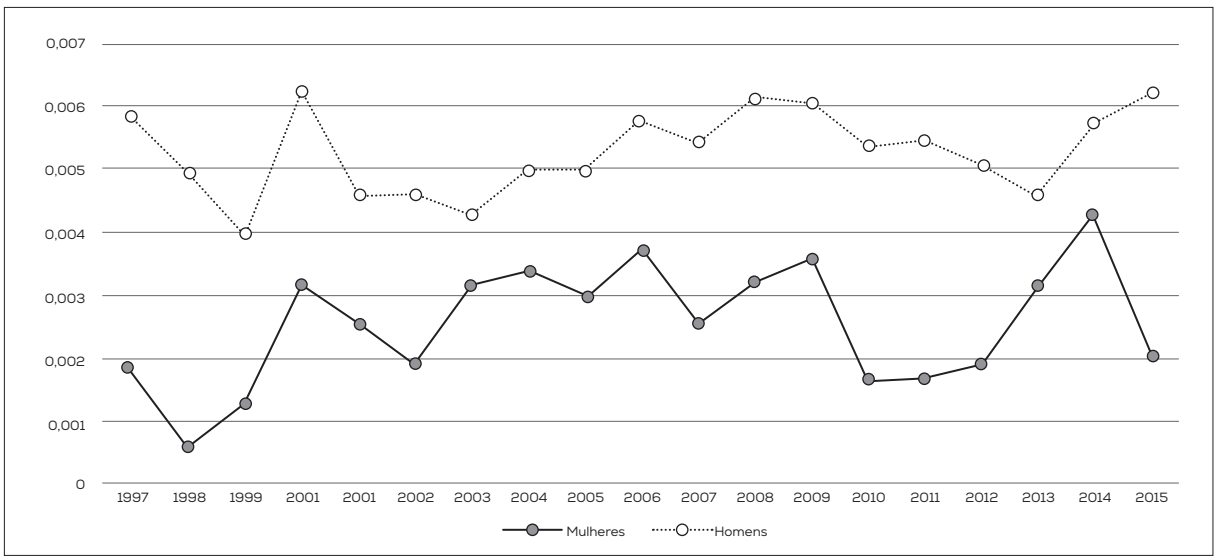
Graphic 9. Closeness centrality for connected members



Source: Research results.

The investigation of the betweenness evolution for networks with all directors suggests that women consistently showed lower results over the period analyzed (Chart 10).

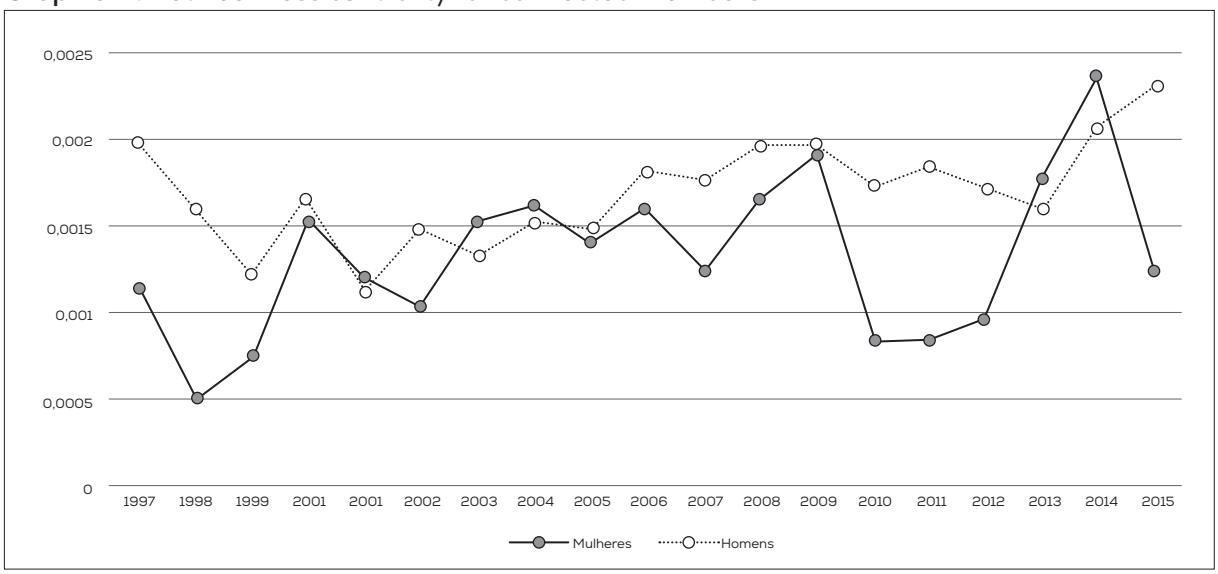
Graphic 10. Betweenness centrality for the entire sample



Source: Research results.

In contrast, the results based on networks comprising only connector directors showed a narrowing of this gap. Still, men's centrality remains higher for most of the series (Chart 11). The difference between men and women reaches its acme in the early years of the time series (1997 to 1999) and between 2010 and 2012:

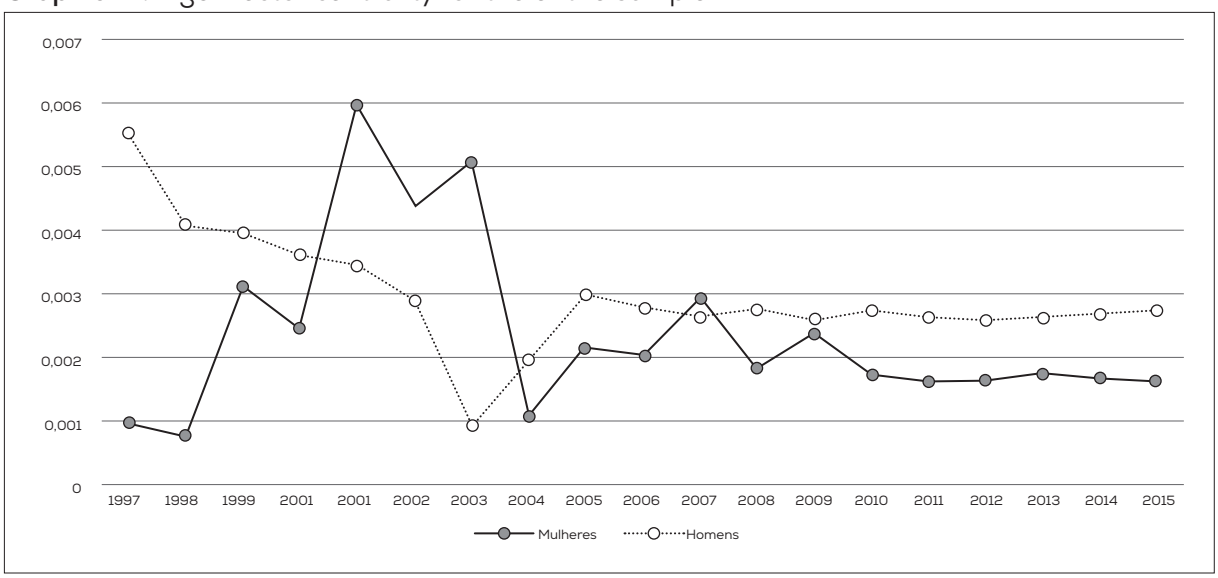
Graphic 11. Betweenness centrality for connected members



Source: Research results.

Finally, by analyzing the evolution of eigenvector centrality, we measure the level of indirect influence that a given board member can have over other boards connected to the network. For the entire sample, we can see that women have less influence (Chart 12), and this pattern only reversed from 2001 to 2003.

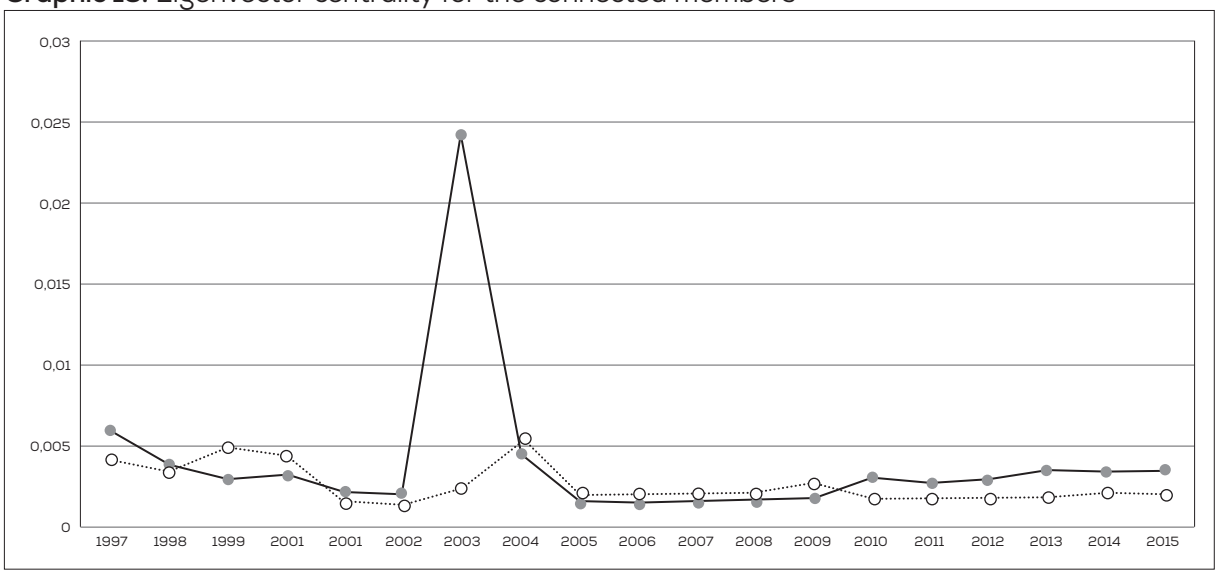
Graphic 12. Eigenvector centrality for the entire sample



Source: Research results.

When analyzing the evolution of eigenvector centrality only for the networks of connected members, we can see high closeness centrality between men and women, except for 2003, which is an outlier in the series (see Chart 13).

Graphic 13. Eigenvector centrality for the connected members



Source: Research results.

Discussion

This section will interpret the data collected for this study while revisiting theoretical concepts that can support the analysis. The most elementary network metric is degree centrality, which expresses total individual activity, not considering the network structure (Borgatti, Everett, & Johnson, 2018). Our analyses reveal that women show higher degree centrality than men when the network of connectors is considered. On the one hand, this supports the idea that women have received many insertion opportunities, on average (Mendes-da-Silva et al., 2008; Zona et al., 2018).

However, the percentage of women's representation, combined with a higher number of boards per woman, suggests that the same women are required to participate in many boards. This may point to pressure to increase gender diversity on boards (Knippen, Shen, & Zhu, 2019). However, this may lead to unintended consequences.

First, highly sought-after directors show inferior ability to dedicate and commit to the boards they are affiliated with, which, in turn, decreases their performance (Ferris, Jagannathan, & Pritchard, 2003; Masulis & Zhang, 2019). Secondly, some boards increase women's representation but fail to engage them in the decision-making process, which creates a scenario of "tokenism" (Elstad & Ladegard, 2012; Torchia, Calabrò, & Huse, 2011). Consequently, the increased inclusion of women on corporate boards is not fully realized.

Thirdly, a low percentage of women's participation combined with a high average may reveal a "bottleneck" (Dalton & Dalton, 2009). This occurs when the percentage of women directors (i.e., holding internal executive positions) is much higher than the percentage of women in the board interlocking network and suggests the difficulty faced by women executives

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who have risen through the internal ranks of organizations to ascend to higher-profile positions on corporate boards.

This interpretation corroborates the evidence that women in the network for the entire sample (Table 1) show lower degree centrality than men. Moreover, women in internal executive positions tend to receive less attention than men and are therefore less frequently inducted to corporate boards. In other words, when it comes to interorganizational access, women fall short of an equitable position (Mendes-da-Silva et al., 2008; Zona et al., 2018).

Eigenvector centrality can be interpreted as an extension of degree centrality, as it captures the propensity of individuals to be connected to other well-connected ones (Borgatti et al., 2018). These results are analogous to the patterns associated with degree centrality: women show higher average levels of eigenvector centrality when the network of connectors is considered.

Eigenvector centrality measures individual prestige in a network (Podolny, 1993; Sauder et al., 2012). Thus, we can interpret women's higher mean eigenvector centrality as a possible prominence of this group (Shi, Sorenson, & Waguespack, 2017). However, the difference between men and women was significantly discrepant (see Chart 11) only in 2003. In the other years of the series, men's and women's mean eigenvector centralities were too similar to suggest any difference.

Closeness centrality refers to the mean distance of individuals to all other participants in a network. Consequently, these individuals are expected to have faster access to information in the network (Borgatti et al., 2018; Larcker et al., 2013). When we examine the network containing the entire sample of directors, women show a higher mean of closeness centrality than men. In contrast, this advantage disappears when the network containing only connectors is analyzed.

This evidence suggests that women in senior internal executive positions (and therefore candidates for board interlocking) tend to access information more quickly than men. This is probably because women tend to attain higher positions in organizations more central to the network. However, since they are not typically invited to join corporate boards beyond the organizations where they already hold seats, they are rendered unable to exploit the full potential associated with rapid access to information.

The last centrality we considered was betweenness, which corresponds to the capacity for global brokerage in networks (Stovel & Shaw, 2012). Our analyses suggest that women show less overall brokerage in the interlocking network by including or excluding directors affiliated with a single board. This suggests that women typically rely on male brokers to access resources and information in the interlock network, corroborating the literature on gender and social capital in corporate networks (Burt, 1998).

Indeed, this difference between men and women can be detrimental to the latter in numerous ways. First, the low degree of global brokerage makes it difficult for them to access information associated with network regions outside the scope of their immediate social circle (Lomi, Lusher, Pattison, & Robins, 2014), and this, in turn, leads to a narrower strategic vision. Furthermore, women may face greater obstacles to being nominated by other women for corporate board positions due to more limited access to interlocking positions. This may explain why interlocking networks tend to absorb a higher percentage of women so slowly.

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FINAL REMARKS

In the Brazilian corporate landscape, male predominance in high-ranking positions has been perpetuated, as well as solid entry barriers for women in this market, especially regarding corporate board positions. This study proposed a comprehensive analysis, shedding light on the social insertion of women in the country's corporate elite and its evolution over time, aiming to understand the inequality of opportunities from a gender perspective.

We estimated four centrality metrics (degree, eigenvector, closeness, and betweenness centrality) to identify the links between boards in Brazil and the degree of women's relevance in this context. The results reveal that women have increased their degree of participation in top management positions in the Brazilian corporate environment and have become part of more corporate boards (an increase from 6% to 10%). However, we are still far from the reality observed in developed countries.

Even so, we have concluded that women achieve high closeness centrality by analyzing the connected members in the corporate network. That is, they have a high degree of centrality in the network but lack brokerage potential, whereas their influence potential is similar to that of male directors. Basically, the bottleneck observed in the Brazilian corporate network is glaring: a few women are highly sought-after, while many other women fail to join more than a single board of directors, remaining limited to their organizations.

Therefore, this paper contributes to a better understanding of unequal opportunities and gender diversity in the Brazilian corporate environment. Furthermore, we hope that the results presented here can deepen the understanding of the insertion of women in elite corporate networks in Brazil, as well as how this has changed over time, fostering the proposal of novel research agendas and corroborating the formulation of public policies targeted at this.

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AUHTOR'S CONTRIBUTION

Thiago de Sousa Barros: Project Administration; Formal Analysis; conceptualization; Data Curation; Writing – First Writing; Writing – Proofreading and Editing; Investigation; Methodology; Obtaining Financing; Resources; Software; Supervision; Validation; visualization.

Charles Kirschbaum: Project Management; Formal Analysis; conceptualization; Data Curation; Writing – First Writing; Writing – Proofreading and Editing; Investigation; Methodology; Obtaining Financing; Resources; Software; Supervision; Validation; visualization.