

Board Interlocking in Brazil: Directors' participation in multiple companies and its effect on firm value

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Abstract

This paper investigates the simultaneous participation of directors in different companies from 320 Brazilian listed firms in 2001, 2003 and 2005. We identify which firms are connected through a network of directors, which corporate characteristics contribute to this phenomenon, and if board interlocking influences firm value and operational performance. Our results show that interlocking directorates are a common practice in Brazil. Besides, larger boards, more dispersed ownership structures, and larger firm size are factors associated with higher level of board interlocking. Moreover, we find that firm value is, on average, negatively impacted by higher level of board interlocking, especially in firms with a “busy board” (one in which a majority of directors hold three or more directorships) or in firms where the CEO hold directorships in other companies. Besides being a pioneering work in this field in Latin America, this paper provides evidence for the elaboration of good corporate governance guidelines from regulators regarding the effectiveness of multiple directorships and its consequences for corporate value.

Key-words: board interlocking, board of directors, corporate governance, directors, firm value

JEL classification code: G32, G34.

1. Introduction

The board of directors is one of the main internal corporate governance mechanisms, due to its roles of monitoring managers, ratifying relevant decisions, and setting the company's strategic guidelines. Virtually all corporate governance codes of best practices, prepared based on recommendations from market agents, highlight the importance of independent board members and the separation between CEO and chairman positions in order to ensure unbiased and impartial decisions (e.g. OECD, 1998).

However, one aspect that has received little attention in the literature refers to the possibility of corporate value being affected by the number of board seats occupied by the directors of the companies. This phenomenon is known as board interlocking¹. It happens when a director serves as a board member in two or more companies, thus establishing a connection between them (Fich and White, 2001). Examples of research in this area can be found in Dooley (1969), Allen (1974), Mizruchi (1996), Fich and White (2001), and Fich and Shivdasani (2006), among others. In Latin America, however, the subject is unexplored and, to our knowledge, no studies were published in this research line.

There are different arguments for the existence of this phenomenon: behavioral economists suggest that companies use board interlocking as a mechanism to improve the contractual relations between different firms, thus reducing implicit uncertainties (Schoorman, Bazerman and Atkin, 1981). Other researchers argue that the phenomenon is simply driven by market competition, since better trained directors constitute a scarce resource like any other, so that companies will compete for the presence of these professionals on their boards² (Fich and White, 2001, Mizruchi 1996).

Regarding the effect of board interlocking on company performance, Mol (2001) argues that linking companies through board members may bring benefits resulting in competitive advantages, such as easing the access to resources, clients and creditors,

disseminating innovations and effective methods, and positively influencing the environment where these companies are inserted in. On the other hand, Fich and Shivdasani (2006) report that an analysis of the 500 largest American companies between 1989 and 1995 indicates that the presence of directors in multiple boards produces a negative effect on firm's market value, supposedly caused by the deterioration of governance quality³.

Our study aims to understand and describe the occurrence of directors' simultaneous participation in multiple companies in Brazil. The research is conducted through analysis of board composition of all actively traded publicly companies on São Paulo Stock Exchange (Bovespa) in 2001, 2003, and 2005. We also investigate which corporate characteristics favor the occurrence of a high level of board interlocking in Brazil. Finally, through different econometric tests, we evaluate the impact of this practice on corporate value.

We provide three main results: firstly, we observe that board interlocking is a recurrent practice in Brazil. In 2003, for instance, the 3,196 board seats of the firms under analysis were occupied by 2,688 professionals. Besides, 74% of the sample firms have at least one officer or director simultaneously working for another company. We also find that the composition and size of the board, firm size, and the level of stock ownership dispersion are the main attributes that influence this phenomenon. Finally, in line with other studies on this field, we observe that board interlocking tends to negatively impact firm value. Particularly, two types of board interlocking stand out as damaging corporate value: the participation of the CEO and/or the chairman of the board in other companies' boards, and the presence of a large ratio of outside directors participating in different companies (the so-called "busy boards"⁴).

Our motivation for this research is based on the argument that the interconnection between companies through their directors is a mechanism that can affect corporate strategies and decisions that, at macroeconomic level, can increase or decrease overall market efficiency. As an illustration of such implication of this subject, Bizjak et al. (2007), provided evidence that recent corporate governance problems in the U.S. market, caused by option

backdating in order to raise executives' gains, may have been disseminated by "mouth-to-mouth" between directors simultaneously serving in different boards.

Overall, we believe that this research offers three main contributions: i) it is a pioneering exploratory research on this field in Brazil and, to our knowledge, in Latin America, therefore contributing to the international literature by providing empirical evidence from an emerging country; ii) we offer evidence on the determinants of board interlocking, showing which corporate characteristics tend to influence the adoption of this practice to a greater or lesser extent; and, iii) we provide evidence, using different operational definitions for board interlocking, that this practice exerts a negative influence on firm value. This result can be considered particularly important, since it offers support for recommendations on this subject to be presented in corporate governance codes of best practices.

The paper is divided as follows: Section II presents a literature review on the subject and discusses the research hypotheses; Section III addresses the methodological and sampling issues; Section IV presents an overview of board interlocking in Brazil, through descriptive statistics and an example of mapping interlocked companies; Section V discusses which factors favor the formation of board interlocking through the application of multivariate probit regressions; Section VI assesses, through alternative econometric tests, the extent to which corporate value and performance are affected by the board interlocking phenomenon; finally, Section VII concludes.

2. Literature Review and Hypothesis

2.1. Outside Directors and Board of Directors' Effectiveness

In order to strengthen the monitoring role attributed to the board, corporate governance codes worldwide recommend the inclusion of independent outside directors on company boards, that is, professionals who do not participate nor are connected with the management team, as a way of improving decision making and, thus, raising company value.

The actual effectiveness of outside directors, however, is a controversial matter, as evidenced by the inconclusive results linking corporate value to board independence.

It is among outside directors that board interlocking is most frequent⁵, possibly because inside directors, working full time as officers, do not have available time to work in other companies. Hence, one of the main critiques against a director working in multiple companies is the evident lack of time for an adequate dedication to defend the interests of the companies' shareholders⁶. Through an event study, Fich (2005) reports a stock price decline of companies whose directors announce their participation in other boards, suggesting that shareholders fear that their interests will be damaged when board interlocking occurs⁷.

Thus, it seems reasonable to presume that outside directors' effectiveness is conditioned not only by their independence from the CEO, but also by their level of dedication and commitment: members who already participate in other companies (mainly those participating on many boards), despite having more contacts or experience, may not perform their task as effectively as other directors. Hence, board interlocking appears in the corporate governance literature as a potential determinant of board effectiveness.

2.2. Board Interlocking: definitions and potential determinants

According to Mizruchi (1996), "the board interlocking occurs when a person affiliated with one organization sits on the board of directors of another organization". Studies on this firms' linkage through common directors have aroused interest in different research areas, such as management, economics, sociology and law. Mizruchi (1996) underlines that board interlocking has become the primary indicator of firms' connections and their contact network with the corporate environment. As a result, its analysis could provide clues about companies' behavior.

Two approaches stand out to explain how companies are connected through their professionals: the first argues that companies benefit when their board members bring better

contacts – such as clients, suppliers, creditors, new experiences – or when directors monitors connected firms. As a result, companies would stimulate their directors to participate in other companies or only would like to hire people serving on other boards. A second perspective argues that the directors' desire to participate in other boards is the sole responsible for its occurrence board interlocking, therefore not being a phenomenon provoked by companies.

Works such as Pennings (1980) and Burt (1983) offers support to the first approach. The authors report that, in industries where few companies concentrate a larger market share, the level of interlocked boards is higher. Thus, board interlocking works as a facilitator for collusion among competitors, favoring oligopolistic market practices. In addition, Carrington (1981) finds a positive relation between market concentration, interconnections between companies and profitability. Overall, Mizruchi (1996) argues that, although access to empirical evidence is difficult, intra-industry board interlocking can be a way of setting restrictions on free market competition.

Some studies also interpret board interlocking as a cooptation and monitoring mechanism by firms. In this view, it would act as an instrument to reduce sources of uncertainty in the economic environment because common directors could improve information flow to their companies. In a similar way, monitoring a certain company by including professionals from another firm in its board is another common form of cooptation. A practical example frequently mentioned in this literature refers to highly financially leveraged companies: they usually take their creditors' representatives in their board of directors, in order to reduce the risk of default (e.g.: Dooley, 1969; Pfeffer, 1972).

Under this perspective of company interdependence, Nicholson et al. (2004) argue that ownership dispersion is positively associated with board interlocking, since the board of companies with a high level of ownership dispersion would include members from different origins and with different relations with the company: creditors, clients, suppliers and professional directors. In the same way, the concentration of control in family-held companies

would be negatively correlated with their directors' participation in other companies (Allen, 1976; Burt, 1980). Finally, another argument contends that the board of directors plays an important role by protecting the firm's reputation towards its investors (Selznick, 1957; Parsons, 1960). Thus, the fact that a director from an important company *i* is invited to serve on the board of another firm *j* may indicate to investors that company *j* is trustworthy.

The second view on board interlocking rationale states that it is not only because of their company's interests that professionals participate in more than one board, but especially out of their self interest. Therefore, board interlocking is more an involuntary consequence of these professionals' individual decisions than of corporate interests. Palmer (1983) corroborates this view, by showing that interlocked companies did not reconstitute the links that were accidentally broken (e.g. due to the death or retirement of a director). Zajac (1988) and Stokman et al. (1988) also observe that directors participate in boards because of financial remuneration, prestige and contacts that can be useful for future career advances.

When analyzing reciprocal board interlocking among CEO's of the 500 largest American companies, Fich and White (2001) observe that the probability of occurrence of this phenomenon decreases as the number of stock options in the CEO's compensation package increases, which leads to the conclusion that, the more their remuneration depends on company performance, the more professionals become dedicated to their tasks in the 'original' firm. Dooley (1969) and Pfeffer (1972) also find that the degree of share ownership by managers is negatively correlated with the formation of board interlocking.

Fich and White (2001) note that the greater the number of annual meetings by the board, the lesser the probability that their members will participate in other firms, a fact justified by the unavailability of time for the directors' activities. They also find that bigger boards are more likely to have a member from another company and identify that professionals with longer company time develop more contacts and, therefore, tend to be invited to participate in other companies.

Although not all arguments presented above can be empirically tested for the Brazilian market, especially due to the lack of data on managers' remuneration or the frequency of board activities, we are able to test the following hypotheses, based on this literature review:

H₁: The probability that board interlocking will occur in a company increases with the number of members in its board of directors.

H₂: A greater participation of outside directors tends to increase the probability that board interlocking will occur.

H₃: The occurrence of board interlocking is more accentuated in more renowned⁸ companies in the market.

H₄: The concentration of stock ownership reduces the frequency of board interlocking in the company.

H₅: Financial leverage should positively affect the existence of board interlocking.

We address below the effects of board interlocking on firm performance and value, and derive from the literature other testable hypotheses.

2.3 Consequences of Board Interlocking for Corporate Performance and Value

Although many empirical studies on the subject show a negative correlation between directors' participation in multiple companies and firms' financial indicators (Fich and Shivdasani, 2006; Fich and White, 2001; Loderer and Peyer, 2002), there are some theoretical studies predicting beneficial results associated with this practice.

Research in organizational sociology argues that the board of directors holds a very valuable social capital for the company, due to two main reasons: their contacts and their knowledge. Nicholson, Alexander and Kiel (2004) highlight that board interlocking is especially advantageous for companies facing scenarios of uncertainty and interdependence in the market, organizational complexity and dispersed ownership, since this mechanism would

act against possible disadvantages of these factors through the directors' social connections and their influence in the market environment.

The concept of social cohesion, according to Mizruchi (1990), is associated with members sharing similar interests and with an extensive network of social contacts (allowing a large flow of relevant information). Through these factors, top management professionals are inserted in a club-like social environment: dense, cohesive and private, which becomes active and potentially useful to its participants through their social contacts.

Using the Transaction-Costs Economics framework⁹, the authors theorize that companies whose directors share top management functions would have more communication routes and better information exchange, which would reduce transaction costs. Boyd (1990) observes that, among firms who face greater uncertainty in the economic environment, those with greater connections with other companies through common directors display a better performance – measured through the sales' increase and return on equity.

Another mechanism through which boards with connections in other companies add value to the company refers to the cognitive capital these members acquire – that is, their personal experience¹⁰. Haunschild and Beckman (1998) note that connections between directors allow the dissemination of organizational innovations through this corporate contact network. The similarity of strategies adopted by interconnected companies is addressed in many studies. Palmer, Jennings and Zhou (1989) find that American companies displayed stronger tendencies to adopt a multidivisional structure if they had interlocks with companies that had already adopted this structure. Davis (1991) shows that the adoption of poison pills is faster in companies connected with firms that already had this anti-takeover mechanism. D'Aveni and Kesner (1993) observe that, in companies whose top management shared multiple directories, hostile takeover attempts were more successful in comparison with target companies that did not have any connection. Even similar political campaign contribution strategies are identified in companies connected through their directors. When analyzing a

sample of 243 American connected companies among the 250 largest in that country, Clawson and Neustadt (1989) observe that the firms linked by their directors were more inclined to contribute to the same political group during the American elections in 1980.

Most sociological-organizational studies on this theme are theoretical. Despite these arguments based on social cohesion and cognitive capital accumulation by professionals who share multiple directorates, few empirical studies economically corroborate the benefits of interlocked boards.

On the other hand, some research in corporate finance and economic behavior present more quantitative work, trying to uncover the effects of board interlocking on companies' financial indicators. In general, most studies find a negative correlation between the frequency of directors' participation in more than one firm and these companies' financial results. Fligstein and Brantley (1992) identify a negative association between interlocks and profitability, in a sample of large American corporations. In an analysis of companies listed on the Swiss stock exchange (Zurich Stock Exchange) between 1980 and 1995, Loderer and Peyer (2002) show that the accumulation of functions in other boards reduces firm value, measured by Tobin's Q ¹¹. The authors justify that the possible reasons for these results are the conflicts of interest directors are exposed to by participating in multiple companies – which would increase the potential of agency costs – and the lack of adequate time to perform multiple mandates¹².

In an analysis of 1493 indications for outside directors, Fich (2005) observes significantly positive reactions on share prices when CEOs from other companies were indicated as outside directors. This result suggests that the market perceives the CEOs of other American companies as having knowledge and contacts especially useful to their company. On the other hand, the author also reports that these CEOs' original firms suffered a share price decrease upon their indication to serve as outside board members in other companies, which might be indicative of the ambiguous nature of board interlocking: beneficial for firms

that acquire an experienced outside director, but harmful to the ‘original’ firm, whose CEO will be busier than before and, hence, may dedicate less attention to maximizing her company’s shareholder return.

When analyzing reciprocal board interlocking among CEOs in a sample of 610 of the largest American corporations, Fich and White (2001) identify a positive association between “two-way” participation of CEOs and Tobin’s Q of the companies that exchanged these professionals¹³.

Oposing the argument that a larger number of contacts, through the company’s directors, results in better opportunities and, consequently, in better corporate performance, Fich and Shivdasani (2006) develop the concept of “busy boards”, defined as the condition in which half or more of the company’s outside directors serve on three or more boards. Under this perspective, the authors avoid the distortion of an approach that uses the mean number of seats in other firms per board member, in which case one occasional director participating in many boards would bias the mean interlocking of the company. Using this qualitative measure of busy boards, the authors show that board members affiliated with too many other companies reduce corporate value and performance. The authors verify that the price-to-book ratio of companies whose boards are classified as busy are 4.2% lower than that of companies whose board does not fit into this classification.

These results lead us to the hypothesis that the marginal benefits of the better contacts and greater experience of directors who participate in multiple companies do not exceed the decrease in the quality of their monitoring activities, so that board interlocking is generally negative to the company – a hypothesis tested further ahead.

H₆: A higher level of board interlocking is associated with lower company value, ceteris paribus. This impact should be more negative in companies with a greater proportion of board members acting on multiple boards (called “busy boards” in this research).

3. Sample, Variables and Database

Our sample consists of all companies listed on the São Paulo Stock Exchange (BOVESPA) whose liquidity index¹⁴ was higher than zero in 2001, 2003 and 2005. The gap of one year between the observations is not a problem for our analysis because there is little variation observed on the level of board interlocking, since the mean and median term of the directors' tenure is approximately two years. After the selection of the sample, with 346 companies for 2001, 319 for 2003 and 320 for 2005, we collected data from all board memberships in the Annual Reports (AR) submitted to the Brazilian Securities and Exchange Commission (CVM). Overall, we have 4,460 top management observations constructed for 2001, 3,392 for 2003 and 3,156 for 2005, totaling 11,008 directorships.

Next, we assess for each director how many times his/her name¹⁵ appeared in the sample. We identify which professionals occupied more than one seat and in which company this seat was occupied, thus allowing the mapping of interconnected companies. However, as a limitation of our analysis, we are not able to assess the participation of directors in privately held companies, since they do not disclose their board composition. This can bias our data, underestimating the real level of board interlocking.

For each company, we calculate the size of the board of directors, as well as the proportion of inside and outside directors¹⁶, and the total number of companies with at least one shared board member. Other binary variables were computed, indicating if the company was connected to another company in the sample through its board members, if the CEO or chairman of the board occupied a seat in another company, and if more than half of the company's outside directors worked in three or more companies (busy board variable).

For the ownership structure, we calculate the percentage of voting stocks held by the controlling block¹⁷ identified in the ARs. The companies listed in the two top special listing

corporate governance segments (Level 2 and New Market) were identified through the Bovespa's website¹⁸.

Financial data, such as the market value of stocks, total assets, net equity, gross debt, operational income, etc., were collected in the Economática® database system for each of the four quarters of the two years analyzed. We also identify to which industry the company belongs and whether it issues American Depositary Receipts (ADRs) Levels 2 or 3, therefore being subject to Sarbanes-Oxley requirements.

All firms were considered for the calculations of the descriptive statistics. However, the tests aiming to evaluate the influence of board interlocking on firm value were restricted to a sub-sample of the 152 non-financial firms with a liquidity index higher than 0,05% of the most liquidity company in each year, during the 3 years under analysis, resulting in a balanced panel with 456 firm-year observations. Our results are presented below.

4. Overview of board interlocking in Brazil: Descriptive Statistics

4.1. The Board of Directors

Table 1 presents data regarding board composition.

[Please insert table 1 here]

According to Table 1, boards of directors display a mean value of 6.4 for the overall sample. It's also possible to note that most of the directors do not work as officers. Therefore, our proxy for the level of independence of the board, calculated as the percentage of non-executive board members, has a mean of 81%. It's important to note, however, that being an outside director does not mean that he/she is automatically independent.

We also find that in more than 30% of the companies, the same person occupies both CEO and chairman positions. This practice could difficult the boards supervisory function, possibly increasing agency costs deriving from bad monitoring of top managers.

4.2. Board interlocking

Table 2 presents data regarding board interlocking.

[Please insert Table 2 here]

According to Table 2, connections of firms via shared directors are a common practice in Brazil. In 2005, more than 68% of the sampled companies were interlocked with at least one board member serving as a director of another company listed in the stock exchange¹⁹.

Another questionable finding in terms of best governance practices is the fact that about 35% of the companies' CEOs held a top management position in another company²⁰. Likewise, in 2005, about 50% of the chairmen of the board served as directors in other companies. These observations suggest some cohesion between the business class in ruling the biggest companies in Brazil. Therefore, a vast network of social contacts and common interests exists, allowing the accumulation of positions by these professionals.

Table 3 provides information on the number of interlocks at firm level.

[Please insert Table 3 here]

According to Table 3, we observe that about 40% of the firms have a board in which half or more than half of their outside directors participate in at least one other company. These companies could face substantial agency problems because their directors might be too busy with other activities. Likewise, more than a quarter of the companies have the so-called

“busy boards” – when half or more than half of the outside directors participate in three or more companies, including their “original” firm. This situation casts doubt on these professionals’ effectiveness as efficient monitors. In addition, we can see that, for 2003, each company in the sample had 5.5 interlocks with other companies, against 4.8 for 2005. Besides, 24 companies were not interlocked in 2003, while only 18 companies did not have any board member from another firm in 2005.

Another interesting analysis can be provided by mapping the connections between companies. For instance, Chart 1 illustrates, in a simplified manner, one of the networks found in 2005.

[Please insert chart 1 here]

Chart 1 provides evidence that the network of interlocks between firms is pervasive and dense. However, it’s important to note that any attempt to map the connections is limited, since they go beyond what can be described in an illustration.

4.3. The directors and their directorships

Table 4 presents evidence on the frequency of board interlocking in Brazil.

[Please insert Table 4 here]

According to Table 4, directors and officers jointly occupied, on average, 1.26 functions in 2003. That is, for every 5 functions, there would only be 4 professionals to perform them, as one of them would work in more than one company. Although the majority of the professionals are exclusively dedicated to their original company, we have noted one board member simultaneously participating in eight different companies in 2003.

5. The determinants of board interlocking in Brazil

In line with the hypotheses developed throughout the literature review section, we use a multivariate probit²¹ regression model, presented below.

$$f(\text{INTERLOCK}_i) = \alpha_1 + \beta_1 \text{BDSIZE}_i + \beta_2 \text{INDEP}_i + \beta_3 \text{CEOCHAIR}_i + \beta_4 \text{CONTROL}_i + \beta_5 \ln(\text{DEBT}_i) + \beta_6 \text{TOBINSQ}_i + \beta_7 \text{ROA}_i + \beta_8 \ln(\text{ASSET}_i) + \beta_9 \text{BOV}_i + \beta_{10} \text{YEAR}_i + \sum_{j=1}^{20} \psi_j \text{IND}_i + \varepsilon_i$$

Equation 1

Where:

INTERLOCK: Binary variable indicating if the company has at least one board member from another company; *BDSIZE*: Board size; *INDEP*: Independence level, proxied as the percentage of outside directors in the board; *CEOCHAIR*: Binary variable, indicating if CEO and chairman positions are held by the same person; *CONTROL*: Percentage of voting shares held by the controlling shareholders; $\ln(\text{DEBT})$: natural logarithm of gross debt on total asset ratio (financial leverage); *TOBINSQ*: Tobin's Q²²; *ROA*: Return on assets – operational income divided by total assets; $\ln(\text{ASSET})$: natural logarithm of mean assets; *BOV*: Binary variable indicating if the company is listed in Bovespa's Level 2 or New Market; *IND*: Industry binary variables; *YEAR*: Year binary variables; ε_i : Random error

The main results of the regression are presented in Table 5.

[Please insert Table 5 here]

According to Table 5, our results support the following hypotheses tested:

- i. There is a positive influence of board size on board interlocking, that is, boards with a larger number of members tend to accept the participation of board members from other companies or, from another perspective, tend to send their directors to other companies, thus creating a link between them.

- ii. Board independence is positively associated with board interlocking: participation of outsiders on the board favors the formation of interlocks.
- iii. There is a negative influence of ownership concentration on board interlocking. This result may be explained by the fact that firms with a higher share concentration have smaller boards, with a higher proportion of directors dedicated to the interests of the controlling group, so these professionals usually do not serve in other companies. Moreover, the concentration of control tends to reduce outsiders' participation in the board.
- iv. Firm size presents a positive and significant influence on the existence of board interlocking, that is, larger companies tend to have more board members from other companies.
- v. Financial leverage does not significantly influence the formation of board interlocking.
- vi. Finally, our results support the hypothesis that firms with better reputation have a higher probability of board interlocking. We use a dummy indicating that the company joined the differentiated corporate governance levels of Bovespa as a proxy for reputation and that variable is positively and significantly related to board interlocking. The idea is that these firms may have directors with better than average reputation in the corporate management market, who would therefore be invited to serve in other companies.

6. Board interlocking and corporate value

In order to assess the effect of board interlocking on firm's value, we run the following model with four different estimation methods: pooled OLS, random effects, fixed effects, and two stages least squares (2SLS).

$$V_{it} = \alpha_i + \beta_1 INT_{it} + \beta_2 BSIZE_{it} + \beta_3 INDEP_{it} + \beta_4 CEOCHAIR_{it} + \beta_5 CONTROL_{it} + \beta_6 \ln(ASSETS_{it}) + \beta_8 ROA_{it} + \beta_9 DEBTONASSET_{it} + \sum_{j=1}^n \psi_j IND_{it} + \beta_{10} YEAR_{it} + \varepsilon_{it}$$

Equation 2

For robustness purposes, we test two different proxies for corporate value (V): Tobin's Q and Price-to-Book Value ratio (PBV). We also use four alternative measures of interlocking: a dummy for the existence of this phenomenon; a dummy for the participation of CEO or chairman of the board in other firms; the total number of board interlocks by all board members, and a dummy variable called 'busy board', according to the definition by Fich and Shivdasani (2006), when half or more of outside board members participate in 3 or more companies. All tests indicate that board interlocking reduces corporate value.

6.1 Fixed Effects and Random Effects for Panel Data

Fixed Effects estimations allow us to evaluate in which manner the change of interlocking over time affects corporate value. This method can isolate intrinsic firm characteristics that could affect the frequency of board interlocking, producing better coefficients, non-biased and consistent, than with OLS. These results are shown in Table 6.

[Please insert Table 6 here]

According to Table 6, the key-variables of interlocking, although negative, they are not statistically significant, except for model number 4 that uses the busy board concept as proxy for company's interlocking level. We believe these results are not statistically significant due to the little variation of interlocking level over time. This happens because the board of directors has a stable composition in a 2 or 3 years time window. Thus, the variation across time is hard to distinguish and the fixed effects model – which isolates constant characteristics over time – will not be the most adequate estimation model to assess the board interlocking effect on firm's value.

Regarding to the random effects model, we also observe all interlocking proxies with negative coefficients. The most significant proxies were the dummy for participation of CEO

or Chairman in other company and the busy board dummy, both statistically significant at 5% level.

6.2 Two Stage Least Squares Estimations (2SLS) and GMM Estimations

An unsolved problem with estimations made by random and fixed effects is the fact they are not able to deal with endogeneity problems as these models assume total exogeneity of regressors. However, as the board interlocking literature alert, the endogeneity problem is present in the interlocking phenomenon: interlocked directorates can reduce firm's value but it is also possible that companies who already have a poor performance induce their directors to look for a position in other companies. So, the interlocking can be both a cause and a consequence of poor firm performance. Thus, we must use an instrumental variable to correct this endogeneity problem.

In line with the literature, (e.g. Fich e Shivdasani, 2006) we run a two stage least squares model where the *interlocking* variables were lagged one period of time to construct an instrument for present interlocking. The instrumental variable is correlated with the variable we want to instrumentalize (interlocking) and being lagged on time, it is not correlated to the errors in the equation – so it can address the endogeneity problem. The results are shown in Table 7.

[Please insert Table 7 here]

According to Table 7, all results are negative for interlocking variables and even more significant, than with the previous methods employed. In sum, they confirm the hypothesis that higher levels of board interlocking are harmful to the company. We obtain virtually the same results when using the Tobin's Q or PBV as proxies for firm value. Besides, we also observe a negative and strong effect on firm's value when CEO and Chairman positions are

occupied by the same person. This result goes in line with the literature about boards, which points that the monitoring effect of directors is reduced when the CEO is also the Chairman of the board.

Using GMM estimations, we also lagged interlocking variables one period on time and the results are consistent with previous estimations. We reject the hypothesis that company value would benefit from a larger number of interlocks. On the opposite, the results indicate that a larger number of participations by directors in other companies is not a positive factor for company value. For the third model, where we assess the effect of number of linkages made by firm's directors, we obtain a negative coefficient indicating that, at each new linkage established by the directors, company value would decrease about 5%, *ceteris paribus*.

Thus, we reject the hypothesis that the company would potentially benefit from connections with other companies through its directors. It is possible, as Loderer and Peyer (2002) suggest that these professionals are actually involved with other problems, which would lead to a deterioration of this firm's corporate governance quality.

We use, in model 4, the 'busy board' concept and we observe that, when at least half of the outside directors participate in 3 or more companies, company value, measured by its Tobin's Q, is considerably reduced. From the economic perspective, considering that the mean Tobin's Q in the sample is 1.29, this finding would mean a decrease in company value by about 28%. The same finding above is verified when using price-to-book value as the dependent variable

The other explanatory variables also provided significant results. The concentration of ownership, for instance, negatively influence company value, suggesting an agency problem taking place in Brazil between controlling and minority shareholders.

6.3 Robustness Checks

As discussed in the literature review, board interlocking might affect company performance due to four main reasons: 1) it is supposed to be a mechanism for manager cooptation and monitoring between connected companies, reducing uncertainties and transaction costs; 2) it could allow more personal contacts and increase information flows through companies' top management, providing data for decision making and disseminating successful strategies; 3) interlocking could reflect a situation of social cohesion, in which only a restricted group of professionals would participate, a fact that would make the relations between these directors more personal and reduce their independent critical judgment; 4) interlocking could overload directors with tasks that would reduce their time and, hence, would be negative for the quality of their decisions.

The first two hypotheses suggest a positive effect of interlocking for the firm, while the latter two foresee harmful consequences of this practice. Thus, there may be a quadratic relation (in inverted U-shaped form) of the effect of interlocking on the firm. According to this hypothesis, when the level of interlocking is low, the directors are not too busy yet and their contacts could act in the benefit of the firm, so that a certain number of connections would be positive for the company. On the other hand, when the level of interlocking is excessively high, the board members would not have time to adequately perform their tasks and, moreover, adding more connections would not provide significant marginal benefits, resulting in a negative effect of excessive interlocking.

Therefore, as a robustness check, we add interlocking variables in their quadratic form to the models. We test two alternative proxies separately: the natural logarithm of the number of connections per company and the percentage of external board members classified as busy in the board, that is, those serving in 3 or more companies.

The regressions against firm value proxies Tobin's Q and PBV ratio suggested a positive quadratic relation²³, which is counterintuitive. However, these coefficients are not

statistically significant and, therefore, we cannot draw clear inferences based on them. We find similar results using the percentage of board members classified as busy.

On the other hand, when regress board interlocking against operational performance indicators return on assets (ROA) and return on equity (ROE), we find a negative and significant quadratic relation, in line with the intuitive abovementioned hypothesis about an optimal level of interlocking. Specifically, up to the number of 5 connections, an increase in the number of connections would positively influence the company's ROA, with a decrease from that point onwards for higher levels of interlocking. We find similar results for ROE, but with lower statistical significance. In general, our results are similar to the ones reported by Non and Franses (2007), who analyzed 101 Dutch publicly-traded companies using a four-year time window²⁴.

In sum, extreme levels of interlocking seem to negatively affect operational performance, although the market did not reflect this relation on stock prices. These conclusions are synthetically presented in Table 8 and, in Figure 1, which depicts the distribution of ROA as a function of the number of firm's interlocks.

[Please insert Table 8 here]

[Please insert Figure 1 here]

7. Conclusion

Our study investigates whether board interlocking, the connection of firms by executives simultaneously serving in two or more boards, actually happens in Brazil and how often this phenomenon occurs. We also analyze which firms' characteristics are more associated with this practice and the influence of this phenomenon on firm value.

We find that board interlocking is a recurring and pervasive practice among listed companies in Brazil. In 2003, 74% of the 320 sampled firms had at least one director from another company. In 2005 this ratio was 68%. We also find that each professional occupied, on average, 1.26 top management positions within the sample. As a caveat, we should highlight that these figures are very probably underestimating the occurrence of interlocking, since we are not able to assess whether these persons also serve as directors in private firms, which are not obliged to disclose public information about their management team and boards.

In line with previous related studies (Mizruchi, 1996, Fich and White, 2001), we find that companies with larger boards and boards with a higher ratio of outside directors tend to tend to have more interlocks with other companies. We also find that companies with more assets and better reputation²⁵ tend to have more interlocks. On the other hand, companies with greater ownership concentration present boards with lower interlocks, possibly due to the influence of the control block on the selection of board members.

Regarding the influence of board interlocking on corporate value, we find in all regressions and models that this practice negatively influences firm value. Specifically, the existence of a CEO and/or chairman of the board serving in other companies tends to reduce corporate value, measured by its Tobin's Q and price-to-book-value ratio. Another relevant finding is that busy boards, in which half or more external members serve in three or more companies, also negatively influence firm value. As a robustness check, we test the plausibility of a quadratic relation, attempting to capture the existence of an optimal level of interlocking. Our regression analysis suggests that such a non-linear relation is plausible when we use operational performance variables, with an optimal interlocking of about 5 connections. In summary, our results suggest that the benefits of interlocking, such as a better contact network of directors or their greater professional experience, do not compensate for the deterioration in these professionals' decision quality and monitoring capacity.

We argue, however, that these results are not evidence against the presence of professional independent directors on boards, which is regarded as essential among the so-called good corporate governance practices. In fact, our evidence should be understood as suggesting a negative impact of having many directors simultaneously participating in many boards, which might overload these professionals and, as a consequence, undermine their capacity to supervise managers and add value to their business, thus causing lower corporate performance. In other words, the participation of independent outside board members is fundamental, as long as they keep focused on the companies they serve in.

In sum, board interlocking seems to be a relevant phenomenon, particularly because of its potential negative influence on firm value. The analysis of this network of corporate interconnections also provides indication that the corporate class ruling the largest Brazilian companies is somewhat cohesive and interrelated. Therefore, this research might contribute to the understanding of the effectiveness of outside directors taking into account the accumulation of their professional duties as a relevant factor for the efficacy of their decisions. In particular, our study can subsidize recommendations about the maximum number of directorships for a director, taken as a relevant input for maximizing corporate value.

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Table 1: Composition of the Board of Directors

This table presents main descriptive statistics for the composition of Brazilian boards in 2003 and 2005. The directors classified as insiders are those who are officers and directors simultaneously. Outside directors are defined as those who only participate in the board. The “independence” proxy is defined by the ratio of outsiders to total board members. Total of 320 firm-level observations for each year.

Category	2003				2005				
	Board Size	Insider Directors	Outside Directors	Independence	Board Size	Insider Directors	Outside Directors	Independence	
Median	6	1	5	0.81	6	1	5	0.80	
Mean (standard deviation)	6.42 (2.88)	1.06	5.36	0.80	6.46 (2.97)	1.03	5.42	0.81	
Minimum	3	1	1	0.33	3	1	1	0.33	
Percentiles	10	3	0	2	0.67	3	0	2	0.67
	30	5	1	4	0.71	5	1	4	0.71
	70	7	1	7	0.89	8	1	7	0.92
	90	10.2	2	9	1.00	11	2	10	1.00

Table 2: Directors relationships and interlocking directorates

This table displays different forms of interlocking present in the sample during 2003 and 2005. The percentage showed in the right side is the proportion of firms in each interlocking category. Total of 320 firm-level observations for each year.

Category	2003	2005
Companies with unified functions of CEO and chairman of the board	31.3%	31 %
Companies practicing board interlocking	74%	68.4%
Companies whose CEO occupies functions in another company	32.6%	35.4%
Companies whose chairman of the board occupies functions in another company	47.6%	48.4%
Companies whose chairman of the board, who is also CEO, occupies functions in another company	42%	44%
Companies in which half or more of the outside directors work in 2 or more companies	40%	39.2%
Companies in which half or more of the outside directors work in 3 or more companies	30%	26%

Table 3: Mean number of linked firms to a given company through shared directors

This table presents, for 2003 and 2005, the number of firms linked to each other through common directors. Total of 320 firm observations for each year.

	Year	2003	2005
	Mean	5.5	4.8
	Median	2	3
	Standard Deviation	7.9	6
	Minimum	0	0
	10	0	0
	30	0	0
	70	6	6
	90	15	2.2
	Maximum	39	30

Table 4: Frequency of board interlocking in Brazil

This table presents the dispersion of interlocking directorships among directors and officers (here called “Administrators”). The left side of the table presents the number of directorships held by a given administrator (one to eight directorships). The right side shows how many professionals occupy that number of functions. “Total Functions” is given by the multiplication of the number of administrators that hold a given number of positions (e.g. 2 administrators, in 2003, held 7 directorships, totaling 14 functions held by only 2 different persons). Total of 320 firms analyzed each year.

Number of functions occupied by an Administrator	2003		2005	
	Administrators	Total Functions	Administrators	Total Functions
8	1	8	-	-
7	2	14	-	-
6	2	12	1	6
5	22	110	21	105
4	47	188	38	152
3	107	321	106	318
2	232	464	272	544
1	2275	2275	2301	2031
Total	2688	3392	2823	3156

Table 5: Probit results assessing the probability of occurrence of board interlocking

This table presents results for a probit regression where the dependent variable is a dummy for the existence of interlocking. The explanatory variables are firms' characteristics. Total of 233 firm-level observations for 2003 and 2005. All t-statistic tests are double-tailed and *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Probit Regression	Observations:	233
	Dependent variable: INTERLOCK	
	Pseudo-R ²	0.4235

Explanatory Variables	Coefficient	p-value
Board size	0.14	0.02***
Outsiders percentage (board independence proxy)	0.85	0.13
CEO and Chairman are the same person	-0.02	0.95
Shareholder controlling block ownership level	-0.99	0.10*
Leverage level - ln(non-equity liabilities)	-0.01	0.87
Tobin's Q coefficient	-0.05	0.46
Return on assets	0.35	0.36
Firm size – ln(assets)	0.52	0.00***
Participation on BOVESPA's index	0.89	0.05**
Year dummy	-0.07	0.79
Constant	-8.15	0.000

Table 6: Summary results for fixed effects and random effects estimations.

This table presents the Fixed and Random Effects estimations to four different models assessing the effect of board interlocking on firm's value. The dependent variable is the Tobin's Q coefficient. Each model evaluates a different proxy for interlocking. The p-value is shown below the coefficients, inside the parenthesis. For all tests, the hypothesis of homoscedasticity was accepted, measured by White's Test, with levels below 10%. The normality of residue distribution was also proved satisfactorily for all models. Total of 456 observations (152 firms for 3 years).

Explanatory variables	Fixed Effects Estimations				Random Effects Estimations			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Average number of seats occupied by the directors	-0.11 (0.45)	-	-	-	-0.07 (0.29)	-	-	-
CEO or Chairman of the Board participate in another company	-	-0.17 (0.22)	-	-	-	-0.27 (0.02)	-	-
Number of interlocks in the company	-	-	-0.03 (0.32)	-	-	-	-0.01 (0.41)	-
Half or more of outside directors occupy 3 or more functions	-	-	-	-0.30 (0.07)	-	-	-	-0.30 (0.02)
Board size (natural logarithm)	0.08 (0.37)	0.07 (0.35)	0.13 (0.30)	0.08 (0.32)	0.04 (0.22)	0.04 (0.22)	0.05 (0.22)	0.04 (0.25)
Board independence – percentage of outsiders	0.95 (0.37)	1.00 (0.32)	1.12 (0.34)	0.73 (0.44)	-0.34 (0.42)	-0.16 (0.71)	-0.33 (0.42)	-0.43 (0.32)
CEO and Chairman are the same person	0.03 (0.92)	0.01 (0.97)	0.03 (0.91)	0.05 (0.84)	-0.23 (0.27)	-0.21 (0.30)	-0.23 (0.28)	-0.23 (0.27)
Percentage of ownership in the controlling block	0.65 (0.61)	0.60 (0.63)	0.67 (0.61)	0.59 (0.63)	-0.61 (0.43)	-0.62 (0.43)	-0.60 (0.43)	-0.65 (0.41)
Company size (asset logarithm)	2.05 (0.12)	2.03 (0.13)	2.05 (0.12)	2.06 (0.12)	-0.13 (0.35)	-0.12 (0.36)	-0.13 (0.34)	-0.12 (0.37)
Return on Assets	1.45 (0.17)	1.54 (0.14)	1.42 (0.19)	1.50 (0.15)	2.00 (0.01)	2.12 (0.01)	2.01 (0.01)	2.04 (0.01)
Gross debt on total assets (firm leverage)	0.12 (0.86)	0.18 (0.78)	0.13 (0.84)	0.14 (0.83)	1.59 (0.00)	1.61 (0.00)	1.60 (0.00)	1.58 (0.00)
constant	-3.06	-3.04	-3.11	-3.06	2.82	2.63	2.74	2.85
R ²	0.24	0.24	0.25	0.25	0.55	0.55	0.55	0.56

Table 7: 2SLS (Instrumental Variables) Estimations and GMM Estimations. This table presents summary results of regression models assessing different operational definitions of interlocking on corporate value, measured by Tobin's Q. The significance levels are presented between parentheses. below the respective coefficient that were obtained. For all tests. the hypothesis of homoscedasticity was accepted. measured by White's Test. with levels below 10%. The normality of residue distribution was also proved satisfactorily for all tests. Total of 456 observations (152 firms for 3 years).

Explanatory Variables	2SLS Instrumental Variables Estimation				GMM Estimations			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Average number of seats occupied by the directors	-0.22 (0.04)	-	-	-	-0.26 (0.04)	-	-	-
CEO or Chairman of the Board participate in another company	-	-0.37 (0.18)	-	-	-	-0.50 (0.11)	-	-
Number of interlocks in the company	-	-	-0.04 (0.05)	-	-	-	-0.05 (0.05)	-
Half or more of outside directors occupy 3 or more functions	-	-	-	-0.57 (0.02)	-	-	-	-0.46 (0.01)
Board size (natural logarithm)	0.06 (0.12)	0.05 (0.13)	0.09 (0.07)	0.05 (0.15)	0.04 (0.10)	0.03 (0.13)	0.08 (0.05)	0.03 (0.18)
Board independence – percentage of outsiders	-0.73 (0.15)	-0.56 (0.25)	-0.64 (0.18)	-0.77 (0.15)	-0.63 (0.14)	-0.38 (0.27)	-0.52 (0.19)	-0.79 (0.10)
CEO and Chairman are the same person	-0.38 (0.07)	-0.29 (0.13)	-0.44 (0.06)	-0.40 (0.07)	-0.37 (0.05)	-0.25 (0.10)	-0.44 (0.05)	-0.31 (0.07)
Percentage of ownership in the controlling block	-0.73 (0.27)	-0.72 (0.27)	-0.64 (0.30)	-0.72 (0.27)	-0.56 (0.27)	-0.54 (0.29)	-0.43 (0.34)	-0.62 (0.24)
Company size (asset logarithm)	-0.14 (0.26)	-0.14 (0.25)	-0.15 (0.23)	-0.15 (0.24)	-0.14 (0.23)	-0.15 (0.21)		-0.13 (0.23)
Return on Assets	1.46 (0.11)	1.68 (0.05)	1.39 (0.14)	1.57 (0.08)	1.00 (0.40)	1.29 (0.24)	0.86 (0.49)	1.19 (0.30)
Gross debt on total assets (firm leverage)	1.61 (0.00)	1.64 (0.00)	1.62 (0.00)	1.61 (0.00)	1.33 (0.00)	1.72 (0.00)	1.70 (0.00)	1.67 (0.00)
constant	2.99	2.81	2.60	2.78	3.56	3.09	3.48	3.11
R ²	(0.51)	(0.22)	(0.23)	(0.51)	(0.49)	(0.52)	(0.47)	(0.50)

Table 8: Tests of quadratic effects of interlocking.

This table presents the results for Pooled OLS estimations assessing the quadratic effect of interlocking variables, allowing us to detect an optimal level of interlocking. As dependent variables, we use four proxies for firm value and performance: Tobin's Q, PVB ratio, ROA and ROE. The explanatory variables are: *LINK*: total number of company connections made by its administrators; *PERCENTBUSY*: ratio of busy directors on total board members. Other control variables, omitted due to limited space, are essentially the same presented at Equation 2. The significance level is reported between parenthesis.

Explanatory variables	Tobin's Q	PBV	ROA	ROE
ln(LINK)	-0.16 (0.52)	-0.09 (0.67)	0.063 (0.009)	0.019 (0.80)
ln(LINK) ²	-0.02 (0.78)	-0.02 (0.70)	-0.018 (0.011)	-0.006 (0.80)
PERCENTBUSY	-1.04 (0.27)	-1.87 (0.03)	0.181 (0.004)	0.207 (0.60)
PERCENTBUSY ²	0.62 (0.50)	1.86 (0.01)	-0.232 (0.001)	-0.208 (0.63)

Chart 1: Mapping of an example interlocking directorates in 2005

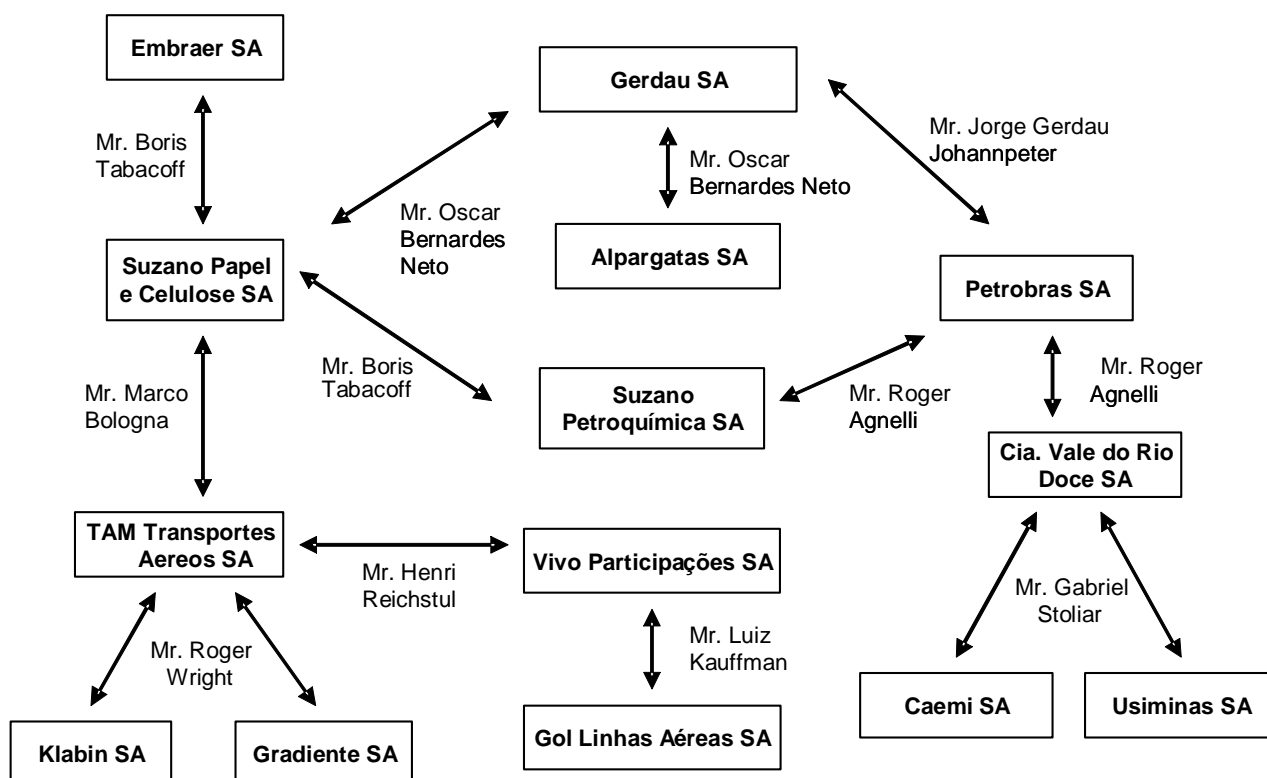
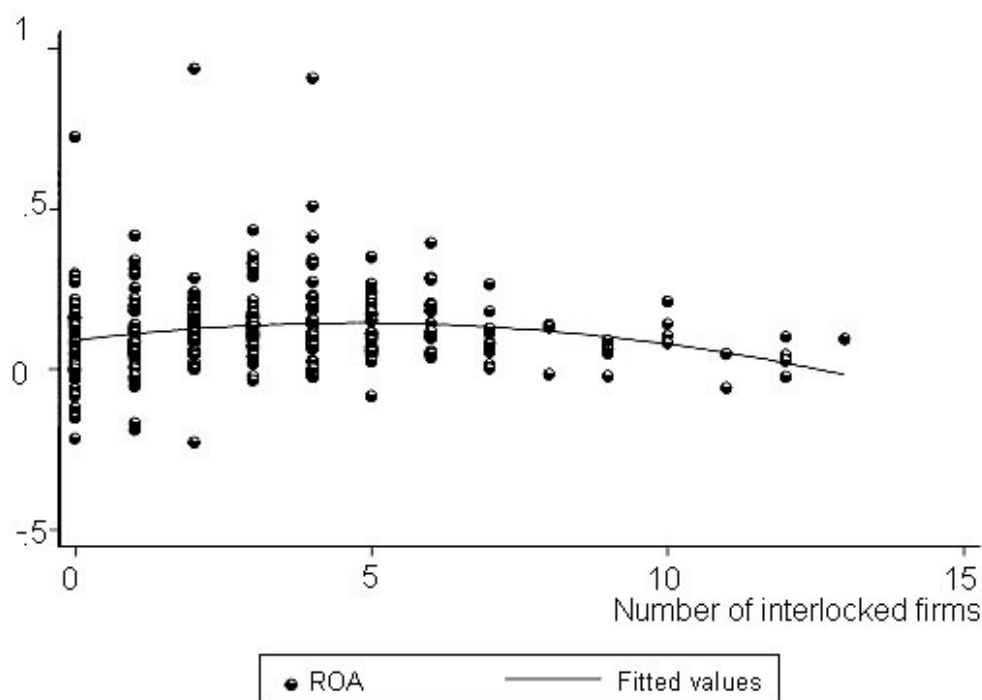


Figure 1: Return on assets (ROA) as a function of the number of interlocks per company.



¹ The literature on this field also employs the terms “*interlocking directorate*”, “*board overlap*”, and “*board ties*” for this phenomenon.

² Dooley (1969) reports that, in 1965, only 3165 professionals occupied the 4007 positions on the boards of the 250 largest American companies. Although most of these board members occupied only one position, some professionals were active in more than nine companies.

³ Fich and Shivdasani (2006) observe that companies whose boards included a majority of professionals interlocked with other companies had, *ceteris paribus*, a price-to-book value approximately 4.2% lower, in comparison with other companies without this practice.

⁴ According to the definition made by Fich and Shivdasani (2006).

⁵ Although it is also frequent among internal board members, Mizruchi (1996) highlights: “*Most interlocks are created by a firm’s outside directors*”

⁶ Lipton and Lorsch (1992) observe that the most frequent problem board members face is the lack of time to perform their activities. Shivdasani and Yermack (1999) argue that the benefits of participating in other boards can be seen as a non-linear function, so that the participation in many boards can excessively reduce the time the board members have available to adequately carry out their monitoring responsibilities.

⁷ It should be highlighted that Fich (2005) also observes positive abnormal returns on the stock of companies that accept the CEO of another company as a board members. The author suggests that the American market perceives CEOs as very valuable for the company’s human capital, due to their management skills and competencies. This can strengthen the thesis that board interlocking is mainly ruled by the market forces that shape competition for human capital treated like any other asset.

⁸ The concept of reputation is loaded with subjectivity. International research on the theme (e.g. Fich and White, 2001) uses the number of directors and executives in a given board as a proxy for the company’s reputation, due to these professionals’ personal reputation. In view of the lack of data in Brazil, we will use two operational definitions as a proxy for reputation: the company’s participation in the most advanced segments of BOVESPA corporate governance (Level 2 and New Market) and the natural logarithm of the company’s assets, assuming that larger companies are more stable and, hence, have a more solid reputation history.

⁹ See Williamson (1999) for further details.

¹⁰ Fich (2005) highlights that qualified human capital can grant companies better competitive margins. Zingales (2000) and Rajan and Zingales (2004) note the growing importance of human capital in corporate value measurement.

¹¹ Tobin’s Q is a commonly used indicator of corporate value as, according to Morck, Shleifer and Vishny (1988), it may capture the added value of intangible factors, such as the quality of the company’s corporate governance.

¹² An exception to this rule occurs, according to the authors, when the chairman of the board of a company i is invited to participate in company j – in this case, exceptionally, an increase in the firm value of j is observed.

¹³ However, the authors remark that they cannot eliminate the endogeneity from their empirical model: companies with higher Tobin's Q may be more attractive for other professionals to participate as board members; but it is also possible that these professionals' participation make the companies achieve better results.

¹⁴ The liquidity index is computed by the Economática® database system. It is calculated based on the following formula:

$$LIQ=100*\left(\frac{p}{q}\right)*\sqrt{\left(\frac{n}{N}\right)*\left(\frac{v}{V}\right)}$$

where: LIQ – stock liquidity index; p – number of days on which at least one deal was completed with the stock in a given period; P – total number of days in the period; n – number of deals with the stock in the period; N – number of deals with all stocks listed in the period; v – monetary volume of deals with the stock in the period; V – monetary volume of deals with all stocks in the period.

¹⁵ In order to avoid errors and omissions, we checked each person's official identity number, trying to capture possible cases of homonyms and guaranteeing the correct assessment of how many functions the professional occupied.

¹⁶ The criterion for classifying insider and outsider directors followed CVM's methodology, according to which the directors who are also executive officers are classified as insiders, while those who solely work in the board of directors are classified as outsiders. Directors classified as substitutes (alternates) were excluded from the database.

¹⁷ The criterion to define the "stock control block" strictly followed the information in the CVM Annual Reports, in which stockholders with more than 5% of stocks are identified and designated as controllers or not, according to the information provided by the companies themselves.

¹⁸ The corporate governance listing segments (Level 1, Level 2 and New Market) of Bovespa are trading segments designed for companies that intend to adopt better corporate governance practices by complying with a series of requirements compatible with each level. Only companies participating in Level 2 and the New Market were selected, since Level 1 firms must comply with minor requirements, essentially related to stock liquidity and information transparency. Level 2 and New Market are segments that actually require better corporate governance practices and grant more rights to minority stockholders.

¹⁹ Again, it's important to emphasize that, since we only look at publicly traded companies listed on Bovespa with some stock liquidity, the level of board interlocking may be understated, since some directors may serve as board members of other companies that are not included in the sample, such as private companies or public companies not traded in the stock exchange.

²⁰ In the vast majority of cases, these situations occur in companies belonging to the same economic group.

²¹ To explain the behavior of a binary dependent variable, such as the existence of board interlocking in a given company, we use the probit model, a binary response model whose main goal is to explain the effects of \mathbf{x} (a set of explanatory variables) on the probability of answer $P(y=1|\mathbf{x})$. See Wooldridge (2006) for further details.

²² Tobin's Q was estimated using Chung and Pruitt's approach (1994): $Q = \frac{VMAO + VMPN + DIVT}{TA}$; where:

VMAO is the value of common stocks; VMPN is the value of preferred stocks; DIVT is the accounting value of short-term debts plus long-term debts less current assets and TA indicates the company's total assets.

²³ This positive quadratic relation, in a 'U' format, would indicate that low or extreme levels of interlocking would be positive for company value, while intermediary levels would be harmful.

²⁴ Non and Franses (2007) observe a positive quadratic relation, though with low statistical significance, for the PB and price-earnings ratios. However, the authors do not present theoretical justifications for this evidence. For the performance variables ROA and ROE, an inverted quadratic relation is found for the interlocking variable (mean number of seats occupied by the board members).

²⁵ The reputation of the firm was proxied by the participation of the firm in BOVESPA's differentiated corporate governance levels.