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Shortening the distance between firms for M&A: the influence of small-world network structure on mergers and acquisitions

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Abstract

Purpose – A small-world network is a type of network structure in which nodes are highly clustered and at short distances without being directly linked. This article analyzes whether the network of interlocking directorates among the largest Brazilian corporations follows a small-world network structure and if the small-world properties (high clustering and short distance between nodes) influence the occurrence of M&A at the domestic and international level.

Design/methodology/approach – The authors tested hypotheses regarding the relationship between small-world network properties and M&A based on a sample of large publicly-listed corporations in Brazil for the time series of 2000–2015 and using network analysis and regression techniques (probit and OLS).

Findings – The results show that while the Brazilian corporate network fits the small-world features of high clustering and short path lengths, only the distance among connected firms has a significant effect on international M&A: the shorter the distance between firms, the more likely firms undertake M&A abroad. Moreover, being integrated into the main component has a significant positive effect on national and international M&A. These findings suggest that the information and knowledge to undertake M&A can be better acquired by belonging to large business communities and not local cohesive clusters.

Originality/value – This research contributes to theories and ongoing debates about the network effects on organizational decisions and the determinants of M&A in emerging markets. In addition, this is the first study to analyze the impact of small-world networks on international M&A while controlling for country-level variables.

Keywords Interlocking directorates, M&A, Cross-border M&A, Network analysis, Corporate networks, Brazil
Paper type Research paper

1. Introduction

Inter-firm networks are widely viewed as playing a fundamental role in M&A. A significant body of literature has evidenced that interlocking directorates – corporate ties which arise when members of boards are serving on the boards of two or more corporations – constitute a device of information about companies for potential acquisition, enabling the goals of the operation to be more efficiently identified, and substantially reducing transaction costs (Beckman and Haunschild, 2002; Bruner, 2016). Nevertheless, there is also a lack of consensus on which network features of board interlocks affect these corporate decisions. Some scholars show that firms with a larger number of direct ties to other firms are more likely to participate in M&A (de Sousa Barros *et al.*, 2021). For others, the indirect connection between one director from the acquirer and one director from the target firm through their board representation on another firm facilitates M&A deals (Cai and Sevilir, 2012). Still others claim that the whole structure of the network – the configuration of the network where firms are

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embedded – shapes the M&A processes and outcomes (Peng and Wang, 2019). This controversy should be resolved to assess the practical implications of recruiting interlocking directors – those who belong to several boards – and identify the most advantageous type of network structure for creating larger firms.

To contribute to this debate, we turn to the small-world theory, which states that a society can be rewired into one single network where everyone is connected through a few intermediaries. A small-world network is a type of structure where nodes are clustered, albeit concomitantly connected to external nodes through a reduced number of links serving as shortcuts between clusters (Newman, 2004; Watts and Strogatz, 1998). The concept of small-world is based on the principle that a sparse network co-exists with a high degree of clustering and with a short distance (path lengths) between nodes. First, clustering is the tendency for nodes to form cohesive subgroups within a network. A network with high clustering indicates that there are numerous cohesive subgroups, which supports local information spreading in a decentralized structure. Secondly, between any pair of nodes in a network, one can calculate the distance, which is given by the minimum number of ties that must be traversed from the starting node to the destination node. A short average distance is important for the overall communication of local clusters due to the ease with which information flows within the network. Small-world studies, therefore, highlight that dissemination of information and knowledge transmission are affected by the characteristics of a network, rather than solely by the attributes of corporations and individuals (Kogut, 2012).

Several studies have explored the properties of small-world networks (high clustering and short distances) and their implications, with disagreements about the impact of small-world connectivity on corporate outcomes. Some studies have shown significant effects of small-world properties on corporate decisions and performance (Biswas, 2020; Schilling and Phelps, 2007; Uzzi and Spiro, 2005), while other studies conclude that such correlations are not statistically representative (Davis *et al.*, 2003; Fleming *et al.*, 2007). Very few explored the link between small-world properties and M&A (Biswas, 2016; Davis *et al.*, 2012), and none of them studied the influence on cross-border M&A.

To fill this gap, this paper addresses the research question: does the level of embeddedness in a small-world network of interlocking directorates influence the likelihood of conducting national and international mergers and acquisitions (M&A)? Based on a sample of the largest Brazilian corporations in a time series (2000–2015) and using network analysis and probit and ordinary least squares (OLS) regression models, the objectives of this article are (1) to analyze whether the corporate board network resembles a small-world network structure, and (2) to ascertain the influence of the small-world properties on the occurrence of national and international M&A deals. Our case study is particularly relevant because Brazil – the largest economy in Latin America and an illustrative example of an emerging economy – has triggered a flurry of M&A activity during the 21st century thanks to the significant growth of national business groups.

This article contributes to the existing literature in four ways. First, it contributes to small-world theory by testing the effect of small-world properties on international M&A for the first time. Second, it contributes to the research area of interlocking directorates by identifying the corporate network features – local clustering, average distance, main component – that influence organizational decisions. Third, because research on determinants of M&A has mostly concentrated on advanced economies (see Galavotti, 2021 for a review), this study adds to the literature on M&A by analyzing national and international M&A performed by firms headquartered in an emerging economy. Fourth, it contributes methodologically by including country-level variables in the assessment of institutional, governmental, legal, or macroeconomic effects on international M&A. To the best of our knowledge, this is the first study in the literature on small-world and board interlocks to control for the effect of country-level variables such as the tax rate, regulatory quality, or corruption level.

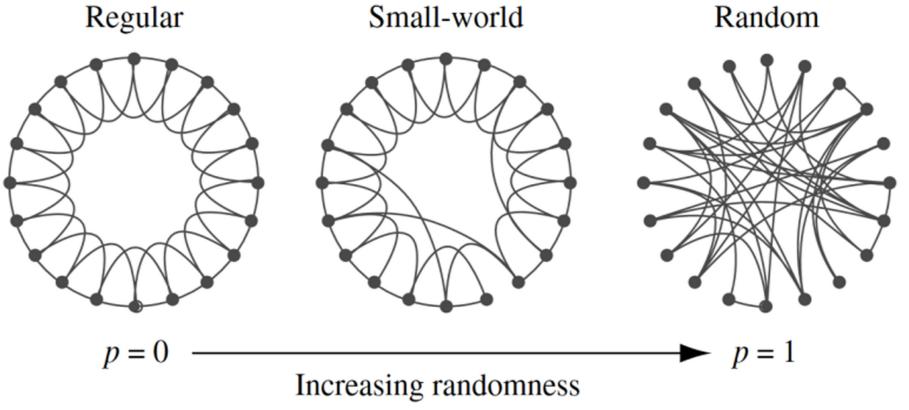
The remainder of this paper is organized as follows. In section 2, scholarship on small world and M&A is reviewed to specify our hypotheses. Section 3 outlines the data collection, identification strategy, and endogeneity and robustness tests. Section 4 shows the results for the effects of small-world structure on M&A. Finally, the last section presents the conclusions, implications and limitations.

2. Theory and hypotheses

2.1 Theoretical underpinnings

The small-world theory is based on the fact that in most networks there is a relatively short distance between any two nodes despite their often large size. Milgram (1967) seminally conceived the small-world network when emphasizing that individuals are separated by a few steps. Subsequently, Travers and Milgram (1969) formalized this still incipient idea of small-world when they calculated the probability of two randomly-chosen people knowing each other in a given population, noting that in such a network the average number of steps (the average distance between two nodes in a network) is low due to high clustering. Small world stands for a network whose structure is placed somewhere between regular and random networks. The two main properties of small-world networks are that they can be highly clustered like regular networks and at the same time have short distance between nodes (small path lengths) like random networks (see Figure 1).

The small-world theory stems from the research in network analysis. By focusing on structures and patterns of relationships, network analysis indeed appears a fruitful theoretical and methodological framework for addressing the emergence of, and change in, interorganizational relations in the course of M&A (Mirc, 2015). The use of network analysis becomes particularly relevant for the study of M&A, where the development of relationships between firms is the primary objective. One of the main advantages of network analysis is that it allows the examination of the local connections and the whole network structure. Studies on the influence of local connections generally view inter-firm ties as pipes facilitating the flow of tangible and intangible resources (Wang and Peng, 2019). This perspective concurs with individual social capital theories that focus on actors' network ties rather than network structures (Lin, 1999). Firms learn, get support, and imitate the behaviors of those with whom they are connected.



Source(s): Watts e Strogatz (1998)

Figure 1.
Examples of regular, small-world and random networks

On the other hand, studies focused on the whole network structure presume that network-level properties, such as density and global clustering, influence the flow of resources (Provan *et al.*, 2007). This approach builds upon collective social capital literature, which views the network in itself as a valuable source of collective resources (Adler and Kwon, 2002; Putnam, 2001). Firms access resources of those who are outside their immediate set of contacts, and the whole network structure also determines the opportunities for coordination, trust, and collective action. Although both approaches – local connections and the whole network structure – are complementary, a relative lack of integration has prevailed when analyzing the impact of interorganizational networks on M&A, as Peng and Wang (2019) noted. We integrate them by analyzing the small world phenomenon, a whole network configuration in which nodes are embedded differently. The analysis of the embeddedness of firms in relational structures can contribute to clarifying the effect of inter-firm networks on corporate decisions.

2.2 Literature review and hypotheses development

Several studies have shown that embeddedness in a small-world network can enhance a firm's performance. Dense local clustering and a short distance between firms in a network facilitate the flow of resources among distant clusters (Uzzi and Spiro, 2005), access to privileged information thanks to personal and organizational proximity (Boschma, 2005), transfer efficiency due to the broader reach to different segments of the network (Phelps *et al.*, 2012), and knowledge search, transmission, and creation by combining ideas from different communities (Yan and Dong, 2018). These studies illustrate that the small-world network structure grants its actors quicker access to novel and diverse information as a result of the short distance between clusters. In addition, Yan *et al.* (2021) showed that small-world properties of collaboration networks can act as mechanisms of knowledge protection. When actors are strongly connected in a local cluster, they tend to share information with their connected partners, making it harder for outsiders to access and obtain information. In this vein, the high local clustering can avoid information leakages and M&A rumors, which have been demonstrated to be M&A deal breakers (Alperovych *et al.*, 2021).

Prior research on small-world and M&A found that firms that are at a shorter distance from other firms are more likely to participate in M&A. As average distance increases, information must travel more to reach firms making the search process longer and more expensive (Biswas, 2016; Davis *et al.*, 2012). The effect of local clustering was not fully conclusive. Davis *et al.* (2012) concluded that local clustering has no significant effect, and Biswas (2016) found a positive effect on M&A at lower levels of clustering but a negative effect at higher levels. Such discrepancies underscore the need for more evidence on the effect of small-world properties on M&A.

How can small-world properties – high clustering and short distance – affect firms for completing M&A deals? The small-world structure links together heterogeneous communities of actors and the resources they control. The high local clustering of firms facilitates transmission, allowing knowledge sharing and diffusion of large amounts of information (Phelps *et al.*, 2012). The short distance between a wide range of firms provides reach, ensuring access to diverse information sources and heterogeneous ideas (Lin *et al.*, 2022; Schilling and Phelps, 2007). Given the dense local clustering and rapid reach to distant groups in a small-world network, being embedded in such a network should give significant advantages to a firm in terms of being exposed to useful information and knowledge, key elements for conducting M&A. Thus, assuming that small-world networks – those whose nodes are locally clustered with short distances – improve information diffusion, transfer efficiency, knowledge creation, and reduce information asymmetry (Ferreira *et al.*, 2021; Phelps *et al.*, 2012), such network properties could favor firms in M&A processes.

H1a. The increase in the average distance of a firm is negatively associated with the probability of the firm undertaking M&A.

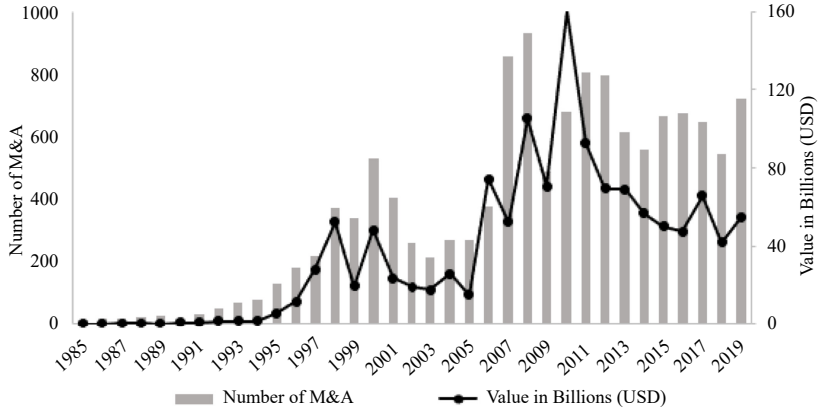
H1b. The increase in the local clustering of a firm is positively associated with the probability of the firm undertaking M&A.

The impact of small-world features on cross-border M&A is still unexplored. Information acquired in networks with high clustering and short average distance might be especially necessary for international M&A to reduce the uncertainties inherent in foreign operations, as Guo and Lv (2018) suggested. Beyond such consideration, a paradigmatic example illustrates the constant flow of M&A in the study period fully covered in the database of this article, involving JBS. This Brazilian large corporation with interlocking directors has become the largest meat processor in the world, acquiring companies in Brazil and abroad such as Swift Armour (Argentina), 50% Inalca (Italy), Swift (United States), Tyson Foods and Cargill, Tasman (Australia), 64% Pilgrim's Pride (United States), Rigamonti (Italy) and Seara (Brazil) (Forero, 2011; Schipani and Leahy, 2017). Considering this scenario, the second hypotheses proposed are:

H2a. The increase in the average distance of a firm is negatively associated with the probability of the firm undertaking international M&A.

H2b. The increase in the local clustering of a firm is positively associated with the probability of the firm undertaking international M&A.

The small-world structure was identified in corporate board networks, mostly in advanced economies (Davis *et al.*, 2003; Kogut, 2012; Semenova, 2022), and some in emerging economies (Biswas, 2020; Sankowska and Siudak, 2016), even in countries such as Brazil from 1997 to 2007 (Mendes-Da-Silva, 2011). However, these findings must be updated because a series of important changes have occurred in Brazil since 2007. First, the number of interlocks between companies decreased, and Brazil became one of the Latin American countries with the lowest number of ties among its large corporations (Cárdenas, 2016). Second, corporate governance guidelines stressing the incorporation of independent directors were disclosed in Brazil during the 2010s. Third, the number of M&A has remarkably increased since 2007, as shown in Figure 2.



Source(s): Institute for Mergers, Acquisitions & Alliances (IMAA Institute)

Figure 2.
M&A in Brazil from 1985 to 2019 – number and value in USD billions

3. Methodology

3.1 Data

To test these hypotheses, four different databases were used: (1) data on the board of directors of Brazilian publicly-listed companies retrieved from the *Comissão de Valores Mobiliários* (Securities and Exchange Commission of Brazil – CVM); (2) data on M&A deals extracted from Reuters; (3) data on the financial statements of firms obtained from Bloomberg, and (4) data on country-level variables from World Bank Governance Indicators and Transparency International (Kaufmann *et al.*, 2011; World Bank, 2021). For this study, we selected firms listed on the B3 (Brazil Stock Exchange and over-the-counter market) from 2010 to 2015. The sample selection criterion was firm size using market capitalization, covering agricultural, industry, service, and financial sectors. In total, the sample consists of 174 firms.

From 2000 to 2015, the Brazilian firms in this sample conducted 317 M&A, predominantly in the domestic market (85.17%). Operations in the international market accounted for 14.83% of all M&A, primarily in the United States, where Brazilian companies conducted thirteen M&A deals, as shown in Table 1.

3.2 Identification strategy

Highlighting the identification strategy is crucial in the field of finance, as it clarifies the methodological criteria and the study variables (Bowen *et al.*, 2016). The dependent variable (*Acq*) is a dummy that takes the value of 1 if the firm conducted at least one M&A in the domestic market or abroad, and 0 otherwise. To analyze the influence of small-world properties on M&A, we assess the effect of average distance, clustering coefficient, and small-world connectivity.

A network comprises N nodes (e.g. firms) and ties (e.g. interlocks). The shortest distance (or shortest path length) between two nodes is the lowest number of ties that must be traversed from one node to another. The firm's average distance (Dist) is the average number of steps of the firm (node) to all other firms (nodes) in the network. The average distance

Table 1.
National and International M&A undertaken by Brazilian firms between 2000 and 2015

Market-country	Frequency	Percentage
Brazil	270	85.17
United States	13	4.10
Argentina	10	3.15
Colombia	4	1.26
Canada	2	0.63
Chile	2	0.63
Mexico	2	0.63
Turkey	2	0.63
Uruguay	2	0.63
Australia	1	0.32
China	1	0.32
Germany	1	0.32
Dominican Republic	1	0.32
India	1	0.32
Oman	1	0.32
Paraguay	1	0.32
Peru	1	0.32
Spain	1	0.32
United Kingdom	1	0.32
Total	317	100

Source(s): Own elaboration based on Reuters

($L_{observed}$) at the network level is the mean of the shortest distance between nodes i and j in a connected network. Distance is only calculable within a connected network (i.e. component), and the distance to isolated nodes is undefined. Therefore, small-world measures are calculated within the main component (the largest subset of the network in which all nodes can reach each other).

$$L_{observed} = \frac{2}{N\,(N-1)} \sum_{i<j} d_{ij} \tag{1}$$

Two nodes are neighbors if they are connected by a tie. The degree centrality (d) of a node (i) is the number of ties. Clustering coefficient measures how well the neighbors of a node are interconnected. According to Watts and Strogatz (1998), the local clustering coefficient ($Clust_i$) has the following representation:

$$Clust_i^{ws} = \frac{2E_i}{d_i\,(d_i-1)} \tag{2}$$

where Ei is the number of connections observed between neighbor nodes of i, and d_i is the degree of node i. The local clustering coefficient of a firm – a node-level measure – is calculated as the proportion of actual ties among its neighbors compared with the number of all possible ties. The global clustering coefficient ($C_{observed}$) – a network-level measure – is defined as the average of the local clustering coefficients for all of the nodes. The local and global clustering coefficients range between 0 and 1, and they get closer to 1 as the network clustering increases.

To identify whether an observed network (e.g. the Brazilian corporate network in 2015) exhibits a small-world structure, their properties are compared to a simulated random graph of the same size and density. For this random graph, $L_{simulated}$ is the average distance, and $C_{simulated}$ is the global clustering coefficient. The small-world connectivity statistic (Sw) is calculated as the ratio [$C_{observed}/L_{observed}$] * [$L_{simulated}/C_{simulated}$], namely [observed clustering coefficient/observed average distance] * [simulated average distance/simulated clustering coefficient] [1]. The small-world quotient provides a null model to compare observed networks with a hypothetical random network. A network is a "small world" when the small-world connectivity statistic is greater than 1. In this line, the small-world connectivity statistic (Sw) at the firm level is estimated as the ratio of local clustering coefficient and the node's average distance.

Belonging to the main component (M~comp) was added as an additional network variable. The main component of a network is the largest set of connected nodes with direct or indirect ties to all actors (Borgatti *et al.*, 2013). This is an important measure because it indicates whether the board of a firm can be reach by any path. If a corporation is out of the main component, the cost of collecting, handling, and selecting information for negotiating and acquiring can increase. Therefore, it is expected that firms belonging to the main component are more likely to participate in M&A.

We also included a set of country-level variables regarding the macro-level environment in which target companies are located. Characteristics of the countries in which target firms are located can determine M&A deals (Verma and Sharma, 2014). In emerging economies, institutional, governmental, legal and macroeconomic variables such as regulatory quality, control of corruption, per capita income, and the tax rate can play a more determinant role in the propensity to undertake M&A, as shown in previous studies (De Sousa Barros *et al.*, 2021; Sun and Chan-Lau, 2017). For example, corruption in the host country can increase acquisition costs and affect both acquirers and targets (Di Guardo *et al.*, 2019; Weitzel and Berns, 2006). Country-level parameters of the target corporation will be covered in this article

when analyzing international M&A made by Brazilian firms. This procedure is consistent with the ownership, location, and internalization (OLI) framework proposed by Dunning (1988) and widely adopted in research on M&A (Forssbæck and Oxelheim, 2008). Such variables have no analytical usefulness for operations occurring in the domestic market.

As additional control variables, we included the firm-specific variables (size, intangible assets, inventories), and firm-level financial variables such as leverage, cash flow, and ROA, as commonly used in finance research (Almeida *et al.*, 2017; Tahir and Alam, 2020). All variables are indexed between firms (i) and time (t), and the study period spans from 2000 to 2015 (see Table 2).

The model used in this article is expressed in the following equation:

$$Acq_{ikt} = f\left(SW_{it-1,}, F_{it-1,}, O_{it}, L_k, I_k, C_{ikt}, \delta_t, f_i\right)$$

All variables included in the regression model are outlined in Table 3:

3.3 Endogeneity and robustness tests

There are questions in the literature regarding the endogeneity observed in indicators within the scope of corporate governance (Wintoki *et al.*, 2012), usually arising from problems of self-selection or reverse causality (Kai and Prabhala, 2007). However, our article does not cover instrumental variables or simultaneous equations, and there is no definitive evidence in the literature regarding the endogeneity of network variables, which are those used in this study (Johnson *et al.*, 2013). Furthermore, aspects related to simultaneity were also considered and the firm-level variables were lagged by one year when they assumed the impact of small-world features on the dependent variable of innovation performance, as suggested by Schilling and Phelps (2007). Unobserved heterogeneity – which deals with the possibility that unmeasured (or non-measurable) differences between observationally-equivalent firms affect M&A due to unmeasured, systematic, and sector effects – was controlled, since the absence of control for this unobserved heterogeneity could result in specification errors (Heckmann, 1979).

Fixed-year effects were included to control for the systematic effects of the study period; for example, differences in macroeconomic conditions, which may affect all M&A. In addition, firm-level effects were included to control for the unobserved specific heterogeneity of each firm. In other words, this article estimates regression coefficients through OLS, in addition to considering the fixed effects of the firm, thus mitigating possible problems of endogeneity of an omitted variable constant over time. Although reference studies in the area only use estimates derived from probit models (Davis *et al.*, 2012; Schilling and Phelps, 2007), this article also performed OLS models, which can be applied for estimates with a binary dependent variable and control for fixed effects and firm-level heterogeneity (Chodorow-Reich and Falato, 2022).

4. Results

4.1 Small-world structure

The parameters for detecting small-world properties in the corporate board networks were estimated for the 2000–2015 series. The observed and simulated values of clustering coefficient, average distance, as well as the small-world connectivity statistic (Sw) are displayed in Table 4. It is noted through the results achieved that the Brazilian corporate network follows a small-world structure, given that the coefficients found for both clustering and average distance are higher than the simulated values and the small-world statistic is greater than 1. The small-world statistic ranges from 9.29 to 21.139 in the Brazilian corporate network. Despite the small-world statistic being sensitive to the number of connected nodes (n),

Variables	Description
Dependent variable	
Acquisition (Acq)	Dummy variable equal to 1 if at least one acquisition was made by company i or its subsidiaries, in year t, in target country k; otherwise, the value is zero
Firm-level financial variables	
Leverage (Lever)	Total debt/total assets of company i in year $t-1$
Cash flow (CashF)	Free cash flow/total assets of company i in year $t-1$
ROA	EBIT/total assets of company i in year $t-1$
Firm-specific variables	
Firm size (Size)	Logarithm of the total assets of company i in year $t-1$
Intangible assets (Intang)	Intangible assets/total assets both in time $t-1$ for company i
Inventories (Invent)	Inventories/total assets both in time $t-1$ for company i
Small world variables	
Clustering coefficient (Clust)	Measure of the clustering coefficient of the firms in network k in year $t-1$
Average distance (Dist)	Measure of the average distance between firms in network k in year $t-1$
Small-world S (Sw)	Ratio [observed clustering coefficient/observed average distance],[simulated average distance/simulated clustering coefficient] in year $t-1$
Network variables	
Main Component (M~comp)	Dummy variable, 1 if company belongs to the main component and 0 otherwise
Country-level variables	
Accountability (Acc)	Score for the target country in a "voice and responsibility" index (see Kaufmann *et al.*, 2011), observed in year t; a higher index value indicates more democracy. Data: WGI
Stability (Stab)	Score for the target country in a "political stability" index (see Kaufmann *et al.*, 2011), observed in year t; a higher index value indicates lower political risk. Data: WGI
Government (Gov)	Score for the target country in a "government effetiveness" index (see Kaufmann *et al.*, 2011), observed in year t; a higher index value indicates higher efficacy. Data: WGI
Regulatory quality (RegQ)	Score for the target country in a "regulatory quality" index (see Kaufmann *et al.*, 2011), observed in year t; a higher index value indicates greater government capacity to formulate and implement strong policies and regulations that enable and promote private sector development. Data: WGI
Laws (Law)	Score for the target country in a "rules and laws" index (see Kaufmann *et al.*, 2011), observed in year t; a higher index value indicates greater judicial integrity. Data: WGI
Corruption (Corrup)	Score for the target country in a "corruption control" index (see Kaufmann *et al.*, 2011), observed in year t; a higher index value indicates greater control. Data: WGI
Military spending (Military_S)	Military spending by target country k in time t, expressed as %GDP. Data: Stockholm International Peace Research Institute and World Bank
GDP	Target market size: GDP growth of target country k in time t, in millions. Data: World Bank
Per capita income (Income)	National income growth of target country k in time t divided by the population of country k. Data: World Bank
Population (Pop)	Population of country k in time t. Data: World Bank
Transparency (Trans)	Score for the country in the Transparency International's Corruption's Index (CPI), observed in year t; a higher index value indicates lower corruption. Data: transparency.org
Tax Rate (Tax)	Total tax rate (% commercial profits) of country k in time t. Data: OECD

Note(s): Table outlining all variables used in the model. The country-level variables encompass the ownership, location, and internalization framework (OLI). The acronym WGI stands for World Governance Index, the acronym GDP stands for gross domestic product, and the acronym OECD stands for Organization for Economic Co-operation and Development

Table 2.
List of variables

Variables	Description
Acq_{ikt}	Dummy variable equal to 1 if at least one acquisition was made by company i or its subsidiaries, in year t, in target country k; otherwise, the value is zero
SW_{it-1}	Small world variables at firm-level in year *t-1*
F_{it-1}	Financial variables for firm i in year *t-1*
O_{it}	Ownership variables for host country in year t
L_k	Location-specific variables for host country k in year t
I_k	Internalization variables for the host country k in year t
C_{ikt}	Firm-specific control variables and country-specific control variables
δ_t	Year dummies, which seek to capture macroeconomic conditions that uniformly influence the probability of firms making acquisitions in a given year
f_i	Firm fixed effects that capture the unobserved (time-invariant) heterogeneity for each firm
ε_{ikt}	Random error term

Source(s): Own elaboration

Table 3. Identification and description of the variables

comparing years with similar network size, we found an increase over the years from 14.35 in 2005 ($n = 260$) to 18.11 in 2013 ($n = 276$), and from 18.333 in 2007 ($n = 306$) to 20.98 in 2014 ($n = 300$).

The small-world statistic especially increased from the early-2000s onwards when new firms entered B3, the main Brazilian stock exchange. These "newcomer" firms recruited directors who were in other large corporations, probably to participate in the information flows and legitimize their governance practices. However, while the network density (the number of actual ties out of all possible ties) decreased from 2000 to 2015, the distance between firms declined. This fact can be explained by the appointment of a set of busy directors with multiple board seats. These "big linkers" have a strong potential to connect distant nodes.

4.2 Small-world and M&A

Table 5 displays the descriptive statistics for the full sample of firms. The number of M&A increased notably during the years of study. The clustering coefficient slightly decreased from 0.657 in 2002 to 0.544 in 2015, and the average distance remained relatively stable during this period. The firms connected on average through four intermediate firms.

To test hypotheses 1a and 1b, the model includes M&A dummy as the dependent variable and small-world properties, belonging in the main component, firm-specific variables (size, intangible assets, inventories), and firm-level financial variables as predictors. Regression analysis models revealed that small-world variables (clustering coefficient, average distance, and the small-world statistic) do not have a significant effect on the propensity to conduct M&A, thus refuting hypotheses 1a and 1b (Table 6). However, being in the main component is significant at the 5% level, namely firms embedded in the large business community are more likely to undertake M&A. Regarding firm-level variables, only firm size significantly affects participation in M&A at the 10% significance level, which indicates that larger companies actually seek to concentrate and expand through M&A, as previous studies have noted (Gorton *et al.*, 2009; Harford, 2005; Phalippou *et al.*, 2015).

When analyzing only international M&A to test hypotheses 2a and 2b, we found a significant negative relationship at the 5% significance level between average distance and undertaking M&A abroad (Table 7). In other words, considering corporate ties established through interlocking directorates, the shorter the distances between firms, the higher propensity to undertake international M&A. According to Biswas (2016), such a negative relationship indicates the importance of greater sharing of information between nearby firms

Small world parameters in network (2000–2007)	2000	2001	2002	2003	2004	2005	2006	2007
Number of firms (n) in the main component	161	144	250	241	262	260	304	306
Density (Δ)	0.029	0.034	0.0378	0.0390	0.0312	0.0261	0.0200	0.0215
Average degree (k)	4.70	4.82	9.42	9.35	8.15	6.75	6.07	6.56
$C_{\Delta observed}$: Observed Clustering Coefficient	0.600	0.638	0.657	0.643	0.651	0.577	0.548	0.572
$D_{observed}$: Observed Average Distance	5.140	5.797	4.428	4.376	4.466	4.507	4.533	4.429
$C_{\Delta simulated}$: Simulated Clustering Coefficient (k/n)	0.029	0.033	0.0377	0.0388	0.0311	0.0260	0.0200	0.021
$D_{simulated}$: Simulated Average Distance (ln(n)/ln(k))	3.285	3.160	2.461	2.453	2.654	2.911	3.170	3.042
$C_{\Delta\ observed}/D_{observed}$	0.117	0.110	0.15	0.15	0.15	0.13	0.12	0.129
$D_{simulated}/C_{\Delta\ simulated}$	112.635	94.436	65.29	63.21	85.28	112.07	158.69	141.872
$Sw = [C_{\Delta\ observed}/D_{observved}]*[D_{simulated}/C_{\Delta\ simulated}]$	*13.148*	*10.393*	*9.69*	*9.29*	*12.43*	*14.35*	*19.18*	*18.323*

Small world parameters in network (2008–2015)	2008	2009	2010	2011	2012	2013	2014	2015
Number of Firms (n) in the main component	319	321	281	295	294	276	300	278
Density (Δ)	0.021	0.020	0.0214	0.0220	0.0230	0.0236	0.0192	0.0200
Average degree (k)	6.59	6.54	5.99	6.45	6.73	6.49	5.75	5.53
$C_{\Delta observed}$: Observed Clustering Coefficient	0.616	0.595	0.548	0.580	0.573	0.568	0.549	0.544
$D_{observed}$: Observed Average Distance	4.314	4.399	4.207	4.089	4.010	4.006	4.455	4.655
$C_{\Delta simulated}$: Simulated Clustering Coefficient (k/n)	0.021	0.020	0.0213	0.0219	0.0229	0.0235	0.0192	0.020
$D_{simulated}$: Simulated Average Distance (ln(n)/ln(k))	3.058	3.073	3.149	3.050	2.982	3.004	3.262	3.290
$C_{\Delta\ observed}/D_{observed}$	0.143	0.135	0.13	0.14	0.14	0.14	0.12	0.117
$D_{simulated}/C_{\Delta\ simulated}$	148.041	150.774	147.64	139.40	130.29	127.71	170.27	165.330
$Sw = [C_{\Delta\ observed}/D_{observved}]*[D_{simulated}/C_{\Delta\ simulated}]$	*21.139*	*20.393*	*19.23*	*19.77*	*18.62*	*18.11*	*20.98*	*19.321*

Source(s): Own elaboration

Table 4. Parameters for detecting small world properties in the corporate networks (2000–2015)

Table 5.
Mean and standard deviation of variables

Year	Deal	Int~aqc	ROA	Size	Lever	CashF	Intang	Invent	Clust	Dist	Sw
2001	0.00758	0	0.0346	19.17	0.308	−0.000207	0.0256	0.102	0.638	5.800	10.39
	0.0869	0	0.176	1.992	0.398	0.0874	0.0296	0.0965	0	0	0
2002	0.00379	0	0.0247	18.83	0.323	0.0332	0.0211	0.108	0.657	4.430	9.690
	0.0615	0	0.174	2.069	0.415	0.0918	0.0261	0.102	0	0	0
2003	0.0227	0	0.0508	18.92	0.300	0.0203	0.0138	0.116	0.643	4.380	9.290
	0.149	0	0.184	2.109	0.405	0.127	0.0125	0.111	0	0	0
2004	0.0265	0.00379	0.0714	19.08	0.275	0.00869	0.0325	0.132	0.651	4.470	12.43
	0.161	0.0615	0.185	2.039	0.402	0.115	0.0832	0.126	0	0	0
2005	0.0303	0.0152	0.0653	19.27	0.273	0.0136	0.0198	0.121	0.577	4.510	14.35
	0.172	0.122	0.191	2.058	0.373	0.114	0.0320	0.117	0	0	0
2006	0.0379	0.00379	0.0656	19.58	0.281	−0.0257	0.0251	0.117	0.548	4.530	19.18
	0.191	0.0615	0.167	1.994	0.376	0.135	0.0630	0.115	0	0	0
2007	0.110	0.00379	0.0595	19.93	0.264	−0.0482	0.0332	0.113	0.572	4.430	18.32
	0.313	0.0615	0.170	2.033	0.337	0.140	0.0651	0.112	0	0	0
2008	0.0947	0.0114	0.0587	19.89	0.311	−0.0649	0.0567	0.117	0.616	4.310	21.14
	0.293	0.106	0.190	2.024	0.353	0.150	0.124	0.111	0	0	0
2009	0.0606	0.00379	0.0768	20.25	0.283	−0.0265	0.0985	0.0984	0.595	4.400	20.39
	0.239	0.0615	0.169	2.068	0.331	0.145	0.179	0.0935	0	0	0
2010	0.121	0.00758	0.0840	20.46	0.288	−0.0268	0.0915	0.0988	0.548	4.210	19.23
	0.327	0.0869	0.144	2.023	0.345	0.128	0.172	0.0925	0	0	0
2011	0.133	0.00758	0.0728	20.50	0.304	−0.0364	0.0986	0.0991	0.580	4.090	19.77
	0.340	0.0869	0.148	1.999	0.344	0.117	0.180	0.0908	0	0	0
2012	0.114	0.0227	0.0640	20.48	0.312	−0.0298	0.0868	0.0963	0.573	4.010	18.62
	0.318	0.149	0.164	1.994	0.325	0.119	0.162	0.0896	0	0	0
2013	0.0871	0.0152	0.0682	20.43	0.308	−0.0227	0.0904	0.0963	0.568	4.010	18.11
	0.283	0.122	0.130	1.955	0.276	0.107	0.164	0.0916	0	0	0
2014	0.0871	0.00758	0.0614	20.35	0.356	−0.00678	0.0892	0.0979	0.549	4.460	20.98
	0.283	0.0869	0.137	1.989	0.403	0.107	0.159	0.0928	0	0	0
2015	0.0947	0.00758	0.0431	20.00	0.387	−0.00251	0.0928	0.101	0.544	4.660	19.32
	0.293	0.0869	0.144	2.045	0.436	0.107	0.157	0.0997	0	0	0
Total	0.0687	0.00732	0.0615	19.89	0.306	−0.0234	0.0751	0.107	0.591	4.447	16.75
	0.253	0.0853	0.164	2.099	0.368	0.125	0.149	0.103	0.0389	0.407	4.135

(*continued*)

Table 5.

Year	M~comp	Acq	Stab	Gov	RegQ	Law	Corrup	Income	Mili_S	Tax
2001	0.466							3,135	1.952	
	0.501							0	0	
2002	0.508	0.390	0.284	0.0317	0.287	−0.303	0.0109			
	0.502									
2003	0.507	0.389	−0.000696	0.186	0.313	−0.400	0.101			34
	0.502	0	0	0	0	0	0			0
2004	0.475	0.508	−0.265	0.313	0.269	−0.132	0.307	9071	1.793	34
	0.501	0.354	0.0305	0.656	0.582	0.689	0.683	14,486	0.879	0
2005	0.497	0.556	−0.337	0.374	0.455	0.0191	0.288	13,838	1.853	34.64
	0.502	0.575	0.779	0.851	0.705	0.975	0.874	16,494	1.150	2.782
2006	0.559	0.396	−0.306	−0.249	−0.0759	−0.468	−0.167	5,552	1.401	33.70
	0.498	0.126	0.212	0.141	0.203	0.113	0.0761	836.6	0.218	1.337
2007	0.573	0.468	−0.334	−0.203	−0.0763	−0.455	−0.156	7,154	1.391	33.76
	0.496	0.0632	0.137	0.104	0.167	0.0584	0.122	482.2	0.227	1.704
2008	0.618	0.498	−0.282	−0.0402	0.103	−0.289	0.0107	10,028	1.452	32.30
	0.487	0.250	0.284	0.370	0.314	0.447	0.410	7,526	0.211	5.477
2009	0.599	0.503	0.166	−0.0251	0.131	−0.154	−0.0539	8,564	1.538	33
	0.491	0.147	0.151	0.340	0.429	0.400	0.387	447.7	0.237	4.274
2010	0.555	0.582	0.0155	0.0861	0.221	0.102	0.0941	13,708	1.613	33.94
	0.498	0.202	0.119	0.428	0.464	0.493	0.406	8,653	0.606	1.703
2011	0.583	0.511	−0.0849	−0.0506	0.213	0.0623	0.212	14,129	1.512	33.91
	0.494	0.150	0.219	0.295	0.220	0.291	0.259	6,207	0.538	1.853
2012	0.609	0.484	0.0631	0.0808	0.187	0.0446	0.0925	16,118	1.642	33.77
	0.489	0.289	0.349	0.517	0.476	0.576	0.526	11,999	0.924	3.720
2013	0.585	0.396	−0.220	0.150	0.261	0.106	0.0793	17,413	1.609	32.91
	0.494	0.573	0.537	0.611	0.572	0.652	0.657	16,759	0.697	3.463
2014	0.578	0.365	−0.0777	−0.0631	0.0440	0.00724	−0.279	13,911	2.033	32.91
	0.495	0.355	0.311	0.344	0.331	0.382	0.373	9,028	2.568	5.107
2015	0.566	0.391	−0.351	−0.113	−0.155	−0.150	−0.361	10,662	1.502	33.92
	0.497	0.169	0.267	0.330	0.365	0.386	0.365	9,534	0.562	2.216
Total	0.558	0.471	−0.139	−0.00381	0.120	−0.0948	−0.00820	12,187	1.591	33.53
	0.497	0.281	0.337	0.423	0.411	0.486	0.454	9,822	0.945	3.231

Source(s): Own elaboration

Variables	(OLS) I	(PROBIT) II	(OLS) III	(PROBIT) IV	(OLS) V	(PROBIT) VI
ROA	0.00915	1.030	0.00846	1.054	0.00850	1.062
	(0.0865)	(0.945)	(0.0873)	(0.935)	(0.0877)	(0.937)
Size	−0.00273	0.222***	−0.00933	0.212***	−0.00236	0.220***
	(0.0219)	(0.0727)	(0.0241)	(0.0725)	(0.0224)	(0.0724)
Lever	−0.0362	0.0182	−0.0230	0.0516	−0.0353	0.00488
	(0.0522)	(0.482)	(0.0513)	(0.474)	(0.0513)	(0.480)
CashF	−0.0111	−0.501	0.00535	−0.493	−0.00971	−0.534
	(0.0895)	(0.777)	(0.0890)	(0.764)	(0.0908)	(0.763)
Intang	0.00691	−0.442	0.000665	−0.523	0.00913	−0.460
	(0.0813)	(0.634)	(0.0714)	(0.637)	(0.0733)	(0.631)
Invent	0.0202	0.997	0.0358	0.997	0.0176	1.003
	(0.209)	(1.157)	(0.207)	(1.160)	(0.205)	(1.157)
M~comp	0.0367	0.437**	0.0349	0.434**	0.0364	0.442**
	(0.0243)	(0.196)	(0.0245)	(0.196)	(0.0248)	(0.196)
Clust	−0.0438	0.715				
	(0.362)	(2.792)				
Dist			−0.0577	−0.311		
			(0.0366)	(0.277)		
Sw					1.33e-05	0.00722
					(0.00454)	(0.0474)
Constant	0.177	−7.475***	0.533	−5.543***	0.145	−7.178***
	(0.473)	(2.311)	(0.574)	(2.028)	(0.468)	(1.802)
FIRM FE	YES	NO	YES	YES	NO	YES
YEAR Dummy	YES	YES	YES	NO	NO	NO
AIC	20.54688	737.8466	17.29988	736.642	20.5641	737.8887
Observations	1,313	1,313	1,313	1,313	1,313	1,313
R^2	0.002		0.005		0.002	
Number of firms	174	174	174	174	174	174

Note(s): Values in parentheses are the standard errors of the coefficients. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively. Equations I, III and V were estimated through an OLS panel, with firm fixed effects, thus controlling for firm heterogeneities. The firm-level financial variables were lagged by 1 period for simultaneity purposes. Alternatively, the same equations were estimated in a probit model, but they are less robust due to the possible correlation between the error and the independent variables of the model. For OLS models, the estimated errors are robust and clustered at the firm level

Source(s): Own elaboration

Table 6.
Panel with OLS and probit models for M&A at national and international level

of a network when negotiating with foreign companies. The small-world connectivity statistic has a significant effect at the 10% level, albeit a negative one. Because the small-world connectivity index (Sw) is built as the ratio between the clustering coefficient and average distance, this negative relationship is due to the significant negative effect of average distance. However, the coefficient is not economically significant because an increase of 1,000 in "Sw" would be associated with a 0.4% decrease in the odds of undertaking an international acquisition. At the firm level, in addition to firm size, the leverage variable is also associated with participation in international M&A operations, confirming previous results widely reported in the financial literature (Ghosh and Jain, 2000). More leveraged companies – mainly through credit on favorable terms (extended term and low cost of capital) obtained abroad – have better conditions with respect to undertaking M&A transactions.

To expand the previous analysis, this article unprecedentedly estimated the model considering country-level variables to assess the impact of target-country-specific factors receiving foreign direct investment (FDI) in M&A transactions (Forssbæck and Oxelheim, 2008). The relationship between average distance and international M&A remains significant – now at the 1% level – when controlling for country-level. The results also highlight that the

Variables	(OLS) I	(PROBIT) II	(OLS) III	(PROBIT) IV	(OLS) V	(PROBIT) VI
ROA	0.0255	3.069	0.0266	3.771*	0.0287	3.235
	(0.0301)	(2.073)	(0.0300)	(2.226)	(0.0304)	(2.097)
Size	0.0114	0.346**	0.00799	0.350**	0.0109	0.346**
	(0.00717)	(0.168)	(0.00631)	(0.167)	(0.00704)	(0.170)
Lever	0.0124	1.446**	0.0158	1.503**	0.00976	1.363**
	(0.0181)	(0.663)	(0.0194)	(0.681)	(0.0193)	(0.667)
CashF	−0.0153	0.119	−0.0117	0.0408	−0.0217	−0.163
	(0.0361)	(1.581)	(0.0353)	(1.639)	(0.0374)	(1.629)
Intang	−0.0381*	−5.511	−0.0453**	−6.892*	−0.0401**	−5.173
	(0.0214)	(3.598)	(0.0207)	(4.009)	(0.0195)	(3.559)
Invent	0.0317	1.183	0.0434	1.417	0.0391	1.485
	(0.0705)	(2.461)	(0.0693)	(2.646)	(0.0709)	(2.562)
M~comp	0.00772	0.529	0.00755	0.715	0.00784	0.548
	(0.0131)	(0.413)	(0.0134)	(0.457)	(0.0132)	(0.420)
Clust	0.0740	4.434				
	(0.112)	(5.757)				
Dist			−0.0231*	−1.551**		
			(0.0134)	(0.716)		
Sw					−0.00045*	−0.126
					(0.00249)	(0.0902)
Constant	−0.275*	−14.34**	−0.0649	−5.632	−0.135	−9.490**
	(0.161)	(5.882)	(0.122)	(4.640)	(0.152)	(4.231)
FIRM FE	YES	NO	YES	YES	NO	YES
YEAR Dummy	YES	YES	YES	NO	NO	NO
AIC	−2110.065	183.1452	−2112.455	178.133	−2113.304	181.7787
Observations	1,313	1,313	1,313	1,313	1,313	1,313
R^2	0.004		0.006		0.006	
Number of Firms	174	174	174	174	174	174

Note(s): The results highlight the impact of each variable on M&A dummy variable, taking into account only M&A undertaken by Brazilian firms abroad (FDI). Values in parentheses are the standard errors of the coefficients. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively. Equations I, III and V were estimated through an OLS panel, with firm fixed effects, thus controlling for firm heterogeneities. The firm-level financial variables were lagged by 1 period for simultaneity purposes. Alternatively, the same equations were estimated in a probit model, but they are less robust due to the possible correlation between the error and the independent variables of the model. For OLS models, the estimated errors are robust and clustered at the firm level
Source(s): Own elaboration

Table 7.
Panel with OLS and Probit Models for international M&A

tax burden in the country of the target company is negatively associated with M&A, which is significant at the 10% level. The lower level of taxes attracts FDI and the acquisition of national companies by external firms (see Table 8). Thus, for the Brazilian firms in this sample, having tax incentives or a lower tax burden is relevant for conducting M&A abroad with foreign companies. Conversely, per capita income has a positive and significant relationship at the 5% and 10% level, demonstrating that firms engage in M&A with firms located in countries with better GDP/population. In summary, evidence allows us to infer, after controlling for firm and country-level variables, that a short distance between firms affects positively international M&A, whereas high clustering does not.

5. Conclusions and implications

5.1 Theoretical contributions

Although the importance of small-world networks has been well established in the corporate governance literature (Kogut, 2012; Semenova, 2022; Uzzi and Spiro, 2005), their implications

Variables	(OLS) I	(PROBIT) II	(OLS) III	(PROBIT) IV	(OLS) V	(PROBIT) VI
ROA	0.565*	8.005	0.494*	14.39	0.550*	11.61
	(0.329)	(0)	(0.283)	(0)	(0.308)	(0)
Size	−0.0482	−0.649	−0.0319	−0.443	−0.0303	−0.589
	(0.0464)	(1.640e+07)	(0.0423)	(0)	(0.0402)	(3.981e+08)
Lever	0.597**	33.16	0.545**	25.24	0.687**	32.44
	(0.284)	(2.355e+09)	(0.264)	(0)	(0.277)	(0)
CashF	−0.368	−24.97	−0.413	−53.15	−0.387	−34.06
	(0.316)	(0)	(0.292)	(0)	(0.296)	(0)
Intang	−0.315**	−22.37	−0.223	−34.46	−0.308**	−20.00
	(0.147)	(0)	(0.153)	(0)	(0.131)	(0)
Invent	0.151	30.08	0.0680	8.931	0.0253	38.66
	(0.541)	(0)	(0.470)	(0)	(0.488)	(0)
M~comp	−0.0557	0.973	−0.0451	1.131	−0.0552	4.557
	(0.0652)	(1.004e+09)	(0.0618)	(0)	(0.0615)	(0)
Clust	−1.149	105.8				
	(0.729)	(0)				
Dist			−0.0226***	17.22		
			(0.0774)	(0)		
Sw					−0.00370*	5.409
					(0.0192)	(0)
Tax	−0.0639***	−8.396	−0.0635***	−12.60	−0.0708***	−16.15
	(0.0136)	(1.586e+08)	(0.0133)	(0)	(0.0143)	(8.710e+08)
Trans	−0.00545	−5.402	−0.00907	−8.715	−0.00887	−11.76
	(0.0185)	(5.545e+07)	(0.0190)	(60,137)	(0.0182)	(2.160e+09)
Acc	−0.343	−140.4	−0.486	−180.9	0.0561	−228.5
	(0.537)	(0)	(0.530)	(0)	(0.513)	(0)
Stab	0.0541	23.28	0.0446	27.59	0.0690	56.70
	(0.0863)	(2.296e+08)	(0.0831)	(0)	(0.0956)	(0)
Gov	0.209	76.07	0.135	108.2	0.0533	156.2
	(0.359)	(1.520e+09)	(0.348)	(0)	(0.341)	(0)
RegQ	−0.133	−94.45	−0.227	−130.9	−0.109	−172.6
	(0.156)	(4.295e+08)	(0.149)	(0)	(0.163)	(0)
Law	−0.196	90.16	−0.0641	107.5	−0.151	156.9
	(0.142)	(0)	(0.104)	(0)	(0.128)	(0)
Corrup	0.203	79.73	0.356*	139.8	0.0492	160.3
	(0.171)	(2.557e+09)	(0.211)	(0)	(0.171)	(0)
Income	2.34e-05**	0.000188	2.58e-05***	0.000594	2.55e-05**	0.000225
	(9.27e-06)	(52,630)	(9.05e-06)	(70.80)	(9.82e-06)	(3.653e+06)
Military_S	0.196	27.38	0.191	44.03	0.251**	53.96
	(0.129)	(8.287e+08)	(0.129)	(0)	(0.115)	(0)
Constant	3.556**	469.2	1.802	723.5	3.285**	951.9
	(1.340)	(0)	(1.152)	(0)	(1.384)	(0)
FIRM FE	YES	NO	YES	YES	NO	YES
YEAR Dummy	YES	YES	YES	NO	NO	NO
AIC	−176.0283	24	−180.1558	6	−184.4098	10
Observations	148	148	148	148	148	148
R^2	0.788		0.794		0.800	
Number of Firms	52	52	52	52	52	52

Note(s): The results highlight the impact of each variable, including country-level variables, on M&A dummy variable, taking into account only M&A undertaken by Brazilian firms abroad. Values in parentheses are the standard errors of the coefficients. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively. Equations I, III and V were estimated through an OLS panel, with firm fixed effects, thus controlling for firm heterogeneities. The firm-level financial variables were lagged by 1 period for simultaneity purposes. Alternatively, the same equations were estimated in a probit model, but they are less robust due to the possible correlation between the error and the independent variables of the model. For OLS models, the estimated errors are robust and clustered at the firm level

Source(s): Own elaboration

Table 8.
Panel with OLS and probit models for international M&A (with country-level variables)

for M&A have rarely been examined (Biswas, 2016; Davis *et al.*, 2012). Consistently with small-world theory, we found that the corporate network in Brazil reproduces a small-world structure of high local clustering and short path lengths in a period of 15 years. The small-world structure remained intact despite the changes in the board directors' composition over time. This finding supports one of the assumptions of the small-world theory that small-world networks are more robust to perturbations than other network structures (Barabasi, 2002; Watts and Strogatz, 1998). Among the small-world properties, only the distance between firms has an impact on international M&A. Firms that are located at a shorter distance from the other firms are more likely to conduct M&A abroad. The absence of a relationship between local clustering and M&A questions the implications of small-world structures, in line with previous studies (Davis *et al.*, 2012; Fleming *et al.*, 2007). Further research using small-world theory should test whether the firms' embeddedness in local clusters influences other corporate behaviors and outcomes like innovation and implied cost of equity capital.

This study also generates two major implications for the literature on inter-firm network effects and M&A determinants. Previous studies highlighted the importance of inter-firm networks in M&A (Cai and Sevilir, 2012; de Sousa Barros *et al.*, 2021). Our study enhances this understanding by identifying the specific network features that affect M&A operations. First, we demonstrated the effect of the average distance on international M&A. Shortening the distance between firms by creating board interlocks in the national market, beyond benefiting firms from information and knowledge flows, can reduce the costs of insecurity and uncertainty related to entry into foreign markets. Building on this finding, further studies should investigate whether M&A conducted by firms highly embedded in small-world structures lead to lower acquisition premium payments since the short distance between firms can mitigate transaction costs.

Second, the results indicate that the most decisive factor in participating in domestic and cross-border M&A is being directly or indirectly embedded in a large subnetwork (component). Therefore, being integrated into large networks with heterogeneous information flows enables M&A, whereas clustering with high internal cohesion does not increase this probability. Such evidence partly corroborates studies, such as Biswas (2016), showing an inverted U-shaped relationship between firm-level clustering and the probability of acquisition. We infer that local clusters can be detrimental when undertaking buyout or merger initiatives, as they provide redundant information. Conversely, creating strategic corporate ties – perhaps to only one company – facilitates the emergence of M&A deals. Indirect connections to a wide range of heterogeneous firms facilitate access to non-redundant information within the corporate sector. The probability of undertaking M&A does not depend on a company being in small groups with high clustering but rather being in large connected communities.

5.2 Practical implications

Our study also generates practical implications for firms in emerging markets. It demonstrates that the recruitment of busy directors plays a crucial role in reducing information asymmetry to achieve success in M&A, and board interlocks within the nation strengthen firms to undertake M&A abroad. Moreover, findings suggest that recruiting directors from other top firms helps to gain acceptability in new markets but increases the risk of takeovers. In an era where corporate governance guidelines stress the incorporation of independent directors and gender quotas, insights into the effects of interlocking directorates should be carefully considered.

In terms of policy implications, we evidenced that corporate networks within the nation are important for international M&A and therefore for creating larger multinational corporations (MNC). Guo and Lv (2018) previously showed that the central position of

independent directors in the corporate board network was essential to facilitating cross-border M&A. As a policy guideline, countries ambitious to increasing outward FDI need to prioritize business networks that shorten the distance between board directors such as intersectoral business associations and exclusive meetings. Moreover, policy-makers should carefully consider legislative changes in the regulation of interlocking directorates because board composition can have an indirect effect on FDI trends and the economic development of the country. When there is so much debate about regulating revolving doors and contributions to political campaigns in emerging economies, future studies should explore whether the political connections of firms have beneficial or detrimental effects on cross-border M&A.

5.3 Limitations of the study

Our research is not without limitations. First, we analyzed only M&A that were completed, not addressing withdrawn deals. Second, due to data limitations, we did not consider the time taken for M&A completion. Finally, we ignored ownership structure and prior research noted that family-owned firms are likely to exhibit an aversion to risky investments like M&A (Raithatha and Ladkani, 2022). Following this line, future studies should examine corporate networks and the small-world phenomenon beyond interlocking directorates and consider ownership ties.

Note

1. Some scholars estimated small world connectivity statistic as the interaction between clustering coefficient and average distance (Sullivan and Tang, 2012). However, we calculated the small world connectivity measure as the ratio of clustering coefficient to the average distance, following several other studies on small world and organizational performance (Biswas, 2020; Sankowska and Siudak, 2016; Semenova, 2022).

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