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LONG-TERM DECISION-MAKING, THE COMPOSITION OF BOARDS OF DIRECTORS: A MULTIVARIATE APPROACH

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***ABSTRACT*:**

Companies must constantly adapt to new market requirements. Transformations due to various economic causes create a complex environment. Furthermore, it is known from the literature that economic markets , such as Ecuador, are subject to a low reputation for decisions to protect minority investments. These factors alter investors' perceptions of Ecuador, as they encourage the beginning of capital expropriation. This negative effect delays the growth of the country's capital market. This study performs a multivariate exploration of the decisions made by companies in the composition of their boards of directors. Based on the results, which are relevant to capital creation and boards, it was determined that there is a high positive relationship between the presence of men on the board of directors and the creation of boards. A positive relationship is also established with the presence of women on the board. Despite this, a low correlation is evident with the establishment of companies on the board. This trend persists across different management areas.

Keywords: Multivariate, Emerging Markets , Boards of Directors, Decision Making, Biplot

1. INTRODUCTION

Market demands require companies to be efficient in their administrative and financial management. Emerging markets like Ecuador are characterized by a low reputation for fairness in decision-making, leading to a lack of interest among domestic and foreign investors due to fear of being expropriated of their capital. In this scenario, the board of directors may be compromised because the concentration of capital causes a decrease in the independence of its directors when making fair and equitable decisions for the benefit of all its shareholders. Therefore, it is important to understand the effects of board composition decisions on financial performance and maximizing company value. This paper aims to explore, using a multivariate principal components (PCA) technique, the composition characteristics of boards of directors and understand the underlying patterns of board composition by owners. The document is structured in the following sections: First section: Literature review, which presents the theoretical basis of our study, the Second Section: Methodology, details the sample of listed companies in Ecuador analyzed and the statistical method used, in Section Three: Result: the data analysis is carried out applying the multivariate technique and finally Section Four: Results and recommendations: the conclusions are presented and new research scenarios are presented.

2. LITERATURE REVIEW

Agency theory

According to the literature, agency theory has as its object of study the contractual relationships of managers who have control over management (Jensen & Meckling, 1976) . This control is delegated by the owners of capital and, due to the need to ensure that their investment generates returns, it establishes a separation between management control and capital control (Jensen & Smith, Jr., 1985) , seeking that managers protect the interests of capital owners over their own personal interests (Jensen, 1986) .

Agency theory uses mechanisms to mitigate conflicts of interest between shareholders and managers. This theory addresses various areas of business management as a research area, such as the composition of the board of directors or gender diversity on the board. For Iazzi et al. (2023) , Italian companies were characterized by the CEO-chairman duality and its influence on fiscal aggressiveness, suggesting the creation of regulatory policies. Likewise, da Silva Campos et al. (2022) report that in Latin America, the most independent and diverse boards achieve successful environmental performance, with social and governance responsibility (ESG), bringing the theory closer to associating with promoting sustainable practices.

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On the other hand, in complex and dynamic markets such as the technology industry, board composition moderates the relationship between surplus resources and innovation, achieving better strategic flexibility and operational efficiency (Pinheiro et al., 2023) . In this same sense, Salisi & Joseph (2020) report that the strengthening of corporate governance after the 1997 financial crisis showed that practices such as board independence and director remuneration are related to financial performance.

Corporate governance

Due to these needs, modern management establishes corporate governance as a practice that ensures optimal successful financial returns and achieves maximization in the company's valuation (Freeman & David, 1983) . In various investigations, the boards of directors and their impact on multiple corporate dimensions manage to promote better environmental, social and governance performance, as well as a reduction in carbon emissions (Alkurdi et al., 2024; Almubarak & Aljughaiman, 2024; Al-Okaily & Naueihed, 2024; de Enrique Arnau & Pinillos-Costa, 2024; Del Prete et al., 2024) . In relation to emerging markets such as Pakistan, Khan & Iqbal (2024) family businesses have a greater presence of women in leadership positions, highlighting cultural and family factors that influence the composition of the boards of directors.

Governance mechanism

Governance mechanisms are the instruments that allow shareholders to resolve conflicts of interest with managers (Holderness & Sheehan, 1991) , playing a critical role in organizational efficiency, being key in the fair distribution of dividends through its policies, environmental sustainability and regulatory compliance. For Del Prete et al. (2024) analyzes how the composition of the board of directors and the ownership structure influence the dividend allocation policy, finding that larger boards with greater ownership do not distribute higher dividends.

Board of Directors

It is the body within the company responsible for management control, chaired by the general manager CEO (Goodstein & Boeker, 1991; Holderness & Sheehan, 1991; Hollman & Forrest, 1991) . The composition of the board of directors is a key decision to ensure optimal financial performance that allows a maximization of the company's valuation. In research related to this governance mechanism, they focus on the composition or structure that, according to the literature, the specific means of these characteristics could ensure the valuation of the company, ensuring optimal financial results (Kenney et al., 2024; Marzuki et al., 2024; Pinheiro et al., 2024; Velte, 2024) . Among the basic characteristics of the boards we have their size, which represents the number of members that make it up, diversity of its members such as the participation of women, also a factor studied is independence, more so if the studies are carried out in emerging economies.

Principal component analysis

Principal components analysis (PCA) is a dimension reduction technique that resolves the problem of multicollinearity in variables by creating new independent variables, called components, from a series of linear regressions. Each component accounts for the variability calculated from statistics such as variance, covariance, and correlations (Kroonenberg & Leeuw , 1980) .

Biplot chart

The biplot is a graphical representation of an NXM matrix, where the rows represent individuals and the columns represent variables (Gabriel, 1971) . Its graphical structure allows the analysis of data involving more than one variable (ODOROFF & GABRIEL, 1990) . In multivariate analysis, the dimension of a data set of N individuals and M variables is reduced by projecting the data onto a fitted space called Euclidean. According to GALINDO & CUADRAS, (1986) , the biplot provides a functional tool that can represent the result of a principal components analysis, showing statistical values and products such as distances between data units and their corresponding groupings, as well as the explained variance and correlations between variables or between individuals.

For example, in a 2-dimensional representation in Image 1 , the individuals or rows are shown with orange circles, and the blue lines that start from the origin and end in an arrowhead represent the variables or columns.

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Imagen 1. Biplot chart

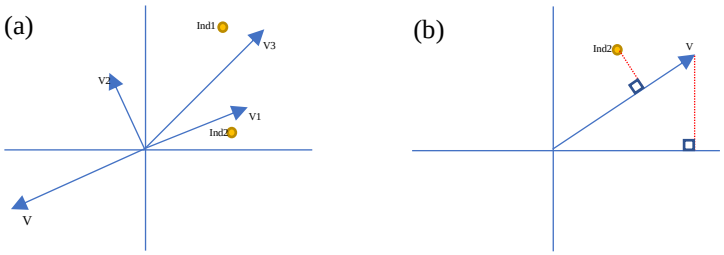

Figure 1: **General representation of a biplot graph**

In Figure 1, graphs (a) and (b), the axes of the planes represent the components that are most representative for individuals and variables, based on the results of a PCA. In graph (a), each vector represents a variable of the study and its graphical interpretation shows the degree of correlation between them. For example, for variables V1 and V3, the correlation is strong because the angle between the vectors is acute, indicating a greater positive correlation. The shorter the angle, the greater the correlation between the variables. If the angle between two variables is 90°, as in the case of V1 and V2, their correlation is zero. On the other hand, when the angle is obtuse, as in the case of V4 and V1, the correlation is inverse.

In graph (b), the angle formed by the vector projected onto the axes provides information about which component has the greatest correlation with the variable. Furthermore, the angle formed by the projection from the individual to a vector shows which variable has the greatest correlation with that individual.

3. METHODOLOGY

Data from the Superintendency of Companies' information system was collected and cleaned. Of the 329 companies registered as of October 31, 2022, only 271 publicly traded companies provided complete information according to the variables defined in Table 1 .

Tabla 1. List of variables for the study

Variables	Description
MANAGER	Number of board members
H	Number of men on the board
J	Number of women on the board
EMP	If a company is on the board
CIIU_G	General sector in which the company is dedicated see classification
CIIU_ES	Specific sector that the company is dedicated to, see classification
CSUS	Subscribed capital
CAUT	Authorized capital
VACC	Share value
PROV	Province of the parent company

To perform the data analysis, the following workflow was developed:

1. Creating a dataset from the external data source of the Ecuadorian Superintendency of Companies
2. Principal component extraction and exploration using R language 4.3.2
3. Bipot graphs from the first 2 principal components that concentrate the greatest variability of the data, through the R 4.3.2 Language
4. Biplot graphics .

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4. RESULTS

Principal component extraction and exploration using R language 4.3.2

Using the Principal Components extraction for the 329 publicly traded companies in Ecuador, Figure 2 shows the total variance calculated. For our analysis, we will consider the two components that account for the greatest variability: PC1 and PC2.

Imagen 2. Scree plot of the number of principal components extracted

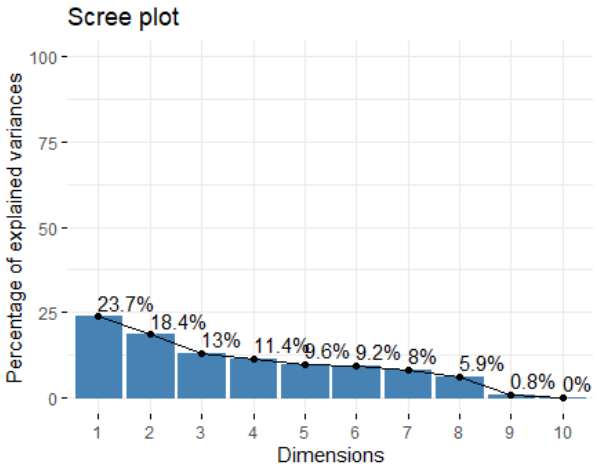

Tabla 2. Main components extracted

5. Bipot graphs from the first 2 principal components that concentrate the greatest variability of the data, through the R 4.3.2 Language
6. Biplot graphics .

A. ***Composition of the boards of directors according to administrative areas***

In Figure 3 , which represents 42.4% of the explained variance in the board composition of 329 publicly traded companies in Ecuador, we observe that the presence of men on the board of directors has a high positive correlation, while the relationship with the presence of women is very positive. On the other hand, the correlation with the formation of companies on the board is negative and significant. To better understand this effect, we segmented the data into three groups based on the zonal sectors of management:

1. In Zone 9, which includes the metropolitan district of Quito, Figure 4 represents 43.80% of the variance in board composition for 73 firms. In this group, the presence of men on the board of directors is strongly correlated, while the correlation with the presence of women is inverse but significant. Furthermore, the correlation with the formation of companies on the board is negative and strong, regardless of the market in which these firms operate (general or main).
2. In Zone 8, which includes the cities of Guayaquil, Durán, and Samborondón, Figure 5 represents 48.5% of the variance in board composition for 153 firms. Here, the presence of men and women on the board is strongly correlated, while the correlation with company formation on the board is weak and negative. This relationship has a weak negative correlation with the general market, and no correlation with the main market.
3. In Figure 6 , which represents 45.9% of the variance in board composition for 45 companies excluding Zones 8 and 9, the presence of men on the board of directors has a strong, positive correlation. The correlation with the presence of women is weak and shows little variability. Furthermore, the composition of companies on the board has a weak, almost zero correlation, indicating that it does not influence composition. In terms of the market, board composition has a good, positive correlation in the overall market and a strong, positive correlation in the core market.

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Imagen 3. **biplot of the 329 companies listed on the stock exchange**

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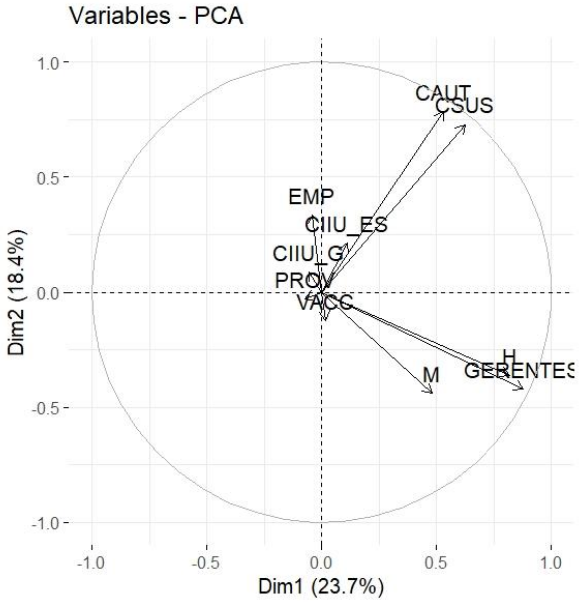

Imagen 4. **Composition of the boards of directors of 73 companies in Zone 9, which makes up the metropolitan district of Quito.**

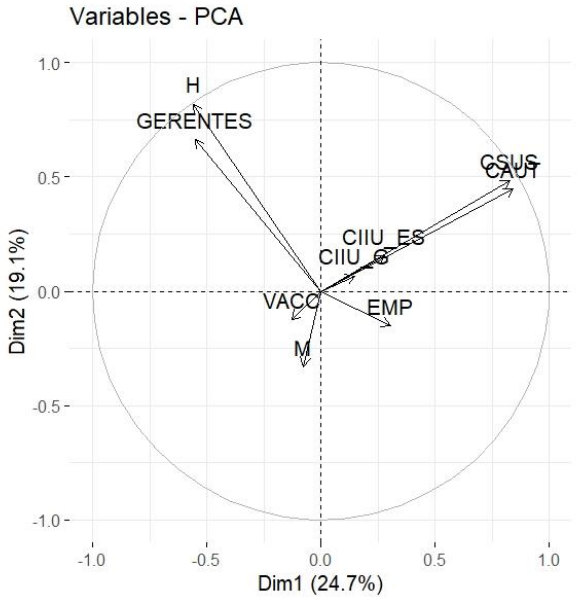

Imagen 5. Composition of the boards of directors of 153 companies in Zone 8, which is made up of the cities of Guayaquil, Duran, and Samborondón.

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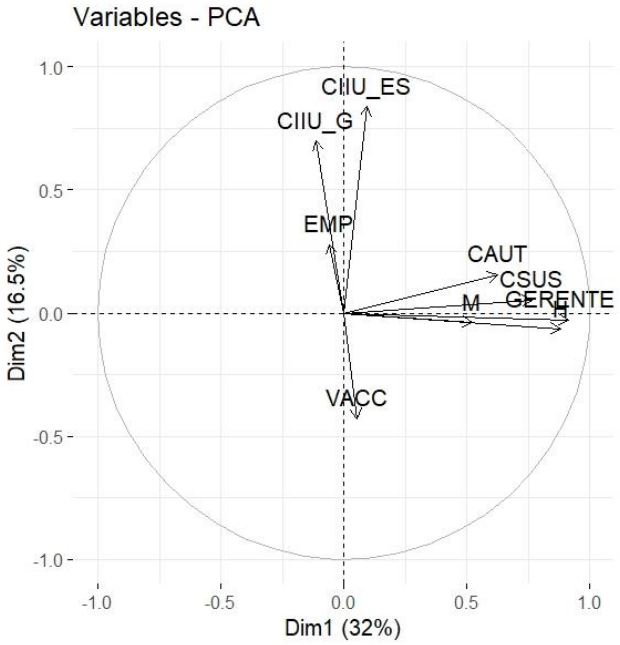
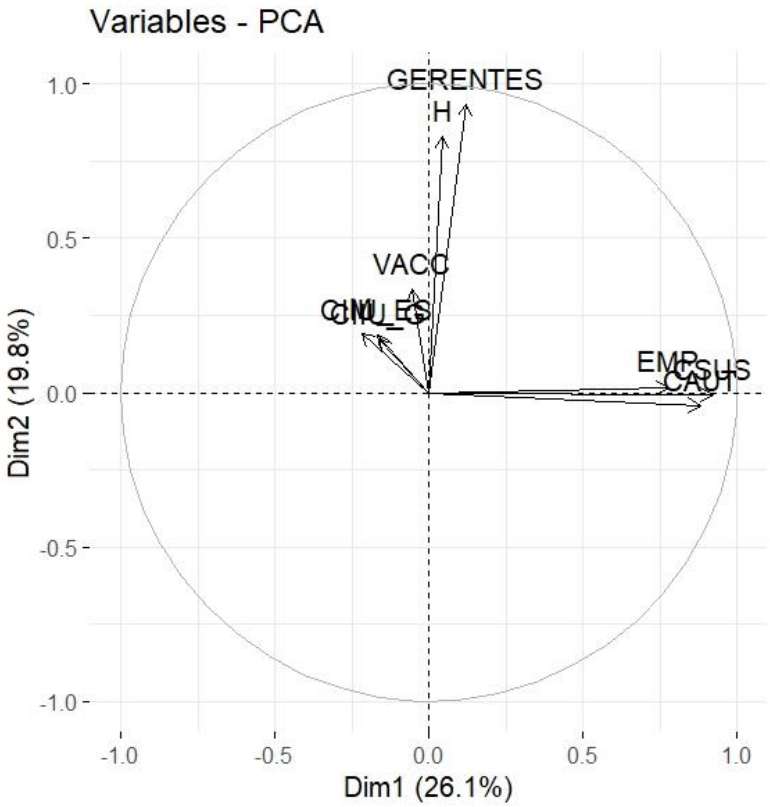


Imagen 6. Composition of the boards of directors in Ecuador of 45 companies except Zones 8 and 9.



5. CONCLUSIONS AND RECOMMENDATIONS

From the analysis of the composition of boards of directors according to the areas of management and the markets in which the companies operate, important conclusions have been obtained:

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First, Figure 4, which covers 42.4% of the variance in board composition across 329 publicly traded companies in Ecuador, highlights a high positive correlation between the presence of men on the board of directors and board composition, as well as a very positive correlation with the presence of women. However, a significant negative correlation is observed with the formation of companies on the board. This trend persists across different management areas. Future research requires in-depth analysis to analyze the context of the International Standard Industrial Classification (ISIC) and determine the characteristics by sector.

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