



## Analysis of the economic and financial performance of companies in the Brazilian energy sector: a proposal for grouping

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### Abstract

This paper aims to group the companies in the Brazilian energy sector according to the economic and financial performance achieved in 2015, as well as to verify the influence of the type of energy, size, control and location of the companies on the economic-financial indicators analyzed. We investigated 70 companies in the energy sector, listed in the "Maiores e Melhores" section of Revista Exame. A quantitative study was developed, applying the techniques of Cluster Analysis, Discriminant Analysis and Analysis of Variance (ANOVA). Performance was measured through 7 indicators: Current Liquidity Ratio, General Liquidity Ratio, General Indebtedness, Long-Term Indebtedness, Adjusted Net Profit, Adjusted Equity and Wealth Created by Employee. As a result, 6 groups of companies were created and such companies were classified according to their economic-financial indicators. We concluded that 70% of the companies belong to groups with "good performance and high liquidity", "good performance and high profitability" or "excellent performance", with satisfactory economic and financial performance. On the other hand, 30% of companies belong to groups with "poor performance and low liquidity", "poor performance and low profitability" or "very low performance", which do not have a satisfactory economic-financial performance. These groups of companies have low profitability (in some cases, negative profitability), together with high indebtedness indices. In addition, it was observed that the size, type of control and main type of energy provided by the company had influence in at least one of the economic-financial indicators studied. Due to the strategic nature of the energy sector and its direct correlation with other sectors, organizations that have been classified as "poor performance and low liquidity", "poor performance and low profitability" or "very low performance" need to seek alternatives to improve their indicators and, consequently, ensure the provision of the services and the survival of the firms themselves.

**Keywords:** Energy Sector. Organizational Performance. Economic. Financial Indicators.

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## Introduction

The access to different energy sources in the current context is indispensable for the quality of human life and for the promotion of economic development. The participation of the energy may be noticed in practically all the daily activities, as well as in the products and services commercialized by the companies.

According to Tolmasquin et al. (2007), the expansion of energy use in Brazil began to undergo significant changes from the end of World War II, due to the expressive population growth, the rapid urbanization process, the industrialization advancement and the construction of an infrastructure based essentially on road transportations. This expansion format has impacted on the way energy is used in the country, i.e., most of the energy is consumed by industries and for transportation. The amount consumed by the population is only a small percentage (BRAZIL, 2016).

Considering the history of crises, the transformations undergone by the Brazilian energy sector and the changes in its regulation. Tolmasquin et al. (2007) state that the energy supply expansion strategy should consider, among other issues, initiatives to promote the use of more sources. In this context, maintaining a sustainable economic and financial performance is fundamental to guarantee the survival of the companies that make up this sector.

The companies' performance analysis could be carried out through economic and financial indicators (SILVA, 2016; ASSAF NETO, 2012; MATARAZZO, 2010; MIRANDA, 2008). This type of analysis, according to Gitman (2010), concedes to examine the economic and financial performance of companies. Also, it generates information to various stakeholders, such as shareholders that study the levels of risk and return, the lenders that evaluate the short-term liquidity and the ability to pay, and managers who work in the decision-internal decisions and monitor company performance.

Considering the importance of analysing the performance of the organizations that compose the energy sector, this article aims to group the companies of the Brazilian energy sector according to the economic and financial performance achieved in 2015, as well as to verify the influence of the characteristics type of energy, size, control and location of the companies on the economic and financial indicators analysed.

In this sense, the present work proposes to answer the following questions: how could companies in the Brazilian energy sector be grouped according to the economic and financial performance achieved in 2015? And how do the characteristics of energy, size, control and location of companies influence the different economic and financial performance indicators analysed?

The study intends to contribute to a better understanding of the Brazilian energy sector economic and financial reality, providing a comparative panorama of the company's performances. Understanding the economic and financial behaviour of the sector is becoming increasingly important as customers increasingly demand products and services with better quality, as there is an increase in competition between companies and as the community in general has demanded social responsibility from organizations (BORTOLUZZI et al., 2011).

Based on the central premise that companies can differentiate themselves and present different performance standards, within a given industry (BAIN, 1968; SCHERER; ROSS, 1990), a better understanding of the positioning of companies and the aspects related to their management models may favour the future allocation of resources. Given this context, the evaluation of economic and financial indicators supports the improvement of failures. It is worth mentioning that it is not only the partners or the shareholders that perform better, but that other agents of society have expressed an interest in understanding how organizations have positioned in relation to their competitive environment (MACEDO et al. 2011).

The justifications for conducting this research are supported by the strategic role of the energy sector. This sector uses inputs from various productive sectors and, at the same time, is an input to other crucial sectors of the economy (BAT-TACHARYYA, 2007). Due to their importance, unsatisfactory performances may offer both indications of small issues and more serious damage, affecting entirely the economic system (BONFIM et al., 2011). Thus, it is considered fundamentally important to analyse the economic and financial behaviour of the companies that integrate the sector.

This article is structured in five sections. In addition to this introductory section, the second section follows the theoretical framework that supports the realization of the research. The third section presents the methodological procedures adopted, followed in the fourth section by the analysis and discussion of the results. Finally, we present the conclusions of the research.

## Theoretical Background

### Brazilian Energy Sector

Since the Industrial Revolution, the economic competitiveness of countries and the quality of life of their citizens are strongly influenced by energy (TOLMASQUIN et al., 2007). According to Barros (2007), fossil fuels and electricity form the basis for operating the technological model and for maintaining the world population's lifestyles.

Energy is a strategic resource, related to the economic power of the countries and the possibility of developing their markets. Tolmasquin (2012) emphasizes that one of the fundamentals of economic sustainability is the ability to provide logistics and energy for the development of production, safely and under competitive and environmentally sustainable conditions.

By its relevance related to the induction of economic development, the energy receives emphasis on the regulation and the fomentation on the part of the State. According to Melo (2016), these state activities play an important role in the implementation of policies and the promotion of development in certain economic sectors.

Throughout the 20th century, Brazil experienced intense economic development, which was reflected in an increasing demand for primary energy. An expressive process of industrialization with the installation of energy-intensive plants and a remarkable demographic expansion are among the factors that led to this growth are, accompanied by a rapid increase in the rate of urbanization (TOLMASQUIN et al., 2007).

According to the National Energy Balance, Brazil's main energy sources are oil, natural gas, electricity, coal, wind energy, biodiesel and sugarcoude products (BRAZIL, 2016). The energy sector is marked by the high share of renewable sources, which remains among the highest in the world. In Brazil, renewable sources represent 41.2% of the total, compared to the world average of 13.5% in 2013.

Given the abundance of natural resources Brazil offers, the development of the energy sector presents itself as an opportunity that is a great challenge: to make abundant natural resources efficiently transformed into energy sources accessible to all sectors. In order to achieve this, the contribution of the actors involved in national energy planning is fundamental to the changes that need to be made in relation to technological capacity building, management and innovation capacity, the availability of resources for investments and the capacity for institutional articulation (TOLMASQUIN et al., 2007).

Moreover, considering the trend of search and generated power supply from sources in the polluting, Ribeiro, Macedo and Marques (2012) emphasize the importance and the need for monitoring the sector, which needs to be permanently focused assessment processes, especially those whose emphasis is on the financial, operational and socio-environmental perspectives. According to Costa and Prates (2005), the depletion of traditional (non-renewable) resources over time implies increasing production costs. This new scenario could affect competitiveness in the global market and affect several aspects related to the economic and financial management of companies in the energy sector.

Most of the final energy consumption in Brazil (approximately 65%) is speeded by industrial production and cargo transportation, which shows its strong relation with the national economic potential (BRAZIL, 2016). Due to the importance of energy for economic and to the potential gains in the quality of life from the efficient supply of goods and services to society, to study the performance of the organizations that integrate the energy sector becomes crucial to understand the potentialities and the limiting factors that affect the strategies of the companies that work in this sector.

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### **Economic and Financial Performance and Indicators Analysis**

The models of organizational performance analysis are indispensable within the context of globalization and competitiveness of the current markets (BORGES et al., 2014). According to Castro (2015), the performance evaluation allows the identification of the strengths and weaknesses of an organization, contributing to the process of strategy management.

One of the dimensions of organizational performance is the economic and financial performance (MATITZ; BULGACOV, 2011). According to Salvatori and Ventura (2012), this performance is considered the primary element for the healthy exist-

ence of a company and is related to financial management, through which it is possible to control budgets and forecasts, justification for the necessary investments.

There is no consensus among researchers on which metric should be used in measuring organizational performance (RICHARD et al., 2009). However, according to Assaf Neto (2012), the use of economic and financial indicators is the most used technique for performance analysis studies. This analysis aims to study the performance of a company in past periods, to diagnose its current position and produce results that serve as the basis for forecasting future trends. Therefore, what we want to evaluate are the consequences that the decisions made by the managers have on aspects such as liquidity, the equity structure and the profitability of the business (ASSAF NETO, 2012).

With data taken from the Balance Sheet and the Income Statement of a company, it is possible to analyse economic and financial indicators. Among the contributions of this type of analysis are the possibility of evaluating the business decisions already made, supporting new decisions and the possibility of verifying the existence of competitive advantage in companies that perform better than the average of their sector of performance (BRITO; BRITO, 2012).

According to Silva (2016), the analysis of the financial statements is developed for diverse purposes, such as credit, investment, merger and acquisition decisions, as well as competition analysis. Matarazzo (2010) also emphasizes that this type of study provides useful and fundamental information to formulate the organizational strategy.

After calculating each indicator, it is relevant to carry out a joint analysis of the indicators, to identify an overview of the performance of the entity approached. Miranda (2008) also emphasizes that it is possible to make comparisons with other companies in the industry and create parameters to improve the management system.

Traditionally, the indicators are classified into groups related to liquidity, debt and profitability. The liquidity indicators allow to assess the organization's ability to pay; additionally, the debt indicators help to understand the financial commitment of the company; and the indicators of profitability are related to the return on invested capital, allowing to evaluate the economic success achieved by the organization in a given period (MATARAZZO, 2010).

The analysis of performance observing the different aspects of the company might be based on principles of the theoretical thinking of the Industrial Organization (OI). The OI concept, developed by Bain (1968) and revisited by Scherer and Ross (1990), involves three analytical dimensions: structure, conduct and performance (ECD).

Nunes Menezes and Dias Jr. (2013) explain that the ECD paradigm contextualizes the relationship action between the performance of the firm, the conduct of agents and focuses action in the market. Its central premise is that the structure of the organization is a determinant of its performance, and this is similar among companies in the same industry. In this way, the use of the structure (through different conduits) is the differential of one company to another, that is, the differentiation in the process is that it results in obtaining a competitive advantage. Thus, structure

and conduct (which is the way in which the company manages its resources) will determine its performance (BAIN, 1968; SCHERER and ROSS, 1990).

According to Mainetti Junior et al. (2014), the conduct depends on the market structure (number of agents and degree of differentiation between products, among other aspects); and the structure depends on basic conditions such as technology available to the sector, raw material, degree of similarity between substitute products and labour force, among others. Within a single industry, companies may differentiate themselves and present different performance standards, which is primarily related to their conduct.

Considering the history of crises and transformations in the Brazilian energy sector and the process of changes in its regulation, it is necessary to carry out the evaluation of the economic and financial performance of the companies that compose it. This type of analysis allows a better understanding companies' positions in the market, as well as the description of several aspects related to management. According to Macedo et al. (2008), the indicators evaluation allows support the improvement of failures and it is interesting to understand the reality of the companies in relation to their competitive environment.

## Methodology

This paper presents an empirical research classified as explanatory. According to Gil (2008), this type of research deepens the knowledge of reality, since it explains the reason or the reason of things. In this sense, the approach used allowed the analysis of the economic and financial performance of companies in the Brazilian energy sector in order to group them and to verify the influence of the characteristics of size, control, location and type of energy provided by the company on the different performance indicators.

The article applied quantitative research techniques. According to Richardson et al. (2008), this type of technique focuses on the use of quantification, both in the collection and processing of information and in data analysis. In the research, multivariate statistical techniques were adopted.

For the definition of the sample to be analysed, the companies of the energy sector were identified in the "*Maiores e Melhores*" section of the online edition of *Revista Exame* (EXAME, 2016a). After that, we collected the economic and financial information and data on the general characteristics of these companies (size, location, control and type of energy produced). The data analysed refer to fiscal year 2015. Altogether, 79 companies in the sector were identified. However, 9 companies that did not have the necessary data to calculate the indicators to be used in the survey were excluded. Thus, the final sample was composed of 70 companies.

Regarding the definition of the economic and financial indicators, the literature does not establish specific standards to be followed. According to Richard et al. (2009), the measurement of organizational performance could involve different dimensions and depths. Thus, the researcheres may have a freer choice and must select indicators to capture their aspects of interest and meet their expectations (ESCRIVÃO JUNIOR, 2012).

In this study, the performance was operationalized through 7 indicators: Current Liquidity Ratio (CLR), General Liquidity Ratio (GLR), General Indebtedness (GI),

Long Term Indebtedness (LTI), Employed Wealth, Adjusted Net Profit (ANP), and Adjusted Return on Equity (ARE). In addition to the indicators, the nominal variables referring to size, location, control and type of service were used. These variables allow the characterization of the companies and could influence the economic and financial performance. The source of the data was also the online edition of *Revista Exame* (EXAME, 2016a).

For the present research, the performance was operationalized through 7 indicators: Current Liquidity Ratio (CLR), General Liquidity Ratio (GLR), General Indebtedness (GI), Long Term Indebtedness (LTI), Employee Created Wealth (ECW), Adjusted Net Profit (ANP) and Adjusted Return on Equity (ARE). In addition to the indicators, the nominal variables referring to size, location, control and type of service were used. These variables characterize the companies and can influence the economic-financial performance. The source of the data was also the online edition of *Revista Exame* (EXAME, 2016a). Table 01 presents the summary description of the variables adopted in the research.

Table 01: Description of the variables used in the research

Variable	Description
Current Liquidity Index (CLI)	Indicator calculated by current assets divided by current liabilities. This indicator shows the relationship between short-term investments and sources of short-term funds, representing the paying capacity (solvency) of the company also in short term.
General Liquidity Index (GLI)	Indicator calculated by the sum of current assets and long-term assets divided by the sum of the total liabilities. It shows a relation between the resources of the company that are not "immobilized" and the total of its debt, representing, therefore, the total capacity of payment of the company (solvency).
General Indebtedness (GI)	Indicator calculated by the sum of current liabilities (debts and short-term obligations) with non-current liabilities, divided by shareholders' equity. Represents the participation of resources financed by third parties in the operation of the company, being an indicator of business risk.
Long-Term Indebtedness (LTI)	Indicator calculated by dividing long-term liabilities by assets. Indicates how much the company is committed to long-term debt in relation to its assets, complementing the analysis obtained with the General Indebtedness indicator.
Adjusted Net Profit (ANP)	Indicator that represents the net income determined after the effects of inflation in the financial statements are recognized. In this amount, interest on capital is adjusted, eventually considered financial expenses.
Adjusted Return on Equity (ARE)	Indicator that results from the division of net income by shareholders' equity, adjusted for inflation. It is the main indicator of business excellence and measures the return on investment to shareholders.
Employee Created Wealth (ECW)	Indicator that represents the total wealth created by the company divided by the arithmetic average of the number of employees, without considering any outsourced services. It indicates the productivity and average contribution of each worker in the wealth generated by the company.
Company size	Nominal variable defined according to the number of employees of the companies, available on the Exame (2016a). SEBRAE (2014) criteria were followed, classifying the companies as micro, small, medium or large.

Location	Nominal variable that represents the geographic region of the headquarters of the companies, within the Brazilian territory (Center-West, Northeast, North, Southeast and South).
Control	Nominal variable that represents the type of control referring to the country that manages the company, containing four categories: Brazilian, state, foreign and mixed.
Type of energy	Nominal variable that represents the main type of energy provided by the company, according to the generation source. Classified in: electricity, gas, ethanol, bioenergy, oil, thermonuclear energy, oil and thermoelectric power.

Source: Prepared by the authors based on Macedo and Corrar (2009) and Exame (2016b).

The data was organized in a spreadsheet of Microsoft Excel®. Statistical Package for Social Sciences® (SPSS) was used for the statistical analysis. Initially, we proceeded to identify missing values (missing), to ensure the validity and reliability of the data. For the data analysis, descriptive statistics and multivariate techniques were used. Descriptive statistics were used to better characterize the companies of energy ethical sector, as well as contribute to the overall understanding of the performance of them.

As multivariate techniques, we applied the analysis of clusters, the discriminant analysis and analysis of variance “ANOVA” (HAIR JUNIOR et al., 2009). As explained by Hair Junior et al. (2009), and these procedures correspond to a set of statistical methods used in situations in which a considerable number of variables are measured at the same time for each sample element.

Cluster analysis was aimed at grouping energy companies according to their performance in 2015. Hierarchical grouping, Ward processing and standardization of “Z Scores” data were used (HAIR JUNIOR et al., 2009). At the end, it was used data crossing and frequency distribution techniques between the groups found and the nominal variables size, location, control and type of energy.

The discriminant analysis, used to identify which variables differentiate the groups and how many of these variables are necessary to obtain the best classification of the individuals of a given population (MÁRIO, 2009), allowed to verify which indicators are more important to classify the economic and financial performance of the companies analysed.

Finally, the use of ANOVA is aimed at the comparison of means and tests the possibility that one or more factors have significant effects on the response variable (SEWARD; DOANE, 2014). Thus, the ANOVA analysis was applied to determine if the variables size, location, control and type of energy are associated to differences in the economic and financial indicators of the companies.

## Results and Discussions

In this section, we present the results of the research, which were obtained through the application of multivariate statistical analyses.



## Grouping of Companies in the Energy Sector Considering Economic and Financial Performance

In order to group the companies according to the economic and financial performance obtained in the year 2015, we used the clusters analysis technique. This analysis allowed companies to be segregated into six different groups, which express the differences between the grouping variables studied (economic and financial indicators). Table 02 shows the companies that make up each of these groups.

Table 02 - Composition of the energy sector groups identified in the research

Group	Number of companies	Companies in the group
Group 1	33 (47,1%)	AES Eletropaulo, Ampla, CEB Distribuição, CEG, Celesc, Celpa, Celpe, Cemar, Cemig Distribuição, Cemig GT, Coelba, Coelce, Comgás, Copel GET, Cosern, CPFL Brasil, CPFL Paulista, CPFL Piratininga, Duke Energy, Elektro, Energia Pecém, Energia Sustentável do Brasil, Energisa Mato Grosso, Energisa Mato Grosso do Sul, Energisa Paraíba, Escelsa, Light Sesa, Petrobras, RGE, Santo Antônio Energia, Taesa, Tractebel e Usina Coruripe.
Group 2	15 (21,4%)	AES Sul, Bahiagás, Cesp, Compagas, Copel Distribuição, EDP Comercializadora, Gasmig, Liquigás, NC Energia, Queiroz Galvão Óleo e Gás, Raízen Tarumã, Sulgás, UEG Araucaria, Usaçúcar e UTE Norte Fluminense.
Group 3	10 (14,3%)	Alto Alegre, Chesf, Eletronorte, Eletrosul, Furnas, Raízen Energia, São Martinho, Usina da Pedra, Usina Delta e Usina Guarani.
Group 4	9 (12,9%)	Biosev, Biosev Bioenergia, CEEE, Celg D, Eletrobrás Amazonas, Eletrobrás Distribuição Alagoas, Eletrobrás Distribuição Piauí, Eletronuclear e Petrogal Brasil.
Group 5	1 (1,4%)	Comerc Energia.
Group 6	2 (2,8%)	Statoil e Eletrobrás.

Source: prepared by the authors

Group 1 is made up of 33 companies (47.1% of the total sample). Most of them develop their activities in the electric energy sector, being large organizations of Brazilian control and that are located in the Southeast Region. On the other hand, Group 2 consists of 15 companies (21.4% of the total), diversified in terms of services provided, size and origin of their control. However, their companies are also located predominantly in cities in the Southeast of the country.

In Group 3, comprising 10 companies (14.3% of the total), most of the activities are related to Ethanol and Bioenergy, under State control, executed by large companies and located predominantly in the Southeast region. In Group 4, there are 9 companies (12.9%), which are exclusively of large size, distributed mostly in the Northeast and Southeast regions, and of foreign control. Most of the companies in

this group are dedicated to electricity, but the presence of Eletronuclear (the only nuclear power supplier in the sample) stands out.

Group 5 consists of only 1 company, Comerc Energia. This is a foreign-owned and medium-sized electric power supplier located in the Southeast Region. Finally, Group 6 is formed by two companies, Statoil and Eletrobrás. Both are located in the Southeast Region, are large and controlled by the State. While Statoil is the oil and gas industry, Eletrobrás is the electric utilities company.

For a more detailed understanding of the composition of the groups, in Table 03 the frequencies for the type of energy, size, control and location are described for the companies that belong to each of the groups formed.

Table 03: Profile of energy sector groups considering economic and financial performance

Feature	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Kind of Power (main)	Electric Power (87.9%)	Energy Electrical (33.3%)	Ethanol and Bioenergy (50%)	Electrical Energy (66.7%)	Energy Electrical (100%)	Electricity (50%)
	Gas (6.1%)	Gas (33.3%)	Energy Electrical (40%)	Ethanol and Bioenergy (22.2%)		Oil and gas (50%)
	Ethanol (3%)	Ethanol (13.3%)	Ethanol (10%)	Thermonuclear energy (11.1%)		
	Oil, gas and electricity (3%)	Thermoelectric Power (6.7%)				
			Oil and gas (6.7%) Bioenergy (6,7%)			
Company size	Large (78.8%)	Large (66.7%)	Big (90%)	Big (100%)	Medium (100%)	Large (100%)
	Medium (18.2%)	Medium (20%)	Medium (10%)			
	Small (3%)	Small (6.7%)				
		Micro (6.7%)				
Control	Brazilian (48.5%)	Brazilian (33.3%)	State-owned (40%)	Foreign (44.4%)	Foreign (100%)	State-owned (100%)
	State-owned	Foreign (33.3%)	Brazilian (30%)	Brazilian (33.3%)		

(27.3%)

Foreigner (15.2%)	State-owned (26.7%)	Foreigner (30%)	State-owned (22.2%)
Mixed (9.1%)	Mixed (6.7%)		

Feature	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
	Southeast (51.5%)	Southeast (53.3%)	Southeast (70%)	Southeast (33.3%)	Southeast (100%)	Southeast (100%)
	Northeast (24.2%)	South (40%)	Northeast (10%)	Northeast (33.3%)		
Location	South (12.1%)	Northeast (6.7%)	South (10%)	North (11.1%)		
	Midwest (9.1%)		Midwest (10%)	Midwest (11.1%)		
	North (3%)			South (11.1%)		

Source: Prepared by the authors.

According to Table 03, electricity is the main type of energy provided by most of the companies that make up the groups, except for Group 3. Also significant is the presence of large companies (most in all groups except for the 5).

Regarding the control, it is observed that Groups 3 and 6 are predominantly state-owned, while Groups 4 and 5 are predominantly foreign controlled. Group 1 is mostly Brazilian controlled, and in Group 2 prevails Brazilian controlled companies and foreign controlled companies. Finally, most of the companies in each group belong to the Southeast Region, and in Group 4 there is an equality in the number of organizations in the Southeast Region and the Northeast Region.

In this way, the 6 groups present different profiles in relation to the general characteristics analysed. In the following subtopics, the differences in economic and financial performance between groups are explored.

### **Economic-financial indicators that generated the statistically significant differences between the groups**

To test the existence of significant differences in terms of economic and financial performance between the 6 groups, a discriminant analysis was performed on the indicators used in cluster analysis. The intention was to verify which of the seven indicators used most contribute to discriminate the 6 groups.

When analysing the results of the discriminant analysis, it was observed that the canonical correlation coefficients of functions 1, 2 and 3 were higher than 0.800, indicating that the degree of fit of the variables extracted together by the Stepwise method was high. It is also concluded that the first function was able to explain 94.7% of the variance of the model variables, while the fifth and last function of the

model had the lowest coefficient, which accounts for 11.5% of the explanation of the variance.

This analysis allowed to identify the indicators that discriminated the most groups, distancing them from each other and bringing the companies closer to each one of them. As shown in Table 04, six indicators were responsible for this discrimination: General Liquidity, Long Term Indebtedness, Wealth Created by Employee, Adjusted Net Profit, General Indebtedness and Adjusted Return on Equity.

Table 04: Results of the discriminant analysis with the economic and financial indicators

Indicator	Wilks	F	Sig.
General Liquidity	0,117	96,350	0,00
Long Term Indebtedness	0,030	60,559	0,00
Wealth Created by Employee	0,010	49,073	0,00
Adjusted Net Profit	0,006	37,260	0,00
General Indebtedness	0,004	29,635	0,00
Adjusted Return on Equity	0,003	25,097	0,00

Fonte: Dados da pesquisa

It is noteworthy that, among the 7 indicators in the analysis of clusters, 6 were significant to differentiate and define the groups formed. Only the indicator of Current Liquidity did not contribute to discriminate the groups, and there were no significant differences for this indicator between the groups. The six indicators that discriminated should be considered when analysing the economic and financial performance of the different groups of companies in the energy sector.

### Classification of Groups According to Economic and Financial Performance

After identifying the characteristics of the groups and analysing the indicators that discriminated them the most, the groups were evaluated and classified according to the economic and financial performance obtained. To perform the classification, the means of the indicators for each group were observed, considering the analysis parameters and comparing the results for the different groups. These procedures allowed the groups to be classified into 6 different categories of economic and financial performance, which are presented in Table 05.

Table 05: Classification of groups according to economic and financial performance

Ranking	Group	Considered aspect	Characterization of the average indicator
EXCELLENT PERFORMANCE	Group 5	Profitability:	ARE: the highest among groups ANP: positive
		Liquidity:	GLI: the highest among groups
		Indebtedness:	GI: the lowest among groups LTI: the lowest among groups

GOOD PERFORMANCE AND HIGH PROFITABILITY	Group 1	Productivity:	ECW: the third largest among groups
		Profitability:	ARE: the second largest among groups ANP: positive
		Liquidity:	GLI: the third lowest among groups
		Indebtedness:	GI: the second largest among groups LTI: the third largest among groups
		Productivity:	ECW: the highest among groups
GOOD PERFORMANCE AND HIGH LIQUIDITY	Group 2	Profitability:	ARE: the third largest among groups ANP: positive
		Liquidity:	GLI: the third largest among the groups
		Indebtedness:	GI: the third lowest among groups LTI: the second lowest among groups
		Productivity:	ECW: the second largest among groups
		Profitability:	ARE: the third lowest among groups ANP: positive
POOR PERFORMANCE AND LOW LIQUIDITY	Group 3	Liquidity:	GLI: the second lowest among groups
		Indebtedness:	GI: the third largest among groups LTI: the second largest among groups
		Productivity:	ECW: the second lowest among groups
		Profitability:	ARE: the lowest among groups ANP: negative
		Liquidity:	GLI: the second largest group
POOR PERFORMANCE AND LOW PROFITABILITY	Group 6	Indebtedness:	GI: the second lowest among groups LTI: the second lowest among groups
		Productivity:	ECW: the lowest among groups
		Profitability:	ARE: the second lowest among groups ANP: negative
		Liquidity:	GLI: the lowest among groups
		Indebtedness:	GI: the highest among groups LTI: the highest among groups
VERY LOW PERFORMANCE	Group 4	Productivity:	ECW: the third lowest among groups

*Legend: ARE = Adjusted Return on Equity; ANP = Adjusted Net Profit; GLI = General Liquidity Index; GI = General Indebtedness; LTI = Long-term Indebtedness; ECW = Employee Created Wealth.*

Source: Prepared by the authors.

Among the companies analysed, a group with the best economic and financial performance is identified: Group 5. This group is formed by a single company, Comerc Energia. This company presented indicators of liquidity and profitability far above the averages of the companies of the other groups, in addition to obtaining a positive Adjusted Net Profit, having good productivity indexes and having debt indi-

cators close to zero. By having the best combined result of the indicators, the performance of this group is considered “Excellent”.

Following, there is a group that performs well, prioritizing profitability to the detriment of liquidity, which is Group 1. On average, the indicators referring to the companies in this group show good productivity and profitability. However, the group has higher average debt indicators and lower repayment capacity (it has the third lowest General Liquidity Index and the second highest Indebtedness Index among the groups). Considering these aspects, the group is considered of “Good Performance and High Profitability”.

On the other hand, there is a group that performs well in terms of liquidity, but lower in terms of profitability: Group 2. On average, this group has General Liquidity greater than 1.0 and relatively low indebtedness indices. However, its average profitability is lower than Group 1, as well as the average Employee Generated Wealth. In this way, we observed that the group presents “Good Performance and High Liquidity”.

A fourth group presents average profitability close to zero, low liquidity and high debt indicators. This is Group 3, which presents the second lowest Employee Wealth Ratio and also the second lowest Overall Liquidity Ratio. Thus, it is noted that such a group presents “Poor Performance and Low Liquidity”.

In addition to these, there is a group with negative average profitability and low productivity but maintaining a high level of liquidity. These characteristics are from Group 6, which has the second highest General Liquidity Index among the groups but obtained negative Adjusted Net Profit and a low productivity (negative Employer Weighted Ratio). Considering these aspects and that the profitability of this group was negative and the lowest among all groups, it is considered to have “Poor Performance and Low Profitability”.

Finally, a group with a poor result for all the indicators was observed: Group 4. In addition to presenting a negative profitability, this group had the lowest General Liquidity Index and the highest indebtedness indices (both general indebtedness and indebtedness through a long term). For these reasons and because it has the worst result of the indicators together, the performance of this group is considered “Very Low”.

The evaluation of the performance of the 6 groups reveals that most of the analysed companies performed well in relation to their economic and financial indicators. In total, 49 of the 70 companies in the energy sector made up the groups classified as Good Performance and High Profitability (33 companies), Good Performance and High Liquidity (15 companies) or Excellent Performance (1 company).

On the other hand, 10 organizations make up the group with Poor Performance and Low Liquidity, 2 are in Poor Performance and Low Profitability, and 9 of the companies form the group whose performance could be considered Very Low if compared to the others. Thus, there are significant differences in the economic and financial performance of companies operating in the energy sector.

## Influence of Energy Type, Size, Control, and Location of Companies on Economic and Financial Indicators

As a final step of the research, we investigated the influence of the type of energy, size, control and location of the companies on the 6 economic and financial indicators that discriminated the performance of the groups CLI, GLI, GI, LTI, ANI and ARE. For this purpose, the one-way ANOVA was used to compare the means of the response variables (in this case, the economic and financial indicators) in the different factor levels (referring to the qualitative characteristics of the companies in the energy sector).

When comparing the means of different categories (or groups) for a given response variable, ANOVA assumes the null hypothesis (H0) that all means are equal. In the case of rejection of the null hypothesis, we have the alternative hypothesis (H1) that at least one mean is different from the others.

In the analysis of the ANOVA results, the significance level of 5% was considered. If the p-value of the statistic for a given characteristic is greater than 5%, the result indicates the existence of no significant differences between the means compared; if the p-value is less than 5%, the null hypothesis must be rejected, and the result indicates the existence of significant differences in at least one pair of compared means. Table 06 presents the results obtained from the ANOVA application, considering the different characteristics analysed.

Tabela 06: Analysis of the variance of the economic and financial performance indicators of energy companies according to the type of energy, size, control and location of companies

Factor	P-value					
	General Liquidity	Long-term Indebtedness	Wealth Created by Employee	Adjusted Net Profit	General Indebtedness	Adjusted Return on Equity
Type of Company	0,675	<b>0,000**</b>	0,061	0,552	<b>0,023*</b>	0,129
Control	0,212	0,202	0,145	0,399	<b>0,024*</b>	0,163
Location	0,748	0,980	<b>0,048*</b>	<b>0,049*</b>	0,399	0,155
	0,998	0,078	0,910	0,854	0,157	0,971

\*\* Significant at 1% \* Significant at 5%

Source: Research Data

Based on Table 06, 3 of the 4 characteristics had an influence on at least one of the economic and financial indicators. For the type of energy, it is noted that there are differences in the means for the Long Term Debt and the General Indebtedness. In this way, we concluded that the main type of energy provided by the company is associated with its capital structure, which influences the variations observed in the different levels of indebtedness of the organizations.

The company size characteristic, which includes the micro, small, medium or large categories, also revealed statistically significant differences for the General Indebtedness levels. Thus, the size of the company is associated with differences in

the percentage of resources by third parties used to finance the operation of the companies in the sector.

For the control characteristic, classified as Brazilian, state-owned, foreign or mixed, significant results were obtained in relation to Employee Created Wealth and Adjusted Net Profit. In this way, the type of control is relevant for explaining the variations observed in relation to the productivity and profitability of the firms in the sector.

## Conclusions

Aiming to group the companies of the Brazilian energy sector according to the economic and financial performance achieved in 2015, as well as to verify the influence of the type characteristics of energy, size, control and location of the companies on the analysed economic and financial indicators, this paper used multivariate statistical techniques. The analysis developed broadens the understanding of a general picture of the performance of the investigated companies, in a comparative way.

Of the 70 companies, 49 were in the “Good Performance and High Liquidity”, “Good Performance and High Profitability” or “Excellent Performance” groups, indicating that 70% of the sample has satisfactory economic and financial performance. These groups of companies are profitable and have a diversity of indicators of indebtedness.

These 49 companies include all gas, oil, gas and electric power, thermoelectric and bioenergy firms, and the most companies that have ethanol, oil and gas or electric power as the main type of energy supplied. Micro and small-sized organizations, in addition to most mid-sized organizations, are present in these groups, along with all mixed capital organizations and most of the foreign, Brazilian and state capital organizations.

The other 21 companies belong to the “Poor Performance and Low Liquidity”, “Poor Performance and Low Profitability” or “Very Low Performance” groups. This result indicates that 30% of the firms analysed do not have a satisfactory economic and financial performance. These groups of companies have low profitability (in some cases, negative profitability), together with high indebtedness indices.

Among these companies are all the ethanol and bioenergy companies and thermonuclear energy companies, as well as the rest of the ethanol, oil and gas and electric power companies. These groups have the majority of the large companies and the others of medium size, along with the other organizations of state, Brazilian and foreign control.

We also concluded that the main type of energy supplied by the company (electricity, gas, ethanol, bioenergy, oil, thermonuclear energy, oil or thermoelectric) and the company size (micro, small, medium or large) levels of indebtedness, exerting influence on its capital structure. On the other hand, the control characteristic (Brazilian, state-owned, foreign and mixed) influences the variations observed with respect to productivity to the profitability of the firms in the sector. Thus, these characteristics must be considered when developing strategies aimed at improving the economic and financial performance of companies in the sector.

Due to the strategic nature of the energy sector and its direct correlation with the other sectors, the organizations that were classified in the groups of “Poor Per-



formance and Low Liquidity”, “Poor Performance and Low Profitability” or “Very Low Performance” need to seek alternatives to improve their indicators. This is important to ensure supply and maintenance of services, as well as the survival of the firms themselves.

As limitations of the work, there is the restriction to a single database, which resulted in a small number of companies classified as micro (1.4%) or small (2.9%). It is also important to highlight that the results obtained are conditioned by the methodology used, the indicators selected for analysis and the period covered (which was restricted to the year 2015).

As an agenda for future investigations, it is suggested to replicate the research using a database with a larger number of companies in the sector. In addition, the results obtained in this research may encourage further studies to investigate the strategic causes of differences in economic and financial performance observed for the different groups identified in the study.

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