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Service quality and earnings management in Brazilian electricity distributors

Paulo Vitor Souza de Souza
Post-Graduate Accounting Program, UFPR, Curitiba, Brazil and
Post-Graduate Accounting Program, UFPA, Belem, Brazil, and
Edilson Paulo
Post-Graduate Accounting Program, UFSC, Florianopolis, Brazil

Abstract

Purpose – This article examines the relationship between service quality and earnings management in Brazilian electricity distributors.

Design/methodology/approach – Service quality was measured using the Global Continuity Performance Indicator, as released by the Brazilian Electricity Regulatory Agency (ANEEL). To measure earnings management, the models by Dechow *et al.* (1995), Kothari et al. (2005), and Pae (2005) were used.

Findings – The results show that lower service quality is related to greater opportunism in management through earnings management. Furthermore, the study shows that managing earnings can distort the true economic and financial position of companies with low operational performance.

Research limitations/implications – The research enhances comprehension regarding the correlation between service quality, measured by the Global Continuity Performance Indicator, and earnings management within a distinct industrial and regulatory framework. This could establish a foundation for prospective studies delving into analogous relationships across diverse sectors or regions.

Practical implications – The findings offer insights for regulatory authorities to promote higher standards in the generation of informational quality, which can impact the quality of services.

Social implications – Enhancing the quality of electrical service through more responsible management practices leads to increased consumer satisfaction, driven by improvements in the continuity of energy supply.

Originality/value – A gap exists in the literature due to the lack of studies examining the relationship between the quality of electrical service, measured by the continuity index, and opportunistic management practices through earnings management.

Keywords Global continuity performance, Earnings management, Brazilian electricity sector, Earnings quality

Paper type Research paper

1. Introduction

Electrical energy is essential for both social life and the economic activities of a society. As a result, lack of quality in the electricity service can affect several residential, commercial, and industrial customers, as many functions of a society depend on electricity (Giannakis *et al.*, 2005). Issues in providing quality energy can therefore result in significant economic losses (Dindar and Gül, 2023).

Therefore, conducting effective regulation to determine the quality of service in the electrical energy industry is important (Sheshinski, 1976), as various consumers encounter inherent aspects of the service, such as continuous and high-quality service (Alexander, 1996).

JEL Classification — M41, M48, Q40

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Worldwide, an important aspect regarding the quality of electricity is the continuity of its supply. Continuity represents the level of availability of the service provided, which is evaluated based on indicators of duration and frequency of interruptions in the electricity supply (Mendonça *et al.*, 2023).

Costello (2019) notes that when energy concessionaires are concerned about their performance, managing their costs can affect the quality of service and, consequently, customer well-being. Thus, as pointed out by Ajodhia *et al.* (2006), a quality regulation system can contribute to improving the quality of the distribution networks.

With market reforms to introduce competition in the electricity sector in recent years, the managers of the companies involved have made efforts to obtain better results, often without taking consumer rights into account, which ends up generating "opportunistic behavior" on the part of these agents (Niesten and Jolink, 2012). Earnings management can be understood as a practice that can represent opportunistic acts of management, which can negatively impact the quality of the financial statements issued (Schipper, 1989).

Earnings management, as defined by Healy and Wahlen (1999), refers to the manipulation of accounting information. This practice, conducted by a company's management, entails manipulating key accounting information and financial reports, or both, with the objective of securing contractual benefits that are not explicitly disclosed in any financial statements or reports (Healy and Wahlen, 1999).

The substantial presence of renewable energy sources in the Brazilian electrical system offers a notable global advantage, particularly in pursuing decarbonization goals and diversifying renewable energy sources beyond hydroelectric plants (Botelho *et al.*, 2022). The Brazilian electricity industry has garnered significant foreign investment in the Latin American market (Li *et al.*, 2020).

Due to the ongoing process of privatization in the Brazilian electrical sector (Muller and Rego, 2021), the number of incentives for the organizations involved to maximize their profits has increased (Sheshinski, 1976). Such incentives may be related to achieving the best tariffs in the electricity sector (Cruz and Almonte, 2019), which may encourage the adoption of earnings management practices (Morais *et al.*, 2019), and it could also potentially lead to an unexpected effect on the quality of services provided to their consumers (Giannakis *et al.*, 2005).

Therefore, it is worth noting that a company motivated to reduce the quality of its service could also manipulate the disclosure of its earnings. As explained above, the following research problem was outlined: What is the relationship between service quality and earnings management within Brazilian electricity distributors?

Thus, this research aims to verify how the quality of service provided by Brazilian electricity distributors affects the discretionary behavior of the firm. To date, no study has been found in the literature that has specifically analyzed the relationship between the quality of the electricity service (measured by the continuity index) and opportunistic practice by managers (earnings management). Additionally, in the Brazilian environment, energy service quality and accounting information are heavily regulated by ANEEL, affecting the relationship between service quality and opportunistic behavior.

Additionally, the relevance of this study lies in analyzing an indicator released by the regulatory body of the electrical energy sector, along with measures of information quality already established in the literature. It is therefore important to identify whether a reduction in the quality of services provided by companies in the electricity sector, aimed at boosting the company's performance, creates incentives for managers to manipulate their accounting results, thus altering the perception of other stakeholders regarding the firm's true performance.

In this manner, investors and creditors can pay attention to the relationship between the quality of services provided and their consequences on the disclosure of the firm's results, contributing to their decisions on allocating resources to companies in the sector. The regulators can use their service quality measures to identify the possibility of management

presenting distorted financial reports (a red flag). Finally, as consumers of electricity services, society can use these findings to monitor companies that provide services at a loss, as a possible reflection of opportunistic actions by their managers.

2. Literature review

2.1 Regulation theories and service quality

Electricity distribution networks have to deal with market failures caused by the natural characteristics of a monopoly (Giannakis *et al.*, 2005). Therefore, a regulatory authority is necessary to manage the relationship between price and quality of service for consumers (Spence, 1975).

Thus, regulating economic sectors requires state intervention to control economic activities to guarantee the well-being of society. Hence, according to the Public Interest Theory of Regulation, regulation stems from the need to serve society, assuming that its objectives cannot be achieved without directing economic activities via the regulatory authorities (Baldwin *et al.*, 2012).

However, according to Yandle (2022), the Public Interest Theory of Regulation should incorporate the view that regulation should be oriented toward serving the general interests of society. Nevertheless, the interests of stakeholders do not always align with this perspective, giving rise to the Theory of Economic Regulation.

The Theory of Economic Regulation reveals the existence of relationships driven by self-interest, in favor of collective interests (Yandle, 2022), with smaller and more homogeneous groups, such as companies belonging to a specific sector, that have greater capacity to influence regulation to the detriment of larger and more diffuse groups, such as the consumers within this sector (Stigler, 1971).

It has therefore become necessary to develop legal provisions that guarantee quality services to society. In Brazil, a process of regulatory reforms in the electricity distribution sector began in 1995, aimed at introducing competitive mechanisms and privatization to these companies, resulting in the privatization of all companies under federal government control (Muller and Rego, 2021). Muller and Rego (2021) state that the privatization policies in electricity distribution aimed to enhance productivity and the quality of services provided to society.

According to Barbosa *et al.* (2018), service quality is a central problem in the electricity distribution sector, as consumers are sensitive to several aspects mainly related to the continuity of energy supply. Therefore, regulators have implemented incentive systems to promote efficiency, service quality, and cost reduction (Giannakis *et al.*, 2005).

In Brazil, the sector is regulated by the Brazilian Electricity Regulatory Agency (ANEEL), which sets forth specific standards for companies to follow (Andrade and Martins, 2017). Established in 1996, ANEEL was created to oversee and regulate the electricity industry (Andrade and Martins, 2017). To govern these companies, ANEEL introduced the Manual of Accounting for the Public Service of Electrical Energy (MCSPEE), through Normative Resolution No. 444/2001, to establish a uniform accounting standard for all entities in this sector (Souza *et al.*, 2024).

The quality of service provided by Brazilian electricity concessionaires is evaluated by ANEEL, which currently ranks distributors based on a Global Continuity Performance Indicator (DGC) that evaluates service continuity, calculated using the duration and frequency of interruptions in the energy supply (Barbosa *et al.*, 2018). The continuity of supply represents the degree of availability of the service provided by an electricity concessionaire (Mendonça *et al.*, 2023). Therefore, continuity in electricity supply is fundamental due to its essential role in the social and commercial life of a society, which causes several social and economic losses due to interruptions in energy supply (Dindar and Gül, 2023).

According to Mendonça *et al.* (2023), regulatory bodies, including ANEEL, compare the continuity indicators of electricity concessionaires through benchmark competition to

establish tolerable limits for the duration and frequency of interruptions, along with penalties for violations of these limits. According to Muller and Rego (2021), performance indicators for electricity distribution services in Brazil are assessed by comparing them to regulatory benchmarks, with a company considered positively evaluated when it meets or exceeds these benchmarks. As a result, to avoid penalties, companies are encouraged to enhance the quality of the service they provide.

The quality of service in electrical energy is fundamental, as it is essential for society. Thus, identifying economic and social characteristics that can explain or be explained by the quality of the services provided from different perspectives is crucial for a better understanding of the functioning of important economic sectors, such as the utility sector. For example, Niesten and Jolink (2012) point out that several consumers have already suffered from opportunistic behavior by electricity companies in the United Kingdom, the Netherlands, and France. However, it is important to determine whether the quality of the service provided by this sector affects the quality of its financial statements.

2.2 Information quality and earnings management

The quality of accounting information refers to the extent to which earnings reported in financial statements reflect an organization's economic and financial reality (Schipper and Vincent, 2003), thus attributing greater reliability to the information used in the decision-making of various users. Furthermore, in the view of Dechow *et al.* (2010), these earnings should provide relevant information about their financial performance and should be able to influence the decisions and judgments of the different users of such information.

Therefore, the quality of reported earnings is considered an important feature that aims to ensure the reliability of financial reports. Furthermore, it incorporates the principle that these reports should be useful for investors and other providers of capital in their decisions on resource allocation (Perotti and Wagenhofer, 2014).

Paulo and Mota (2019) indicate that when discussing the quality of earnings, it is understood that the low quality of accounting reports is linked, among other factors, to manipulating their information. The manipulation of accounting information can be reflected in earnings management, which according to Healy and Wahlen (1999), represents a practice performed by the management of a company that consists of manipulating key accounting information and financial reports, or both, to obtain contractual benefits that are not evidenced in financial statements or reports.

Earnings are considered managed when they tend to be uninformative to their users. According to Bhattacharya *et al.* (2003), a company's earnings may be uninformative due to the influence of at least one of three factors: managerial motivation, where managers are driven to manipulate results; accounting standards, which may allow substantial flexibility; and the application of accounting standards, as even in environments with stringent standards, their enforcement may be flawed. Therefore, it is understood that the manipulation of accounting information can be one of the factors that lead managers to manage results.

The literature on earnings management identifies two approaches: the quantitative approach, which involves the use of empirical models to calculate discretionary accruals that indicate the presence or absence of management; and the qualitative approach, which employs the analysis of four categories to detect management through the examination of revenue recognition, capitalization, amortization policies, misreported assets and liabilities, and the use of operating cash flows (Naidu *et al.*, 2009).

Accruals can be used for earnings management to adjust the company's results in each period, since measurement on a cash basis only, cannot capture the total effects of transactions in an organization (Dechow and Dichev, 2002). Discretionary accruals represent the measure of earnings management due to the intentional manipulation of accounting information, and these end up causing significant financial impacts compared to non-discretionary accruals, which result from the company's normal activities (Kang and Sivaramakrishnan, 1995).

Discretionary accruals are unreal and are intended to manipulate accounting results, while non-discretionary accruals represent the real situation of a company (Paulo and Mota, 2019).

Qualitative earnings management requires a case-by-case checklist, which involves identifying unusual behaviors and the proper application of generally accepted accounting principles. Additionally, the qualitative approach will not produce the magnitude of the earnings management; it only seeks to identify its existence and possibly its direction, based on the researcher's interpretations (Naidu *et al.*, 2009).

Earnings management is a practice that cannot be directly observed by the reader of financial statements (Costa and Soares, 2021). Therefore, specific models are needed to demonstrate a level of discretion that may indicate potential manipulations of the results. Companies with high levels of earnings management tend to provide lower-quality financial reports due to the increased manipulation of discretionary information (Menicucci, 2020).

Thus, accounting can be influenced by manipulating the accounting information. For example, Dindar and Gül (2023) point out that one of the highest priorities of companies operating in energy distribution is to obtain greater results. Moreover, Niesten and Jolink (2012) highlight that private companies operating in the electricity sector have increasingly sought to obtain greater earnings. As a result, opportunistic behavior among their agents has been observed.

The regulatory process can create incentives for managers to adopt practices aimed at meeting specific informational demands (Alexandre and de Oliveira Mello, 2017). Consequently, from the perspective of Morais *et al.* (2019), the regulatory environment can influence the earnings management of companies. In Brazil, the determination of the value of the electricity tariff is carried out through the Periodic Tariff Review (RTP), which takes place every four years and is conducted by analyzing technical data from distributors by ANEEL (Cruz and Almonte, 2019). During this period, distributors have incentives to manage earnings between one RTP period and the next, aiming to secure better tariffs and as a result increase their revenues (Cruz and Almonte, 2019).

Thus, managing results by manipulating information can help managers achieve certain goals related to achieving greater earnings or maximizing their interests, especially those linked to accounting numbers. For this reason, it is important to discuss the significance of earnings management in the context of regulation because of the impact of these practices on the quality of financial reports, which are influenced by accounting measures.

Cruz and Almonte (2019) analyzed whether Brazilian electricity concessionaires adopt earnings management practices before and after the periodic tariff review, and found that in tariff review years, there is a higher generation of accruals, which tends to reverse in the years following the event. However, the relationship between management practices and service quality, as analyzed in this research, was not examined.

Therefore, it is observed that the opportunistic behavior of managers can influence both the quality of accounting information (Healy and Wahlen, 1999; Cruz and Almonte, 2019; Paulo and Mota, 2019) and the quality of services offered to their consumers (Niesten and Jolink, 2012). Additionally, based on the shift in the regulatory framework of the Brazilian electricity sector through privatization (Muller and Rego, 2021), which allowed companies to choose the quantity produced in order to maximize profits (Sheshinski, 1976), a potential adverse effect on service quality may arise due to the high cost of operations (Giannakis *et al.*, 2005). Ultimately, the tariff is based on technical data from distributors, which leads to increased earnings management during tariff review periods (Cruz and Almonte, 2019).

In conclusion, companies with lower service quality may be manipulating accounting information with the aim of achieving specific goals. Therefore, this research was based on the following hypothesis:

H. There is a negative relationship between service quality (continuity indicator) and earnings management in Brazilian electricity distributors.

3. Method

3.1 Data and sample

This study aims to identify whether service quality is related to the quality of accounting information in Brazilian companies operating in the electricity sector. As a sample, Brazilian electricity distribution companies have access to information on the Global Continuity Performance Indicator (DGC).

This index has been presented annually since 2011 for distribution companies, with data collected up to 2021. Table 1 shows data on the initial quantitative sample and the exclusion of companies to arrive at the final sample for this study.

As shown in Table 1, 52 companies were eligible to conduct the survey, while 9 companies were excluded due to the lack of information on the quality indicator of the service provided by these distributors. The analysis was therefore carried out through the company's cross-sections between 2011 and 2021.

According to Muller and Rego (2021), in Brazil, a process of regulatory reforms was initiated, leading to the privatization of electricity distributors. Thus, the companies included in the sample of this research are mainly privately owned.

The data on service quality, measured using the DGC, are sourced from the ANEEL website, through the information contained in the Continuity Ranking [1] and the Collective Continuity Indicators [2]. The data related to the accounting information quality models was also obtained from ANEEL, but through access to the individual accounting statements of the distribution companies stored in the Economic-Financial Information Center [3].

3.2 Research model of quality of electricity service

Service quality in electricity distributors is measured by the Global Continuity Performance Indicator (DGC), which is calculated as the simple arithmetic average of the proportions between the measured values and the annual limits of global indicators of the distributors (ANEEL, 2022a).

The Equivalent Interruption Duration per Consumer Unit (DEC) and the Equivalent Interruption Frequency per Consumer Unit (FEC) represent the global indicators. The DEC represents the average duration of time during which each consumer unit had no electricity supply, while the FEC represents the average number of interruptions that occurred per consumer unit, both calculated over a specific observation period (ANEEL, 2022b). Equation (1) illustrates the method for measuring the companies' DGC:

$$DGC = \frac{\left(\frac{DEC_{Refined}}{DEC_{Limit}} + \frac{FEC_{Refined}}{FEC_{Limit}}\right)}{2} \quad (1)$$

Where:

DGC = Global Continuity Performance Indicator; $DEC_{Refined}$ = Equivalent Duration of Interruption per Unit (annually calculated value); DEC_{Limit} = Equivalent Outage Duration per Unit (annual limit value); $FEC_{Refined}$ = Equivalent Interruption Frequency per Unit

Table 1. Research sample selection

Sample specification	Number
Electric power distributors regulated by ANEEL from 2011 to 2021	61
(−) Companies that do not present information on DCG in all periods	(9)
(=) Final number of samples	52

Source(s): Prepared by the authors

(annually calculated value); FEC_{Limit} = Equivalent Interruption Frequency per Unit (annual limit value).

3.3 Research models of earnings management

Due to the requirement for specific analyses, through the recognition of revenues, capitalization, amortization policies, reported assets and liabilities, and the use of operating cash flows (Naidu *et al.*, 2009), the qualitative approach to earnings management becomes impractical for the sample set, as the information obtained is derived from secondary data provided by ANEEL.

For this reason, a quantitative approach was employed through the calculation of earnings management, using empirical models to calculate discretionary accruals. Three different models were used to measure Earnings Management (EM): the Jones model modified by Dechow *et al.* (1995), Kothari *et al.* (2005), and Pae (2005).

In these models, the calculation of total accruals must initially occur using the following equation:

$$TA_{it} = ((\Delta CA_{it} - \Delta Cash_{it}) - (\Delta CL_{it} - \Delta Deb_{it}) - Dep_{it})/Ass_{it-1} \quad (2)$$

Consequently, after calculating the total accruals, regression is necessary to obtain the discretionary accruals. For the model by Dechow *et al.* (1995), accruals are obtained through the following equation:

$$TA_{it} = \alpha\left(\frac{1}{Ass_{it-1}}\right) + \beta_1(\Delta Rev_{it} - \Delta AR_{it}) + \beta_2(FA_{it}) + \varepsilon_{it} \quad (3)$$

According to the model by Kothari *et al.* (2005), the asset return is inserted, as evidenced in the following equation:

$$TA_{it} = \alpha\left(\frac{1}{Ass_{it-1}}\right) + \beta_1(\Delta Rev_{it} - \Delta AR_{it}) + \beta_2(FA_{it}) + \beta_3(ROA_{it}) + \varepsilon_{it} \quad (4)$$

Finally, Pae's model (2005) was used because it represents an evolution compared to previous models, as it considers variables related to operating cash flow (past and present), as well as the natural reversal of accruals from previous periods (Paulo and Mota, 2019), according to the following equation:

$$TA_{it} = \alpha\left(\frac{1}{Ass_{it-1}}\right) + \beta_1(\Delta Rev_{it}) + \beta_2(FA_{it}) + \gamma_1(CFO_{it}) + \gamma_2(CFO_{it-1}) + \gamma_3(TA_{it-1}) + \varepsilon_{it} \quad (5)$$

Where:

TA_{it} = Total company accruals *i* in the period *t*, weighted by the total assets at the end of the period *t-1*; ΔCA_{it} = Variation in the company's current assets *i* in the period *t;* ΔCL_{it} = Variation in the company's current liabilities *i* in the period *t;* $\Delta Cash_{it}$ = Variation in the company's cash and cash equivalents *i* in the period *t;* ΔDeb_{it} = Variation of the company's current liabilities debt *i* in the period *t;* Dep_{it} = Company depreciation and amortization expense *i* in the period *t;* Ass_{it-1} = Total assets of the company at the end of the period *t-1*; ΔRev_{it} = Variation in the company's net revenues *i* in the period *t-1* for the period *t*, weighted by total assets at the end of the period *t-1*; ΔAR_{it} = Variation in accounts receivable (clients) of the company *i* in the period *t-1* for the period *t*, weighted by total assets at the end of the period *t-1*; FA_{it} = Balances of the company's fixed assets and

deferred assets accounts *i* at the end of the period *t*, weighted by total assets at the end of the period *t-1; ROA_{it}:* Return on Company Assets *i* in the period *t; TA_{it-1}* = Total company accruals *i* in the period *t-1; CFO_{it}* = Company's operating cash flow *i* at the end of the period *t*, weighted by total assets at the end of the period *t-1; CFO_{it-1}* = Company's operating cash flow *i* at the end of the period *t-1*, weighted by total assets at the end of the period *t-2*; ε_{it} = regression error (residuals) that represents the discretionary part of the accruals.

The use of the models by Dechow *et al.* (1995), Kothari *et al.* (2005), and Pae (2005) to measure earnings management aims to enhance the robustness of the results analysis by combining different methodological approaches to increase accuracy and reliability. Each model presents a distinct perspective on discretionary accruals, allowing for a more comprehensive view and mitigating potential biases.

It is worth noting that the parameters for estimating accruals were defined per year for each of the companies included in the sample.

3.4 Variables

Measurements from the regulatory body, collected directly from the ANEEL database, were used to verify the relationship between service quality and accounting information in electricity distributors.

Therefore, in addition to the two main analysis measures (DGC and EM), data regarding control variables that may affect the companies' earnings management levels were collected. The selected control variables were used to mitigate the influence of external factors that could bias the results of the analysis. Thus, Table 2 presents information about the dependent, independent, and control variables used in the study.

Table 2. Research variables

Variables	Definition
Earnings Management by Dechow *et al.* (1995) (DSS)	Earnings management measure obtained using the Jones model modified by Dechow *et al.* (1995)
Earnings Management by Kothari *et al.* (2005) (KLW)	Earnings management measure obtained using the Jones model modified by Kothari *et al.* (2005)
Earnings Management by Pae (2005) (PAE)	Earnings management measure obtained through Pae's model (2005)
Global Continuity Performance Indicator (DGC)	Simple arithmetic average of the proportions between measured values and annual limits of the distributors' DEC and FEC global indicators (ANEEL, 2022b)
EBITDA Margin (EBI)	Indicator that measures the company's resource generation, considering only its operational activities, and which represents the relationship between Operating Earnings and Net Revenue (Lin *et al.*, 2021)
Size (SIZE)	Indicator that represents the company size measured by its total assets, thus representing the natural logarithm of its total assets (Wu *et al.*, 2015)
Return on Assets (ROA)	Indicator that measures the ability of a company to generate earnings with its resource applications, representing the relationship between Net Income and Total Assets (Zang, 2012)
Current Liquidity (CCL)	Indicator that measures the company's short-term payment capacity and which represents the relationship between Current Assets and Current Liabilities (Agustia *et al.*, 2020)
Indebtedness (IND)	Indicator that measures the use of third-party debt in the company's capital structure, representing the relationship between Payable Liabilities and Total Assets (Agustia *et al.*, 2020)

Source(s): Prepared by the authors

3.5 Analytical procedures

Based on the variables in the table above, three distinct Ordinary Least Squares (OLS) regression models were designed, varying only with respect to the dependent variable (different measures of earnings management). Similar studies that use various proxies for earnings management apply OLS regression models (Cruz and Almonte, 2019; Paulo and Mota, 2019; Silva *et al.*, 2019). The following equations represent the models analyzed:

$$|DSS|_{it} = \beta_{0+}\beta_1 DGC_{it} + \beta_2 EBI_{it} + \beta_3 SIZE_{it} + \beta_4 ROA_{it} + \beta_5 CCL_{it} + \beta_6 IND_{it} + \sum_{i=1}^{n} D_t Year_t + \sum_{i=1}^{n} D_i Firm_i + \mu_{it} \quad (6)$$

$$|KLW|_{it} = \beta_{0+}\beta_1 DGC_{it} + \beta_2 EBI_{it} + \beta_3 SIZE_{it} + \beta_4 ROA_{it} + \beta_5 CCL_{it} + \beta_6 IND_{it} + \sum_{i=1}^{n} D_t Year_t + \sum_{i=1}^{n} D_i Firm_i + \mu_{it} \quad (7)$$

$$|PAE|_{it} = \beta_{0+}\beta_1 DGC_{it} + \beta_2 EBI_{it} + \beta_3 SIZE_{it} + \beta_4 ROA_{it} + \beta_5 CCL_{it} + \beta_6 IND_{it} + \sum_{i=1}^{n} D_t Year_t + \sum_{i=1}^{n} D_i Firm_i + \mu_{it} \quad (8)$$

Where:

$|DSS|_{it}$, $|KLW|_{it}$, $|PAE|_{it}$ = Module of residuals obtained by the earnings management models by Dechow *et al.* (1995), Kothari *et al.* (2005) and Pae (2005), respectively; DGC_{it} = Company Continuity Global Performance Index *i*, in the period *t*; EBI_{it} = Company's EBITDA Margin *i*, in the period *t*; $SIZE_{it}$ = Company Size *i*, in the period *t*; ROA_{it} = Return on Company Assets *i*, in the period *t*; CCL_{it} = Company's Current Liquidity *i*, in the period *t*; IND_{it} = Company Debt *i*, in the period *t*; $\sum_{i=1}^{n} D_t Year_t$ = Control of dummy variables per year; $\sum_{i=1}^{n} D_i Firm_i$ = Control of dummy variables per firm; and μ_{it} = Residues obtained by the models.

The utilization of earnings management metrics in the modules was driven by the objective of detecting the intention to manipulate earnings, regardless of the direction (positive or negative).

The choice of OLS for analyzing the relationship between service quality and earnings management is justified by the suitability of OLS for panel data, which allows for controlling both cross-sectional and temporal variations. With a sample of 52 companies analyzed from 2011 to 2021, the study outlines a robust number of observations, ensuring that the application of OLS is statistically significant and appropriate. Furthermore, OLS enables the control of multiple independent variables, which is essential for isolating the effect of service quality on earnings management. This method offers a clear interpretation of regression coefficients and is widely used in academic literature, ensuring the validity and reliability of the results. Therefore, the use of OLS is not only feasible but also a robust methodological choice for the proposed analysis.

4. Results

4.1 Descriptive statistics

Initially, it is important to provide information about some descriptive statistics regarding the dependent and independent variables of the research. Table 3 shows information on the measures of position (mean, median, minimum, and maximum) and dispersion (standard deviation and coefficient of variation) for these variables.

Regarding the dependent variables, which represent the levels of results management presented by companies, it is noted that the average level of management is around 0.08. Therefore, it is important to highlight that these variables were used in the module, and as a result, there are no negative values, as shown by the minimum and maximum values. Finally, as for the dispersion measures, the values for the standard deviation (0.1392–0.1414) and coefficient of variation (1.5651–1.5948) are low, indicating low dispersion of the variables, meaning that outlier treatment is not necessary.

The independent variable of interest represents service quality. The variation between high and low quality is 0.0296 and 3.6931 respectively with an average of 0.9306. Moreover, on the levels of dispersion, the standard deviation is around 0.4295, with a coefficient of variation of 0.4615, that is, the data are not highly dispersed and therefore do not require treatment to reduce their amplitude.

Finally, among the control variables, only the EBITDA margin and return on assets (ROA) showed minimum negative values, probably due to negative results (earnings) in their operations or net income. On the contrary, the other variables show only positive values. Consequently, these controls have similar means and low dispersions, except for ROA, which has a high coefficient of variation; in other words, it is more dispersed in relation to the data mean.

Below are the results related to the Pearson Correlation Matrix, aiming to measure the intensity and direction between the dependent and independent variables adopted in this research. Table 4 displays the correlation matrix with the coefficients and significance of the interactions:

The correlation matrix reveals a strong interrelationship between DSS, KLW, and PAE, suggesting that these variables capture similar types of behavior. Indebtedness (IND) has a moderately positive impact on DSS, KLW, PAE, and SIZE, but shows a strong negative correlation with ROA, indicating an adverse impact on the companies' profitability. Profitability (ROA) is closely linked to EBI, while CCL shows a negative correlation with ROA, suggesting that higher CCL values are associated with lower profitability. Company's size (SIZE) exhibits low correlations with most variables, except for DGC and IND, highlighting its limited influence on other factors.

4.2 Validation of regression models

For a clearer presentation of the results related to the regression models with panel data, a series of tests is required for regression validation and correction. Table 5 presents the heteroscedasticity, normality, and multicollinearity test results for the three regression models.

Table 3. Sample descriptive statistics results

Variable	Obs	Average	Median	Minimum	Maximum	Standard deviation	Coef. Variation
DSS	563	0.0896	0.0544	0.0001	1.8108	0.1402	1.5651
KLW	563	0.0880	0.0524	0.0004	1.8108	0.1392	1.5819
PAE	511	0.0886	0.0497	4.9e−05	1.7907	0.1414	1.5948
DGC	563	0.9306	0.8661	0.0296	3.6031	0.4295	0.4615
EBI	563	0.0692	0.0880	−1.4223	1.6373	0.1403	2.0274
ROA	563	0.0254	0.0447	−1.4548	1.1244	0.1268	4.9899
CCL	563	1.2213	1.1244	0.1109	5.2137	0.5990	0.4904
IND	563	0.7557	0.6819	0.1604	4.4348	0.4641	0.6142

Source(s): Search results

Table 4. Pearson correlation matrix

	DSS	KLW	PAE	DGC	EBI	SIZE	ROA	CCL	IND
DSS	*1*								
KLW	0.9861***	*1*							
PAE	0.9563***	0.9363***	*1*						
DGC	0.1458***	0.1334***	0.1568***	*1*					
EBI	−0.3492***	−0.2876***	−0.2996***	−0.3417***	*1*				
SIZE	−0.0355	−0.0426	−0.0150	0.2993***	−0.0894**	*1*			
ROA	−0.3794***	−0.3064***	−0.3587***	−0.3221***	0.8701***	−0.0860**	*1*		
CCL	−0.0947**	−0.0696*	−0.0915**	−0.3285***	0.3001***	−0.1989***	0.3531***	*1*	
IND	0.4883***	0.4322***	0.5225***	0.3558***	−0.5795***	0.2625***	−0.6952***	−0.4658***	*1*

Note(s): The values represent the coefficients, and ***, **, and * correspond to the statistical significance at 1%, 5%, and 10%, respectively
Source(s): Search results

Table 5. Regression validation tests

Models	Heteroscedasticity test *p*-values	Normality test	Multicollinearity test VIF (minor ∼ major)
Model 1 - DSS	0.0001	0.0001	1.232–5.339
Model 2 - KLW	0.0001	0.0001	1.232–5.339
Model 3 - PAE	0.0001	0.0001	1.238–5.823

Note(s): This table presents the results of the *p*-values from the heteroscedasticity and normality tests, as well as the Variance Inflation Factors (VIF) from the multicollinearity test
Source(s): Search results

In this statistical analysis of regression models, the results of the heteroscedasticity test show significant *p*-values. Therefore, the hypothesis of homoscedastic errors is rejected, and regression models must be corrected using the Heteroskedastic Autocorrelation Consistent (HAC) estimator. Regarding normality tests, they also presented the significance of their *p*-values. That is to say, the hypothesis of normal data distribution is rejected. However, this premise can be softened due to the number of observations analyzed (between 511 and 563). Finally, the VIF test for multicollinearity denotes that, in all regressions, the variables exhibit values between 1.232 and 5.823. In other words, values below 10 indicate that the variables are not correlated and that they can be used together in the same model.

Additionally, to select the most appropriate panel data regression model, Chow, Breusch-Pagan, and Hausman tests were conducted to guide the use of pooled panel data, fixed effects, or random effects models. Table 6 provides presents the test statistics results for the three regression models:

As shown in Table 6, for all three regression models, the *p*-values were significant (*p*-value <0.05), indicating the rejection of the null hypothesis. This confirms that the Fixed Effects model is the most suitable for the panel data set used. Therefore, for all three models, the fixed effect panel approach is more appropriate.

4.3 Regressions with panel data by fixed effects

Table 7 shows the analysis results for the relationship between service quality and earnings quality provided by Brazilian electricity distributors.

Through the findings described in the interactions above, it becomes evident that the Global Continuity Performance Indicator (DGC) variable, which measures the service quality provided by distributors, demonstrated a positive relationship in all models with the

Table 6. Panel diagnostic tests

Tests	H0	H1	Result	Model
Model 1 – DSS				
Chow	Pooled	Fixed effects	*p*-value = 0.0001	Fixed effects
Breusch-Pagan	Pooled	Random effects	*p*-value = 0.0003	Random effects
Hausman	Random effects	Fixed effects	*p*-value = 0.0001	*Fixed effects*
Model 2 – KLW				
Chow	Pooled	Fixed effects	*p*-value = 0.0001	Fixed effects
Breusch-Pagan	Pooled	Random effects	*p*-value = 0.0021	Random effects
Hausman	Random effects	Fixed effects	*p*-value = 0.0001	*Fixed effects*
Model 3 – PAE				
Chow	Pooled	Fixed effects	*p*-value = 0.0001	Fixed effects
Breusch-Pagan	Pooled	Random effects	*p*-value = 0.0003	Random effects
Hausman	Random effects	Fixed effects	*p*-value = 0.0001	*Fixed effects*

Source(s): Search results

Table 7. Regression model results

Variables/Model	Model 1 - DSS	Model 2 - KLW	Model 3 - PAE
Constant	0.089	0.097	0.055
	(0.485)	(0.479)	(0.684)
DGC	*0.049***	*0.054***	*0.052**
	(0.046)	*(0.042)*	*(0.054)*
EBI	−0.124	−0.122	−0.033
	(0.459)	(0.519)	(0.874)
SIZE	−0.019	−0.020	−0.016
	(0.165)	(0.162)	(0.233)
ROA	0.018	0.084	0.001
	(0.929)	(0.683)	(0.998)
CCL	*0.041***	*0.044***	*0.039**
	(0.026)	*(0.018)*	*(0.051)*
IND	0.069	0.049	0.090
	(0.417)	(0.606)	(0.346)
Obs No.	563	563	511
Year control	Yes	Yes	Yes
Firm control	Yes	Yes	Yes
R^2	0.4304	0.3830	0.4585

Note(s): DGC = Global Continuity Performance Indicator; EBI = EBITDA Margin; SIZE = Company Size; ROA = Return on Assets; CCL = Company's Current Liquidity; IND = Indebtedness
This table presents the results for three models, each differing only in the dependent variable. The values highlighted in bold represent significant effects. The values outside the parentheses are the regression coefficients, the values inside the parentheses are the *p*-values, and ***, **, and * correspond to the statistical significance at 1%, 5%, and 10%, respectively
Source(s): Search results

management measures. This occurs because the index represents a proportion between the duration of interruptions and their frequency per consumer unit. In other words, the higher the DGC, the worse the continuity level in service provision tends to be, and this indicator is related to the levels of management of results.

The result obtained among the variables of interest denotes that management discretion, measured by earnings management, is greater in companies with low performance in their

operations, especially when analyzing this performance measured by the quality of the service provided. This finding becomes important as it suggests that low-quality service drives incentives for earnings management.

Furthermore, the current liquidity variable explains and controls the levels of earnings management; that is, high-liquidity companies (according to the three models) tend to have higher levels of earnings management. This finding offers evidence that high liquidity facilitates earnings management, as companies with low levels of liquidity may encounter challenges in obtaining additional financing due to earnings management practices.

4.4 Additional analysis

In order to better support the findings obtained, the dependent variable of the research was operationalized differently. According to the study by Roychowdhury (2006), companies suspected of manipulating their activities, i.e. companies that tend to perform earnings management, are companies with a net income (scaled by total assets) greater than or equal to zero, up to a limit of 0.005 (0.5%). In his study, Roychowdhury (2006) reached a total of 503 observations with suspected manipulation.

However, this study decided to increase the margin to a limit of 0.01 (1.0%) as the study sample consists of a small number of companies. Thus, 24 of the 563 observations showed earnings close to zero, within a limit of up to 1%. These observations are considered to relate to the number of companies per year suspected of engaging in earnings management, as the variable of interest is a dummy variable, where 1 represents suspicious companies and 0, non-suspicious companies. To obtain the results, a logit regression model was used. Table 8 provides the results for the relationship between service quality and earnings quality, however, in accordance with Roychowdhury's (2006) model.

The results above demonstrate convergence with the results presented earlier. These findings denote that companies with higher DGC and lower service quality levels are more likely (or have a greater odds ratio) to carry out earnings manipulation, which shows that companies suspected of engaging in earnings management are more likely to offer low-quality services. This confirms the previous results, according to the earnings management models by Dechow *et al.* (1995), Kothari *et al.* (2005), and Pae (2005).

5. Discussion

The findings of this research indicate that electricity distribution companies with better service quality tend to report lower levels of accrual discretion (and are less suspicious of

Table 8. Logit regression model results

Variable	*ODD Ratio*	*Std. err*	*z*	*P* > |*z*|
Constant	0.2792	0.4908	−0.73	0.468
DGC	3.0183	1.2632	2.64	0.008***
EBI	2.3214	7.8168	0.25	0.802
SIZE	1.0425	0.1126	0.39	0.700
ROA	0.1314	0.5748	−0.46	0.643
CCL	0.1772	0.1302	−2.35	0.019**
IND	0.0948	0.1099	−2.03	0.042**

Note(s): Obs No. = 563; Year Control = Yes; Firm Control = Yes; Pseudo R^2 = 0.0964
DGC = Global Continuity Performance Indicator; ME = EBITDA Margin; SIZE = Company Size; ROA = Return on Assets; CCL = Company's Current Liquidity; IND = Indebtedness
The values inside the parentheses represent the *p*-values, and *** and ** correspond to the statistical significance at the 1% and 5% levels, respectively
Source(s): Search results

manipulating results); that is, they have fewer opportunistic managers who manipulate their results to a lesser extent. On the other hand, companies with lower service quality (due to longer durations and frequent interruptions) tend to have more opportunistic management, which manipulates their results to a greater extent.

5.1 Theoretical implications

These results align more closely with the notion put forth by the Theory of Economic Regulation, suggesting that all organizations in the industry are driven by their economic interests (Yandle, 2022). However, these interests do not always go against the public interest, which would generate greater well-being for society. Therefore, it becomes clear that different interests can affect how the service reaches its consumers, in this case, society.

On the other hand, the relationship between the service quality and the quality of the accounting information obtained denotes that the opportunistic acts performed by the management are related to the poor quality of the service. In other words, companies that provide low-quality services are more likely to manipulate their accounting information to conceal the damage caused by the services they deliver to consumers.

The findings support the research hypothesis that a manager's opportunistic behavior can influence the quality of the financial reports issued, reflected in higher levels of discretionary accruals. This, in turn, is related to the highest index of continuity (low quality of service), thus confirming the study by Niesten and Jolink (2012), which pointed out that consumers can be affected by the services they receive due to the opportunistic behavior present in the electricity sector.

Additionally, the findings align with the perspective of Alexandre and de Oliveira Mello (2017) due to the idea that in companies within regulated sectors, managers may adopt practices aimed at meeting specific information demands. It also supports the study by Giannakis *et al.* (2005), which indicates that high operational costs in the electricity sector can negatively impact service quality, with profit-maximizing incentives in these companies, as noted by Sheshinski (1976). Therefore, as Morais *et al.* (2019) conclude, the regulatory environment can influence results management, which is more evident in companies that offer lower service quality.

5.2 Managerial/policy implications

Companies with poor organizational performance, as reflected in the continuity of their services, may resort to earnings management practices to artificially enhance their image and thus compensate for the poor quality of the services they provide. Additionally, such electric utility companies face incentives to manipulate their financial results to meet regulatory targets and avoid penalties. When electric utilities present low service quality, they may face negative perceptions from investors and regulators, leading them to adjust their financial statements to improve their image.

Moreover, in the highly regulated electricity sector, the pressure to meet requirements can result in financial adjustments that deviate from operational reality, resulting in earnings management. Finally, issues arising from service continuity can negatively impact the company's corporate reputation, thus contributing to the use of earnings management practices to mitigate the negative effects on the reputation and market attractiveness of the company.

The relationship between service quality and earnings management has significant political implications. When energy distributors with poor performance manipulate results to enhance their image, they can conceal operational problems and mislead both regulators and investors. Thus, it is essential for public policies implemented by regulatory agencies for key services to become more stringent, promoting greater transparency and effectiveness. Additionally, monitoring should be strengthened to ensure that financial information accurately reflects operational reality and drives genuine improvements in service quality.

5.3 Limitations and future research agenda

This study has several significant limitations, including reliance on data that may not capture detailed internal information from the companies and the restriction to the period from 2011 to 2021, which may not reflect recent changes in regulation and the market. Additionally, using only the Global Continuity Performance Index (DGC) as a measure of service quality might not cover all aspects of the quality of service provided by the distributors.

To advance the research, it is recommended to explore internal company data and extend the analysis period to include more recent data, assessing how regulatory and market changes impact the relationship between service quality and earnings management. Incorporating additional service quality measures and analyzing the impact of specific regulatory policies could furnish a more comprehensive view. For example, including the analysis conducted by Cruz and Almonte (2019) on the Periodic Tariff Review (RTP) may contribute to a better understanding of the relationship between earnings management and service quality, specifically during periods of greater incentives for better tariffs among electricity distributors. Finally, comparative international studies could also reveal differences and similarities in the relationship between service quality and earnings management, considering variations in regulations and market practices.

6. Conclusions

This study aimed to assess the relationship between service quality and earnings management in Brazilian electricity distributors. For this purpose, 52 companies were analyzed from 2011 to 2021, using the Global Continuity Performance (DGC) indicator as a measure of service quality and the models by Dechow *et al.* (1995), Kothari *et al.* (2005), and Pae (2005).

In general, the research results indicated a significant relationship between service quality delivery and earnings management. These findings establish a correlation between service performance and earnings management, suggesting that both may arise from the attitudes that determine the approach to company management.

It has therefore become clear that opportunistic acts by managers of electricity concessionaires tend to become visible simultaneously both in the quality of service and in the accounting information. The literature well accepts the earnings management models analyzed as they reflect opportunistic acts by the company management. As such acts are related to lower levels of continuity in the energy supply, they lead to implications for the manipulation of accounting information by managers, aimed at influencing the perception of different users of accounting information regarding the company's true performance.

The results obtained can be valuable to various stakeholders in the market, who need to make decisions related to these companies. They can help regulators by signaling that companies offering low-quality services may face a more rigorous scrutiny of their financial results due to the potential for earnings management. The study can also provide insights for investors and creditors, who can consider the impact of service quality on the reported results, leading to better decisions regarding the allocation of resources to these companies. Finally, society—as a consumer of energy services—can use the research findings to monitor companies that provide services at a loss as a reflection of opportunistic actions by their managers.

The main limitation of this study is the absence of some necessary regulatory data in the earnings management models, which only allows the use of information under the corporate standards. Another limitation is the number of variables used that refer to quality in the provision of electrical energy services. In Brazil, only information related to the continuity index is disclosed, which limits the current research to using only this dimension.

Future research should expand the study to other countries that disseminate information on the service quality provision from the perspective of continuity, to verify whether the effects of the indices are maintained in the quality of the financial reports. It is also suggested that future researchers perform studies within the Brazilian context, using other measures to assess the

quality of accounting information alongside the service quality index used in this research. Additionally, future research could analyze how artificial intelligence can improve the analysis of large volumes of data to detect manipulation patterns, such as machine learning and predictive analytics, thereby contributing new perspectives on the relationship between service quality and earnings management in electric utility companies.

Notes

1. Available at: https://antigo.aneel.gov.br/ranking-da-continuidade
2. Available at: https://antigo.aneel.gov.br/indicadores-coletivos-de-continuidade
3. Available at: https://antigo.aneel.gov.br/central-de-informacoes-economico-financeiras

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About the authors

Paulo Vitor Souza de Souza has a PhD in Accounting Sciences from the University of Brasília (UnB – Brazil) and a Post Doctorate in Accounting from the Federal University of Santa Catarina (UFSC – Brazil). He is an Adjunct Professor at the Department of Accounting Sciences at the Federal University of Paraná (UFPR – Brazil). He is the coordinator of the Center for Studies in Accounting and Finance for External Users (NECFE / UFPA – Brazil). Research on the quality of accounting information and financial accounting in regulated sectors, with a focus on the electricity sector. Paulo Vitor Souza de Souza is the corresponding author and can be contacted at: paulovsouza@ufpr.br

Edilson Paulo has a PhD in Accounting and Controllership from the University of São Paulo (USP – Brazil) and a Post Doctorate in Accounting from the Federal University of Santa Catarina (UFSC – Brazil). He is an Associate Professor of the Postgraduate Program in Accounting at the Federal University of Santa Catarina (UFSC – Brazil). He is the coordinator of the Center for Studies on the Quality of Corporate Information and Regulated Sectors (NESREG / UFSC – Brazil). He is the President and Director of the National Association of Postgraduate Programs in Accounting Sciences (ANPCONT – Brazil).