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INFLUENCE OF COVID-19 ON FISCAL AGGRESSIVENESS OF ELECTRIC ENERGY SECTOR COMPANIES LISTED ON B3

INFLUÊNCIA DA COVID-19 NA AGRESSIVIDADE FISCAL DAS EMPRESAS DO SETOR DE ENERGIA ELÉTRICA LISTADAS NA B3

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ABSTRACT

This study examines the impact of the COVID-19 pandemic on the tax aggressiveness of companies listed on the Brazilian Stock Exchange (B3) in the electricity sector. A total of 41 companies were analyzed from 2009 to 2022. Tax aggressiveness was assessed using the effective tax payment rate (CASHETR) and Effective Tax Rate (ETR). The primary independent variable of interest was a dummy variable representing the pandemic period (COVID-19), while Return on Assets (ROA), leverage (LEV), and Company Size (TAM) served as control variables. Two panel data regression models are employed to test the hypothesis that COVID-19 influences companies' tax aggressiveness. The findings indicate that companies exhibited increased tax aggressiveness during the COVID-19 period for the dependent variable, CASHETR, thereby supporting the established hypothesis. Regarding the control variables, the results demonstrate that ROA has a significant positive effect on tax aggressiveness, suggesting that companies with higher returns on assets tend to adopt less aggressive tax strategies. The LEV variable yielded varying results across models but was statistically significant in both models. Conversely, the TAM did not show statistical significance. It is concluded that electric power companies engaged in tax management during the COVID-19 pandemic, seeking more effective strategies to reduce tax liabilities and mitigate the impact of the crisis.

Keywords: Tax Aggressiveness, COVID-19, Electricity Sector, Tax Planning.

RESUMO

A presente pesquisa teve por objetivo investigar se a pandemia da COVID-19 impactou a agressividade fiscal das empresas listadas na Bolsa de Valores Brasileira (B3) do setor de energia elétrica. Para isso, foram analisadas 41 empresas durante o período de 2009 a 2022. A agressividade fiscal foi mensurada pela Taxa Efetiva de Pagamento de Tributos (CASHETR) e pela Taxa Efetiva de Tributos (ETR). A variável independente de interesse foi a dummy do período pandêmico (COVID-19), enquanto o Retorno sobre Ativos (ROA), Alavancagem (LEV) e o Tamanho da Empresa (TAM) foram as variáveis de controle. Para testar a hipótese de que a COVID-19 impactou a agressividade fiscal das empresas foram utilizados dois modelos de regressão com dados em painel. Os resultados revelaram que as empresas foram mais agressivas tributariamente durante o período da COVID-19, em relação à variável dependente CASHETR, não refutando a hipótese estabelecida. Em referência às variáveis de controle, os resultados mostraram que: o ROA exibiu um efeito positivo significativo na agressividade fiscal, ao indicar que empresas com maior retorno sobre ativos tendem a adotar estratégias fiscais menos agressivas; a variável LEV apresentou resultado distinto segundo cada modelo, mas, mostrou-se relevante estatisticamente em ambos; já o TAM não demonstrou significância estatística. Conclui-se que as empresas de energia elétrica gerenciaram seus tributos no período da COVID-19, ao buscar estratégias mais efetivas para se pagar menos tributos e, assim, minimizar os efeitos da crise.

Palavras-Chave: Agressividade Fiscal, COVID-19, Setor de Energia Elétrica, Planejamento Tributário.

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1. INTRODUCTION

The pandemic began in the early months of 2020, when the new coronavirus, SARS-CoV-2, spread worldwide and caused COVID-19. To prevent the spread of the virus, preventive measures were adopted owing to its high transmission rate. Social isolation has been implemented in several countries, resulting in travel restrictions and temporary closure of schools, airports, universities, and non-essential services (Dias et al., 2020). These actions had a significant impact on the Brazilian economy, with a 4.1% drop in Gross Domestic Product (GDP) in 2020 compared to 2019 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2021).

The COVID-19 pandemic has had a significant impact on the global economy (Cassiolato et al., 2021), and the control and isolation measures adopted have resulted in major instabilities and challenges for companies. Mobility restrictions, company closures, and supply chain interruptions have resulted in a generalized economic slowdown in commerce in general (Gullo, 2020).

One of the sectors that showed the most instability during the pandemic period was the electricity sector, characterized by a significant drop in global energy consumption as a result of the shutdown that many companies and industries faced during this crisis (Correa et al., 2021). Many inactive companies stopped demanding electricity, whereas industries, mostly closed or operating with limited capacity, experienced a considerable reduction in their energy consumption (Correa et al., 2021). Information released by the Energy Research Company (EPE) in the National Energy Balance in 2021 shows that the Internal Energy Supply (OIE) in Brazil registered a decrease of 2.2% in 2020 compared to the previous year. With more people working from home and spending more time there, there have been changes in energy consumption patterns, which may have significantly impacted demand. Energy distribution companies have to adapt quickly to changes in demand and consumption patterns (Sampaio, 2022).

This scenario has been quite challenging, given that electricity infrastructure is designed to cope with predictable demand patterns, and the economic uncertainty caused by the pandemic may have affected the ability of electricity companies to obtain financing for projects and investments, as well as investor confidence. This situation has caused these companies to suffer a significant drop in revenue, which has led many of them to look for ways to preserve their liquidity (David, 2021).

Nascimento (2022) pointed out that COVID-19 has had significant consequences for Brazil and the world, affecting several companies that have implemented measures to contain the spread of the virus. In this challenging scenario, the need to preserve financial resources has led many organizations to seek different strategies. One of these is tax avoidance practices (here called tax aggressiveness), such as postponing tax payments and using specific tax benefits for the crisis period, which was essential to sustain these companies during this period (Moraes et al., 2023).

Tax aggressiveness is understood as the use of legal strategies to reduce the tax burden (Andrade et al., 2020; Campos & Dantas, 2022; Xavier et al., 2022), becoming even more crucial in times of crisis when the search for financial efficiency intensifies. This aggressiveness involves managing taxable income to reduce it, and its degree explicitly measures the impetus to reduce the incidence of taxes (Santos & Oliveira, 2020). During the pandemic, several issues linked to tax aggressiveness arose, one of which was the search for tax incentives and specific government support programs to deal with the economic impacts of the crisis. Companies seek to benefit from these measures by taking advantage of opportunities to reduce their tax burdens and obtain financial relief (Manguelly et al., 2023).

The literature (Ariff et al., 2023; Athira & Ramesh, 2023; Kobbi-Fakhfakh & Bougacha, 2023; Khan & Nawaz, 2023; Nascimento, 2022) suggests that tax aggressiveness is affected by elements such as economic crises and extraordinary events such as the COVID-19 pandemic (Nicola et al., 2020). Ariff et al. (2023) showed that companies in financial difficulty had low tax aggressiveness before and during the pandemic, although during the pandemic they observed an increase in tax aggressiveness compared to the pre-pandemic period. In this context, Nascimento (2022), when investigating the influence of the COVID-19 pandemic on the tax behavior of Brazilian non-financial companies listed on the Brazilian capital market from 2010 to 2021, concluded that there was an increase in the level of tax aggressiveness during this period.

In view of the above, this research aims to investigate whether the COVID-19 pandemic has impacted the tax aggressiveness of companies listed on the Brazilian Stock Exchange (B3) in the electricity sector to verify whether these companies have sought tax strategies to reduce their tax burden and maximize their economic and financial results. During the COVID-19 pandemic, this search may have been more recurrent because of the economic uncertainties and financial challenges faced.

This study is justified because it provides results of concrete actions taken from a tax perspective by the management of companies in the electricity sector to deal with the COVID-19 crisis. As such, it adds elements to the literature that have investigated the impact of different crises, such as financial crises, especially COVID-19, on the tax management of entities. It should be noted that other studies that have used COVID-19 as a predictor of tax aggressiveness have not focused their efforts on a strategic and regulated sector like this (Marinho et al., 2022; Nascimento, 2022), which is why this study is innovative in this respect. It also offers insights for further studies using other lenses and sectors to advance our understanding of the effects of critical events on corporate tax practices.

2. LITERATURE REVIEW

2.1 Tax aggressiveness

Given Brazil's high tax burden, companies pay a significant amount of taxes, which is why entrepreneurs have been looking for alternatives to reduce this type of expense. To achieve this goal, it is necessary to carry out analyses and studies of the accounting information available to companies to identify legal alternatives that can maximize their profits (Martelli & Silva, 2016). According to the Brazilian Federal Revenue Service (RFB, 2021), the country has the highest tax burden in Latin America and one of the highest globally, representing approximately 32.45% of the Gross Domestic Product (GDP) in 2019 and 31.58% of the GDP in 2020 (RFB, 2021). As such, taxes have become an essential factor in companies' decision making, and as a result, many are looking for ways to reduce them.

To this end, tax planning is referred to as tax aggressiveness, which can be understood as a way of maximizing company profits through the analysis of tax laws in order to apply them in an advantageous way in the accounting and structuring of activities with favorable taxation. According to Tang (2005) and Martinez and Dalfior (2015), tax aggressiveness is a form of tax planning in which taxpayers use various legal arrangements to reduce their tax costs. In this context, according to Alves (2021) and Brilhante and Alves (2020), a company considered to be tax aggressive uses many incentives made available by the government and other aspects present in tax and corporate legislation to reduce the tax burden and, consequently, increase its liquidity and profitability.

In their seminal study on tax aggressiveness, Hanlon and Heitzman (2010) state that there is still no universally accepted definition and that there is no final concept for tax aggressiveness. Tax avoidance (tax planning) is more linked to more aggressive tax planning by using the legal form of tax legislation to one's advantage in order to reduce the taxes to be paid without exceeding the legal limits (Wang et al., 2020). Therefore, tax aggressiveness can be defined as a set of actions designed to reduce the tax burden and maximize financial results (Lietz, 2013).

To study tax aggressiveness, metrics calculated from accounting data are used to better understand the scenarios in which companies find themselves. These metrics include the Effective Tax Rate (ETR), calculated as the sum of expenses with Corporate Income Tax (IRPJ) and Social Contribution on Net Profit (CSLL) divided by Profit Before Taxes (LAIR); Book-Tax Differences (BTD), defined as the difference between book and tax profits; CASHETR (Effective Tax Payment Rate (CASHETR), calculated by dividing the total amount of direct taxes paid (IRPJ and CSLL) by LAIR.

These metrics are used internationally (Chen et al., 2010; Hanlon & Heitzman, 2010; Wang et al., 2020) and in national (Martinez and Ramalho, 2014; Martinez and Silva, 2017) studies investigating the tax behavior of organizations. For this research, the direct tax rates (IRPJ and CSLL) appropriated as an expense and paid will be adopted, as they are the most commonly found in the Brazilian literature. The interpretation is that the lower the rate, the more tax planning actions are employed by the company. BTD will be disregarded because studies show that it is not appropriate for understanding the level of tax aggressiveness in organizations, but rather earnings management (Magalhães & Ferreira, 2018; Martinez & Leal, 2019).

2.2 Previous studies and research hypothesis

The study proposed by Athira and Ramesh (2023) highlighted the COVID-19 pandemic as a crucial opportunity to assess how companies manage their taxes during a crisis, considering previous tax reforms. The authors found that companies avoided paying taxes during COVID-19 to cope with financial crises such as a lack of cash balances. In addition, the study highlights the importance of fiscal aggressiveness during extreme events, such as the COVID-19 pandemic. These findings emphasize the need to use tax policies in the context of fiscal aggressiveness during the pandemic.

Ariff et al. (2023) analyzed whether the financial crisis was related to fiscal aggressiveness and the COVID-19 pandemic. It used a global database sample comprising 38,958 annual company observations from 32 countries for the period 2015-2020. The results showed an increase in fiscal aggressiveness during the pandemic compared to the pre-pandemic period and that the pandemic intensified the negative relationship between financial crisis and fiscal aggressiveness.

Kobbi-Fakhfakh and Bougacha (2023) analyzed the impact of the COVID-19 pandemic on the fiscal aggressiveness of publicly traded companies in the United States from 2019 to 2021. The results showed that the COVID-19 outbreak triggered an increase in the ETR (Effective Tax Rate (ETR) and a reduction in the BTD (Book-Tax Differences), there was a reduction in tax aggressiveness in the post-pandemic period. Further analysis shows that this effect was mainly due to a reduction in deferred tax expenses. The authors suggest that, due to the significant drop in revenue during the post-pandemic period and the closure of markets, the impact on business was negative. From this study, it is important to highlight some other secondary findings: the pandemic did not cause a significant change in CASHETR; higher financial leverage suggests higher tax payments; CASHETR was lower in the industries most impacted by the pandemic, such as airlines and energy services, among others.

According to Khan and Nawaz (2023), who surveyed 175 Pakistani companies from 2010 to 2021 using the ETR and CASHETR, companies have incentives to engage in aggressive tax practices when managerial benefits outweigh costs, and these practices prevail when companies face financial difficulties. The COVID-19 financial crisis offers significant

insights into whether tax aggressiveness differs significantly between the pre-covid-19and post-COVID-19 financial challenges. The results show that financial difficulties had a statistically significant impact on tax aggressiveness. In addition, the study concludes that companies engaged more in aggressive tax practices during periods of financial difficulty.

Brazilian studies that have investigated the impact of crises such as COVID-19 on companies' tax aggressiveness are scarce, and even fewer have explored the impact by sector. Nascimento (2022) investigated the influence of the COVID-19 pandemic on the tax aggressiveness of 326 Brazilian non-financial companies listed on B3 from 2010 to 2021. The results of the multiple linear regression analysis indicated a negative and significant relationship between the tax aggressiveness metrics (ETR and CASHETR) and the variable representing the post-COVID-19 pandemic period. This means that during the pandemic (2020 and 2021), the level of tax aggressiveness of the companies in the sample was higher than that in previous years.

Oliveira and Machado (2023) analyzed the impact of the pandemic on tax avoidance by publicly traded financial and non-financial companies on B3, considering the pre-pandemic (2019), pandemic (2020 and 2021), and post-pandemic (2022) periods. The sample consisted of 200 Brazilian companies listed on B3, of which 36 were financial and 164 non-financial. The results of this study differed from those of Nascimento (2022), as the ETR and CASHETR rates showed no statistically significant differences for the three periods investigated.

Despite not actually researching the effect of COVID-19 on tax avoidance practices, Marques et al. (2022) analyzed the association between the environment of economic uncertainty and the level of tax aggressiveness of companies listed on B3. This scenario can be read as close to that of the pandemic, given the great uncertainty surrounding the economic trajectory of organizations during and after COVID-19. By analyzing data from 252 organizations from 2013 to 2018, they found no positive association between tax aggressiveness and the environment of economic uncertainty.

Specifically, with regard to studies that have somehow analyzed the impact of crises on the fiscal aggressiveness of companies from different B3 sectors, the following results stand out: the average ETR of 59 companies in the electricity sector from 2013 to 2018 was 25% (Santos & Oliveira, 2020); positive association between ETR and the crisis variable (COVID-19) of 453 companies, and the quantile regression test showed that ETR changed during the crisis period at quantiles 0.25 and 0.75 (Costa França, 2024).

Most of the previous studies (Athira & Ramesh, 2023; Ariff et al., 2023; Costa Neta & França, 2024; Kobbi-Fakhfakh, 2023; Marques et al. 2022; Nascimento, 2022; Santos & Oliveira, 2020) have shown that tax aggressiveness is influenced by various factors such as economic crises and extraordinary events such as COVID-19. Thus, based on the foundations presented in this preliminary literature review, the research tests the following hypothesis: H1: Companies in the electricity sector listed on B3 were more aggressive in tax terms during the COVID-19 period.

This hypothesis is based on the premise that the crisis caused by the pandemic significantly affected the electricity sector, leading companies to adopt more aggressive strategies to reduce the incidence of taxes and preserve their liquidity. Considering the particularities of the sector, such as a decrease in energy consumption and operational restrictions, it is plausible to assume that companies have sought ways to face these challenges through more aggressive tax strategies.

3. METHODOLOGICAL PROCEDURES

3.1. Sample and data collection

A total of 63 companies listed on B3 in the electricity sector were surveyed. Subsequently, companies that did not have complete data to calculate the variables for the period between 2019 and 2022 are excluded. Consequently, 22 companies were excluded, resulting in a final sample of 41 companies.

Accounting information was obtained from the financial reports available on the Economática database and the website of the Brazilian Securities and Exchange Commission (CVM). With regard to the period of analysis, it should be noted that 2019 and 2022 were considered to have no impact on COVID-19, with 2019 being the year prior to the appearance of COVID-19 and 2022 being the year of the effective resumption of economic activities. The years 2020 and 2021 were considered to have been affected by COVID-19.

3.2 Variables and analysis procedures

3.2.1 Dependent variables

ETR, calculated by dividing the sum of current and deferred IRPJ and CSLL expenses by LAIR (Martinez & Silva, 2017), was adopted as the dependent variable in this study. The use of this metric is in line with the national and international literature (Martinez & Silva, 2017; Martinez & Ramalho, 2014; Alves, 2021; Hanlon and Heitzman, 2010; Marinho et al., 2021). This rate is an inverse measure of tax aggressiveness, as the lower the effective tax rate, the greater the level of aggressiveness of the company (Hanlon and Heitzman, 2010; Costa, Silva, & Klan, 2023).

In addition, the CASHETR was used as a proxy for tax aggressiveness. This consists of dividing the total amount paid by the company in direct taxes (IRPJ and CSLL) by the LAIR. It is an important metric for understanding how much a company spent on taxes during the analysis period (Alves 2021).

3.2.2 Independent variable of interest

A dummy for the pandemic period was used as the independent variable of interest, with zero indicating the absence of the pandemic period and one indicating its presence. The use of the pandemic period dummy is a crucial strategy in this study on the impact of COVID-19 on the fiscal aggressiveness of companies in the electricity sector listed on B3. This binary variable makes it possible to control for the specific effects of the pandemic on the ETR and CASHETR, isolating them from other influences.

3.2.3 Independent control variables

Independent control variables are those considered potential factors that may influence the results of the research but are not the main focus of the investigation. In this study, the independent control variables adopted were those that stood out in recent research on tax management and tax aggressiveness. Therefore, these variables impact companies' tax aggressiveness but are not directly related to the COVID-19 pandemic (Martinez & Cerize, 2020).

Table 1 shows the control variables used, their descriptions, and the literature (source) used to highlight them.

Table 1 - Control variables

Control variables	Description	Source
ROA (Return on assets)	Company operating profit divided by assets.	(Armstrong et al., 2012; Marinho et al., 2021; Martinez & Cerize, 2020; Martinez & Ramalho, 2014).
LEV (Leverage)	Long-term debt divided by total assets.	(Martinez & Ramalho, 2014; Marinho et al., 2021; Martinez & Cerize, 2020; Martinez & Martins, 2016).
TAM (Size)	Natural logarithm of the company's total assets.	(Arpini, Rotter & Piccoli, 2020; Bis, Martinez, 2017; Proner et. al, 2021; Martinez; Martins, 2016; Wang et al., 2020).

Source: Author's elaboration.

Return on assets (ROA) was used because it indicates the company's operational efficiency and has an inverse relationship with tax aggressiveness. Studies show that companies with higher ROA tend to be less aggressive in their tax practices (Armstrong et al., 2012; Marinho et al., 2021; Martinez & Cerize, 2020; Martinez & Ramalho, 2014). This suggests that the solid generation of profits in relation to total assets may reduce companies' motivation to adopt aggressive tax strategies since they have less need to resort to tax advantages to optimize their financial results.

In relation to leverage (LEV), which represents a company's level of indebtedness, the literature has shown a positive relationship with tax aggressiveness. Studies suggest that companies with higher levels of debt tend to adopt more aggressive tax practices, probably to take advantage of the tax benefits arising from the appropriation of interest on debt (Martinez & Ramalho, 2014; Marinho et al., 2021; Martinez & Cerize, 2020; Martinez & Martins, 2016).

The size of the company can influence tax practices in various ways, but does not follow a clear pattern; therefore, it should be evaluated considering the specific factors of the company and its tax/regulatory environment. Some studies have shown that larger companies may deal differently with a financial crisis (Arpini et al., 2020; Bis and Martinez, 2017; Proner et. al, 2021). Larger companies, despite being more exposed to public scrutiny, have greater incentives and power to influence the political process. Therefore, they are expected to exhibit higher levels of tax aggressiveness (Martinez & Martins, 2016; Wang et al., 2020).

3.2.4 Data analysis technique

To identify the effects of the pandemic on the tax aggressiveness of the sample companies, two econometric models were established. Equations 1 and 2 represent the estimated models for the ETR and CASHETR variables, respectively:

$$ETR_{it} = \beta 0 + \beta 1 * Dummy_{it} + \beta 2 * ROA_{it} + \beta 3 * LEV_{it} + \beta 4 * TAM_{it} + \varepsilon_{it} \quad (1)$$

$$CASHETR_{it} = \beta 0 + \beta 1 * Dummy_{it} + \beta 2 * ROA_{it} + \beta 3 * LEV_{it} + \beta 4 * TAM_{it} + \varepsilon_{it} \quad (2)$$

In the models proposed above, i and t represent the company and the year; represents the intercept of the regression; and represent the dependent variable of the Effective Rate of Taxation and the Effective Rate of Payment of Taxes on profit, respectively, of company i in year t; is the independent variable of interest represented by the pandemic period dummy, with 0 for the absence of the pandemic period and 1 for its presence; β2, β3, and β4 represent the independent control variables, which are the coefficients determining tax aggressiveness, namely ROA (Return on Assets), LEV (leverage), and TAM (size); and represents the regression error.

Panel data regression was used to test the research hypotheses. According to Martinez and Silva (2017), this is the most appropriate approach given that the information on the selected companies varies over the years. In line with Martinez and Silva (2017) and Fávero (2013), the choice of statistical tool for panel data analysis, whether related to fixed or random effects, requires statistical tests. This allows for the objective choice of the best type of model (simple pooled, panel with fixed or random effects), as well as testing for problems with multicollinearity of the independent quantitative variables, heteroscedasticity, and autocorrelation. To do this, the following flow of analysis was applied: 1) Chow's test to identify whether the data behaved like a simple pooling or a panel of data; 2) Hausman's test which analyzes whether the panel with random effects is the best choice or not; 3) Modified Wald test to identify problems with heteroscedasticity; 4) Inoue and Solo (2006) test to identify problems with serial autocorrelation; and 5) VIF test to analyze problems with multicollinearity.

It should be noted that before applying the econometric models (Equations 1 and 2) and their assumptions, descriptive statistics techniques were used to analyze and identify problems with outliers. Measures of central tendency (mean and median) and data dispersion (standard deviation and coefficient of variation) were analyzed. Once these problems were identified, the winsorization technique was applied to the variables, establishing a probability of 1%. In this procedure, the upper and lower limits are defined using the probability, and these limits are replaced by the highest and lowest remaining values of the established limits. It is important to note that although there is no rule, winsorizations are generally carried out at the 1%, 2.5%, or 10% levels (Becker, 2015).

4. PRESENTATION AND ANALYSIS OF RESULTS

4.1. Descriptive análisis

The data analysis began by checking the descriptive statistics of the dependent variables for the non-pandemic and pandemic periods. The results are presented in Table 2.

Table 2 - Descriptive statistics of the dependent variables

Variable: CASH_ETR							
Description	**Statistics**	**Period without COVID**	**Period with COVID**	**Years without a pandemic**		**Years with a pandemic**	
				2019	**2022**	**2020**	**2021**
Mean	0,07775	0,096	0,060	0,083	0,109	0,054	0,065
Median	0,02340	0,045	0,006	0,042	0,059	0,023	0,003
Standard Deviation	0,13725	0,168	0,095	0,114	0,211	0,070	0,116
Coefficient of Variation	1,76527	1,756	1,590	1,383	1,927	1,284	1,782
Minimum	0,00000	0,000	0,000	0,000	0,000	0,000	0,000
Maximum	1,08990	1,090	0,410	0,477	1,090	0,213	0,410
N	116	58	58	29	29	29	29

Variable:ETR							
Description	Statistics	Period without COVID	Period with COVID	Years without a pandemic		Years with a pandemic	
				2019	2022	2020	2021
Mean	0,078	0,083	0,073	0,065	0,101	0,082	0,064
Median	0,016	0,025	0,006	0,024	0,036	0,007	0,006
Standard Deviation	0,153	0,162	0,144	0,100	0,208	0,176	0,106
Coefficient of Variation	1,966	1,962	1,979	1,538	2,062	2,144	1,665
Minimum	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Maximum	1,090	1,090	0,912	0,477	1,090	0,912	0,410
N	116	58	58	29	29	29	29

Source: Author's elaboration.

Table 2 shows that the average ETR variable was approximately 8.3% during the pandemic period and approximately 7.3% during the pandemic period, indicating a reduction of 1%. In addition, this variable, when compared with the nominal variable of 34%, suggests the presence of tax planning in companies. The results obtained are similar to other studies that have also found this decrease (Athira & Ramesh, 2023; Ariff et al., 2023; Kobbi-Fakhfakh & Bougacha, 2023; Khan & Nawaz, 2023; Nascimento, 2022).

It can also be seen that the average of the CASHETR variable is 9.6% in the period without a pandemic effect, and 6% in the pandemic period, indicating a reduction of 3.6%. The results show that there was tax planning for the pandemic period, as shown by the studies conducted by Athira and Ramesh (2023), Ariff et al. (2023), Kobbi-Fakhfakh and Bougacha (2023), Khan and Nawaz (2023) and Nascimento (2022).

The descriptive statistics, especially for the CASHETR variable, show that there was a reduction in companies' tax burden during the most intense period of COVID-19, as can be seen in 2020, and that the average and median obtained corresponded to the lowest tax burden measured (0.054 and 0.023, respectively). Thus, there are signs that companies in the electricity sector have used tools related to tax management by reducing the payments and appropriations made, suggesting that the hypothesis established for this study is not rejected.

4.2. Analysis of the models

A multicollinearity test was applied to check whether the independent variables in the model showed a strong correlation. The results revealed an average VIF of 1.01 for the ROA, LEV, and TAM variables. Because the average value was below 10, it can be concluded that there were no significant multicollinearity problems. The p-values of the Chow test obtained for Equations 1 and 2 (0.000 and 0.000, respectively) indicate that the data behaved as a panel. Therefore, it is necessary to define the treatment effect, whether fixed or random. We used the Hausman test, the results of which indicated that the best model for the two equations was the panel with fixed effects (0.000 and 0.000 for Equations 1 and 2). The results of the Wald test indicated that the models estimated for Equations 1 and 2 present heteroscedasticity problems, given that the p-values obtained were 0.000 and 0.000, respectively. When the serial autocorrelation test was used, the p-values obtained for Equations 1 and 2 were greater than 5% (0.425 and 0.853, respectively). Therefore, no serial autocorrelation problems were detected.

Table 3 presents the results of the regressions used to investigate the effect of COVID-19 on the fiscal aggressiveness of companies in the energy sector. These results allow us to test the hypothesis that these companies adopted more aggressive practices in 2020 and 2021 (the critical period for COVID-19) than in 2019 and 2022 (the period without COVID-19 effects).

Table 3 - Results of the regressions with the dependent variables ETR and CASHETR

Variables	Painel A - ETR		Painel B - CASHETR	
	Coefficient	Robust standard error	Coefficient	Robust standard error
COVID	-0,0203736	0,018455	-0,0385349**	0,014728
	(0,279)		(0,014)	
ROA	0,00253**	0,001202	0,001803	0,001168
	(0,044)		(0,134)	
LEV	-0,00948***	0,001045	0,0042976**	0,012842
	(0,000)		(0,002)	
TAM	0,0354077	0,05034	0,042	0,059919
	(0,488)		(0,489)	
Const	-0,5109822	0,805814	-6214912	0,937916
	(0,531)		(0,513)	
N obs	114		114	

Note: *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Source: Author's elaboration.

The results in Table 3 show that COVID-19 positively influences the fiscal aggressiveness of the sample companies when the dependent variable is CASHETR. The coefficient for the COVID variable, which represents the dummy for the pandemic period when associated with CASHETR, is -3.85%, indicating that holding all other variables constant, an increase is associated with a decrease of approximately 0.0385 units in the dependent variable CASHETR, which suggests that the variable is statistically significant. This finding corroborates the literature (Athira and Ramesh, 2023; Ariff et al., 2023; Kobbi-Fakhfakh and Bougacha, 2023; Khan and Nawaz, 2023; Nascimento, 2022).

With regard to the dependent variable ETR, the coefficient for the COVID variable is -2.04%. This indicates that, holding all other variables constant, an increase of one unit in COVID is associated with a decrease of approximately 0.00204 units in the dependent variable ETR; however, it is not statistically significant in explaining the variability in ETR at a significance level of 5%. In other words, the presence or absence of COVID does not have a significant effect on ETR. This result is not in line with the studies by Athira and Ramesh (2023), Khan and Nawaz (2023) and Nascimento (2022), but it is important to note that these studies had different samples from this research, which may be a plausible explanation for the difference in results.

These findings allow us to state that the established hypothesis that companies in the electricity sector listed on B3 were more aggressive in fiscal terms during the COVID-19 period cannot be refuted since the evidence shows an increase in the fiscal aggressiveness of companies during the pandemic. This is reflected in the model, in which the dependent variable is CASHETR. Although the other dependent variable did not confirm this premise, the descriptive data showed that there was also a reduction in the percentage of taxes recognized during COVID-19.

This is in line with what many previous studies have concluded that in periods of crisis, when companies go through various financial difficulties, many of them use aggressive tax strategies to meet their targets and capital needs (Khan et al. 2017; Dang & Tran, 2021). However, it is worth considering that the impact on the tax payment rate, CASHETR, may be related to the decrease in the volume of companies' activities and not only to more pronounced tax avoidance practices. Further research is required to uncover this situation. This analysis is based on the fact that the rate inherent in the payment of taxes seems to better reflect the scenario under investigation. It more accurately portrays the financial actions taken to deal with the crisis because it is more sensitive to capturing the fiscal policies and strategies undertaken by organizations to preserve financial resources. The results prove that during the COVID-19 period (2020–2021), there was a significant reduction in tax payments by companies in the electricity sector.

The other variable, despite being frequently used to investigate the degree of tax aggressiveness, includes tax expenses and revenues that will affect the tax burden in future periods; therefore, it does not seem to be the most suitable for understanding the effects of extraordinary events due to the inexpressive window of data for study. Although this finding refutes this hypothesis, it is in line with those of other studies (Kobbi-Fakhfakh & Bougacha, 2023; Oliveira & Machado).

ROA, when associated with CASHETR, is 0.18%. This indicates that holding all other variables constant, an increase in ROA is associated with an increase of approximately 0.0018 units in the dependent variable, CASHETR. However, the p-value is 0.134, which suggests that ROA is not statistically significant in explaining the variability in CASHETR at the 5% significance level, not corroborating Nascimento (2022). However, this study looked at all non-financial companies

listed on B3, which differs from the current study, which only looked at companies in the electricity sector. When related to the ETR variable, ROA is 0.25%, indicating that holding all other variables constant, an increase of one unit in ROA is associated with an increase of approximately 0.0025 units in the dependent variable, ETR. This suggests that ROA is statistically significant in explaining the variability in ETR at the 5% level, which is in line with Nascimento (2022) and Ariff et al. (2023).

When analyzing the LEV variable in relation to CASHETR, an index of 0.43% was found, which means that keeping all the other variables constant, an increase in LEV is related to an increase of approximately 0.0043 units in the dependent variable CASHETR. The z-value associated with this coefficient is 3.35, and the p-value is 0.002, indicating that this variable is statistically significant in explaining the variability in CASHETR. These results corroborate what was shown in the findings of Nascimento (2022) and Ariff et al. (2023). However, when relating it to ETR, the LEV coefficient is -0.95%, indicating that keeping all other variables constant, an increase of one unit in LEV is associated with a decrease of approximately 0.0095 units in the dependent variable ETR. The z-value associated with this coefficient is -9.07, and the p-value is 0, indicating that the LEV variable is statistically significant in explaining the variability in ETR at a 5% significance level. This result is not consistent with the findings of Ariff et al. (2023), Athira and Ramesh (2023), and Nascimento (2022), where the coefficients obtained were positive.

In addition, the TAM variable has a coefficient of 0.42, which means that the larger the size, the greater the CASHETR. However, the p-value is 0.489, indicating that TAM is not statistically significant in explaining the variability of CASHETR. When related to the ETR, the TAM variable also had no significant effect. These results diverge from the study proposed by Nascimento (2022), who compared all non-financial companies in B3.

5. FINAL CONSIDERATIONS

The aim of this study was to investigate whether COVID-19 had an impact on the fiscal aggressiveness of companies listed on B3 in the electricity sector. To this end, we hypothesized that companies in this sector were more fiscally aggressive during the COVID-19 period (2020 and 2021) than during the other two periods (2019 and 2022). Regression models with fixed-effects panel data were applied to test this hypothesis.

The results showed that the research hypothesis could not be refuted, since the COVID-19 variable proved to be statistically relevant during the pandemic period, indicating that companies were more aggressive when the result of this variable was associated with CASHETR. In other words, companies in the sector were more tax aggressive during the pandemic period, corroborating Athira and Ramesh (2023) and Ariff et al. (2023), Khan and Nawaz (2023) and Nascimento (2022).

It should be noted that no statistically significant results were found in the analysis of the ETR variable. However, there was a reduction in the rate compared to its nominal value, possibly due to tax planning strategies adopted during the period, suggesting an increase in the degree of tax aggressiveness of the companies in question. This conclusion can also be drawn when examining the results of the descriptive statistical analysis, which revealed a decrease in the tax payment rate during the pandemic. This reduction was significantly lower than the nominal rate of IRPJ and CSLL (34 %), and the rate found in another study in the sector (22 %) (Santos & Oliveira, 2020).

This study adds new elements to the literature investigating the impact of crises and extraordinary events on tax management, as most studies show that companies adopt tax reduction actions during a crisis. This is because an important sector of B3, which was greatly affected by COVID-19, was investigated in isolation. The findings show that companies collected less tax during the pandemic, as they looked to tax strategies for mechanisms to cope with the financial crisis and, in some way, improve their economic performance. As a practical contribution, this study demonstrates to different users of accounting information, such as financial analysts and supervisory bodies (Receita Federal do Brasil), that managers in the electricity sector took tax actions during the health crisis to achieve their goals.

In addition, it is essential to highlight as a limitation of this study, the approach of only one sector, although it is of great relevance to the government and society, and one that has been greatly affected by COVID-19. No similar studies were identified that could be used to compare results. In this context, it is recommended that further research be carried out on tax aggressiveness in different sectors and in different countries within the same sector in order to assess the impacts on companies' tax behavior resulting from COVID-19 and other extraordinary situations such as financial crises. This would provide a more in-depth understanding of tax practices in times of crisis and the extent to which managers seek more aggressive alternatives to deal with them.

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