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Tax aggressiveness in a scenario of economic crisis and financial difficulty: an analysis of companies listed on B3

Agresividad tributaria en un escenario de crisis económica y dificultades financieras: un análisis de las empresas listadas en B3

Agressividade tributária em cenário de crise econômica e dificuldade financeira: uma análise em empresas listadas na B3

Authors

Cássia de Oliveira Ferreira

PhD student in Controllershship and Accounting – Federal University of Minas Gerais (UFMG)
Master in Controllershship and Accounting - Federal University of Minas Gerais (UFMG).
Address: Av. Antônio Carlos 6627, Pampulha, Room 2017 Belo Horizonte – MG. Identifiers (ID):

ORCID: <https://orcid.org/0000-0003-4779-8497>

LATTES: <http://lattes.cnpq.br/4055416467748764>

E-mail: cassiaoliveiraf26@gmail.com

Laiz de Fátima Carvalho

PhD student in Controllershship and Accounting - Federal University of Minas Gerais (UFMG)
Master in Controllershship and Accounting - Federal University of Minas Gerais (UFMG).
Address: Av. Antônio Carlos 6627, Pampulha, Room 2017 - Belo Horizonte – MG. Identifiers (ID):

ORCID: <https://orcid.org/0009-0003-2570-4311>

LATTES: <https://lattes.cnpq.br/0082257359690442>

E-mail: laizcarvalho@apicegestaoempresarial.com.br

Otávio Araújo de Carvalho

PhD student in Controllershship and Accounting – Federal University of Minas Gerais - UFMG
Master in Controllershship and Accounting Federal University of Minas Gerais – UFMG.
Address: Av. Antônio Carlos 6627, Pampulha, Room 2017 - Belo Horizonte – MG. Identifiers (ID):

ORCID: <https://orcid.org/0000-0002-4547-6411>

LATTES: <http://lattes.cnpq.br/3732538727837416>

E-mail: otavioaraujo@ufmg.br

Jacqueline Veneroso Alves da Cunha

PhD in Accounting Sciences. Federal University of Minas Gerais – UFMG. Address:
Av. Antônio Carlos 6627, Pampulha, Room 2039 - Belo Horizonte – MG. Identifiers (ID):
ORCID: <https://orcid.org/0000-0003-2522-3035>
LATTES: <http://lattes.cnpq.br/8590544630950327>
E-mail: jvac@face.ufmg.br

Abstract

Objective: This study aimed to examine the relationship between economic crisis scenarios, financial difficulties, and tax aggressiveness in companies listed on B3.

Methodology: This descriptive and documentary study employed a quantitative approach, incorporating a sample of 326 companies. Data analysis entailed using descriptive statistics and regression analysis with panel data.

Results: The findings of this study suggest that a crisis environment does not promote the adoption of aggressive tax strategies by the companies within the sample. This contradicts established literature, which has posited that there is a heightened effort to decrease tax liability during periods of crisis. Nonetheless, it was observed that companies experiencing financial difficulties tend to adopt aggressive tax strategies in an effort to alleviate their tax burdens.

Study Contributions: This research aims to contribute to discussing tax aggressiveness among Brazilian companies during economic crises, pointing out discrepancies with previous studies. Additionally, it seeks to broaden the understanding of tax aggressiveness in situations of crisis and financial difficulty, thereby enhancing the body of knowledge in the tax domain.

Keywords: Tax Aggressiveness, Economic Crisis, Financial Difficulty.

Resumen

Objetivo: El objetivo de este estudio fue comprobar la relación entre escenarios de crisis económica, dificultades financieras y agresividad fiscal en las empresas cotizadas en B3.

Metodología: Este estudio, de carácter descriptivo y documental, adoptó un enfoque cuantitativo, con una muestra compuesta por 326 empresas. El análisis de los datos se realizó mediante estadística descriptiva y análisis de regresión con datos de panel.

Resultados: Los resultados encontrados indican que el entorno de crisis no favorece la adopción de estrategias tributarias agresivas por parte de las empresas de la muestra, contradiciendo lo evidenciado en la literatura, que existe un mayor esfuerzo por reducir la tributación en períodos de crisis. Sin embargo, se identificó que las empresas en dificultades financieras tienden a adoptar estrategias tributarias agresivas, buscando reducir sus cargas tributarias.

Contribuciones del estudio: Este estudio tiene como objetivo enriquecer el debate sobre la agresividad fiscal en las empresas brasileñas durante las crisis económicas, destacando divergencias en relación con investigaciones anteriores. Además, la investigación busca ampliar el conocimiento en el área tributaria, promoviendo la comprensión del perfil de agresividad tributaria en escenarios de crisis y dificultad financiera.

Palabras clave: Agresividad Fiscal, Crisis Económica, Dificultad Financiera.

Resumo

Objetivo: O objetivo deste estudo foi verificar a relação entre os cenários de crise econômica, dificuldade financeira e a agressividade tributária em empresas listadas na B3.

Metodologia: Este estudo, de natureza descritiva e documental, adotou uma abordagem quantitativa, com uma amostra composta por 326 empresas. A análise dos dados foi realizada por meio da estatística descritiva e análise de regressão com dados em painel.

Resultados: Os resultados encontrados apontam que o ambiente de crise não favorece a adoção de estratégias de agressividade tributária pelas empresas da amostra, contradizendo ao evidenciado pela literatura, de que existe um maior esforço para reduzir a tributação em períodos de crise. Entretanto, identificou-se que empresas em dificuldade financeira tendem a adotar estratégias de agressividade tributária, buscando reduzir seus encargos fiscais.

Contribuições do Estudo: Este estudo visa enriquecer o debate sobre agressividade tributária em empresas brasileiras durante crises econômicas, evidenciando divergências em relação a pesquisas anteriores. Além disso, busca ampliar o conhecimento na área tributária, fomentando a compreensão do perfil de agressividade tributária em cenários de crise e dificuldade financeira.

Palavras-chave: Agressividade Tributária, Crise Econômica, Dificuldade Financeira.

1 Introduction

Brazil was identified as having the second-highest tax burden in Latin America in 2022, reaching approximately 33.7% of its Gross Domestic Product (GDP) (Receita Federal do Brasil, 2022). Given this substantial tax imposition, companies must engage in tax planning as a means of diminishing tax-related expenses while enhancing profitability (Vello & Martinez, 2014).

Tax planning facilitates the lawful reduction of tax liabilities, thereby enabling companies to achieve greater efficiency in expenditures and improve their competitive edge (Lietz, 2013; Gomes, 2016; Machado & Medeiros, 2016). Lietz (2013) defined tax planning through the lens of tax aggressiveness, which encompasses the strategies companies employ to minimize tax payments. This often involves exploiting legal ambiguities or interpreting tax legislation advantageously. Strategies may include relocating profits to jurisdictions with lower tax rates, adjusting transfer prices, and other methods aimed at lightening the tax load. Scholes

and Wolfson (1992) argued that tax aggressiveness not only aims to lessen the tax burden but also strives to create value for the company, thereby increasing shareholder wealth.

Martinez (2017) noted the rising interest in and the expanding body of literature on tax aggressiveness. Wilde and Wilson (2017) proposed a framework for categorizing research on this topic, highlighting determinant factors such as (i) organizational characteristics and their link to tax aggressiveness, (ii) regulatory efforts to monitor tax aggressiveness, (iii) incentives at the company level for adopting aggressive tax practices, and (iv) the influence of companies' operational environments on tax aggressiveness, including the economic climate. Martinez (2017) suggested that the last category holds promise for future research.

The literature reveals that companies tend to adopt more aggressive tax strategies during economic downturns as a mechanism to ensure business continuity (Richardson et al., 2015). Conversely, domestic research indicates that aggressive tax maneuvers do not intensify during crises (Momente et al., 2017; Damascena et al., 2017). These discussions, both national and international, focus on the macroeconomic landscape rather than a company's internal conditions (Silva et al., 2014).

Further investigations by Akamah et al. (2020) and Martinez and Silva (2018) correlated financial difficulties within firms with increased tax aggressiveness as companies aim to circumvent insolvency by economizing taxes. Avoiding higher taxes enables financially distressed companies to preserve operating cash, which can alleviate their economic challenges (Rezende et al., 2017). These studies associate financial adversity with an internal economic crisis within companies, independent of the broader macroeconomic environment.

Hence, in periods of economic downturns and financial hardships, companies are under considerable pressure to cut costs and conserve resources. Within such a framework, aggressive tax strategies emerge as a viable approach for companies seeking to mitigate their tax obligations and improve their financial health. Companies facing financial difficulties sometimes require immediate liquidity to address challenges such as debt payment and operational maintenance. Thus, reducing the tax burden can generate additional cash flow, contributing to the necessary liquidity (Martinez & Silva, 2018). During periods of crisis, there is an increased focus on financial results to meet shareholder expectations and ensure company survival (Momente et al., 2017; Damascena et al., 2017). In this context, aggressive taxation may be considered a strategy to enhance short-term results. Moreover, economic crises can lead to adjustments in government policies and tax regulations (Richardson et al., 2015), prompting companies to modify their tax aggressiveness strategies in response, aiming to maximize tax benefits or minimize adverse impacts.

The literature presents inconclusive findings regarding how companies adapt their tax aggressiveness strategies during periods of economic crises and financial difficulties (Richardson et al., 2015; Akamah et al., 2020; Martinez & Silva, 2018; Momente et al., 2017; Damascena et al., 2017), highlighting the need for further investigation.

Given this context, this study aims to answer the following research question: **What is the relationship between economic crisis scenarios, financial difficulties, and tax aggressiveness in companies listed on B3?** Thus, the main goal is to examine the association between economic crisis scenarios, financial difficulty, and tax aggressiveness among these companies.

It is important to note that the years 2015 and 2016, characterized by an increase in corruption, national judicial investigations, and political impeachment proceedings, mark a divergence in the Brazilian context from the global crisis of 2008, which is frequently analyzed in related research (Momente et al., 2017). Furthermore, 2019 and 2020, associated with the

health and economic crisis induced by the COVID-19 pandemic, pose one of the most significant challenges in recent history (Instituto de Pesquisa Econômica Aplicada, 2021).

This study differentiates itself by expanding its temporal scope beyond previously studied periods, incorporating significant domestic and global crises. By analyzing tax aggressiveness in both crisis scenarios (external environment) and financial difficulty scenarios (internal environment), this research aims to provide insights across various contexts. The theoretical contributions of this study include enhancing the understanding of the relationship between economic crises, financial difficulties, and tax aggressiveness in companies listed on B3, covering periods not previously analyzed. Moreover, it seeks to contribute to the literature by examining tax aggressiveness within the Brazilian context, highlighting discrepancies with international findings (Momento et al., 2017; Damascena et al., 2017).

Practically, the study may inform government and tax authorities about tax aggressiveness in companies, serving as an indicator for enhancing control and inspection mechanisms during economic crises. Additionally, research on tax aggressiveness holds significant value in both Brazilian and international academic fields due to the dynamic nature of tax legislation, which influences the behavior of economic agents (Martinez, 2017). Socially, this study offers valuable insights for developing public tax policies in times of crisis and underscores the importance of transparency and corporate responsibility in economically challenging times.

2 Literature Review

2.1 Tax Aggressiveness

Although there has not been a consensus in the literature regarding the concept of tax aggressiveness, Scholes and Wolfson (1992) posited in their seminal work that tax aggressiveness is intended to create value for a company, thereby maximizing shareholder wealth. Martinez (2017) indicated that, within the Brazilian accounting realm, tax aggressiveness encompasses initiatives aimed at reducing companies' tax liabilities.

Chen et al. (2010) characterized tax aggressiveness as a management strategy designed to lower taxable income through deliberate tax management activities. This perspective has guided research towards investigating the determinants influencing tax aggressiveness and the reasons behind variations in its practice among firms (Hanlon & Heitzman, 2010). These investigations have revealed that the determinants of tax aggressiveness are varied, paving the way for a more nuanced comprehension of this phenomenon within corporate tax management.

Significantly, studies such as those by Law and Mills (2017) and Edwards et al. (2016) have examined the association between tax aggressiveness and specific organizational attributes, including company size, sector of operation, the efficacy of internal control mechanisms, and the financial constraints faced by companies. These studies showed that companies experiencing increased financial constraints tend to exhibit heightened levels of tax aggressiveness and that tax aggressiveness is more pronounced among companies with limited cash reserves. Moreover, there have been efforts to associate tax aggressiveness with macroeconomic factors, as demonstrated by Richardson et al. (2015), who found a positive correlation between tax aggressiveness and the 2008 global financial crisis.

This research endeavors to augment our understanding of the factors linked with aggressive tax practices, with a particular emphasis on economic crises and financial hardships as elements that have, to date, seldom been examined jointly in the scholarly literature.

2.2 Economic Crisis Scenario

The concept of crisis is inherently associated with unsustainable economic growth followed by downturns stemming from a variety of issues, including financial sector insolvency, high inflation, and other exogenous events capable of affecting a nation's economy. These consequences are visible through the bankruptcy of businesses, increased unemployment, and the degradation of the population's economic well-being (Roubini & Mihm, 2010).

Within the Brazilian context, crises since the 1980s have been marked by recessions. During the 1980s, Brazil experienced instability characterized by hyperinflation and issues related to foreign debt. The introduction of the Real Plan in 1994 established stability but necessitated considerable adjustments. The Asian financial crisis of 1997–1998 impacted the Brazilian economy, and the 2000s were challenged by issues concerning public debt, leading to the Global Financial Crisis of 2008. The recession from 2014 to 2016, influenced by factors such as the decline in commodity prices, represented another pivotal period. Additionally, the COVID-19 pandemic in 2020 has introduced further economic challenges, underscoring the cyclical and complex nature of the crises influencing Brazil's economic trajectory.

Existing literature demonstrates that in scenarios of economic crisis, organizations strive to lessen their tax burdens, adopting more aggressive tax strategies to ensure business continuity (Edwards et al., 2016; Martinez & Silva, 2018; Momente et al., 2017; Richardson et al., 2015). Nonetheless, findings within the Brazilian context are mixed, indicating that economic crisis does not positively correlate with tax aggressiveness (França et al., 2018).

Accordingly, this study aims to explore the potential relationship between tax aggressiveness and financial difficulty during periods of economic crisis in the Brazilian setting. The underlying hypothesis posits that crises can significantly influence the tax strategies of companies. During economic downturns, organizations are expected to intensify their tax aggressiveness to reduce tax liabilities, thereby protecting their margins and ensuring operational sustainability. This hypothesis suggests that economic uncertainty and the imperative to conserve resources during adverse periods may prompt companies to engage in more aggressive tax behaviors.

2.3 Scenario of Financial Difficulty

The literature does not present a unanimous and consolidated concept of what constitutes financial difficulty (Platt & Platt, 2006). Nevertheless, certain situations can delineate a company's scenario of financial difficulty, either individually or collectively. In this context, studies have endeavored to introduce indices and events capable of identifying companies experiencing financial difficulties, as discussed by Rezende et al. (2017). The authors utilized financial variables such as dry liquidity, asset turnover, and equity over liabilities to distinguish companies in financial difficulty. The findings enhance predictability concerning financial distress and aid managers in decision-making processes and in selecting strategic actions conducive to returning the company to financial health (Inekwe et al., 2018).

Beaver (1966) was among the first to address the concept of financial difficulty in the literature, characterizing it through the disclosure of events such as (i) securities default, (ii) overdrawing of bank accounts, and (iii) non-payment of preferred share dividends. Moreover,

according to Wruck (1990), a company is deemed financially difficult when its cash flow is insufficient to meet current obligations.

Subsequently, Pindado et al. (2008) and Tinoco and Wilson (2013) introduced a definition of financial difficulty based on two factors: (i) earnings before interest and taxes, depreciation, and amortization (EBITDA) being lower than financial expenses for two consecutive years, indicating inadequate operational resource generation to cover financial obligations; and, (ii) a decline in the company's market value for two consecutive periods.

Pindado et al. (2008) and Tinoco and Wilson (2013) argue that these approaches are valid as an EBITDA lower than debt interest expenses signifies that the company lacks operational profitability sufficient to fulfill its financial commitments. Additionally, Pindado et al. (2008) highlighted that both the market and stakeholders are likely to perceive negatively an organization that reports adverse operating results (the first condition) until the situation is rectified and the company's financial status is restored.

This research posits that a decline in market value over two consecutive years signals potential financial challenges faced by a company. The method adopted seeks to identify financial difficulty in organizations under study by using the decrease in market value as a benchmark. Therefore, this research proposes that financial difficulty, characterized by this consecutive decline, correlates with the implementation of more aggressive tax management strategies by these companies.

3. Methodology

3.1 Typology, Population and Sample

This study can be categorized as descriptive, documentary, and ex-post facto. It adopts a quantitative approach to address the research problem (Martins & Theophilo, 2016). The population of this study comprises all the companies listed on the B3 stock exchange from 2010 to 2022. This timeframe is selected because 2010 marks Brazil's inaugural year of international accounting standards application, while 2022 represents the most recent full calendar year for which financial statements were accessible at the time of this research.

The final sample included 326 companies with the necessary variables for analysis throughout the period. It was essential to omit 111 companies from the study due to incomplete data across the 13-year period. Regarding the sectoral breakdown of the sample, companies operating within the public utility sector predominated, accounting for 21.66%, followed by those in the industrial goods (16.62%) and cyclical consumption (15.23%) sectors.

Data collection was executed via the Eikon Refinitiv database, encompassing variables such as the effective tax rate (ETR), market value of the company, EBIT/EBITDA, and total assets. Following the data collection phase, it was consolidated into a database, with a specific focus on reviewing the data to ensure its integrity. The analysis, encompassing modeling and statistical testing, was performed using the R software and the RStudio environment. This analytical framework is recognized for its robustness and efficacy in conducting statistical analyses.

3.2 Measurement of Variables and Data Collection

The dependent variable in this study represents the tax aggressiveness of the sampled companies, employing the ETR as the chosen proxy. Among the various proxies identified in

the literature, the ETR is frequently utilized to assess tax aggressiveness, particularly in the context of publicly traded companies (Stickney & McGee, 1982; Ramalho & Martinez, 2014). In numerous studies, the ETR is calculated by dividing income tax and social contribution on net income expenses by accounting for profit before taxes (Hanlon & Heitzman, 2010; Gomes, 2016).

Moreover, the literature identifies additional proxies for tax aggressiveness, including book-tax differences (BTD), which represent the discrepancy between accounting profit and taxable income; the cash ETR, reflecting the actual rate of taxes paid; the differences in tax (Dtax), tax shelter, marginal tax rate, and unrecognized tax benefits (UTB), the latter signifying unrecognized tax benefits (Gomes, 2021). Selecting the ETR as the most appropriate proxy for this study is predicated upon its analysis of taxes as calculated within the calendar year, thus excluding the cash transaction information associated with the cash ETR. It is crucial to note that companies may defer tax payments for reasons unrelated to tax aggressiveness, such as financial constraints, which do not necessarily indicate noncompliance with tax authorities.

Regarding BTD, the differentiation between accounting and taxable income can be temporary, complicating the analysis of a company's tax aggressiveness. Furthermore, both UTB and Dtax focus predominantly on evaluating tax aggressiveness through unrecognized tax benefits, which may not align with the objectives of this investigation.

In this context, Table 1 delineates the variables utilized in the study. It is important to note the strategy of employing the logarithm of the variables to linearize the relationship between them, enhancing the suitability of the equation for statistical analysis.

Table 1

Description of the variables.

Variable	Description	Operationalization	Expected effect	Basis
ETR	Effective tax rate	$ETR = (\text{expenses with } IRPJ + CSLL) / LAIR$	Not applicable	Stickney and McGee (1982)
CRISIS	Economic recession	Dummy - GDP decrease between one period and the next gets 1, 0 otherwise	-	Damascena et al. (2018)
D-FIN	Financial difficulties	Dummy - Company classified in financial difficulty (market value for two consecutive years) receives 1, 0 otherwise	-	Rezende et al. (2017) Pindado et al. (2008)
CRISIS*D-FIN	Interaction between economic recession and financial difficulty	CRISIS*D-FIN	-	Richardson et al. (2015)
LEV	Financial leverage	EBIT/EBTDA	-	Richardson et al. (2015) Edwards et al. (2016)
SIZE	Active	Active	-	Rezende et al. (2017) Pindado et al. (2008)

Source: Research data.

To achieve the stated objective and elucidate the dependent variable (i.e., ETR), the study selected independent variables that embody an economic crisis at the macro level and financial distress at the firm-specific context. The Economic Crisis variable captures the

scenario of economic recession in Brazil's GDP, as utilized in recent studies to depict a macroeconomic downturn (Damascena et al., 2018; Santana et al., 2021). The periods identified as experiencing economic recession, marked by a decline in GDP, include 2011, 2014, 2015, 2016, and 2020.

Grounded in the assumption that companies in a recessionary economy may encounter substantial financial strain, it is posited that to alleviate these pressures, firms might engage in strategies to minimize costs, including optimizing tax obligations. Such strategic adjustments in tax strategies can lead to a decrease in ETR, which often signifies a reduced effective tax burden relative to taxable income, potentially indicating higher tax aggressiveness.

The proxy delineated by Rezende et al. (2017) was employed to examine the financial distress within the studied companies. These authors designed a model to forecast financial distress, categorizing it as a precursor for company insolvency. According to their model, a firm is considered financially distressed if it experiences a decline in market value between two consecutive periods, with the period subsequent to this decline marked as the entry into financial distress.

Accordingly, it is hypothesized that the financial distress variable will exhibit an inverse relationship with the ETR, similar to the anticipated effect of the crisis variable. The implication is that financial difficulty correlates with a lowered ETR, indicating increased tax aggressiveness. Like during economic crises, firms facing financial distress might revise their tax policies to navigate these challenges, potentially leading to enhanced tax optimization and efficiency efforts.

Incorporating the approach by Richardson et al. (2015), the interaction between Economic Crisis and Financial Difficulty (CRISIS*D-FIN) variable was introduced to examine the relationship between Economic Crisis and Financial Difficulty in the context of tax aggressiveness. Moreover, control variables were selected based on the research by Rezende et al. (2017), Pindado et al. (2008), and Richardson et al. (2015). The "Assets" variable was selected to represent company size, while the Financial Leverage (LEV) variable indicates the firm's reliance on external capital. This leverage context is posited to affect tax aggressiveness, especially during periods of economic crisis and financial difficulty (Richardson et al., 2015).

An increase in financial leverage typically results in higher costs associated with interest and financial expenses, which can influence taxable profits and decrease ETR. Companies employing debt financing benefit from tax deductions on interest payments, reducing ETR, suggesting a lower effective tax burden relative to taxable income, and, by extension, heightened tax aggressiveness. Thus, an inverse relationship between financial leverage and ETR is anticipated.

Moreover, firms with substantial assets often possess dedicated tax departments capable of engaging in proactive tax planning. This may involve exploiting legal tax loopholes, utilizing tax incentives efficiently, and implementing tax-minimizing structures aimed at reducing ETR. Consequently, it is logical to predict an inverse relationship between ETR and company size, as larger firms with the requisite resources and tax planning expertise are better positioned to implement strategies that effectively minimize their tax burdens.

3.3 Data Analysis Procedures

To analyze the data, we first applied descriptive statistics to illustrate the characteristics of our sample, including measures of central tendency and variability. Subsequent analysis involved regression, deemed appropriate for exploring the dependence relationships between a

variable of interest and two or more independent variables (Gujarati, 2011). Constructing an accurate econometric model is crucial, considering the temporal and spatial organization of the data. Given the nature of our sample and the data set, we chose to use panel data modeling (Wooldridge, 2002).

The period under review spans from 2010 to 2022. Wooldridge (2010) notes that studies utilizing longitudinal data typically estimate model parameters through one of three panel data analyses: (i) the pooled ordinary least squares model, (ii) the fixed effects model, and (iii) the random effects model. Selecting among these models requires careful consideration of the data's characteristics and limitations, supported by specific diagnostic tests.

This study employed the Chow test, the Breusch-Pagan Lagrange multiplier (LM) test, and the Hausman test. Table 2 presents the hypotheses tested and the decision rules corresponding to the results obtained.

Table 2

Panel data model specification tests

Test	Hypotheses	Decision Rule
Chow test	H ₀ : Pooled H _a : Fixed effects	Prob > F = 0.05 H ₀
Breusch-Pagan test	H ₀ : Pooled H _a : Random effects	Prob > chibar2 = 0.05 H ₀
Hausman test	H ₀ : Random effects H _a : Fixed effects	Prob>chi2 = 0.05 H ₀

Source: Prepared by the authors.

The initial analysis undertaken was the Chow test, which assesses the appropriateness of adopting fixed effects (FE) over the pooled approach. This test articulates the null hypothesis (H₀) as favoring the pooled approach, with the alternate hypothesis (H₁) suggesting the preference for FE (Wooldridge, 2010). Subsequently, the study applied the Breusch-Pagan LM test to make an informed choice between the random effects (RE) model and the pooled approach (Gujarati & Porter, 2010). The final comparative analysis involved the Hausman test to discern the more suitable model between RE and FE (Gujarati & Porter, 2011; Fávero et al., 2015).

Following the specification of the most fitting model, the investigation proceeded to examine the assumptions regarding the residuals of this model. The variance inflation factor (VIF) was computed to identify the presence of multicollinearity among the explanatory variables, with VIF values exceeding 10, signaling significant collinearity (Fávero et al., 2015). The investigation next employed the Wald test to assess the presence of heteroscedasticity. Upon confirmation of heteroscedasticity, the study further examined the assumption of serial correlation in the residuals by implementing the Wooldridge test.

4. Analysis of Results

Table 3 presents the descriptive statistics of the dataset, including means, standard deviations, and the range (minimum and maximum values) of the quantitative variables employed in this research. It is important to highlight that the variables economic crisis (CRISIS), financial difficulty (D-FIN), and the interaction between economic crisis and financial difficulty (CRISIS*D-FIN) are categorized as dummy variables, while the remaining variables are continuous. Moreover, frequency analysis was conducted for these variables.

The ETR exhibits a substantial variation, with values ranging from -331 to 54.72. This variation indicates a considerable heterogeneity in the levels of tax aggressiveness among the companies analyzed. The mean ETR of -0.03, along with a standard deviation of 7.08, suggests that the distribution of the data is asymmetrical and characterized by the presence of extreme values. Particularly noteworthy is the negative coefficient of variation of -236%, which points to a significant variability with respect to the mean. This variability, marked by exceedingly low values, underscores the necessity for further investigation to comprehend the nature and ramifications of these disparities in the tax efficiency of the companies under study.

Table 3

Descriptive statistics.

Variable	Maximum	Minimum	Mean	Standard Deviation	Coefficient of Variation
ETR	54.72	-331	-0.03	7.08	-236%
SIZE	28.47	12.92	21.73	2.17	0.1%
LEV	1	-323.0485	0.45	6.03	13.19%

Source: Research data.

Analysis of the Size variable reveals a range of variation from 12.92 to 28.47, with a mean of 21.73 and a standard deviation of 2.17. The coefficient of variation, 0.1%, indicates relatively low variability in relation to the mean, suggesting consistency in the dimensions assessed. This pattern suggests that the companies in the study exhibit similar sizes, contributing to a more homogeneous analysis of this characteristic.

The LEV variable ranges from -2.0360 to 4.5747, with a mean of 0.7274 and a standard deviation of 0.9825. The coefficient of variation, 13.19%, underscores significant variability in leverage levels, indicating diverse capital structures among the analyzed companies. This variance in data suggests that some companies may be more financially leveraged than others, which can significantly influence risk management and tax decision-making processes.

The frequency of the CRISIS variable is notably significant, occurring in almost a third of the situations analyzed. Conversely, the variable representing D-FIN shows a frequency of 13.90% throughout the study period, indicating a moderate prevalence of this phenomenon among the companies investigated. However, a standard deviation of 0.35 suggests considerable dispersion of the data around the mean, indicating significant variability in the levels of financial difficulty experienced by the companies. The highest frequency of financial difficulty, 33%, was observed in companies within the sample in 2014, a year characterized by an economic recession.

The variable representing the interaction between crisis and financial difficulty (CRISIS*D-FIN) shows a mean of 0.06, indicating a moderate presence of this interaction in the observations. However, a standard deviation of 0.25 points to considerable variability in the data, suggesting that the relationship between crises and financial difficulties varies substantially among the companies analyzed. The coefficient of variation, reaching 3.57%, emphasizes this variability concerning the mean, suggesting that companies respond in remarkably different ways during periods of crisis in terms of financial difficulties. This wide range of data highlights the complexity of this interaction, indicating that the impact of crises on the financial status of companies does not follow a uniform pattern, which can have significant implications for the formulation of tax strategies during adverse periods.

To analyze differences in tax aggressiveness among the companies across economic sectors, we applied the Kruskal-Wallis test to assess differences in means. Table 4 presents the median ETR values, segmented by the economic sectors included in the sample.

An analysis of ETR by sector indicates that the financial and public utility sectors exhibit the highest mean ETRs, 0.1804 and 0.1955, respectively, characterizing these sectors as exhibiting low tax aggressiveness. In contrast, the lowest mean ETRs are found in the information technology, communications, cyclical and non-cyclical consumption, others, oil, gas, and biofuels sectors, demonstrating that these sectors are more aggressive in terms of taxes.

Table 4

Median ETR values per economic sector and Kruskal Wallis test.

Economic sector	Mean ETR	Standard deviation	Observations
Industrial goods	0.0879	1.67	728
Communications	0.0000	0.23	195
Cyclical consumption	0.0000	10.85	949
Non-cyclical consumption	0.0000	1.68	312
Finance	0.1804	11.49	546
Basic materials	0.0924	1.0	351
Others	0.0000	1.4	286
Oil, gas, and biofuels	0.0000	14.73	130
Health	0.0990	1.38	234
Information technology	0.0000	0.60	117
Public utility	0.1955	2.44	533
Kruskal-Wallis (Chi-Square statistics)	166.345***		

Note: The statistical significance of the tests is represented using the indicators *10%, **5%, and ***1%.

Source: Research data.

The findings indicate variations in the levels of tax aggressiveness across the economic sectors of Brazilian companies, which may be attributed to the structure of the country's tax legislation. This legislation grants tax benefits to certain products, services, or sectors based on principles of "selectivity and essentiality," leading to disparities in the tax burden. Consequently, companies that do not receive these tax incentives may face higher taxation, potentially prompting them to adopt more aggressive tax strategies as a form of compensatory justice.

Table 5 presents the annual ETR means, categorized by the financial condition of the companies. The data reveals fluctuations in the ETR means over the years, with companies not experiencing financial difficulties exhibiting relatively stable ETRs compared to their financially distressed counterparts, demonstrating greater volatility. Specifically, during 2018, 2019, and 2021, the lowest ETRs were observed among companies facing financial difficulties, suggesting increased tax aggressiveness in these periods. This pattern may reflect a strategic attempt to reduce tax liabilities during times of economic downturn following years marked by recession. This behavior suggests companies' efforts to alleviate the negative financial consequences of such economic challenges.

This analysis aligns with Damascena et al. (2018), who found that companies with financial constraints could exhibit higher ETRs, except during economic crises, when the trend may reverse. Financially constrained companies might be more inclined to decrease their ETRs during crises, attributed to heightened operational risks during economic instability. Additionally, Santana et al. (2021) observed that despite reductions in profitability rates during economic recessions, direct taxes might not significantly change, owing to the reliance of tax adjustments on the accounting outcomes.

Table 5*Mean ETR per year.*

Year	Mean ETR of companies without financial difficulties	Mean ETR of companies in financial difficulty	Mean ETR
2010	0.3238	-	0.3238
2011	0.3532	0.4193	0.3610
2012	0.3169	0.3687	0.3220
2013	0.3047	0.3762	0.3125
2014	0.3111	0.3110	0.3111
2015*	0.3184	0.2831	0.3131
2016*	0.3777	1.1970	0.4438
2017	0.3600	0.4281	0.3643
2018	0.2712	0.1491	0.2633
2019	0.3316	0.1839	0.3297
2020*	0.3573	0.4246	0.3603
2021	0.2746	0.0561	0.3307
2022	0.1085	0.2379	0.1361
Mean ETR	0.0099	0.0973	0.0528
	Difference in the means test	0.4242	

*Periods of economic recession.

Source: Research data.

Companies may escalate their engagement in aggressive tax practices due to the associated benefits and risks. Furthermore, credit-constrained companies may intensify these practices to diminish tax payments and finance their operations (Richardson et al., 2015) and generate internal cash (Edwards et al., 2016).

While the ETR means that over various years, it offers valuable insights into the tax practices of companies during different periods, the p -value of 0.4242, as indicated by the t -test, suggests insufficient evidence to reject the null hypothesis. This implies that the difference between the means is not statistically significant. As a result, there is no statistical evidence supporting the claim that there are significant differences in the ETR means between companies experiencing financial difficulties and those that are not. Nevertheless, this conclusion should be considered in the broader context of the study. Although the t -test did not reveal statistically significant differences in the ETR means between financially distressed companies and their counterparts, econometric modeling enabled the identification of the statistical significance of the D-FIN variable on the ETR variable.

Table 6 displays the outcomes of the econometric modeling alongside the validation statistics. The regression model applied was adjusted using statistical tests derived from the literature to validate its appropriateness.

Table 6*Validation and estimation of the proposed model.*

Random Effects Model		
Variable	Coefficient	p -value
CRISIS	-0.1223	0.6374
D-FIN	-1.4964	**
CRISIS*D-FIN	1.5930	*
LEV	0.0043	0.8287
LNATIVE	-0.1146	0.0900

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Constant	2.6994	0.0708
No. of observations		3195
No. of companies		326
Chow		0.0006247***
Breusch-Pagan		0.9497***
Hausman		0.0070
Wooldridge		0.02542
Wald		53.70***

Note: The statistical significance of the tests is represented using the indicators *10%, **5%, ***1%.

Source: Research data.

Several tests, including the Chow, LM, Breusch-Pagan, and Hausman tests, were employed to determine the most suitable panel data model for this research. The Chow test was first applied to assess the appropriateness of FE versus pooled models, positing the null hypothesis (H_0) as pooled and the alternative hypothesis (H_1) as FE (Wooldridge, 2010). Subsequently, the Breusch-Pagan LM test was utilized to choose between the RE and pooled models (Gujarati & Porter, 2010), followed by the Hausman test, which facilitated the choice between RE and FE models (Gujarati & Porter, 2010).

The presence of multicollinearity among explanatory variables was also examined through the VIF test. As noted by Gujarati and Porter (2011), a VIF value exceeding 10 indicates significant collinearity. The outcomes revealed a mean VIF of 1.31, suggesting the absence of multicollinearity.

The Wald test was conducted to diagnose heteroscedasticity issues, calculating a statistic for group heteroscedasticity in residuals within a fixed-effect regression model. According to the Wald test, the null hypothesis stipulates that the model's residuals are homoscedastic, whereas the alternative hypothesis points to significant heteroscedasticity. The test's findings, significant at the 1% level, indicated heteroscedasticity problems.

Following the detection of heteroscedasticity, the assumption of serial correlation of residuals was evaluated employing the Wooldridge test, which confirmed no autocorrelation. In light of heteroscedasticity, the robust standard error model proposed by White was adopted to address this issue (Gujarati & Porter, 2011; Fávero et al., 2015).

The model validation tests deemed random effects estimation suitable, with heteroscedasticity adequately corrected by robust standard errors. The empirical analysis demonstrated that D-FIN exerts a negative and significant influence on the ETR, in alignment with existing literature (Pindado et al., 2008; Rezende et al., 2017; Martinez & Silva, 2018; Akamah et al., 2020). This study found that companies experiencing financial difficulties tend to use aggressive tax mechanisms to improve their financial outcomes. This finding supports the existing literature which posits that financial distress negatively influences tax aggressiveness. In scenarios of financial difficulty, companies from the sample were observed to adopt measures aimed at mitigating the impact on their results, thereby reducing their ETR.

However, when examining the occurrence of tax aggressiveness post-economic crisis, marked by a reduction in GDP between the periods under study, this variable was discovered to exert no significant influence on ETR. A significant and negative relationship was anticipated, supporting the findings of national studies (Damascena et al., 2018; França et al., 2018), which suggested that aggressive tax practices do not intensify during periods of crisis, potentially attributable to a heightened sense of conservatism among managers due to an increased risk of scrutiny. The non-significance of the Economic Crisis variable in this analysis might be explained by the unique characteristics of the sample, predominantly comprising

public utility companies (21.66%). These entities often prioritize value maximization strategies that are not centered on taxation.

The outcomes of this investigation are consonant with the conclusions of Santana et al. (2021), who contended that even against a backdrop of declining profitability indices during economic recessions, direct taxes may not undergo significant fluctuations. This phenomenon can be attributed to tax adjustments contingent upon the accounting result. The consistency in these findings underscores the critical role of tax adjustments in maintaining the stability of direct taxes across different economic conditions.

Moreover, the interaction variable between Economic Crisis and Financial Difficulty was found to be statistically significant, albeit with a positive relationship, diverging from the anticipated outcome of this study. The implications suggest that in times of crisis and financial difficulty, companies exhibit higher ETR, indicative of reduced tax aggressiveness. This stands in contrast to the assertions of Damascena et al. (2018), who posited that financially distressed companies, particularly during economic downturns, seek to minimize taxation costs more aggressively than their unrestricted counterparts. Hence, macroeconomic crises were presumed to elicit a generalized uptick in tax aggressiveness, especially among financially distressed firms driven to engage in aggressive tax behaviors.

The variables pertaining to LEV and SIZE were not found to be statistically significant, rendering it impossible to ascertain a relationship between a company's size and capital structure and its tax aggressiveness. This is contrary to findings reported in extant literature (Richardson et al., 2015; Edwards et al., 2016; Rezende et al., 2017; Pindado et al., 2008), indicating an association between increased financial leverage and reduced ETR—highlighting greater tax aggressiveness. Additionally, it was anticipated that larger companies possessing the means for proactive tax planning would be able to optimize their tax obligations, suggesting an inverse relationship between ETR and asset size.

5. Final considerations

The aim of this study was to explore the relationship between economic crisis scenarios, financial difficulty, and tax aggressiveness among companies listed on B3 from 2010 to 2022. The selection of this period was justified by the mandatory adoption of the International Financial Reporting Standards in Brazil starting in 2010. The research utilized descriptive statistics and regression models for panel data to operationalize the data.

The primary finding of this study indicated that companies experiencing financial difficulties are more inclined to adopt aggressive tax strategies as a measure to reduce their tax burden. This behavior can be attributed to the companies' efforts to mitigate adverse impacts on their financial outcomes during challenging times. Furthermore, the study revealed differences in tax aggressiveness across various economic sectors, suggesting that the sector in which a company operates can influence its level of tax aggressiveness, possibly due to tax benefits allocated to specific sectors, thereby lowering these companies' effective tax rates.

Another significant finding was that the Economic Crisis variable did not notably influence tax aggressiveness. This outcome aligns with several findings in the existing literature but contrasts with research conducted by Santana et al. (2021), which found that, despite decreased profitability during periods of economic recession, direct taxes did not exhibit statistically significant variations. Additionally, this study demonstrated the statistical significance when examining the interplay between Economic Crisis and Financial Difficulty, albeit in an unexpected direction. This contradicted the findings of Damascena et al. (2018),

who suggested that companies under financial constraints during economic crises are likely to reduce their tax expenditures.

It is important to acknowledge that the outcomes of this study are constrained to the selected period and sample. Therefore, to broaden the understanding of this topic, future research should consider different samples and periods, as well as incorporate additional control variables. Given the diverse methods available for measuring tax aggressiveness in the literature, forthcoming studies could also benefit from employing alternative proxies for this variable.

This research contributes to the ongoing debate and advancement in the field by highlighting discrepancies among previous studies' findings. In addition, it aids in spreading knowledge in taxation and fosters a deeper comprehension of how economic crises and financial difficulties shape tax aggressiveness profiles. By focusing on companies listed on B3, the study provides insights into potential patterns or trends in tax aggressiveness across specific sectors during crises, information that could be of value to investors, regulators, and tax policymakers.

Furthermore, the study offers perspectives on how companies adjust their tax aggressiveness strategies in response to economic crises and financial challenges. These insights are instrumental for understanding companies' strategies.

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