

The Moderating Effect of Tax Risk on the Relationship Between CEO Duality and Tax Aggressiveness in Brazilian Publicly Traded Companies

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Abstract: This study examines the moderating effect of tax risk on the relationship between CEO duality and tax aggressiveness in Brazilian publicly traded companies. The analysis addresses the corporate governance and taxation literature by focusing on leadership structure and tax risk within an emerging-market context characterized by high tax burdens and regulatory complexity. The empirical analysis relies on panel data from 159 firms over the 2010–2024 period, comprising 1,321 firm-year observations, and employs the Feasible Generalized Least Squares (FGLS) estimator. Tax aggressiveness is assessed using effective tax rate (ETR) and cash ETR measures, while tax risk is proxied by the volatility of these indicators. The results indicate a positive and statistically significant association between CEO duality and ETR, whereas no statistically significant association emerges for cash ETR. Given the conventional inverse interpretation of ETR and cash ETR as proxies for tax aggressiveness, the positive ETR coefficient indicates higher effective taxation and, consequently, lower tax aggressiveness. Tax risk exhibits a positive and statistically significant moderating effect on the relationship between CEO duality and tax aggressiveness when measured by cash ETR, suggesting lower tax aggressiveness under higher tax risk among firms with CEO duality. COVID-19 effects vary across tax aggressiveness measures and models. The findings contribute to the literature by highlighting the joint relevance of leadership structure and tax risk for corporate tax decisions in emerging markets.

Keywords: CEO duality, tax aggressiveness, tax risk, corporate governance, effective tax rate, Brazilian publicly traded companies.

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INTRODUCTION

Topics such as corporate taxation and tax aggressiveness have become central to debates on corporate governance, transparency, and organizational sustainability, particularly in emerging economies. This growing interest reflects both the practical and theoretical relevance of corporate tax behavior, as firms' tax strategies



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directly affect government revenues, tax equity, and business competitiveness. Beyond mere compliance with tax laws, tax decisions represent strategic choices that may influence financial performance, institutional reputation, and relationships with stakeholders. Consequently, corporate tax behavior has increasingly been recognized as an important dimension of corporate governance and organizational responsibility.

In countries such as Brazil, which is characterized by a high tax burden and considerable legislative complexity, understanding the determinants of tax aggressiveness is essential for examining the interactions between firms, the state, and society (Arpini, Ritter, & Piccoli, 2020; Gomes, Nossa, Moreira, & Teixeira, 2022; Hoppe, Schanz, Sturm, & Sureth-Sloane, 2019). The literature generally conceptualizes tax aggressiveness as a continuum of corporate tax strategies, ranging from legitimate tax planning to more aggressive practices that, although not necessarily illegal, may be perceived as opportunistic. Armstrong, Blouin, and Larcker (2012) conceptualize the phenomenon as the extent to which the effective tax burden is reduced through such strategies. This definition is particularly relevant in emerging economies, where institutional weaknesses and regulatory ambiguities blur the boundary between legitimate tax planning and aggressive practices.

Empirical studies typically measure tax aggressiveness using proxies based on effective tax rates, particularly the effective tax rate (ETR) and the cash effective tax rate (cash ETR). These measures capture the level of taxation effectively borne by firms, thereby allowing indirect inference of the degree of tax aggressiveness. Although widely used, these proxies do not fully distinguish between legitimate tax planning and more aggressive practices and are best understood as approximations of corporate tax behavior. Moreover, these metrics may reflect distortions arising from the complexity of the tax system, differences in tax bases, or the legitimate use of tax incentives (Abd-Elmageed, Abdel Megeid, & ElSayed, 2020; Adela, Agyei, & Peprah, 2023; Hoopes, Langetieg, Maydew, & Mullaney, 2024; Kolias & Koumanakos, 2022).

Corporate tax aggressiveness has been extensively investigated within the accounting and corporate governance literature, particularly in institutional environments characterized by high regulatory complexity and substantial tax burdens, such as Brazil (Arpini et al., 2020; Gomes et al., 2022; Hoppe et al., 2019). This literature emphasizes the role of institutional and organizational mechanisms in shaping firms' tax strategies. Prior studies indicate that board composition, audit practices, executive compensation, and ownership structure can significantly influence corporate tax behavior (Klassen, Lisowsky, & Mescall, 2016; Richardson, Taylor, & Lanis, 2016).

Within this context, CEO duality stands out (the situation in which the same individual holds both the board chair and CEO positions). This concentration of power may foster conflicts of interest and decisions aligned with executives' private objectives, including in the tax domain (Dávila-Velásquez & Lagos-Cortés, 2020; Goergen, Limbach, & Scholz-Daneshgari, 2020; Osazevaru, 2022). Although some studies treat duality solely as a control variable (Azmi, Abd Hamid, Ismail, & Palil, 2024; Khelif, Samaha, & Amara, 2021; Kolias & Koumanakos, 2022), its impact on tax aggressiveness warrants more thorough investigation, especially in emerging economies.

In Brazil, research on this topic remains limited. Prior studies have examined the relationship between CEO duality and the effectiveness of compliance systems (Soares, Nossa, Brugni, & Fully, 2024) or its direct association with tax aggressiveness among companies listed on the B3 stock exchange (Proner, Trevizan, Batistella, & Einsweiler, 2021; Sant'anna & Júnior, 2019). However, significant gaps remain regarding the factors that may moderate the strength of this relationship. Among these factors, tax risk is particularly noteworthy.

Tax risk is the uncertainty surrounding the outcomes of firms' tax strategies, including the possibility of tax audits, penalties, interest charges, and reputational damage. Beyond reflecting the variability of tax outcomes, tax risk shapes managerial decision-making by altering the risk-return trade-off inherent in tax strategies. Prior studies have documented its association with tax aggressiveness (Choi & Park, 2022; Mangoting, Yuliana, Effendy, Hariono, & Lians, 2021; Saragih & Ali, 2023); however, evidence on its moderating role in the relationship between CEO duality and tax aggressiveness remains scarce, particularly in emerging markets. This study seeks to address this gap.

The relevance of this investigation is heightened by the Brazilian context, which features the highest tax burden in Latin America, along with high regulatory complexity and significant compliance costs (Hoppe et al., 2019; Nguyen, Pham, Prior, & van Hemmen, 2022). Furthermore, the Brazilian stock market exhibits distinctive

governance characteristics and ownership concentration patterns that may shape corporate tax behavior. This institutional environment combines the challenges typical of emerging economies with the pressures of global markets, making Brazil a particularly compelling case for investigation (Lima, da Silva, & Lucena, 2022).

Against this backdrop, this study seeks to answer the following research question: What is the moderating effect of tax risk on the relationship between CEO duality and tax aggressiveness in Brazilian publicly traded companies? Accordingly, the central objective is to analyze how tax risk moderates this relationship.

This research makes several contributions to the literature. First, it advances scholarship on corporate governance and tax behavior by treating CEO duality as a central independent variable. Second, it provides additional evidence that tax risk conditions tax aggressiveness, showing that higher-risk environments may prompt more conservative tax positions. Finally, it offers an empirical contribution by examining the phenomenon in the Brazilian context, where the tax structure and institutional environment differ markedly from those of the developed economies predominantly examined in the international literature.

Beyond its academic contributions, the study carries significant practical implications. For regulators and policymakers, understanding how organizational power structures influence tax decisions may inform the design of rules to promote fiscal transparency and equity. For investors and governance practitioners, the findings offer a basis for assessing risks associated with corporate tax practices. For society at large, the research contributes to ongoing debates on tax justice and tax compliance, issues of particular relevance in countries marked by high tax burdens and pronounced social inequality.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Scholars have examined factors that influence tax cost reduction and, in turn, corporate behavior (Callahan, Plečnik, & Ryou, 2024; Hutchens, Rego, & Williams, 2024). This debate has primarily unfolded in the U.S. and Europe, driven by the growing recognition that most firms seek to minimize their tax burden.

In accounting and corporate governance, this discussion is typically framed along a continuum of tax-planning practices, ranging from lawful tax-efficiency decisions to more aggressive strategies that may be scrutinized by tax authorities. In this study, tax aggressiveness is understood as the extent to which a firm reduces its effective tax burden, without necessarily implying illegality. This delimitation is relevant because metrics such as ETR and cash ETR capture effective tax rates but, in isolation, do not permit the conclusion that any regulatory violation has occurred.

The topic gained greater visibility after media coverage of cases involving large corporations such as Apple, Starbucks, and Facebook, reinforcing the perception that this behavior is widespread in the business environment. However, empirical evidence indicates that many firms in the US and Europe pay significant taxes every year (Kovermann & Velte, 2019; Thomsen & Watrin, 2018).

Beyond its economic dimension, tax aggressiveness has attracted growing social attention, largely driven by extensive media coverage of these practices (Chen, Schuchard, & Stomberg, 2019; Qi, Li, & Zhang, 2023). In the United States, tax legislation varies across sectors, resulting in different levels of effective taxation. European countries such as Belgium and France also report high levels of effective tax collection (Thomsen & Watrin, 2018).

Tax aggressiveness may be viewed favorably for its potential to increase profits and cash flows. However, it may also entail high additional costs, including fines and penalties from tax audits (Boussaidi & Hamed-Sidhom, 2021; Martinez, 2017). Corporate tax decisions, therefore, involve a trade-off: while reducing the tax burden may generate economic benefits, more aggressive strategies tend to amplify tax, reputational, regulatory, and monitoring risks (Adela et al., 2023; Tran et al., 2023).

CEO duality occurs when an individual simultaneously holds the roles of board chairman and CEO (Dávila-Velásquez & Lagos-Cortés, 2020; Goergen et al., 2020; Osazevaru, 2022). From an agency theory perspective, this concentration of roles is criticized for expanding the CEO's power and influence over the board of directors, potentially compromising the board's independence, effectiveness, and oversight capacity (Fama &

Jensen, 1983; Jensen & Meckling, 1976). Under this view, CEO duality is presumed to weaken control mechanisms and broaden the scope for opportunistic managerial decisions, including the adoption of tax strategies to maximize accounting results, cash flows, or executive compensation.

Stewardship theory, by contrast, argues that CEO duality can benefit the firm by promoting more integrated leadership and greater decisional agility (Dahya, Lonie, & Power, 1996; Hassan, Hijazi, & Naser, 2017). In this framework, the concentration of roles does not necessarily indicate board capture or managerial opportunism; rather, it may foster strategic unity, faster decision-making, and alignment between the formulation and execution of corporate strategies. In the tax domain, this suggests that CEOs with greater centralized decision-making authority may encourage tax-reduction strategies while avoiding excessively risky practices that could jeopardize long-term organizational sustainability.

In the context of US firms, Minnick and Noga (2010) analyzed the relationship between CEO duality and tax planning, finding no evidence that duality leads firms to adopt aggressive tax behavior. In contrast, Amri, Ben Mrad Douagi, and Guedrib (2023), examining Tunisian firms, found that CEO duality positively affects tax aggressiveness. Armstrong, Blouin, Jagolinzer, and Larcker (2015), in turn, investigated whether incentives granted to tax directors were associated with lower effective tax rates and more aggressive tax planning. Their results indicated that firms encourage tax managers to reduce the impact of taxes on net income, prioritizing accounting results over cash flow outcomes.

These findings are consistent with the hypothesis that managers anticipate personal gains from increased tax aggressiveness. Equity-based incentives tend to encourage more aggressive behavior relative to shareholder expectations (Rego & Wilson, 2012). Furthermore, executive compensation tied to accounting profits may induce managers to adopt self-serving, result-maximizing behaviors (Alves & Ayub, 2019; Cui, Xu, Zhang, & Zhang, 2021). The literature thus suggests that the relationship between managerial power and tax aggressiveness depends not only on the formal governance structure but also on economic incentives, the board's monitoring capacity, and the firm's exposure to future tax costs.

Oussii and Klibi (2024) find that CEO power reduces firms' tax aggressiveness, particularly when the CEO is monitored by institutional investors. Similarly, Boussaidi and Hamed-Sidhom (2021) find that, in Tunisia, CEO duality can reduce tax aggressiveness, suggesting that managers avoid tax practices that could compromise long-term organizational performance.

In the Brazilian context, Proner et al. (2021) analyzed companies listed on the B3 stock exchange and found that CEO duality was not statistically significant and therefore did not influence tax aggressiveness. The authors attributed this result to corporate governance mechanisms, such as board monitoring and ownership structure, which oversee managerial actions and thereby shape decisions about adopting more aggressive tax practices (Amri et al., 2023).

Zhou (2011), by contrast, finds empirical evidence of a positive and significant relationship between CEO duality and tax aggressiveness among Chinese firms. Duality increases aggressiveness by strengthening the relationship between the board and senior management, thereby facilitating the implementation of aggressive tax practices. Halioui, Neifar, and Ben Abdelaziz (2016), in a study of US companies, similarly find that CEO duality is positively associated with tax aggressiveness, a result attributed to increased opportunistic behavior by the CEO.

The literature linking CEO duality to tax aggressiveness has methodological limitations that require cautious interpretation. The most prominent is endogeneity, a recurring issue in corporate governance and finance research that can produce biased and inconsistent estimates, jeopardizing causal inference (Roberts & Whited, 2013; Wintoki, Linck, & Netter, 2012). In this context, omitted variable bias stands out; it stems from unobserved heterogeneity in attributes such as managerial ability, risk appetite, governance quality, and ownership structure. Because these attributes can simultaneously determine both the adoption of duality and corporate tax behavior, the observed association between CEO duality and tax aggressiveness may reflect these attributes rather than a causal relationship (Dyreng, Hanlon, & Maydew, 2010; Hermalin & Weisbach, 2003).

Reverse causality, or simultaneity, is also a concern because leadership structures and other governance mechanisms may be adjusted in response to a firm's tax exposure and behavior, rather than serving solely as

antecedents to those outcomes (Hermalin & Weisbach, 2003; Wintoki et al., 2012). Moreover, CEO duality is not randomly assigned. Firms endogenously choose their leadership structure based on attributes that are likely correlated with their tax decisions (Armstrong et al., 2015; Hanlon & Heitzman, 2010).

Much of the existing research on CEO duality and tax aggressiveness, however, treats duality as exogenous or as a mere control variable without employing identification strategies, such as instrumental variables, generalized method of moments (GMM) estimators, or difference-in-differences, that could mitigate these biases (Armstrong et al., 2015; Kovermann & Velte, 2019; Wintoki et al., 2012). As a consequence, the reported coefficients should be read as conditional associations rather than as evidence of causality, and part of the inconsistency across findings may stem not only from differences in sample composition, institutional context, and proxy measurement, but also from uneven treatment or outright neglect of endogeneity across studies (Hanlon & Heitzman, 2010; Kovermann & Velte, 2019).

In summary, the literature presents three distinct lines of evidence. The first suggests that CEO duality increases tax aggressiveness because of concentrated power and reduced oversight. The second indicates that duality may reduce aggressiveness when the CEO prioritizes reputation, organizational continuity, and long-term results. The third line of evidence shows no statistically significant effect, possibly attributable to other governance mechanisms. Given these inconclusive findings, the following non-directional hypothesis is formulated:

H1: CEO duality has an effect on firms' tax aggressiveness.

Although the literature presents various conceptualizations of tax risk, no consensus has yet emerged on this construct. Kovermann (2018) and Neuman, Omer, and Schmidt (2020) define tax risk as the possibility of divergence between expected and actual tax outcomes. In the tax context, this arises because strategies adopted to reduce the tax burden may fail to produce the intended effects, leading to additional payments following audits by tax authorities.

While the literature identifies multiple dimensions of tax risk, including financial, reputational, and legal risks (Brühne & Schanz, 2022; Saragih & Ali, 2023), this study takes the perspective that aggressive tax practices may be identified by tax authorities, resulting in interest and penalty payments.

Much of the prior literature does not treat tax risk as a moderating variable. Some studies, however, have begun to incorporate it to examine its moderating effect on various dimensions of business management, such as business risk, firm value, and the cost of debt (Guedrib & Bougacha, 2024; Irawan & Turwanto, 2020; Syafira, 2024). Despite these advances, the influence of tax risk on the relationship between CEO duality and tax aggressiveness remains underexplored, and existing findings are inconclusive.

The complexity of tax legislation, high levels of tax non-compliance, and the heavy tax burden in Brazil may further shape this relationship, as CEO duality amplifies the decision-maker's authority (Henrique, Saporito, Inez, & Silva, 2022). In this context, tax risk may alter how concentrated decision-making power translates into tax choices. When tax risk is low, CEOs with greater decision-making authority may have greater latitude to pursue tax-burden-reduction strategies. Conversely, high levels of tax risk raise the expected costs associated with audits, penalties, interest charges, litigation, and reputational damage, thereby inducing more conservative decisions even in firms with CEO duality (Bai, Zhang, & Wang, 2024; Baudot, Johnson, Roberts, & Roberts, 2020; Qi et al., 2023).

Understanding how tax risk affects this dynamic is relevant to assessing whether a CEO holding dual roles intensifies or curtails aggressive tax practices in higher-tax environments. Including this moderating variable thus contributes to a more comprehensive understanding of how governance structures shape corporate tax decision-making. Given that ETR and cash ETR are inverse proxies for tax aggressiveness, such that positive coefficients indicate lower aggressiveness, the second hypothesis is formulated as follows:

H2: Tax risk moderates the relationship between CEO duality and tax aggressiveness, such that higher levels of tax risk tend to attenuate the adoption of aggressive tax practices.

METHODOLOGY

Sample Definition and Data Collection

The data were collected from the LSEG Workspace® database and cover a sample of 159 firms listed on the B3 (Brasil, Bolsa, Balcão) stock exchange. Financial institutions and investment funds were excluded because of their specific tax treatment in Brazil (Andrade, 2023), as were firms that lacked data on the variables required for the study during the 2010–2024 period. This timeframe was selected due to the mandatory adoption of International Financial Reporting Standards (IFRS) in the country from 2010 onward, the termination of the Tax Transition Regime (Regime de Transição Tributária – RTT), and the COVID-19 pandemic. After the initial screening, 1,321 observations were retained.

Given the absence of data for certain firm-year combinations across some variables used in the models, the final dataset is an unbalanced panel. Consequently, the number of firm-year observations varies according to the availability of data required to measure the dependent, independent, and control variables.

Table 1: Composition and selection of the research sample

Panel A: Sample selection procedure		Observations
Description		
Firms listed on the stock exchange with data available on Refinitiv		713
(-) Financial firms		-90
(-) Investment funds, insurance companies, supplementary pension funds, and public or private foundations		-238
(-) Firms without sufficient information		-226
Final number of firms		159
Initial number of observations		3,775
(-) ETR and Cash ETR negative or greater than 1		-1,625
(-) Observations with insufficient data for variable calculation		-805
(-) Observations excluded as outliers		-24
Final number of observations		1,321
Panel B: Distribution of observations by year		
Year	N° of Observations	%
2010	39	2.95
2011	63	4.77
2012	83	6.28
2013	91	6.89
2014	82	6.21
2015	71	5.37
2016	71	5.37
2017	93	7.04
2018	99	7.49
2019	101	7.65
2020	99	7.49
2021	122	9.24
2022	128	9.69
2023	125	9.46
2024	54	4.09
Total	1,321	100%

Cases in which the ETR and cash ETR proxies could be distorted by zero, negative, or economically inconsistent denominators were also addressed. This included observations in which pre-tax profit was equal to or less than zero. Observations with zero denominators were excluded from the computation of these

metrics, while extreme values or values incompatible with their economic interpretation were treated in accordance with the outlier identification procedure described in subsection 3.3.

Negative ETR values can arise from corporate losses and may reflect relevant information about a firm's tax behavior, such as the presence of accumulated tax loss carryforwards. However, retaining these observations in the sample could introduce bias and interpretive distortions into the analysis, compromising the validity of the results. This procedure is relevant because ETR and cash ETR are sensitive to losses, negative tax bases, and outliers, which can produce distorted inferences regarding tax aggressiveness when not adequately treated (Blouin, 2014; Chen, Chen, Cheng, & Shevlin, 2010; Hanlon & Heitzman, 2010). Table 1 presents the criteria used to select the firms comprising the study sample.

Definition of Variables

The dependent variable, tax aggressiveness (TA), was measured using two proxies. The effective tax rate (ETR) was calculated as the ratio of tax expense on profit, comprising corporate income tax (IRPJ) and social contribution on net profit (CSLL), to earnings before income tax (EBIT). The cash ETR was defined as cash taxes paid divided by pre-tax profit (Chen et al., 2010; Kolas & Koumanakos, 2022). Both proxies are widely employed to measure tax aggressiveness and are restricted to taxes levied on profit, specifically IRPJ and CSLL, thereby reflecting the effective tax burden borne by firms in a given period.

The independent variable is CEO duality, operationalized as a dummy variable that takes the value 1 when the CEO and the board chairman are the same individual and 0 otherwise. Although the literature presents mixed and inconclusive evidence on the CEO's influence on tax aggressiveness, this study expects that role concentration will affect corporate tax behavior. This expectation is grounded in the characteristics of the Brazilian stock market, the complexity of current tax legislation, the corporate governance structures of Brazilian firms, and empirical evidence reported by prior studies, including Amri et al. (2023) and Zhou (2011).

Tax risk is captured by two variables. Risk 1 is the standard deviation of ETRs over the three-year window from $t-2$ to t , and Risk 2 is the standard deviation of cash ETRs over the same window (Guedrib & Bougacha, 2024; Kolas & Koumanakos, 2022).

The control variables include firm size, financial leverage, capital intensity, the book-to-market ratio, common shares outstanding, operating cash flow volatility, and a COVID-19 indicator. Firm size was measured as the natural logarithm of total assets, and a positive relationship with tax aggressiveness was expected. Financial leverage, defined as the ratio of total debt to total assets, was also expected to be positively associated with tax aggressiveness.

Capital intensity was calculated as the ratio of net fixed assets to total assets. A negative relationship with tax aggressiveness is expected, as firms with higher capital intensity tend to be more sensitive to the differential tax treatment of depreciation expenses.

The book-to-market ratio was measured as the book value of shareholders' equity scaled by the firm's market capitalization and is expected to be negatively associated with tax aggressiveness. The variable common shares outstanding, measured as the natural logarithm of the number of common shares issued and outstanding, is similarly expected to be negatively associated with tax aggressiveness.

Operating cash flow volatility was measured as the standard deviation of operating cash flow, scaled by total assets, over a three-year window. It is expected to be negatively related to tax aggressiveness. Finally, the COVID-19 variable takes a value of 1 during the pandemic period and 0 otherwise, with 2020–2022 defined as the pandemic years.

It is worth noting that alternative measures for tax risk, such as tax audits, were not used because data from the tax administration were not available for the Brazilian stock market at the time of this study. These variables are consistent with prior studies examining tax aggressiveness, corporate governance, and tax risk (Amri et al., 2023; Cao, Feng, Lu, & Shan, 2021; Guedrib & Bougacha, 2024; Guenther, Matsunaga, & Williams, 2017; Halioui et al., 2016; Kolas & Koumanakos, 2022; Oussii & Klibi, 2024). Table 2 presents the definitions and operational descriptions of the dependent, independent, control, and moderating variables used in the study.

Table 2: Definitions of variables used in econometric models

Variables	Abbreviation	Description	Source
Dependent Variables			
Tax aggressiveness	ETR	Effective tax rate (ETR): Total income tax expenditure on profit, scaled before taxes	Chen et al. (2010) and Kolias and Koumanakos (2022)
	CASH ETR	Cash ETR: Proportion of tax paid in cash on profit before taxes.	
Independent Variables			
CEO Duality	DUAL	Dummy Variable: assumes a value of 1 when the functions of the CEO and the chairman of the board are performed by the same person and 0 otherwise.	Kolias and Koumanakos (2022)
Moderating Variables			
Fiscal risk	RISK1	Standard deviation of three-year ETRs during the period t-2 to t.	Guedrib and Bougacha (2024)
	RISK2	Standard deviation of three-year cash ETRs during the period t-2 to t.	
Control Variables			
Company size	SIZE	Natural logarithm of total assets.	Amri et al. (2023); Armstrong et al. (2012); Dyreng et al. (2010); Guedrib and Bougacha (2024); Kolias and Koumanakos (2022) and Richardson et al. (2016)
Financial Leverage	LEV	Total debt over total assets.	
Capital Intensity	CAPINT	Net fixed assets over total assets.	
Common Stock Outstanding	CSHO	The natural logarithm of the company's common stock outstanding.	
Book-to-market	BTM	Book value of equity scaled by market capitalization.	
Cash Flow Volatility	OCF_VOL	Standard deviation of operating cash flow scaled by total assets measured over a three-year period.	
COVID-19	COVID	Dummy Variable: value 1 for years of the COVID-19 pandemic and 0 otherwise.	

Econometric Model

The empirical model used to examine the relationship between CEO duality and tax aggressiveness, as well as the moderating role of tax risk in this relationship, is estimated using fixed-effects panel data and is expressed as follows:

$$TA_{it} = \alpha_0 + \beta_1 DUAL_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 CAPINT_{it} + \beta_5 CSHO_{it} + \beta_6 BTM_{it} + \beta_7 OCF_VOL_{it} + \varepsilon_{it} \quad (\text{Model 1})$$

$$TA_{it} = \alpha_0 + \beta_1 DUAL_{it} + \beta_2 RISK_{it} + \beta_3 DUAL_{it} \times RISK_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 CAPINT_{it} + \beta_7 CSHO_{it} + \beta_8 BTM_{it} + \beta_9 OCF_VOL_{it} + \varepsilon_{it} \quad (\text{Model 2})$$

In the estimated models, the TA_{it} variable represents both the ETR and cash ETR proxies. The RISK variable is also operationalized in two ways: RISK1 is calculated from ETR volatility, and RISK2 is based on cash ETR volatility. These specifications allow us to assess both the direct association between CEO duality and tax aggressiveness and the moderating effect of fiscal risk on this relationship.

The data analysis was performed using R® software, version 4.4.3. Outliers were identified and addressed using a procedure for detecting and handling extreme values, accounting for the nature of the variables and the sensitivity of the tax proxies to atypical observations. Specifically, the Blocked Adaptive Computationally Efficient Outlier Nominators (BACON) method, developed by Billor, Hadi, and Velleman (2000), was adopted to reduce the influence of extreme observations on the estimated coefficients. Based on this procedure, outliers were removed by excluding observations outside the 1st and 99th percentiles. After excluding 24 outliers, the final sample consisted of 1,321 observations.

In addition, statistical tests were conducted to select the most appropriate econometric specification. The Hausman test indicated that the fixed-effects model was appropriate across all scenarios analyzed. The

choice of estimator was preceded by diagnostic tests to assess heteroscedasticity (Breusch-Pagan test), serial autocorrelation (Wooldridge test), cross-sectional dependence (Pesaran CD test), and multicollinearity (Variance Inflation Factor, VIF). This step is necessary in panel data models because violations of these assumptions can compromise estimator efficiency and the validity of statistical inferences.

The results indicated no cross-sectional dependence or multicollinearity. However, all models exhibited heteroscedasticity and serial autocorrelation. For this reason, the feasible generalized least squares (FGLS) estimator was adopted in its alternative version, because the traditional Parks model (Parks, 1967) requires the number of periods (T) to be at least as large as the number of cross-sectional units (N), a condition not met in this research ($T < N$). This alternative specification is recommended by Reed and Ye (2011) and proved adequate given the identification of heteroscedasticity and first-order autocorrelation, together with the absence of cross-sectional dependence among the companies analyzed.

RESULTS ANALYSIS

Descriptive Statistics and Correlations

The descriptive statistics for the variables used in the study reveal key characteristics of the data. For the ETR variable, the mean and median indicate that, in both groups (Dual = 0 and Dual = 1), most firms have ETRs close to 24%, with moderate dispersion, as reflected in the standard deviation.

For the cash ETR variable, firms with CEO duality (Dual = 1) show a slightly higher mean and greater dispersion, suggesting greater variability in cash tax payments within this group. However, the median cash ETR is lower in the duality group, warranting caution when interpreting the mean, as the distribution may be skewed or influenced by extreme values.

Table 3: Descriptive statistics of the variables used in the research

Variables	Dual	Mean	Median	Standard deviation	1st quartile	3rd quartile
ETR	0	0.2436	0.2390	0.1521	0.1422	0.3104
	1	0.2363	0.2409	0.1376	0.1383	0.2933
CASHETR	0	0.1275	0.0788	0.1566	0.0000	0.2108
	1	0.1346	0.0558	0.1613	0.0000	0.2462
RISK1	0	0.4122	0.0588	3.5174	0.0229	0.1518
	1	0.1369	0.0431	0.3880	0.0165	0.0949
RISK2	0	0.1966	0.0223	1.1919	0.0000	0.0808
	1	0.1197	0.0243	0.3938	0.0000	0.0706
SIZE	0	22.1105	22.0358	1.8302	20.8315	23.3340
	1	23.4560	23.3028	1.2540	22.4778	24.3822
LEV	0	0.7447	0.5758	2.2902	0.4361	0.7106
	1	0.5595	0.5751	0.1931	0.4504	0.7058
CAPINT	0	0.2329	0.1820	0.2218	0.0219	0.3511
	1	0.2161	0.2057	0.1831	0.0414	0.3178
CSHO	0	18.9077	19.2043	2.2075	17.6870	20.4160
	1	20.4406	20.6014	0.9700	19.7110	21.1362
BTM	0	2.6529	1.1838	8.9390	0.5939	2.2563
	1	2.1299	1.4937	1.8530	0.9337	2.8392
OCF_VOL	0	0.0214	0.0151	0.0251	0.0088	0.0259
	1	0.0188	0.0141	0.0174	0.0074	0.0244

Table 3 shows the descriptive statistics of the study sample, including the mean, median, standard deviation, first quartile, and third quartile. For the tax risk indices (RISK1 and RISK2), firms without CEO duality (DUAL = 0) have higher average risk levels and larger standard deviations than those with CEO duality, indicating greater dispersion in this group. Furthermore, the means substantially exceed the medians,

particularly for RISK1 and RISK2; interpretation of these indicators should therefore account for possible right-skewness and sensitivity to outliers. Even after outlier treatment using the BACON method, the distributions remain asymmetric, warranting interpretive caution. The firm size variable shows a higher mean in the CEO duality group, suggesting that larger firms are more likely to adopt this governance structure.

The leverage variable shows lower means among firms with CEO duality, suggesting a more conservative capital structure, while capital intensity shows little variation across groups. The common shares outstanding and book-to-market variables exhibit similar behavior across groups, with minor differences in means and medians. Finally, operating cash flow volatility shows a slight difference between groups, with a marginally lower mean for firms with CEO duality, though dispersion is low across both groups.

In the Pearson correlation matrix, the ETR variable shows weak correlations with most other variables, except for a slight positive correlation with cash ETR. CEO duality likewise exhibits predominantly weak correlations, with only a low-to-moderate positive association with the common shares outstanding variable. The Risk 1 and Risk 2 variables show weak correlations with the remaining variables, with modest associations observed between Risk 1 and ETR and between Risk 2 and cash ETR. No consistent patterns were found.

Firm size shows moderate positive correlations with several variables, particularly CEO duality and common shares outstanding. Leverage displays a slight negative correlation with ETR. Capital intensity has weak but positive correlations with firm size and leverage. Common shares outstanding, in addition to their strong correlation with firm size, also show a positive correlation with CEO duality. The book-to-market variable shows weak negative correlations with most variables, without any substantive relationships. Cash flow volatility shows weak negative correlations with multiple variables, including a slight negative correlation with leverage.

Overall, the correlation coefficients indicate low-magnitude associations among the explanatory variables, with no evidence of excessively high correlations, suggesting the absence of severe multicollinearity in the preliminary data analysis. Table 4 displays the Pearson correlation coefficients among all variables included in the study.

Table 4: Pearson correlation for the complete sample

Variables	ETR	CASHETR	DUAL	RISK1	RISK2	SIZE	LEV	CAPINT	CSHO	BTM	OCF_VOL
ETR	1										
CASHETR	0.184	1									
DUAL	-0.015	0.014	1								
RISK1	0.035	-0.045	-0.026	1							
RISK2	0.025	0.129	-0.021	0.087	1						
SIZE	0.048	0.141	0.233	0.078	0.014	1					
LEV	-0.070	-0.057	-0.027	0.038	-0.013	-0.166	1				
CAPINT	0.012	0.047	-0.032	-0.015	-0.002	0.061	0.044	1			
CSHO	0.003	0.189	0.224	0.046	-0.006	0.762	-0.169	0.002	1		
BTM	-0.056	-0.051	-0.020	0.061	-0.024	-0.088	-0.023	0.035	0.023	1	
OCF_VOL	-0.014	-0.003	-0.034	0.006	0.017	-0.201	0.162	0.001	-0.117	0.061	1

Note: The Pearson correlation coefficients in the table correspond to all variables used in the research.

Discussion of Results

The CEO duality variable showed a positive and statistically significant relationship with ETR but was not statistically significant for cash ETR in Model 1. Because ETR and cash ETR are conventionally interpreted as inverse proxies for tax aggressiveness, positive coefficients indicate a higher effective tax rate and, consequently, lower tax aggressiveness. The results thus suggest that firms with CEO duality tend to exhibit lower tax aggressiveness when measured by ETR, a finding consistent with Kolias and Koumanakos (2022).

Regarding the first hypothesis, which posits that CEO duality influences firms' tax aggressiveness, the findings provide partial support, with support limited to the ETR proxy in Model 1. CEO duality yielded a

statistically significant effect only on ETR, indicating that the relationship between CEO duality and tax aggressiveness is proxy-dependent, with lower aggressiveness observed only through the lens of ETR.

These findings do not corroborate those of Yahaya, Oon, and Jusoh (2024); Chan, Mo, and Zhou (2013); and Li, Maydew, Willis, and Xu (2023).

From an agency theory perspective, managerial behavior may be shaped by both monitoring mechanisms and shareholder incentives. Managers may be induced to act in alignment with principals' interests or subjected to more intensive oversight of their actions (Jensen & Meckling, 1976).

Because managers bear responsibility for decision-making, tax strategies often reflect the alignment or misalignment of interests between shareholders and agents (Kovermann & Velte, 2019). Shareholder control over managers may be exercised through remuneration incentives, bonuses, and non-financial recognition. However, these measures do not always ensure the expected alignment, as managers may prioritize personal interests over those of shareholders (Huang, Ying, & Shen, 2018).

Managerial behavior is therefore likely to be shaped by personal and professional motivations, including concerns about market reputation, career advancement opportunities, and risk tolerance. These factors may make managers more risk-averse and, consequently, more inclined toward less aggressive tax behavior (Liu, Li, Tong, & Zhang, 2022).

The results of this study indicate that, among B3-listed firms, CEO duality is associated with lower tax aggressiveness, particularly when measured by ETR. This interpretation should nonetheless be made with caution, given that the effect of duality was not statistically significant for cash ETR. This suggests that, while CEO duality may reduce shareholder monitoring, managers who hold both the CEO and board chairman positions may avoid more aggressive tax strategies because of concerns about the legal, reputational, and professional consequences of their decisions, a finding that aligns with prior studies (Baudot et al., 2020; SChen et al., 2019; Qi et al., 2023).

In this context, the media plays a central role in amplifying the visibility of corporate conduct, subjecting managers to public scrutiny. Negative exposure can therefore compromise not only their professional credibility but also their standing in corporate and social circles, heightening their aversion to aggressive tax practices (Bai et al., 2024; Liu et al., 2022).

Finally, a negative relationship is observed between firm size and effective tax rates, indicating that larger firms tend to bear lower effective tax burdens, which is consistent with more aggressive tax behavior. Additionally, firms with higher leverage, greater cash flows, and a larger number of common shares outstanding tend to be less tax-aggressive, with findings that align with the existing literature (Adela et al., 2023; Kolas & Koumanakos, 2022). Table 5 presents the results of the FGLS regressions for Model 1. Statistical significance is reported at the 10%, 5%, and 1% levels, respectively.

When tax risk is introduced into the analysis, no statistically significant relationship is observed between tax risk and tax aggressiveness when the variables are considered in isolation.

This result suggests a lack of statistical evidence for a direct association between tax risk and the adoption of more or less aggressive tax strategies, indicating that its effect may be contingent on other institutional and organizational factors, such as corporate governance mechanisms, the regulatory environment, and the structure of managerial incentives (Hoopes et al., 2024; Nascimento, Souza, Marques, & Barbuda, 2024; Passos, Petri, & Theiss, 2024).

Nonetheless, a moderating effect of tax risk is identified when tax aggressiveness is measured by cash ETR. Because higher cash ETR values indicate lower cash-basis tax aggressiveness, this result suggests that, at higher levels of tax risk, CEO duality is associated with reduced tax aggressiveness.

The findings thus offer partial support for the second hypothesis that tax risk moderates the relationship between CEO duality and tax aggressiveness, thereby attenuating the adoption of aggressive tax practices. In the interaction model, the main effects should be interpreted conditional on the level of tax risk.

Table 5: Results of FGLS regressions for Model 1

Variables	Model FGLS			
	Model 1			
	ETR		CASH ETR	
DUAL	0.0274***	(0.0044)	-0.0006	(0.0037)
SIZE	-0.0777***	(0.0078)	-0.0385***	(0.0067)
LEV	0.1702***	(0.0387)	0.2694***	(0.0293)
CAPINT	-0.0302***	(0.0080)	0.0337***	(0.0055)
CSHO	0.0758***	(0.0146)	0.0287**	(0.0111)
BTM	-0.0001	(0.0023)	-0.0078***	(0.0020)
OCF_VOL	0.5468***	(0.1838)	0.5631***	(0.0878)
Observations	1,267		1,267	
Year fixed effects	Yes		Yes	
Firm fixed effects	Yes		Yes	
Adjusted R ² (%)	43		59	
VIF mean	1.48		1.47	

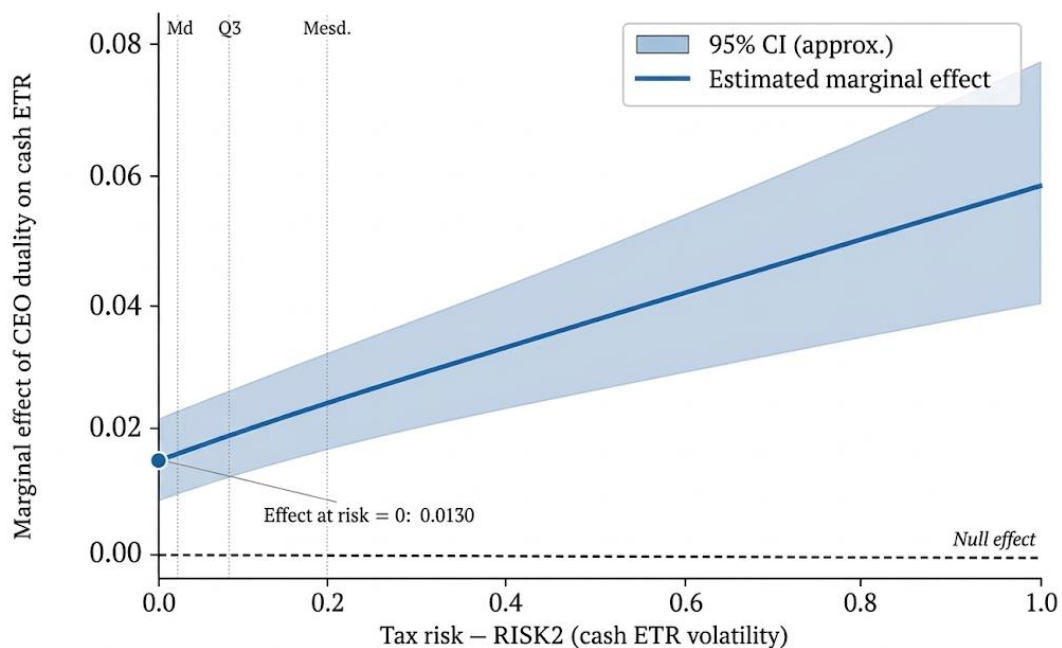
Note: Coefficients are reported with standard errors in parentheses. All models include year and firm fixed effects. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively. (*) No value was identified.

This effect may reflect heightened risk aversion in uncertain tax environments, particularly when the CEO simultaneously serves as board chairman, thereby increasing personal exposure to the legal and reputational consequences of controversial decisions. CEO duality may also be associated with a more conservative leadership profile in which risk mitigation takes precedence over the pursuit of short-term tax benefits (Chari, David, Duru, & Zhao, 2019; Kovermann & Velte, 2019). The results of the FGLS regressions for Model 2 are presented in Table 6. Statistical significance is reported at the 10%, 5%, and 1% levels, respectively.

Table 6: Results of FGLS regressions for Model 2

Variables	Model FGLS			
	Model 2			
	ETR		CASHETR	
DUAL	-0.0006	(0.0124)	0.0130**	(0.0040)
RISK	0.0003	(0.0011)	0.0012	(0.0018)
DUAL*RISK	0.0222	(0.0260)	0.0449***	(0.0091)
SIZE	-0.0387*	(0.0176)	-0.0157*	(0.0077)
LEV	0.1308*	(0.0725)	0.2465***	(0.0385)
CAPINT	0.0064	(0.0218)	0.0065	(0.0081)
CSHO	0.1256***	(0.0315)	0.0112	(0.0129)
BTM	-0.0106*	(0.0047)	-0.0116***	(0.0019)
OCF_VOL	0.336	(0.3935)	0.6133***	(0.1576)
Observations	1,267		1,267	
Year fixed effects	Yes		Yes	
Firm fixed effects	Yes		Yes	
Adjusted R ² (%)	9		62	
VIF mean	1.48		1.47	

Note: Coefficients are reported with standard errors in parentheses. All models include year and firm fixed effects. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. RISK1 was used for the ETR variable, and RISK2 for the cash ETR variable.



Note: Marginal effect of CEO duality on cash ETR across levels of tax risk (RISK2); 95% confidence interval (CI) (Approximate). Since cash ETR is an inverse proxy for tax aggressiveness, positive values indicate lower aggressiveness. Model 2 (FGLS), Table 6.

Source: Research data generated with Anthropic (2026).

Figure 1: Marginal effect

Figure 1 presents the marginal effect. In the context of corporate sustainability, these results may be interpreted to suggest that less aggressive tax strategies, particularly in countries with high fiscal and economic volatility, help build more resilient organizations by reducing exposure to legal, financial, and reputational contingencies. In this sense, governance structures that promote more prudent tax decisions over the medium and long term strengthen corporate sustainability by fostering greater stability, transparency, and trust in relationships with investors, creditors, and other stakeholders.

In this regard, our findings are consistent with those of Martinez and Ramalho (2017), who document that companies comprising the Corporate Sustainability Index (Índice de Sustentabilidade Empresarial – ISE) listed on the B3 (Brazilian Stock Exchange) tend to be less tax-aggressive than their non-index counterparts. Although tax planning is legitimate, reduced tax aggressiveness may contribute to greater tax compliance and predictability of public revenue collection, thereby supporting the financing of public policies and collective welfare.

Moreover, in emerging economies marked by high regulatory and institutional complexity, these results reinforce the view that governance mechanisms can yield benefits that extend beyond financial performance. That is, firms that align their tax and financial strategies with sustainability principles are less exposed to cascading tax liabilities and tend to face lower overall risk than their peers. Asset prices are also sensitive to accounting information and risk-related postures, with positive implications for the cost of capital and firm value (Martinez & Ramalho, 2017).

Robustness Test

In view of the COVID-19 pandemic and its impact on the global economy during the period under analysis, a dummy variable was included, set to 1 for pandemic years and 0 otherwise. The analyses were conducted to assess whether the pandemic had any significant effect on the variables of interest. This approach was warranted by the various legislative measures that temporarily modified deadlines, tax rates, and other fiscal

and ancillary obligations, as well as by programs created to mitigate the pandemic's impact on heavily affected sectors.

The results indicate that the COVID-19 variable was positive and statistically significant, suggesting that effective tax rates increased during the pandemic, consistent with firms adopting less aggressive tax behavior. This pattern may be explained by the adverse economic conditions of that period, characterized by revenue declines, market volatility, and rising corporate indebtedness, which redirected firms' attention toward more pressing concerns related to survival and operational continuity, at the expense of tax planning strategies (Avelar, Ferreira, Silva, & Ferreira, 2021; Gil, Theiss, & Dalcero, 2023).

The inclusion of the COVID-19 variable did not materially alter the interpretation of the main results. In Model 1, CEO duality remained positive and statistically significant for ETR and also showed a positive, significant relationship with cash ETR, reinforcing the evidence that firms with CEO duality tend to exhibit lower tax aggressiveness. This result strengthens support for the first hypothesis in the robustness test, indicating that the effect of CEO duality holds for both tax aggressiveness proxies when the pandemic period is controlled for.

In Model 2, however, the interpretation remains more circumscribed. The interaction between CEO duality and tax risk remained positive and statistically significant only for cash ETR but yielded no statistically significant result for ETR. The robustness test thus provides partial corroboration of the second hypothesis, suggesting that higher levels of tax risk attenuate the adoption of aggressive tax practices among firms with CEO duality, particularly when aggressiveness is measured by cash ETR.

In sum, the results suggest that the pandemic had a meaningful effect on firms' average effective tax rates but did not substantially alter the central relationships examined. The main findings are therefore stable, with mixed effects observed only for the two tax aggressiveness proxies, reflecting the sensitivity of the inferences to the choice of measurement criterion. The lack of a direct, significant effect of tax risk was maintained, as was the significance of its moderating role. Table 7 reports the results of the additional tests conducted to assess the robustness of the findings.

Table 7: Results of the additional tests

Variables	Fixed effect							
	Model 1				Model 2			
	ETR		CASHETR		ETR		CASHETR	
DUAL	0.0283***	(0.0047)	0.0160***	(0.0035)	-0.0018	(0.0123)	0.0383***	(0.0024)
RISK					0.0001	(0.0011)	-0.0005	(0.0018)
DUAL*RISK					0.0224	(0.0258)	0.0551***	(0.0056)
SIZE	-0.0367***	(0.0068)	-0.0507***	(0.0035)	-0.0481***	(0.0125)	-0.0379***	(0.0056)
LEV	-0.0085	(0.0397)	0.3660***	(0.0274)	0.1251*	(0.0717)	0.3387***	(0.0335)
CAPINT	-0.0413***	(0.0090)	0.0185***	(0.0058)	0.0107	(0.0216)	0.0418***	(0.0062)
CSHO	0.0663***	(0.0198)	0.0904***	(0.0108)	0.1232***	(0.0309)	0.0802***	(0.0117)
BTM	-0.0076***	(0.0019)	-0.0089***	(0.0019)	-0.0076*	(0.0045)	-0.0104***	(0.0018)
OCF_VOL	-0.1952	(0.1647)	0.5964***	(0.1262)	0.2808	(0.3894)	0.6122***	(0.1299)
COVID	0.0401***	(0.0061)	0.0326***	(0.0039)	0.0246*	(0.0123)	0.0138**	(0.0051)
Observations	1,267		1,267		1,267		1,267	
Year fixed effects	No		No		No		No	
Firm fixed effects	Yes		Yes		Yes		Yes	
Adjusted R ² (%)	45		61		65		60	
VIF mean	1.45		1.45		1.45		1.45	

Note: The Coefficients are presented with standard errors indicated in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. RISK1 was used for the ETR variable, and RISK2 for the cash ETR variable. Due to collinearity between COVID and year fixed effects, an alternative model without year fixed effects was estimated.

CONCLUDING REMARKS

This study examined how tax risk moderates the relationship between CEO duality and tax aggressiveness among publicly traded Brazilian companies. The results indicate that firms with CEO duality tend to exhibit lower tax aggressiveness, particularly when measured by ETR and, in the robustness tests, also by cash ETR. This finding suggests that concentrating the chief executive and board chairman roles in a single individual may be associated with a more conservative approach to tax decision-making.

Regarding tax risk, no statistically significant evidence of a direct effect on tax aggressiveness was found. The findings, however, reveal a moderating effect only in the specification in which tax aggressiveness is measured by cash ETR. In this context, higher tax risk was associated with lower tax aggressiveness among firms with CEO duality. This evidence did not hold across all model specifications and should therefore be interpreted with caution.

The inclusion of the COVID-19 variable produced mixed results, with differences in statistical significance across ETR and cash ETR and across models with and without the interaction term. These findings suggest that the pandemic affected corporate tax strategies in heterogeneous ways, depending on each firm's economic and financial conditions, governance mechanisms, and risk exposure.

From both theoretical and empirical perspectives, this study contributes to the literature by providing evidence on the relationship between corporate governance structure and tax behavior in the Brazilian context, particularly regarding CEO duality, and by incorporating tax risk as a moderator. The results advance understanding of how governance decisions may shape corporate tax strategies, especially in emerging economies with high regulatory and tax complexity.

The findings also have practical implications for investors, regulators, and governance practitioners, showing that decisions about organizational power structures can affect tax planning, tax aggressiveness, and tax risk management. However, the proxies used, ETR and cash ETR, do not fully distinguish among lawful tax planning, the legitimate use of tax incentives, and potentially irregular practices and therefore carry no presumption of illegality.

From a corporate sustainability perspective, the findings may inform the development of sounder corporate and tax strategies, as governance structures can influence stability, transparency, and trust that support relationships with investors, creditors, and other stakeholders. Although tax planning is a legitimate practice, reduced tax aggressiveness may foster greater tax compliance and greater predictability of public revenue collection, thereby supporting the financing of public policies and collective welfare.

Several limitations should be acknowledged. First, the exclusive reliance on ETR and cash ETR as measures of tax aggressiveness represents an important limitation, as these indicators do not fully capture the complexity of corporate tax behavior, particularly with respect to indirect taxes and alternative forms of tax planning. Moreover, both measures primarily capture profit-based taxation and do not incorporate consumption taxes, thereby limiting a comprehensive assessment of corporate tax aggressiveness.

A further methodological limitation concerns the construction of the tax risk variable from the volatility of ETR and cash ETR. This approach may give rise to endogeneity problems, yielding biased and inconsistent estimates, as well as statistical circularity, because the moderating variable is derived from the same underlying measure used to operationalize the dependent variable. The results should therefore be interpreted as associative evidence rather than as evidence of a strict causal relationship in which tax risk alters the relationship between CEO duality and tax aggressiveness.

Future research could broaden the scope of the analysis by examining different organizational contexts, including privately held companies and small and medium-sized enterprises, thereby providing a more comprehensive understanding of corporate tax behavior across institutional environments. The incorporation of additional measures of tax aggressiveness is also encouraged, including book-tax differences (BTD), tax uncertainty indicators, tax contingencies, and measures related to tax assessments and litigation. Such extensions may strengthen the empirical evidence and contribute to a more comprehensive understanding of the determinants of corporate tax aggressiveness.

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