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THE INFLUENCE OF INTERREGIONAL DIFFERENCES ON THE RELATIONSHIP BETWEEN PUBLIC DEBT AND ECONOMIC GROWTH IN BRAZILIAN STATES

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ABSTRACT

This study investigates whether interregional differences influenced the relationship between public debt and economic growth in Brazilian states between 2015 and 2021. Although the literature has advanced in analyzing the effects of debt on economic growth, there is still limited understanding of how this relationship varies across regions with different levels of development, revenue-raising capacity, and fiscal management. This study addresses this gap by adopting an interregional approach applied to subnational entities, using a dynamic panel regression model (System GMM). The results indicate that the influence of public debt on economic growth varies by region, reflecting structural inequalities and differing management capacities. While public investment and educational attainment foster economic growth, high levels of indebtedness hinder this progress, especially in less developed regions. The analysis reinforces the importance of responsible fiscal policies and regional development strategies that consider the socioeconomic specificities of each state. The findings highlight the need for efficient debt management and policies aimed at strategic investments to promote sustainable growth and reduce regional disparities.

Keywords: Public debt. GDP. Dynamic panel. Brazilian states. Regional disparities.

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1 INTRODUCTION

The relationship between public debt and economic growth has attracted increasing interest among scholars and policymakers due to its complexity and its economic and social implications. Economic growth is driven by factors such as improvements in productive resources, technological advances, productive efficiency, and favorable economic policies, which result in higher living standards and greater availability of goods and services. However, high levels of indebtedness can impair this productive capacity. The financial crises of 2007–2008 and the COVID-19 pandemic intensified this debate, highlighting the challenges of debt management and its effects on economic growth.

Despite advancements in the literature on public debt and economic growth, few studies have addressed the issue from an interregional perspective. Yet, regional inequalities can significantly alter this relationship. Factors such as the level of economic development, socio-spatial characteristics, territorial history, and administrative autonomy may influence how debt impacts growth (Corrêa et al., 2019). More developed regions, with better infrastructure and stronger revenue-generating capacity, tend to use debt more efficiently, thereby promoting economic growth (Asteriou et al., 2020; Alshammary et al., 2020). In contrast, regions with limited investment in key sectors such as education (Arruda et al., 2013; Musa et al., 2024; Özmen & Mutascu, 2023) and less efficient management face greater challenges in converting debt into economic development. This gap in the literature limits our understanding of the differentiated effects of debt in contexts with varying levels of development, fiscal capacity, and management quality.

Furthermore, the literature has yet to reach a consensus on this relationship, with studies arriving at divergent conclusions. While some highlight the negative effects of debt on economic growth (Sutherland & Hoeller, 2012; Ash et al., 2020; Louzano et al., 2021), others suggest that debt may have a positive impact up to a certain threshold, beyond which the relationship becomes negative (Silva et al., 2021; Salomão Neto & Silva, 2023). Moreover, some studies indicate that the impact of debt on growth may be nonlinear and vary across countries (Woo & Kumar, 2015; Reinhart & Rogoff, 2010; Chicoli, 2020; Ash et al., 2020; Liu & Lyu, 2021; Asteriou et al., 2020; Silva et al., 2021; Onofrei et al., 2022).

In this context, the present study seeks to answer the following question: Do interregional differences influence the relationship between public debt and economic growth in Brazilian states? By addressing this question, the research contributes to the literature by filling a gap regarding the influence of regional disparities on the dynamics between public debt and economic growth.

In Brazil, regional disparities among states make the analysis of public debt particularly relevant. This is because Brazilian states exhibit different levels of economic development, revenue-raising capacity, and fiscal management quality—factors that may influence how public debt affects economic growth. More developed regions, with more diversified economies and higher tax revenues, such as São Paulo and Santa Catarina, tend to make productive use of debt (Gadelha & Goes, 2023; Louzano et al., 2021). In contrast, states with low revenue and greater dependence on federal transfers, such as those in the North and Northeast regions, face structural challenges that hinder the transformation of debt into sustainable growth (Salomão Neto & Silva, 2023). Recent studies indicate that the fiscal response of these states to indebtedness tends to be more restrictive, which compromises infrastructure investment and economic development (Souza et al., 2024).

Moreover, Brazilian states have faced difficulties in debt management, which has led to a steady increase in public debt since the 2000s. Between 2015 and 2016. the states of Minas Gerais, Rio de Janeiro, and Rio Grande do Sul declared a state of financial emergency. In 2017. São Paulo reported a debt level exceeding 200%, while in the other Brazilian states, debt levels

ranged from 30% to 130% (Santana et al., 2019).

In this context, the aim of this study is to analyze whether interregional differences influence the relationship between public debt and economic growth in Brazilian states. To achieve this goal, a dynamic panel data regression model (System GMM) was employed, in which economic growth (real GDP per capita) was explained by the relationship between consolidated debt and net current revenue (used as a proxy for public debt), along with control variables that are theoretically considered determinants of economic growth.

This study contributes to the literature by exploring how regional disparities affect the relationship between public debt and economic growth at the subnational level an area still underexplored. Understanding this dynamic may provide valuable insights for the design of more effective public policies and regional development strategies. Furthermore, adopting a regionalized perspective can help identify more suitable strategies for achieving sustainable economic growth, taking into account the specific characteristics of each region. By focusing on the Brazilian context, the study also offers findings that may be relevant to other countries with similar federal structures, thus extending its impact beyond national borders.

In addition to this introduction, the article is structured into four further sections. The next section presents the theoretical framework, discussing the relationship between public debt and economic growth, as well as the influence of regional differences on this relationship. The third section details the methodological procedures adopted, followed by the presentation and discussion of the results. Finally, the concluding remarks are presented.

2 THEORETICAL FRAMEWORK

2.1 Public Debt and Economic Growth

According to economic theory, public debt can either stimulate economic growth or hinder it, depending on the size and structure of the debt, as well as how the borrowed resources are allocated (Onofrei et al., 2022). According to Woo and Kumar (2015), the use of resources obtained through government borrowing can positively influence economic growth. Costa (2009) reinforces this view by highlighting that public debt can be an important tool for the provision of public goods. However, Hilton (2021) warns that the effectiveness of such borrowing depends on the efficient allocation of resources to sustainable projects, ensuring positive returns to GDP. Thus, the central issue is not merely the existence of debt, but how it is managed and distributed across different regions.

The literature indicates that the relationship between debt and economic growth is not linear. Asteriou et al. (2020) argue that debt can stimulate growth when well managed, but may have negative impacts when it reaches high levels. This argument is supported by Reinhart and Rogoff (2010), who identified a debt-to-GDP threshold, suggesting that above 90%, growth tends to decelerate. However, this generalist approach overlooks potential regional differences, such as those observed in Brazil, where states have markedly heterogeneous socioeconomic conditions.

Other studies, such as Panizza and Presbitero (2014), who analyzed the relationship between public debt and economic growth in OECD countries, found no evidence of a direct causal relationship between the two variables. Conversely, Sutherland and Hoeller (2012) found evidence of a negative impact of indebtedness on macroeconomic performance and argued that high levels of debt reduce governments' ability to respond to crises. Additionally, Ash et al. (2020) point out that factors such as high inflation can undermine fiscal sustainability. However, Liu and Lyu (2021) counter this view by arguing that well-managed debt can support economic growth by enabling strategic investments. In this context, fiscal management and the productive structure of each region are key to understanding the differentiated impacts of debt on growth.

Literature reviews such as those by Heimberger (2022) and Onofrei et al. (2022) emphasize that there is no consensus on the effects of public debt on economic growth. The relationship may be positive, negative, or nonlinear, depending on the debt structure and the allocation of resources. Wei (2024) adds that while government debt can contribute to economic growth, excessive debt levels may pose risks to economic stability, thereby limiting growth potential. This debate reinforces the need to consider regional and state-specific factors when analyzing the impact of public debt. Rahman et al. (2019) argue that the effects of debt vary according to the level of economic development and the macroeconomic conditions of each country. Similarly, Reinhart and Rogoff (2010) contend that the relationship between debt and growth cannot be viewed homogeneously, as there is a tipping point at which debt becomes a constraint on growth.

In the context of emerging economies such as Brazil, the relationship between debt and growth proves even more complex. Chicoli (2020) found evidence of a nonlinear effect between indebtedness and economic growth, suggesting that moderate levels of debt may boost the economy, while excessive levels may restrain it. Silva et al. (2021) analyzed the Brazilian case and found that public debt can enhance economic growth in the short term but may become detrimental in the long term. However, these studies do not distinguish the impacts across regions of the country, which have distinct economic and fiscal realities.

At the subnational level, some studies attempt to address this gap. Lazarin et al. (2019) analyzed the relationship between public debt and municipal investment in the state of Paraná and concluded that higher indebtedness tends to increase the Ipardes Municipal Development Index, suggesting a positive effect of well-managed debt. Focusing on municipalities in Goiás, Silva et al. (2021) found that debt has a positive effect on economic growth in the short term; however, this effect becomes negative over the long term. Louzano et al. (2021), analyzing Brazilian states, observed a negative relationship between debt and economic growth, although this relationship may become positive depending on the fiscal policy adopted.

In summary, the relationship between public debt and economic growth is indeed complex. The influence of interregional differences is a crucial factor, as the way resources are allocated and the productive structure of each state directly affect the impact of indebtedness. While some regions may benefit from public debt through strategic investments, others may suffer from the negative consequences of excessive and poorly managed debt. Therefore, careful debt management is essential to ensure its economic benefits.

2.2 Regional Differences and the Relationship Between Public Debt and Economic Growth

Regional differences among Brazilian states may influence the relationship between debt and economic growth due to a range of distinctive factors that vary from one region to another. According to Liu and Lyu (2021), this nonlinear relationship manifests differently in emerging and developed countries. Corrêa et al. (2019) emphasize that the development of a region may differ from that of a country due to issues of scale, socio-spatial characteristics, territorial historicity, and administrative autonomy.

Ahlborn and Schweickert (2018) argue that heterogeneity in the debt-growth relationship can be explained by the varying degrees of fiscal uncertainty across countries. Wei (2024), analyzing the economic impact of government debt in different countries, observed that economic and fiscal policies, as well as debt management systems, have a significant influence on economic outcomes. Liu and Lyu (2021) add that factors such as economic systems, current account balances, internal crises, and the degree of economic openness also shape this dynamic.

Chudik et al. (2017), in their study of developed and developing countries between 1965 and 2010. further emphasize the importance of financial deepening, debt repayment history, and the nature of a country's political system. Rahman et al. (2019) highlight that the relationship

between debt and economic growth depends on the period analyzed, the countries involved, and the models used in the research. Égert (2015), exploring potential nonlinear effects in the relationship between public debt and economic growth, adds that this relationship varies over time and depends on the specific characteristics of each country.

More developed states, with greater infrastructure and revenue-generating capacity, tend to use debt more productively, thereby fostering economic growth. According to Asteriou et al. (2020), in their analysis of the relationship between public debt, investment, and economic growth in African countries, an increase in public debt was associated with greater investment in infrastructure, which contributed positively to economic growth. Alshammary et al. (2020) reported similar findings in Middle Eastern and North African countries, where rising levels of public debt promoted infrastructure investment and, consequently, economic growth. Nisa and Khalid (2024), examining the impact of infrastructure on economic growth in both developed and developing countries, argue that infrastructure plays a significant role in promoting growth in developing economies, whereas its impact is more limited in developed nations.

Moreover, regions with a history of low investment in education may face greater challenges in converting public debt into economic growth. Arruda et al. (2013), analyzing Brazilian states, demonstrated that human capital contributes to increases in per capita income. The study by Musa et al. (2024) highlights that regions with low levels of educational investment encounter significant difficulties in leveraging public debt to stimulate economic growth. Özmen and Mutascu (2023) add that insufficient investment in education can result in slower economic growth, thereby hindering the productive use of public debt.

Thus, the literature indicates that regional differences in Brazil can influence the relationship between debt and economic growth, due to the specific characteristics of each region. Factors such as infrastructure, revenue-generating capacity, and investment in education directly affect the use of debt and its impact on economic performance.

3 METHODOLOGICAL PROCEDURES

3.1 Data and Sources

To analyze whether interregional differences influence the relationship between public debt and economic growth in Brazilian states, data from the 26 Brazilian states and the Federal District were considered for the period from 2015 to 2021. A brief description of the variables and data sources is presented in Table 1.

Table 1

Variables Used in the Model

Variables	Description	References	Expected Sign
Dependent:			
PIB_{it}	State Gross Domestic Product per capita (in thousand BRL, at 2010 constant prices).	Asteriou et al. (2020); Alshammary et al. (2020); Onofrei et al. (2022); Chicoli (2020); Woo e Kumar (2015); Louzano et al. (2021).	
Independents:			
Inv_{it}	Capital expenditure (executed) on investments per capita (in BRL).	Asteriou et al. (2020); Louzano et al. (2021).	+
ESC_{it}	Average years of schooling for individuals aged 25 and over.	Asteriou et al. (2020); Louzano et al. (2021).	+
$AbCom_{it}$	Trade openness (exports plus imports) per capita (in thousand BRL FOB).	Asteriou et al. (2020); Alshammary et al. (2020); Onofrei et al. (2022); Chicoli (2020); Louzano et al. (2021).	+

Região*Div$_{it}$	Interaction dummy between the five Brazilian regions (North, Northeast, Central-West, South, and Southeast) and Divit, represented by the ratio of Consolidated Debt (CD) to Net Current Revenue (NCR) (CD/NCR).		

Source: prepared by the authors.

The dependent variable in the model is represented by the real growth rate of per capita GDP, used as a proxy for economic growth. The key explanatory variable is public debt, measured by the ratio of Consolidated Debt to Net Current Revenue (CD/NCR). Additionally, the model includes macroeconomic and educational indicators as control variables in order to capture the impact of other determinants of economic growth, such as: executed investment expenditures; average years of schooling for individuals aged 25 and over, used as a proxy for human capital; and trade openness, represented by the sum of imports and exports for each state. These variables have been widely used in previous studies, such as Asteriou et al. (2020), Louzano et al. (2021), Alshammary et al. (2020), Onofrei et al. (2022), and Chicoli (2020), which supports their relevance and applicability in the context of economic growth analysis.

Thus, investment in infrastructure is expected to have a positive effect on economic growth, as it is considered one of the main explanatory factors in growth models (Cullison, 1993). Regarding trade openness per capita measured by the sum of exports and imports a positive effect on economic growth is also expected, as argued by Smith (2002), who highlights free trade as an important driver of economic growth.

To assess whether intraregional differences influence the relationship between debt and economic growth, an interaction dummy variable was included. This dummy was constructed by multiplying the dummy variable for the Brazilian region (North, Northeast, Central-West, South, and Southeast) by the value of the public debt proxy (CD/NCR). Data related to the human capital proxy and trade openness were obtained from the Institute for Applied Economic Research (Ipeadata, 2024), while data on per capita GDP, public debt, and investment expenditures were obtained from the National Treasury Secretariat – Siconfi (Siconfi, 2024). All monetary variables were adjusted and standardized to Brazilian reais (R$).

3.2 Econometric Model

For this analysis, a panel data regression model was employed, as it allows for the study of the dynamics of observations over time something that cannot be achieved with a single cross-section. This method increases the precision of the estimates by combining multiple time periods for the same unit, resulting in a larger number of observations (Cameron & Trivedi, 2005).

Moreover, since past economic growth can influence current growth levels, the inclusion of the lagged dependent variable is important. In this context, a dynamic panel model was used (Cameron & Trivedi, 2005), following the basic structure presented in Equation 1 (eq.1):

$$log\text{PIB}_{it} = \alpha_i + \beta_1 log\text{PIB}_{it-1} + \beta_3 log\text{Inv}_{it} + \beta_4 \text{ESC}_{it} + \beta_5 log\text{AbCom}_{it} + \mu_j \sum \text{dRegião}_j.\text{Div}_{it} + \varepsilon_{it} \quad \textit{(eq.1)}$$

where, PIB$_{it}$ is the per capita Gross Domestic Product of state *i* in year*t;* Inv$_{it}$ s the *per capita* investment expenditure; ESC$_{it}$ s the average number of years of schooling for individuals aged 25 and over in state *i* at time *t*; AbCom$_{it}$ is *per capita* trade openness (exports plus imports divided by the population); dRegião$_j$.Div$_{it}$ are interaction dummies for region *j* and the state debt (consolidated debt/net current revenue); and); and ε_{it} is the error term.

The dynamic panel estimation was conducted using the System GMM estimator, developed by Arellano and Bover (1995) and Blundell and Bond (1998), due to the short panel

nature of the study, composed of 27 observational units (*i*) over 7 years (*t*) (Cameron & Trivedi, 2005). In short panels, the System GMM estimator can be sensitive to the choice of instruments, potentially leading to biased estimates if the instruments are not properly selected or if there are issues with serial correlation in the error terms. Furthermore, this method may be affected by endogeneity between the explanatory variables and the error term, which can compromise the consistency of the estimates (Cameron & Trivedi, 2005).

To mitigate these potential limitations, appropriate instruments were used, and the validity of the estimates was assessed through tests for serial correlation and instrument validity. Instrument validity was tested using the Sargan-Hansen test, and serial correlation was assessed using the Arellano-Bond test (Cameron & Trivedi, 2005).

Moreover, models that analyze economic variables such as those explaining economic growth often face endogeneity issues (Vieira, Abrantes & Almeida, 2020). Accordingly, the Wooldridge test was applied to identify potential endogeneity among the variables under study (Cameron & Trivedi, 2005). In addition, the Wald test was used to assess the presence of heteroskedasticity in the model. Finally, the overall validity of the estimation model was evaluated using the Wald chi² test. Data processing and analysis were performed using Stata (Data Analysis and Statistical Software), version 16.1. with the base command *xtdpdsy*.

4 RESULTS AND DISCUSSIONS

4.1 Descriptive Data Analysis

Table 2 presents the descriptive statistics of the variables used for the period from 2015 to 2021. These statistics include the mean, standard deviation, minimum, and maximum values.

Table 2
Descriptive Statistics of the Study Variables

Variables	Mean	Standard Deviation	Minimum	Maximum
GDP (thousand BRL per capita)	R$ 16.82	R$ 8.71	R$ 7.73	R$ 50.99
Debt per capita	85.81	60.29	18.91	321.92
Trade openness (thousand BRL FOB per capita)	R$ 6.107.09	R$ 5.902.43	R$ 87.36	R$ 35.729.20
Investment (BRL per capita)	R$ 176.71	R$ 93.48	R$ 28.39	R$ 508.21
Schooling (years)	9.08	1.04	6.99	12.20

Source: Prepared by the authors based on the data.

As shown in Table 2, the average per capita GDP of Brazilian states during the analyzed period was BRL 16.82 thousand. Maranhão recorded the lowest value in 2019 (BRL 7.73 thousand per capita), while the Federal District had the highest value in the same year (BRL 50.99 thousand per capita). The standard deviation was BRL 8.71 thousand, indicating significant dispersion in per capita GDP values across the observed units. Furthermore, the range (BRL 7.73 thousand to BRL 50.99 thousand) suggests that there are states with highly divergent levels of economic output, likely reflecting regional inequalities.

Regarding the proxy for public debt of Brazilian states (consolidated debt/net current revenue), the average was 85.81. This indicator ranged from a minimum of 18.91 (Pará in 2016) to a maximum of 321.92 per capita (Rio de Janeiro in 2020). The variable showed a high standard deviation of BRL 60.29 and a wide range (BRL 18.91 to BRL 321.92), indicating considerable variation in debt levels across states. This disparity may suggest that some states face serious fiscal challenges, while others maintain more controlled levels of indebtedness.

Furthermore, the average per capita trade openness across Brazilian states was BRL

6,107.09 thousand (FOB), ranging from BRL 87.36 thousand FOB per capita (Roraima in 2015) to BRL 35,729.20 thousand FOB per capita (Mato Grosso in 2021). This wide variation in trade openness indicates that some states engage in minimal exports, while others have economies strongly oriented toward international trade.

The average per capita investment expenditure was BRL 176.71, with the highest value recorded in Mato Grosso do Sul in 2021 (BRL 508.21 per capita). This result highlights disparities in the investment capacity of the states, which may be linked to revenue generation, fiscal priorities, and local budget constraints.

On the other hand, the average number of years of schooling for individuals aged 25 and over was 9.08 years. The states of Alagoas and Maranhão recorded the lowest educational levels in 2015, with 6.99 and 7.08 years, respectively. The range (6.99 to 12.20 years) shows that some states still have average education levels below completion of primary education, while others reach levels closer to the completion of secondary education.

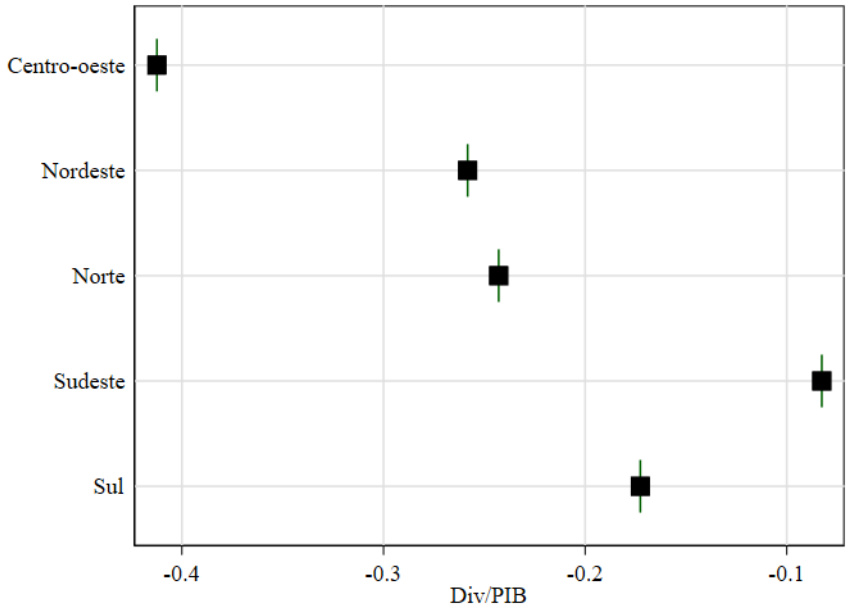
These descriptive results indicate considerable regional inequality among the states analyzed, as evidenced by the high standard deviations and wide ranges in variables such as per capita GDP, indebtedness, exports, and investment. This heterogeneity suggests that some states have greater revenue and investment capacity, while others face more severe fiscal challenges. These findings are consistent with those of Souza (2018), who highlights the significant variation in the distribution of resources and the concentration of wealth in specific areas, reflecting persistent regional disparities.

Figure 1 illustrates the variation in the ratio of public debt per capita to per capita GDP (Debt/GDP) across the five Brazilian regions North, Northeast, Southeast, South, and Central-West between 2015 and 2021. All regions showed a reduction in the Debt/GDP ratio, which may be explained by the enforcement of the Fiscal Responsibility Law (FRL) (Complementary Law No. 101, enacted in 2000).

One factor that may have contributed to this reduction is the progressive improvement in the oversight and understanding of the application of the Fiscal Responsibility Law (FRL) over the years. The FRL introduced important advances in Brazil's fiscal rules, directly impacting state-level fiscal management, particularly by establishing strict limits and guidelines for controlling public finances, which may explain the decline in the Debt/GDP ratio. According to Linhares et al. (2013), the FRL implemented austerity measures aimed at achieving balanced public accounts. Additionally, in 2017, the enactment of the Fiscal Recovery Regime (FRR), whose adjustment measures were considered crucial for restructuring state finances, also played a significant role in the fiscal consolidation process, as noted by Torrezan and Paiva (2021).

It is worth noting that the Central-West region achieved the largest reduction in the public debt-to-GDP ratio compared to other regions, decreasing by more than 41% relative to 2015, from 2.71 to 1.69. The Central-West also holds the lowest Debt/GDP ratio among the five Brazilian regions. This region has experienced robust economic growth, primarily driven by agribusiness and the expansion of agro-industrial activities, which have boosted tax revenues and strengthened regional finances. In addition, stricter fiscal policies and the efficient management of public resources may have contributed to the reduction of public debt.

Figure 1
Box Plot of the Relationship Between Public Debt and GDP in Brazilian Regions from 2015 to 2021



Source: prepared by the authors.

The Northeast was the second region to most significantly reduce this ratio, with a decrease of approximately 26% (from 7.70 to 5.85). In 2015, the Northeast had the highest Debt/GDP ratio among all regions, but by 2021, it had fallen to second place, having been surpassed by the Southeast. This reduction reflects efforts by Northeastern states to improve fiscal efficiency and direct investments toward productive sectors. The results show that, although the Northeast has the lowest per capita GDP among the five regions, it does not exhibit a particularly high level of per capita indebtedness. Nevertheless, despite the improvement, the region still faces structural challenges that hinder a more pronounced reduction.

The Southeast region recorded the weakest relative performance over the analyzed period, reducing its debt-to-GDP ratio by only 8.3%. Although the region has the highest per capita GDP among the five regions, the Southeast was unable to significantly reduce its debt burden and, in 2021, became the region with the highest public debt among all Brazilian regions. This outcome may be due to a combination of pre-existing high debt levels, slower relative economic growth, and challenges in implementing effective fiscal policies. Furthermore, the states of Minas Gerais, Rio de Janeiro, and São Paulo have struggled to reduce their high levels of indebtedness since 2015 (Santana et al., 2019).

In summary, the relationship between public debt and economic growth varies across Brazilian regions. Some regions have managed to reduce their public debt despite having lower per capita GDP, suggesting more effective financial management. Other regions have increased their public debt despite economic growth, which may indicate challenges in debt governance. Additionally, some regions have maintained economic growth while also increasing their public debt, raising concerns about the long-term sustainability of such debt. Therefore, the relationship between public debt and economic growth depends on the specific policies and circumstances of each region, highlighting the need for Brazilian regions and states to revise their fiscal and economic policies in order to promote economic growth without compromising public finances through unsustainable state-level debt.

4.2 Econometric Model Results

To analyze whether interregional differences exist in the relationship between public debt and economic growth in Brazilian states from 2015 to 2021, Equation (1) was estimated using the System GMM method. Table 3 presents the estimated results.

Table 3
Results of the Dynamic Panel Data Model

Variables	Coefficients	Standard Error	p-value
$LogPIB_{it-1}$	0.866	0.045	**0.000*** **
$logInv_{it}$	0.050	0.012	**0.000** **
$logAbCom_{it}$	-0.009	0.009	0.314
Esc_{it}	0.027	0.011	**0.012** **
logDiv_S	-0.035	0.019	**0.071***
logDiv_SE	-0.022	0.018	0.221
logDiv_CO	-0.045	0.023	**0.045** **
logDiv_NE	-0.058	0.024	**0.015*** **
logDiv_NO	-0.045	0.023	**0.047** **
Constante	0.124	0.181	0.492
Est. Sargan	95.599	p-valor	0.378
Est. Wald	3.342.20	p-valor	0.000
N observações	162		

*Note. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level. The variable logDiv was excluded from the model due to collinearity.*
Source: prepared by the authors.

The results obtained from the Sargan test (instrument validity), the Arellano-Bond test (first-order autocorrelation), and the Wald test (overall significance) confirm the statistical adequacy of the model. Moreover, as the monetary variables were expressed in logarithms, the estimated coefficients represent income elasticities with respect to the determinants included in the regression.

The coefficient for the lagged per capita GDP growth rate (LogPIBit–1) was positive and statistically significant, indicating that per capita GDP from the previous year positively influences its current values. Specifically, a 1% increase in per capita GDP in the previous year results, on average, in a 0.866% increase in the current year across states. These findings are consistent with those of Chicoli (2020), who analyzed 36 emerging countries between 1990 and 2017 and found similar evidence regarding the relationship between past and future growth. This pattern suggests that, in Brazilian states, the upward trajectory of per capita GDP is driven by a continuous temporal pattern of its own positive outcomes.

Regarding the key variables of the study, which capture the effects of regional differences on the relationship between state debt and per capita GDP, it was observed that only the Southeast region was not statistically significant. In contrast, the variables for the South, Central-West, North, and Northeast regions were significant and had negative coefficients. These results indicate that, in those regions, indebtedness adversely affects economic growth in a differentiated manner across states.

This finding suggests that interregional differences do influence the relationship between debt and economic growth, thus not rejecting Hypothesis 1. This result is in line with the study by Silva and Ribeiro (2018), which identified unequal distribution of economic activities across Brazilian territory. Furthermore, as Corrêa et al. (2019) point out, the development and economic growth of a region may vary due to socio-spatial characteristics, differing historical trajectories, or even administrative autonomy—factors that can influence the variations observed in the effects of debt on growth.

The North and Northeast regions, historically characterized by lower growth rates, show a more pronounced negative effect of indebtedness on per capita GDP. This may be explained by the fact that high levels of debt limit resources that could otherwise be allocated to structural investments, thus exacerbating fiscal vulnerability in those regions. Similarly, Onofrei et al. (2022) argue that in less developed regions, debt may negatively affect growth due to lower efficiency in resource allocation and weaker institutional development.

In contrast, the South region, despite showing high levels of debt, maintained relatively stable economic growth compared to other Brazilian states (see Figure 1). These results suggest that elevated debt levels in these states may exert an adverse influence on their economic performance. High indebtedness can lead to elevated interest payments and debt service costs, preventing investment in sectors with growth potential. This may indicate greater fiscal management capacity in those states or a more favorable institutional environment for investment, reinforcing Panizza and Presbitero's (2014) argument that the impact of debt depends on the institutional context.

These negative effects of debt on per capita GDP growth are consistent with several studies in the literature. Woo and Kumar (2015) argue that high levels of debt are associated with slower growth, especially in emerging economies. Chudik et al. (2017) point out that the relationship between debt and growth is nonlinear, with excessive debt levels tending to harm economic performance. Chicoli (2020) also found evidence that debt reduces governments' investment capacity, thereby limiting growth. Complementarily, Onofrei et al. (2022) emphasize that high indebtedness undermines fiscal sustainability, potentially generating long-term adverse effects.

A key determinant of these effects is how borrowed resources are used. Often, states use debt to cover fiscal deficits or finance current expenditures instead of investing in infrastructure and human capital, which are essential for sustainable growth. This dynamic is discussed by Caríssimo et al. (2024), who point out that debt service (interest and amortization) constrains the investment capacity of Brazilian states, further weakening their fiscal management. According to Rahman et al. (2019), Woo and Kumar (2015), and Hilton (2021), public debt will only have a positive effect on economic growth if the borrowed resources are used to finance productive expenditures. Chicoli (2020) argues that if public investment is high, then a greater public debt can lead to greater economic growth.

In addition, Brazil faces a degree of fiscal uncertainty due to the country's history of rising debt, recurring economic crises, and the relatively recent expansion of trade openness. All of these factors can influence economic growth, as pointed out in studies by Ahlborn and Schweickert (2018), Liu and Lyu (2021), and Chudik et al. (2017). According to Onofrei et al. (2022), in less developed regions, public debt may interfere with economic growth due to inefficient resource use, bureaucratic obstacles, underdeveloped public institutions, and high interest rates.

Regarding investment spending (*logInvit*), a positive and statistically significant influence on economic growth was observed, supporting the academic literature that has argued increased investment spending creates a favorable environment for economic growth. Asteriou et al. (2020), analyzing Asian countries, found that the investment rate has a significant positive effect on economic growth, as did Hilton (2021), who identified this relationship in developing countries. However, the effectiveness of such investments depends on institutional factors and strategic planning by governments, highlighting the need for more efficient fiscal policy.

Thus, it can be inferred that investments have been sufficiently effective in driving positive changes in the economic growth of the states. Well-structured and strategically planned investments are crucial to promoting medium- and long-term growth. In addition, policies aimed at reducing economic inequality should consider disparities in regional economic infrastructure

(Lima, Paulo & Souza, 2020). Renzi et al. (2019) add that the macroeconomic policies of a public entity should take into account social, political-institutional, and environmental issues.

As for trade openness, the results indicate that the variable was not statistically significant for Brazilian states during the analyzed period. This finding suggests that, despite the potential benefits of economic openness, the states have not yet managed to translate this factor into consistent productivity gains and economic growth.

According to Cardozo (2018), during this period there was an increase in commodity exports, especially in the North, Southeast, and South regions. These primary goods account for the largest share of Brazil's exports, making the trade balance dependent on the surplus of primary products. Furthermore, Ribeiro and Jacinto (2008) argue that greater trade openness may increase competition among firms, stimulate investment in research and development, and raise the demand for skilled labor thus enhancing overall economic productivity.

However, it is worth noting that trade openness only generates economies of scale if states focus their international trade on the production of goods in which they have comparative advantages, thereby positively impacting per capita income and improving population welfare. According to Arruda et al. (2013), in regions with stronger economic growth (Central-West, South, and Southeast), trade openness positively affects per capita income. This occurs due to the unique dynamics of each region's internal market and their respective stages of development. Nevertheless, as the results of this study show, when considering all regions jointly, the average effect of trade openness on economic growth is not significant.

Next, it is observed that the proxy variable for education (*Escit*) showed a significant effect on per capita economic growth, aligning with the findings of Arruda et al. (2013). This result reinforces the importance of human capital in reducing regional disparities and promoting sustainable growth. Therefore, public policies focused on education are essential to strengthening the economic foundations of states and mitigating inequalities.

In this sense, it is important for states to manage public debt through policies aimed at reducing public expenditures and promoting economic incentives. According to Chudik et al. (2017), if a government is able to control its public debt and maintain a downward trajectory over the years, even with a high level of indebtedness, it can achieve growth comparable to entities with low debt levels.

In conclusion, the results suggest that public indebtedness may be a limiting factor for economic growth, especially in less developed regions. However, its influence depends on institutional variables and the efficiency of resource allocation, pointing to the need for a more structured fiscal management approach to optimize the impact of public debt on the economic growth of Brazilian states.

5 FINAL CONSIDERATIONS

This study analyzed whether interregional differences influence the relationship between public debt and economic growth in Brazilian states between 2015 and 2021. Based on the System GMM method, the results indicate that the lagged per capita GDP growth rate has a significant positive effect on current economic growth, corroborating findings in the literature. Furthermore, it was found that the relationship between public debt and economic growth is not uniform across Brazilian regions. While states with greater fiscal capacity and developed infrastructure are able to use debt productively, less developed regions face challenges in converting indebtedness into sustainable growth.

The results also show that investment spending and increased educational attainment have a positive influence on long-term economic growth. Therefore, policies that promote the efficient allocation of resources to infrastructure and human capital are essential to mitigating the negative effects of debt on growth.

The main academic contribution of this study lies in expanding the debate on subnational fiscal sustainability by demonstrating that the effect of public debt on growth depends on regional socioeconomic conditions. This advances the literature by showing that debt management must be tailored to the specificities of each state, avoiding one-size-fits-all policies that disregard regional disparities.

In addition to its academic relevance, this study offers important practical implications for policymakers and public administrators. The findings reinforce the need for public policies that are adapted to the diverse regional contexts and include differentiated strategies for states with greater fiscal vulnerability. The research highlights that a controlled debt trajectory, combined with strategic investments and educational policies, can promote sustainable economic growth and reduce inequalities. In this regard, public managers can use these results to support decision-making, balancing debt sustainability with regional economic development. Thus, it is crucial that Brazilian states implement public policies focused on debt control, expenditure reduction, and economic incentives. A downward trajectory of public debt may allow states to grow more sustainably, even when starting from high debt levels. These efforts are essential to achieving balanced economic growth and reducing regional disparities in Brazil.

Among the study's limitations, it is important to note the difficulty in identifying all institutional and structural factors that may influence the relationship between debt and economic growth. Moreover, the research focuses on a specific period (2015–2021), and may be affected by cyclical events such as economic crises or changes in fiscal policy. Future research should explore how institutional factors, such as public management efficiency and fiscal governance, affect this relationship. Additionally, studies that examine the effects of different types of public spending distinguishing between current expenditures and productive investments may provide further insights into the fiscal sustainability of Brazilian states.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest regarding this submitted work.

AUTHOR CONTRIBUTIONS

Roles	1st author	2nd author	3rd auhtor
Conceptualization	♦	♦	♦
Data curation	♦		
Formal analysis	♦	♦	♦
Funding acquisition			
Investigation	♦		
Conceptualization	♦	♦	
Project administration			
Resources	♦		
Software	♦	♦	
Supervision		♦	♦
Validation	♦	♦	♦
Visualization	♦	♦	♦
Writing – original draft	♦		
Writing – review & editing	♦	♦	♦