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Budgetary Dependency and Public Debt: Key Drivers of investment expenditure for Brazilian states

Dependência Orçamentária e Dívida Pública: elementos determinantes das despesas com investimento para os Estados brasileiros

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Abstract: This article investigates the relationship between investment expenditure and the degree of budgetary dependency among Brazilian states over the period 2001–2018. The central hypothesis is that the level of budgetary dependency generates heterogeneous effects on investment expenditure. A panel threshold model is employed to test this hypothesis. The results indicate nonlinear dynamics in the relationship between investment expenditure and budgetary dependency: at high levels of net funded debt, an increase in budgetary dependence—or a reduction in budgetary autonomy—is associated with a decline in investment expenditure.

Keywords: Public expenditure; Fiscal Federalism; Brazilian States.
JEL Classification: H54; H77; H72

Resumo: O artigo analisa a relação entre despesas com investimento e o grau de dependência orçamentária nos Estados brasileiros no período 2001 – 2018. A hipótese de pesquisa é que o grau de dependência orçamentária produz reações distintas sobre as despesas com investimento. A pesquisa faz uso da metodologia em painel *threshold*. Os resultados da apontam para reações distintas na relação entre despesas com investimento e grau de dependência orçamentária, na medida em que para níveis elevados da dívida consolidada líquida, um aumento no grau de dependência orçamentária/ou redução da autonomia orçamentária há uma redução nas despesas com investimento.

Palavras-chave: Gastos Públicos; Federalismo Fiscal; Estados brasileiros.
Classificação JEL: H54; H77; H72

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1. Introduction

Fiscal decentralization following the enactment of the 1988 Constitution aimed to reduce Brazil's severe interregional inequality. To address this issue, one of the key institutional mechanisms for balancing public finances was the implementation of intergovernmental transfers. Within the Brazilian federal system, these transfers are designed to promote budgetary equilibrium by correcting fiscal disparities, thereby enabling subnational entities with low tax revenue capacity to receive higher budget allocations for expenditures that improve income distribution.

In contrast the fiscal federalism framework, the Fiscal Responsibility Law (LRF - *Lei de Responsabilidade Fiscal*), established in the early 2000s, aims to achieve fiscal stability by imposing limits and targets on public managers regarding public budget usage.

Constitutional transfers aim to mitigate budgetary distortions among various federal entities. Conversely, the LRF seeks to correct the uncontrolled utilization of public funds. While intergovernmental transfers may increase funding sources for subnational entities—enabling budget managers to allocate resources toward greater provision of public goods—the LRF may create countervailing effects. By encouraging states to allocate larger portions of their budgets to personnel expenditures (which face a 60% cap relative to net current revenue for Brazilian states), the law may indirectly reduce investment expenditure.

The literature has identified multiple determinants of public expenditures, particularly socioeconomic, political, and demographic factors. However, the declining investment capacity of Brazilian states over the past two decades appears linked to the federal system's architecture and fiscal constraints, particularly since the LRF's institutionalization in the early 2000s.

The need to understand the key drivers of investment expenditures is particularly relevant, given their importance as instruments and mechanisms for economic growth stimulation.

This article examines the relationship between investment expenditures and budgetary dependency levels across Brazilian states. The hypothesis is that budgetary dependency produces heterogeneous effects on investment expenditure depending on fiscal constraint severity (measured by net funded debt).

The article comprises four sections beyond this introduction. Section 2 presents the literature review, establishing the relevant variables for the analysis. Section 3 presents the research data and methodology. The study employs cluster analysis for data organization and processing, followed by a panel threshold model. Section 4 provides the results analysis, while Section 5 summarizes the main findings.

2. Literature Review

The investment expenditure-budgetary dependency nexus in Brazilian states merits particular examination given its implications for subnational fiscal sustainability. The Brazilian states' investment capacity remains constrained by both own-source revenue

generation, and intergovernmental transfers, both of which play a significant role in state budget composition. Understanding the impact of budgetary dependency on public investments requires an approach based on the literature on fiscal federalism and drivers of public expenditure—focusing on the Brazilian context.

2.1. Fiscal Federalism and Drivers of Public Expenditure

The analysis of public expenditure in federal economies is based on the theory of fiscal federalism, which can be divided into two main strands: first-generation theories and second-generation theories.

First-generation theories, shaped by the seminal contributions of Tiebout (1956), Musgrave (1959), and Oates (1972), laid the foundation for debates on fiscal decentralization. At the core of this literature is the notion of optimal assignment of economic responsibilities across different tiers of government. Musgrave (1959) introduced a conceptual framework that defines three essential functions of government: allocation, redistribution, and stabilization. Oates (1972) further advanced this line of thought by arguing that decentralization enhances efficiency by allowing public service provision to reflect local preferences, particularly in heterogeneous jurisdictions.

Second-generation theories, emerging in the 1990s, move beyond the normative assumptions of benevolent government behavior to focus on institutional incentives and strategic interactions among political actors. Petchey and Levtchenkova (2002) introduced the idea that fiscal equalization concessions are not exogenous, but rather determined by the strategic behavior of governments, leading to an "equalization game." Wagner (2007) highlighted the "polycentric" competition between different levels of government, in which some units produce services and others articulate their provision, interacting with the market.

Beyond the fiscal federalism framework, a substantial body of literature has examined the drivers of public expenditure. Fisher (1964) categorized these drivers into three main groups: socioeconomic, political, and demographic variables. Private income has consistently been identified as a key variable of public expenditure, with empirical studies such as Bird (1970), Kiewiet and Szalaky (1996), Mercer and Gilbert (1996) and Dickson and Yu (1997) providing evidence of a positive relationship between income levels and government spending.

In the field of political influences, the theory of political-budgetary cycles, formulated by Nordhaus (1975), suggests that rulers manipulate economic results to maximize their chances of reelection, impacting public expenditure patterns. Finally, in terms of demographic influences, Ashworth et al. (2005) find that variables such as population size, density, and age structure play a significant role in shaping expenditure levels.

2.2. Literature Focused on the Brazilian Context

The body of literature addressing fiscal federalism in Brazil has concentrated on three key dimensions: fiscal decentralization, the effects of the LRF, and the role of intergovernmental transfers in shaping public investment patterns.

Fiscal decentralization in Brazil is characterized by a high degree of budgetary dependency of states on federal transfers. Research by Arretche (2004) and Rezende and Afonso (2006) highlights the constrained fiscal autonomy of states, underscoring how intergovernmental transfers influence the distribution of resources among various categories of public expenditure.

Rocha and Giuberti (2008) argue that the taxing powers granted to subnational governments—both states and municipalities—are insufficient to meet their spending obligations. Consequently, fiscal equalization mechanisms, particularly intergovernmental transfer systems, serve as essential instruments for mitigating budgetary imbalances related to the capacity of subnational governments to fulfill their expenditure responsibilities.

The work of Rocha and Giuberti (2008) further stresses the pivotal role of these transfers in balancing subnational finances, given the inherent limitations in their revenue-generating capacity. Nonetheless, despite their critical role in reducing fiscal disparities, the structure of these transfers may generate unintended incentives, such as diminishing the own-source revenue efforts of states and municipalities heavily reliant on federal funds. Moreover, the criteria governing the allocation of transfers can affect the fiscal autonomy of subnational entities and shape the composition of public expenditures, often favoring current spending at the expense of capital investment. This debate is crucial for policy formulation aimed at enhancing the efficiency of fiscal federalism, ensuring that revenue equalization mechanisms do not undermine local revenue mobilization efforts or compromise fiscal sustainability over the long term.

The implementation of the LRF in 2000 introduced rules to control personnel expenditure and state-level indebtedness, but it did not set limits on investment expenditure. Studies such as Neduziak and Correia (2018) indicate that, in the post-LRF period, public investment became an adjustment variable, declining in response to the constraints imposed by personnel expenditure limits.

The effects of intergovernmental transfers on public investment are also examined by Correia and Neduziak (2019), who find that positive shocks in federal transfers to states lead to an increase in subnational debt, though with varying impacts depending on the group of states analyzed. In a broader context, Sakurai and Menezes (2011) identified cyclical patterns in municipal public spending, highlighting a maximization of current expenditure and a reduction of investment during electoral periods.

The reduction of federal transfers from 2008 onward prompted a restructuring of state governments' revenue composition. Data from the National Treasury indicate that since then, states' own revenues—especially those from tax collection—have come to

represent an increasing share of net current revenue, while federal transfers have gradually lost their relative weight.

In a context of low economic growth—particularly after 2008—and a high degree of budgetary dependency of state-level governments on federal transfers, the transfer system ultimately shifted fiscal risk to lower levels of government during times of crisis (Assunção, Ortiz, and Pereira, 2012). The decline in federal transfers, combined with the increase in personnel expenditures, raises concerns about the capacity of subnational governments to adjust their spending and implement cuts amid financial difficulties.

The post-2008 period was characterized by uncertainty and an increased risk of fiscal fragility in the public finances of subnational entities, which led to the establishment of a credit monitoring and evaluation mechanism by the National Treasury. As part of this effort, in 2012, the National Treasury Secretariat instituted Ordinance No. 306, which regulated the payment capacity of subnational entities (CAPAG - *Capacidade de Pagamento*). This regulation established criteria to assess the possibility of raising foreign credit operations, assigning a fiscal rating to subnational governments. According to Manoel, Neto, and Neto (2016), this ordinance made it possible to officially assess the fiscal situation of a given state from the federal government's perspective.

The Ministry of Finance revised the payment capacity rating methodology through Ordinance No. 501 (2017), streamlining the CAPAG calculation and enhancing its accessibility. The revised methodology established three primary criteria: indebtedness, current savings, and liquidity.

Given that federal transfers represent a considerable portion of the states' net current revenue, their progressive reduction compromises the relevance of this indicator as a parameter for the definition of tax rules, such as those established by the LRF for personnel expenditures and Net Funded Debt. For instance, the relative growth of tax revenues relative to transfers suggests that setting new tax parameters based on tax revenue could offer a more accurate measure of states' actual ability to finance their expenditures.

Therefore, the federal structure and fiscal restrictions have produced different patterns of behavior among Brazilian states regarding public investment capacity. This research seeks to contribute to the literature by using a panel threshold model to test the hypothesis that the degree of budgetary dependency has heterogeneous effects on state-level investment expenditure, conditional on the level of fiscal constraint—as measured by net funded debt.

3. Data and Methodology

This study examines the existence of a non-linear relationship between investment expenditure and the degree of budgetary dependency across Brazilian states during the 2001–2018 period, under the hypothesis that such dependency is shaped by the level of Net Funded Debt.

Fiscal variables were obtained from the National Treasury database, while state-level GDP data were sourced from the IBGE. Both fiscal and GDP figures were deflated to 2020 prices. Population data were also extracted from the IBGE database.

The research time frame considers two essential factors. First, it must fully incorporate the LRF empirical effects across the study period. Given the discretionary nature of investment expenditures, the LRF's implementation from 2003 onward likely influenced investment spending dynamics, particularly through state budget adaptations to comply with the law's personnel expenditure constraints. Second, the timeframe aligns with consolidated state government terms, with 2018 representing the most recent complete electoral cycle for all state executives in the dataset.

The study employed two complementary analytical techniques to examine the research hypothesis. Initial data exploration and preprocessing utilized cluster analysis, which enabled identification of distinct groupings among Brazilian states, thereby providing preliminary evidence for potential nonlinear relationships. Subsequently, a panel threshold model was implemented to formally test for nonlinear effects, with this method specifically selected for its capacity to endogenously determine threshold variables that demarcate structural breaks in the observed relationships. The following sections elaborate on each methodological approach.

3.1. Data Organization and Treatment

Cluster analysis is a multivariate exploratory technique used to identify the presence of homogeneous patterns within a dataset. The main objective of applying this technique is to allocate observations into a relatively small number of internally homogeneous—but mutually heterogeneous—groups (or clusters). Thus, the observations within each cluster should exhibit a degree of internal similarity, based on the selected variables.

As an exploratory or interdependence-based method, the inclusion of new observations or variables requires the reapplication of the analysis in order to properly reassess the grouping structure.

The use of cluster analysis aims to examine how the ordering and allocation of observations behave based on the specified number of groups.

Once the research objectives are defined, an appropriate measure of distance must be selected to determine how close the observations are from one another.

There are two main approaches to multivariate cluster analysis: hierarchical and non-hierarchical methods. Hierarchical methods identify the structure and allocation of observations while determining the number of resulting clusters. In contrast, non-hierarchical methods begin with a predefined number of clusters and evaluate how well each variable contributes to the groupings.

The choice between these methods should align with the study's objectives. Authors such as Bussab et al. (1990) and Johnson and Wichern (2007) highlight that different measures of distance and methods may produce distinct results, depending on the analytical goals.

Non-hierarchical methods offer advantages for large samples, as they do not require recalculating and storing a new proximity matrix at each step of the algorithm. Another advantage is their capacity to reassign subjects to different clusters if a better fit is identified. Accordingly, the non-hierarchical cluster analysis method—k-means—is particularly suitable when the number of clusters is unknown, especially in the context of large datasets.

Johnson and Wichern (2007) point out three steps in the elaboration of the non-hierarchical clustering method (k-means): (i) define the initial number of clusters and the respective centroids; (ii) assign each observation to the cluster with the nearest centroid, then update the centroid of the cluster receiving the new observation, as well as that of the cluster that lost it; (iii) repeat the previous step until no subject can be reassigned to a closer centroid in another cluster.

Furthermore, variables should be standardized prior to applying the k-means algorithm if they are measured on different scales.

3.2. Panel threshold model

To examine the validity of the non-linearity hypothesis, through Equation 1, the Hansen's (1999) panel threshold model is used as follows:

$$y_{it} = \beta_0 X_{it} + \begin{cases} \beta_1 Z_{it} + e_{it} & q_{it} \leq \gamma \\ \beta_2 Z_{it} + e_{it} & q_{it} > \gamma \end{cases} \quad (1)$$

Where y_{it} is the dependent variable (investment expenditure in Brazilian states), and X_{it} represents the control variables: GDP per capita, public savings rate, election year dummy, and LRF dummy. q_{it} is the threshold variable that splits the sample into different regimes. This study employs the Net Funded Debt to Net Current Revenue ratio as the threshold variable that defines the structural change in the relationship between investment expenditure and budgetary dependency.

Investment expenditure, the model's dependent variable, is a key component of public budgeting, reflecting a government's ability to allocate resources toward infrastructure and economic development. This variable is sensitive to both structural and cyclical factors, such as tax revenues, intergovernmental transfers, and fiscal constraints.

Regarding the independent variables, GDP per capita is included to capture a state's economic capacity, which is directly related to its tax revenue potential and ability to finance public investment. States with higher GDP per capita tend to have greater fiscal autonomy, reducing reliance on transfers and potentially allocating more resources for investments. The literature suggests that regions with higher levels of economic development tend to exhibit greater tax collection capacity, and, consequently, a broader fiscal margin for public investment.

The public savings rate measures a government's ability to generate fiscal surpluses that can be directed toward investment. States with higher public savings rates enjoy greater budgetary flexibility to undertake investments, while those with lower savings tend to face constraints in allocating resources to infrastructure. This factor reflects the fiscal sustainability of subnational governments and their capacity for financial planning.

The inclusion of the election year dummy is justified by the theory of political budget cycles, which posits that governments modify their spending patterns during election periods. In election years, spending tends to shift between current expenditures and investment outlays, potentially affecting the allocation of resources for infrastructure.

The LRF dummy is included to capture the effects of the legislation on states' investment capacity. While the LRF is expected to have imposed limits on expenditure growth, it may also have encouraged greater fiscal discipline, thereby influencing how resources are allocated to investment.

The threshold variable selected for the model is the ratio of Net Funded Debt to Net Current Revenue (NFD/NCR), which reflects the degree of fiscal constraint faced by states. High levels of this indicator indicate a greater commitment of current revenue to indebtedness, reducing the margin for public investments. Thus, this variable serves as a determining factor to establish the different regimes in the relationship between investment expenses and the degree of budgetary dependency.

The degree of budgetary dependency is measured by the ratio between the State Participation Fund (FPE - *Fundo de Participação dos Estados*) and Tax Revenue, reflecting the weight of intergovernmental transfers in the composition of state-level revenues. States that rely more heavily on the FPE tend to exhibit lower fiscal autonomy and may follow different patterns in investment allocation—especially under conditions of fiscal constraint.

The selection of this set of variables enables an assessment of how economic, political, and fiscal factors influence the dynamics of public investment across Brazilian states, contributing to the broader debate on the impact of budgetary dependency on the sustainability of subnational public finances.

This methodology makes it possible to examine the differentiated effects of budgetary dependency on investment expenditure across lower and upper regimes—depending on whether the threshold variable falls below or above the cutoff value γ, in this case, the ratio of Net Funded Debt to Net Current Revenue. The coefficients β_1 and β_2 represent the effect considered in the lower and upper regimes, respectively. To test the statistical significance of γ, i.e. the existence of a threshold effect, Hansen (1999) demonstrates that it is possible to consistently identify the γ parameter by estimating confidence intervals (bootstrap), using the Maximum likelihood estimation and the LR statistic.

4. Results and Discussion

Table 1 displays the results of the cluster analysis. The identification of three clusters allowed the identification of the characteristics of a set of variables: net funded debt, budget dependency indicator and investment expenses.

Table 1: Mean values of selected variables by cluster

Cluster	NFD*	BDI	Investment Expenditure*
1	1.40	0.27	0.05
2	0.63	0.40	0.07
3	0.72	1.35	0.11

*Values as a share of Net Current Revenue (NCR)
Source: Own elaboration based on the results of the cluster analysis using data from the National Treasury.

The cluster analysis revealed a grouping pattern consistent with the cophenetic correlation values across all possible combinations of distance and linkage methods. Considering the selected variables (net funded debt, budget dependency indicator and investment expenditure), it was possible to identify that high levels of debt are associated with a lower degree of budgetary dependency as well as a lower level of investment expenditure. Figure 1 below summarizes the results of the cluster analysis.

Figure 1: Net Funded Debt, Budgetary Dependency, and Investment Expenditures in Brazilian States (mean values over the period 2001–2018)
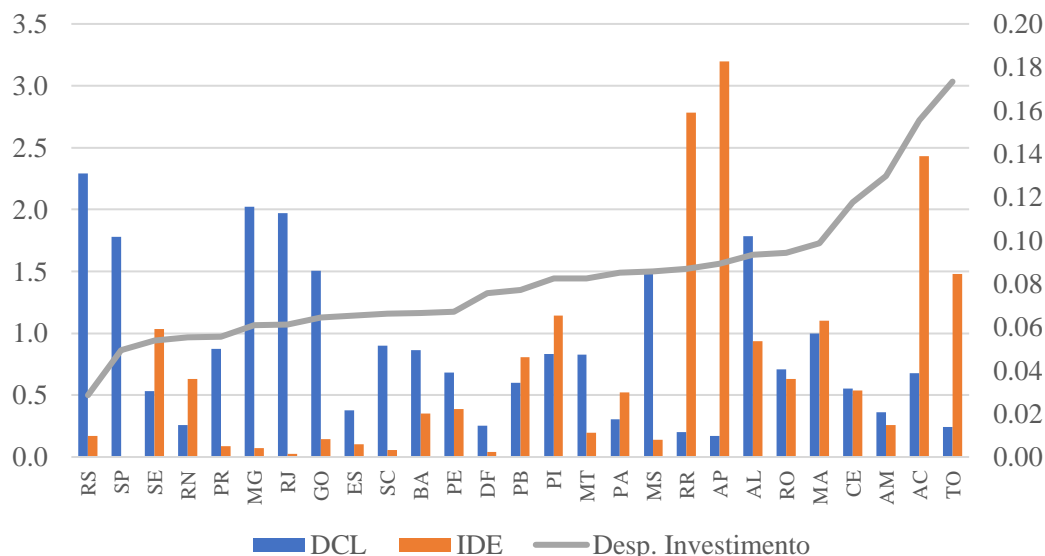
Source: Own elaboration based on data from National Treasury data.

By associating the net funded debt for each of the three clusters identified in the cluster analysis with the budget dependency indicator and investment expenditure, it became evident that net funded debt serves as a reliable reference parameter for the identified groups. Establishing net funded debt as the threshold variable allowed for the identification of several nonlinear relationships. Therefore, panel threshold regression effect seeks to corroborate and quantify this non-linearity relationship.

The variable net funded debt was chosen as the threshold variable of the experiment, consistent with the cluster analysis. The Lagrange Multiplier test is employed to evaluate the null hypothesis of no threshold effect (linear model). If the null hypothesis is rejected, the test proceeds to assess two threshold effects (alternative hypothesis Ha) against a single threshold effect (H0), continuing iteratively until the null hypothesis cannot be rejected. The p-value is calculated using the bootstrap technique, and the Lagrange test is programmed to correct heteroscedasticity when present.

Table 2 presents the results of the panel threshold model. The within R^2, typical of this estimator, showed a high value (0.452), indicating that the within estimator is appropriate. All individual parameters were statistically significant. The overall set of parameters was also significant, as evidenced by the F-statistic (57.240).

The parameters associated with the research control variables—per capita GDP, savings rate, Election Year dummy, and LRF dummy—were statistically significant and exhibited the expected signs.

Initially, the empirical analysis estimated a model with two thresholds, given that the H0 of the linear model had been rejected in favor of a model with a simple threshold. In the second step, the H0 of the simple threshold model could not be rejected.

Table 2: Threshold estimator results

Threshold		Lower		Upper	
1.52		1.39		1.89	
LM Test		Bootstrap p-value	F	Prob	
23.471		0.034	58.160	0.024	
Investment Expenditure	Coef.	Std. Error		t-Statistic	p-value
Constant	19.656*	0.253		77.610	0.000
GDP Per capita	0.029*	0.004		6.502	0.000
Savings Rate	0.755*	0.207		3.639	0.000
Election Year Dummy	0.150*	0.042		3.527	0.000
LRF Dummy	-0.174**	0.073		-2.375	0.018
0	0.208**	0.105		1.973	0.049
1	-0.310*	0.115		-4.480	0.000

N. Obs.	486	
F	57.240	
R^2	within	0.452
	between	0.123
	overall	0.020

*Significant at 1% level. **Significant at 5% level. Standard errors in parentheses.
Source: Own elaboration based on Gretl software output.

The results divided the sample into two groups: one with a net funded debt to net current revenue ratio below 1.52, and another with a ratio above 1.52. In both cases, a 1% shock in the budgetary dependency indicator (BDI) had distinct effects on investment expenditures.

For the group with debt below 1.52, the shock corresponded to an increase of 0.208%, while for the group with debt above 1.52, the effect was a decrease of -0.310%. These findings align with the fiscal federalism literature and the determinants of public expenditures, highlighting the role of fiscal constraints in states' budget allocation.

The first-generation fiscal federalism theory, as outlined by Oates (1972) and Musgrave (1959), suggests that fiscal decentralization enables better alignment of public policies with local preferences. However, as pointed out by the literature related to second-generation fiscal federalism theory (Petchey and Levtchenkova, 2002; Wagner, 2007), fiscal equalization mechanisms may create adverse incentives, such as a reduction in own-source revenue efforts by states. The results of this empirical study support this view by demonstrating that budgetary dependency has varying effects on investments depending on the fiscal situation of the state.

Rocha and Giuberti (2008) emphasize that states' taxing powers are insufficient to cover their governmental responsibilities, making intergovernmental transfers essential to mitigate budgetary inequalities. However, the present empirical analysis indicates that these fiscal equalization instruments do not affect states uniformly. While states with lower levels of indebtedness may use intergovernmental transfers to expand their investment expenditures, those with higher debt levels appear to allocate such resources toward other expenses—possibly for fiscal adjustment or debt servicing.

The literature focused on the Brazilian context also highlights the relevance of the LRF in shaping patterns of public spending. Neduziak and Correia (2018) emphasize that, following the implementation of the LRF, investment expenditure became an adjustment variable in state budgets. This may partly explain the results observed for the group of highly indebted states, where increased fiscal autonomy is associated with reduced investment levels. This finding suggests that states with greater indebtedness may be prioritizing deficit control and compliance with the fiscal limits established by the LRF, at the expense of public investment.

Conversely, the relationship between political cycles and public expenditures, as discussed by Nordhaus (1975), may indicate that states with lower debt levels have greater fiscal space to increase investment spending in response to changes in budgetary dependency—particularly during election years. This aspect is relevant to understand the effects of federal transfers on state-level expenditures and their allocation between current expenditures and investments.

The study contributes to the broader debate on the fiscal sustainability of Brazilian states by suggesting that the structure of intergovernmental transfers and existing fiscal constraints directly influence the allocation of resources toward investment. The findings reinforce the need to revise fiscal equalization mechanisms to ensure that transfers promote state-level development without undermining fiscal autonomy or encouraging behaviors that may exacerbate long-term financial imbalances.

Conclusion

This study examined the relationship between investment expenditures degree of budgetary dependency in Brazilian states between 2001 and 2018. The research raised the hypothesis that budgetary dependency generates distinct effects on investment expenditures, conditioned by the level of fiscal constraint—captured through net funded debt—as the threshold in this relationship.

Fiscal federalism theory has evolved under the premise that governments respond to the full set of incentives embedded in the institutional environment. Additionally, the literature identifies a range of factors as key drivers of public expenditures, including socioeconomic, political, and demographic variables. In the Brazilian states' context, the literature has emphasized the influence of the political, fiscal, and federal environment on budgetary variables.

The findings reinforce the hypothesis that the effects of budgetary dependency on investment expenditures are heterogeneous, depending on the level of indebtedness, which defines the threshold in the model. Subnational entities with high levels of public debt tend to reduce their investment expenditures as their budgetary dependency increases. In summary, the research provides results that can qualify fiscal equalization mechanisms. Federal systems that rely on intergovernmental transfers to promote budgetary equity must consider the possibility of adverse effects—such as the reduction of investment expenditures—in highly indebted states facing increased budgetary dependency.

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