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Budgetary Solvency Factors in Brazilian Municipalities

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Abstract

Objective: This study aims to analyze the relationship between budgetary solvency and the determining factors of financial autonomy, current balance, indebtedness, and public investment in medium and large Brazilian municipalities. The analysis seeks to understand the impact of these variables on the financial condition of municipal entities, contributing to the improvement of public management financial planning, and decision-making in public administration.
Method: The research uses data from 409 Brazilian municipalities with a population of over 50,000 inhabitants, covering the period from 2016 to 2021. To estimate the models, linear regression was applied using the Arellano-Bover, 1995, system estimator with robust correction.
Results: The findings indicate that the budgetary solvency of medium and large municipalities is negatively impacted by levels of indebtedness and investment. However, no statistically significant relationship was identified between budgetary solvency and the variables financial autonomy and current balance. These results support the formulation of fiscal policies and municipal financial planning.
Contributions: The study contributes by presenting a mapping of the budgetary solvency of Brazilian municipalities, providing support for public managers in the execution of sustainable fiscal policies. Additionally, it offers support for control bodies in assessing fiscal management and promotes academic debate on the importance of budgetary solvency in municipal administration.

Keywords: Budgetary Solvency; Financial Autonomy; Current Balance; Indebtedness; Investment.

Introduction

A public entity is in good financial condition when it can honor its debts and simultaneously provide services at acceptable levels (Bisogno et al., 2014; Jimenez, 2018; Zafra-Gómez et al., 2009a). Although there is no consensus on which would be the best model to express the financial condition of local governments, Bisogno et al. (2019) point out that authors (Greenberg & Hiller, 1995; Wang et al., 2007; Zafra-Gómez et al., 2009a) have addressed the issue by discussing different types of solvency.

Researchers generally assess solvency in four dimensions: cash solvency, budgetary solvency, long-term solvency, and service-level solvency (Maher et al., 2020). Budgetary solvency, considered the core of financial health, reflects the ability of a public entity to generate revenues to cover its expenses without incurring a deficit (Zafra-Gómez et al., 2009a).

In the Brazilian context, where resource scarcity often compromises the provision of public services, budgetary solvency becomes particularly relevant (Gomes et al., 2013). However, although studies in Brazil investigate the relationship between the financial condition of public entities and its determinants (Carneiro & Brasil, 2010; Dantas et al., 2019; Marconato et al., 2021), there is a gap in the examination of the factors that specifically influence budgetary solvency.

In this sense, by replicating the work of Bisogno et al. (2019) entitled *Budgetary solvency of Italian local governments: an assessment*, this research questions the relationship between budgetary solvency and the determinants that express aspects related to financial autonomy, current balance, indebtedness, and public investment in medium and large Brazilian municipalities.

The specific challenges of the Brazilian context amplify the relevance of this investigation: the high dependence on intergovernmental transfers, due to low own-source revenue, increases fiscal vulnerability, especially in economic crises (Dantas et al., 2019; Brito & Brito, 2020); the imbalance between revenues and expenditures often results in indebtedness to finance essential services, compromising solvency by allocating future resources to interest and amortization (Costa & Morais, 2021; Macedo & Corbari, 2009); in turn, investments in physical capital require long-term financing, generating benefits over equivalent periods, but potentially intensifying fiscal stress in the short term (Costa & Morais, 2021; Dantas et al., 2019).

Although there is no complete equivalence between Brazil and Italy regarding administrative organization and revenue collection, there are similarities between the model adopted by Brazilian municipalities and Italian local governments. As in Brazil, Italian public administration is organized into three levels: central government, regional governments, and local governments, which include provinces and municipalities.

Like Brazilian municipalities, Italian local governments are responsible for providing essential public services to citizens, being financed by transfers from central and regional governments, in addition to the collection of local taxes, such as property and economic activity taxes, fees, and fines (Bisogno et al., 2019).

Based on these structural similarities, the present study investigated the determinants that influence the budgetary solvency of medium and large Brazilian municipalities. The study included a sample composed of 409 Brazilian municipalities with a population exceeding 50,000 inhabitants for which financial indicators were calculated referring to the period from 2016-2021. The results suggest that budgetary solvency is negatively related to the level of indebtedness and to the level of investment, but does not have a statistically significant relationship with financial autonomy and with current balance.

These findings highlight the relevance of the topic and position the study as a pioneering contribution to the national literature, by demonstrating the impact of indebtedness and investment on the budgetary solvency of Brazilian municipalities. Previous studies (Carneiro & Brasil, 2010; Dantas et al., 2019; Marconato et al., 2021) analyzed factors that influence the financial condition of public entities, but did not specifically address the elements that affect budgetary solvency.

The study also enhances the understanding of the application of budgetary solvency models by enabling comparison with the original work developed in Italy (Bisogno et al., 2019), contributing to the international comparative literature.

Although the research data do not allow inferences about the influence of current balance and financial autonomy on budgetary solvency, the influence of the levels of indebtedness and investment is clear. These findings are crucial for public managers, oversight bodies, financiers, and society, providing support for informed decisions.

This article offers: (i) a mapping of the budgetary solvency of Brazilian municipalities with a population above 50,000 inhabitants; (ii) support for public managers in the planning

and execution of more efficient fiscal policies, aiming at long-term financial sustainability; (iii) assistance to oversight bodies in evaluating fiscal management practices, contributing to transparency and accountability in public administration; (iv) discussion for society on the importance of budgetary solvency and its determinants, encouraging participation and monitoring of municipal finances; and (v) an empirical database for future academic research, which can be replicated or adapted in other geographic or temporal contexts.

2 Literature Review and Hypothesis Definition

2.1 Budgetary Solvency

Although there is some consensus on the dimensions of solvency for assessing the financial condition of local governments and on the importance of financial condition for the effective, efficient, and economical provision of public services, there is no agreement on the indicators to be used to measure such dimensions (Cuadrado-Ballesteros et al., 2019; Iacuzzi, 2022; Wang et al., 2007).

Authors who address the measurement of financial condition based on solvency (Bisogno et al., 2019; Cuadrado-Ballesteros et al., 2014; García-Sánchez et al., 2012b; Maher et al., 2020; Wang & Liou, 2009; Zafra-Gómez et al., 2009abc) rely on the concepts of Groves et al. (1981) to characterize financial indicators in the dimensions of cash solvency, budgetary solvency, long-term solvency, and service-level solvency.

The study by Wang and Liou (2009) concluded that budgetary solvency is the most important dimension of financial condition for financial management, reflecting the combined effect of revenue collection and expenditure control, while Greenberg and Hillier (1995) and the Canadian Institute of Chartered Accountants [CICA] (1997) aggregated budgetary solvency indicators into the categories of sustainability, flexibility, and vulnerability (Bisogno et al., 2019; García-Sánchez et al., 2012b; Zafra-Gómez et al., 2009abc).

Sustainability refers to the ability of an entity to provide public services, meeting its obligations to creditors, without increasing levels of indebtedness and taxation; flexibility represents the ability of an entity to adapt to external changes, within the limits of its fiscal capacity, through restructuring of sources derived from taxes and indebtedness; and vulnerability reflects the level of independence of an entity in relation to transfers and donations received from other entities (Bisogno et al., 2019; García-Sánchez et al., 2012b; Zafra-Gómez et al., 2009abc).

2.2 Relationship between Budgetary Solvency and Financial Autonomy

Financial autonomy can be expressed as the freedom to establish and collect taxes and allocate financial resources without external interference (except for the general rules defined by the central government), so that the higher the levels of freedom in tax collection, the easier it is to obtain revenues to meet citizens' demands without compromising the solvency of a local government (Bisogno et al., 2019).

In Brazil, with the promulgation of the 1988 Federal Constitution, there was a fiscal decentralization that assigned distinct tax competencies to the federated entities, increasing the independence of states and municipalities through the capacity to establish and collect taxes (Brito & Brito, 2019; Leroy et al., 2017; Suzart et al., 2018; Vieira et al., 2017).

Although municipal tax collection has shown growth following the 1988 Federal Constitution, municipalities remain highly dependent on intergovernmental transfers, as their own revenue collection is insufficient to meet part of the social demand for public policies (Carneiro & Brasil, 2010; Mendes et al., 2018). This scenario of Brazilian municipalities depicts a situation of budgetary and fiscal vulnerability, in which the largest portion of their budgetary resources is defined exogenously (Brito & Brito, 2020).

From a fiscal perspective, the more autonomous municipalities are, the less they incur debt (Benito & Bastida, 2004). Municipalities with strong dependence on intergovernmental transfers and which, therefore, cannot rely on alternative sources if these transfer flows decrease, are more prone to financial problems, such as failure to meet payment obligations and the potential to increase their level of indebtedness and, consequently, the risk to budgetary solvency (Bocchino & Padovani, 2021; Brito & Brito, 2020; Trussel & Patrick, 2009). This context leads to the first research hypothesis:

H1: the budgetary solvency of medium and large Brazilian municipalities is positively affected by financial autonomy.

2.3 Relationship between Budgetary Solvency and Current Balance

Current expenditures exceeding current revenues are interpreted as a warning sign of financial stress, with the balance between revenues and expenditures being a requirement for achieving budgetary solvency (Bisogno et al., 2019). In this regard, Bisogno et al. (2019) point out that scholars (Bisogno et al., 2013; Manes Rossi et al., 2012) have emphasized

the importance of the current balance indicator.

The current balance is addressed in national legislation both directly and indirectly. For example, the 1988 Federal Constitution prohibits credit operations that exceed the amount of capital expenditures, meaning that loans cannot finance current expenditures (Federal Constitution, 1988).

In turn, Law No. 4,320, of March 17, 1964, requires that, as much as possible, a balance be maintained during the fiscal year between collected revenue and incurred expenditure, while the Fiscal Responsibility Law mandates that the budget guidelines law shall provide for the balance between revenues and expenditures (Silva et al., 2021).

Public entities that incur expenditures exceeding their revenue collection are obtaining resources through indebtedness (Costa & Morais, 2021; Mello & Slomski, 2009) to provide ordinary services to the population, consequently causing a negative impact on their budgetary solvency. Thus, the second research hypothesis is:

H2: the budgetary solvency of medium and large Brazilian municipalities is positively affected by the current balance.

2.4 Relationship between Budgetary Solvency and Indebtedness

To increase their revenues, public entities choose between expanding taxation, which results in greater financial autonomy, or incurring indebtedness through the acquisition of loans (Suzart, 2012).

From the perspective of the primary result, if current primary revenues are not sufficient to finance current primary expenditures, the entity's current level of spending would exceed its own means, forcing the municipality to reduce expenditures and increase current revenues initially or, if the situation persists, to take on short-term debt, the servicing of which will require new financing to be honored, thus masking real long-term debts (Benito & Bastida, 2004).

Obtaining loans is commonly one of the main options for adjusting the funding sources of the public entity; on the other hand, indebtedness can affect the execution of future expenditures and lead to the insolvency of public entities, as these entities are required to allocate a portion of their revenues to cover expenses related to the amortization and charges of previously incurred debt (Macedo & Corbari, 2009; Suzart, 2012).

Thus, when a municipality relies on indebtedness to meet the population's demands, it is more susceptible to insolvency, as it is required to service the debt even during periods of financial difficulty; consequently, obtaining new loans becomes more challenging, as these entities are less creditworthy to creditors due to presenting a higher risk of default (Alijarde & López, 2001; Chaney, 2005; Trussel & Patrick, 2009).

Since an increase in indebtedness leads to a deterioration of the financial condition of the public entity, the third research hypothesis is established:

H3: the budgetary solvency of medium and large Brazilian municipalities is negatively affected by the level of indebtedness.

2.5 Relationship between Budgetary Solvency and Investment

Bisogno et al. (2019) argue that investments in new infrastructure may lead to a reduction in current expenditures, improving the efficiency of local governments and positively affecting the sustainability category of budgetary solvency. However, in their work Budgetary solvency of Italian local governments: an assessment, this hypothesis was not confirmed. Supporting the initial position of Bisogno et al. (2019), Trussel and Patrick (2009) found that American districts with fiscal difficulties have lower capital expenditures.

The issue is controversial because other studies (Ehalaiye et al., 2017; Vera, 2018) indicate that a positive year-to-year variation in investments positively affects the variation in indebtedness and, therefore, reduces budgetary solvency: the implementation of investments in physical capital by the government requires a large volume of resources, generally necessitating the acquisition of long-term credit as a financing source to distribute the benefit and burden of investments over equivalent periods (Costa & Morais, 2021; Santana et al., 2019).

The assumption that indebtedness finances investment in capital goods was also confirmed by Benito and Bastida (2004), who concluded that investment expenditures have a positive influence on the variation in the debt stock, and by Balaguer-Coll et al. (2015), who found, on average, a positive relationship between investment and debt.

According to Dantas et al. (2019), the higher the investments in capital expenditures, the more prone to fiscal stress the public entity will be, since the results of this type of expenditure are, as a rule, long-term, not alleviating the pressure for spending in the short term.

Therefore, one point to be considered is the maturation period of investments. In the case of the work by Bisogno et al. (2019), the investment indicator was calculated considering the ratio between investment expenditures and current expenditures over a three-year period. Further studies would need to be conducted to assess whether, with longer periods, this indicator captures the efficiency generated by investments and the consequent reduction in current expenditures. Consequently, the fourth research hypothesis is:

H4: the budgetary solvency of medium and large Brazilian municipalities is negatively affected by the level of investment.

3 Methodology

To investigate whether the budgetary solvency of Brazilian municipalities with a population exceeding 50,000 inhabitants is influenced by financial autonomy, current balance, level of indebtedness, and level of investment, a quantitative (using secondary data) and descriptive research was conducted, meaning that the facts were analyzed, classified, and interpreted while preserving their original characteristics (Gil, 1996).

3.1 Population and Sample

The research sample consists of 409 Brazilian municipalities with a population exceeding 50,000 inhabitants in 2021. The analyzed period corresponds to the years 2016 to 2021. The choice of municipalities as the unit of analysis aimed to cover the largest volume of data from governmental entities and maintain consistency with the study being replicated. Regarding the population size of the municipality, the selection stemmed from the observation that, during the analyzed period, the smaller the municipality in population terms, the greater the likelihood of presenting inconsistencies in the published accounting and fiscal statements.

3.2 Data Collection and Processing

The research data were collected from the Brazilian Public Sector Accounting and Fiscal Information System (Siconfi), under the option "Consult Finbra," and are distributed in the Annual Accounts, the Budget Execution Report (RREO), and the Fiscal Management Report (RGF) (Brazilian Public Sector Accounting and Fiscal Information System [Siconfi], 2022).

MS Access was used to calculate the value of the 11 indicators (7 indicators composing the dependent variable

and 4 indicators representing the independent variables). To this end, records related to 667 municipalities were stored in MS Access, corresponding to those Brazilian municipalities with a population exceeding 50,000 inhabitants in 2021, with data available on Siconfi.

After data cleaning, 258 municipalities were excluded from the initial sample, leaving 409 municipalities per year, equivalent to 2,454 observations. The exclusions were mainly due to the existence of negative balances in patrimonial accounts that are not characterized as reducing accounts (60%), the absence of publication of the Budget Execution Summary Report – RREO or the Fiscal Management Report – RGF (25%), and other reasons such as the absence of balances in the accounts used to calculate the indicators, or because one of the indicator's components presented a negative total, inconsistent with its metric, etc. (15%).

The calculation of the dependent variable was carried out in accordance with the data aggregation process proposed by García-Sánchez et al. (2012a) and adopted by Bisogno et al. (2019), Cuadrado-Ballesteros et al. (2014), Cuadrado-Ballesteros et al. (2019), and Zafra-Gómez et al. (2014). This process consisted of ranking the municipalities in the sample based on the results of indicators I to VII (described in subsection 3.3 of this work) into quartiles for each year, and assigning points ranging from zero to one, depending on the position each municipality's result occupies in each quartile.

The point assignment process considered the positive relationship (the higher the result, the better the budgetary solvency of the municipality) and negative relationship (the higher the result, the worse the budgetary solvency of the municipality) of indicators I to VII, as described in Table 1.

Table 1. Scoring Criteria for Budgetary Solvency

	POSITION	POINTS
INDICATORS POSITIVELY RELATED TO BUDGETARY SOLVENCY (Indicators II and VII)	Value < 1st quartile	0.00
	1st quartile ≤ value < 2nd quartile	0.25
	2nd quartile ≤ value < 3rd quartile	0.50
	Value ≥ 3rd quartile	1.00
INDICATORS NEGATIVELY RELATED TO BUDGETARY SOLVENCY (Indicators I, IIII, IV, V, and VI)	Value < 1st quartile	1.00
	1st quartile ≤ value < 2nd quartile	0.50
	2nd quartile ≤ value < 3rd quartile	0.25
	Value ≥ 3rd quartile	0.00

Source: García-Sánchez et al. (2012a)

The sum of the scores assigned to the seven indicators produced the dependent variable, which represents a relative index of budgetary

solvency and takes values between 0 and 7.

In addition, as budgetary solvency is represented by three categories, the results of the indicators were also summed to create the variables used to test the robustness of the results, namely: sustainability (equivalent to the non-financial budgetary results indicator, takes values between 0 and 1), flexibility (sum of the net savings, debt service, and net debt indicators, takes values between 0 and 3), and vulnerability (sum of the current financial independence, total financial independence, and fiscal revenue indicators, takes values between 0 and 3).

3.3 Model Variables

The model proposed by Bisogno et al. (2019) relates the dependent variable Budgetary Solvency to four independent variables: financial autonomy, current balance, investment, and indebtedness. The model also includes the control variables population density, employed population, nominal GDP, and the proportion of the elderly population.

Following the proposal of Bisogno et al. (2019), Cuadrado-Ballesteros et al. (2014), Cuadrado-Ballesteros

et al. (2019), García-Sánchez et al. (2012b), and Zafra-Gómez et al. (2009abc), the dependent variable budgetary solvency is calculated through indicators aggregated into the categories of financial sustainability, flexibility for adaptation to external changes, and vulnerability (independence from external resources).

Italian local governments are an unusual case in which the accounting system relies on the coexistence of the modified cash basis and the accrual basis: the modified cash basis is adopted for both budgetary purposes and accounting records during the year, while measurement based on the accrual basis is used to prepare financial statements and the annual accountability report (Cohen et al., 2017; Cuadrado-Ballesteros et al., 2019).

In this research, the calculation of the indicators was based on the accrual basis, although receivables are not accounted for in all Brazilian municipalities, to maintain consistency with the original comparative study adopted in Italy. The categories that compose the dependent variable, as well as the independent and control variables, are presented in Table 2.

Table 2. Categories of the Dependent Variable and Independent and Control Variables

Categories/Variables	Indicator	Metric	Relationship with Budgetary Solvency
Sustainability	I - Non-financial budgetary results indicator	Non-financial budgetary accounts payable divided by non-financial budgetary accounts receivable.	-
Flexibility	II - Net savings indicator	Difference between accounts receivable (derived from current budgetary revenues) and accounts payable (derived from current budgetary expenditures), non-financial, reduced by the payment of annual amortization (interest and principal), per capita.	+
	III - Debt service indicator	Payment of annual amortization – interest and principal, per capita.	-
	IV - Net debt indicator	Annual variation in the accumulation of long-term credit operations, per capita.	-
Vulnerability	V - Current financial independence indicator	Current budgetary accounts payable divided by current budgetary accounts receivable, excluding current transfers.	-
	VI - Total financial independence indicator	Total budgetary accounts payable divided by total budgetary accounts receivable, excluding transfers.	-
	VII - Fiscal revenue indicator	Tax accounts receivable divided by current budgetary accounts receivable.	+
Independent	VIII - Financial autonomy	Proportion of revenues obtained from taxes and other tax revenues in relation to total current revenues.	+
	IX - Current balance	Ratio between current revenues and current expenditures.	+
	X - Level of indebtedness	Ratio between total debt and realized current revenue.	-
	XI - Level of investment	Ratio between investment expenditures and total current expenditures (average percentage over the last three years).	-
Control	Population density	Number of inhabitants of the municipality, from 2016 to 2021, divided by the municipality's area in km².	
	Employed population	Percentage of the employed population in the municipality from 2016 to 2021.	
	Nominal GDP	Nominal GDP of the municipality from 2016 to 2021.	
	Elderly population	Proportion of the population aged 60 or older, from 2016 to 2021, in relation to the total municipal population.	

Source: Bisogno et al. (2019), Cuadrado-Ballesteros et al. (2014), Cuadrado-Ballesteros et al. (2019), García-Sánchez et al. (2012b) and Zafra-Gómez et al. (2009abc).

The level of population employment, population density, per capita GDP, and the proportion of the elderly population in the municipality are variables that express socioeconomic context characteristics that may affect budgetary solvency and, therefore, were used as control variables (Bisogno et al., 2019; García-Sánchez et al., 2012b; Jimenez, 2018).

Unemployment affects both revenue collection and the demand for public services: higher unemployment rates mean that fewer residents can pay taxes and that the demand for local social services may increase, which results in lower financial sustainability, consequently leading to increased deficits and potentially indebtedness (Bolívar et al., 2018; Jimenez, 2018; Vera, 2018), whereas lower unemployment rates are associated with a better budgetary solvency situation (Wang & Liou, 2009).

The observed relationship between population density and budgetary solvency is sometimes contradictory (Sousa et al., 2019). Municipalities with higher population density require more services such as paving, public lighting, potable water, urban cleaning, health, leisure, and social assistance, leading to higher expenditures and, consequently, worse budgetary solvency (Bisogno et al., 2019).

Conversely, municipalities with lower population density showed worse financial indicators due to the incremental costs of providing public health and education services in remote communities or the transportation of the population to public facilities located in urban centers (Sousa et al., 2019).

Per capita GDP is a proxy for income level and is a controversial determinant whose relationship with financial condition was positive in some studies and negative in others (García-Sánchez et al., 2012b). Municipalities with higher per capita GDP tend to have better financial conditions because they can generate a larger volume of own revenues (Marconato et al., 2021).

However, the results of Sousa et al. (2019) and Bolívar et al. (2018) indicate that GDP did not influence the financial condition of municipalities, possibly because municipalities with greater economic activity expand their tax base, but, on the other hand, face increased pressure for expenditures due to the need for a greater supply of public services.

Finally, the demand for social and health services increases when there is a higher proportion of elderly people in the population, expanding public expenditure and negatively affecting the budgetary solvency of the municipality, more specifically its vulnerability category (Bisogno et al., 2019; Zafra-Gómez et al., 2009c).

Due to the unavailability of data for Brazilian municipalities regarding the GDP variables for the years 2020 and 2021 and employed population for the year 2021, projections of these variables were made by calculating the variation from previous periods.

3.4 Estimation of the Econometric Model

The model by Bisogno et al. (2019) was replicated to test the hypotheses in medium and large Brazilian municipalities, as per Equation 1:

$$\text{Budgetary Solvency}_{it} = \beta_0 + \beta_1 \text{Financial Autonomy}_{it} + \beta_2 \text{Current Balance}_{it} + \beta_3 \text{Indebtedness}_{it} + \beta_4 \text{Investment}_{it} + \beta_5 \text{Density}_{it} + \beta_6 \text{Employed Population}_{it} + \beta_7 \text{Elderly Population}_{it} + \beta_8 \text{GDP}_{it} + \xi_{it} \qquad (1)$$

Where the subscripts i and t refer to each municipality and year, respectively.

The estimation presented in Equation 1 was also used to test the robustness of the model, replacing the explained variable Budgetary Solvency with the categories of sustainability, flexibility, and vulnerability, which compose Budgetary Solvency. The robustness of the model was also tested through four equations analyzing the relationship of budgetary solvency with each of the independent variables individually (financial autonomy, current balance, indebtedness, and investment).

The selection of the estimator was preceded by tests for autocorrelation, heteroskedasticity, and endogeneity. The result of the Wooldridge test for panel data correlation indicated the presence of serially correlated errors (Prob>F = 0.0000). Both the Breusch-Pagan test and the White test showed that the variance of the errors, conditioned on the values of the explanatory variables, is not constant, meaning the errors are heteroskedastic (Prob>χ^2 = 0.0000 and p = 0.0000). The Wu-Hausman test revealed endogeneity: there is a relationship between the error term and the independent variables.

Due to the detection of autocorrelation, heteroskedasticity, and endogeneity in the data, it was decided to use the 1995 Arellano-Bover system estimator with robust correction, which assumes no autocorrelation in idiosyncratic errors and requires that the panel-level effects are not correlated with the first difference of the

first observation of the dependent variable. Therefore, when unobserved panel-level effects are correlated with lagged dependent variables, standard estimators are inconsistent, making the choice of a linear dynamic panel data model appropriate (StataCorp, 2021).

To assess whether the implemented model was adequately specified, two tests were conducted after estimation: the Arellano-Bond test for zero autocorrelation in first-differenced errors, under the null hypothesis of no serial correlation among the error terms, and the Sargan test for overidentifying restrictions, under the null hypothesis that the overidentifying restrictions are valid.

In this study, statistical tests were conducted at a significance level of 0.05. The extreme values of the independent variables and control variables were winsorized at 1%, and the natural logarithm was applied to the control variables GDP and population density.

4 Results and Implications

4.1 Descriptive Statistics

The calculation of budgetary solvency resulted in a classification of the municipalities in the sample, with the lowest score being zero and the highest being seven. This score was obtained by summing the seven indicators that compose the dependent variable budgetary solvency.

Table 3 shows that half of the Brazilian municipalities with a population above 50,000 inhabitants have budgetary solvency greater than 3.00, and that municipalities classified between the first observation and the first quartile received 25% of the maximum score, while municipalities classified up to the third quartile (75% of the sample) received 61% of the maximum score.

The results of the descriptive statistics of the independent variables show that financial autonomy (the ratio between revenues obtained from taxes and current revenues) has a median of 21%, with the highest ratio being 52%, which highlights the limited financial autonomy of medium and large Brazilian municipalities. The current balance indicates that current revenues, at their minimum value, represent 93% of current expenditures, and at their maximum value, exceed current expenditures by 49%.

The indebtedness result indicates that the median value is 16%, meaning that 50% of medium and large Brazilian municipalities have a ratio between consolidated debt and realized current revenue of up to 16%, while the investment variable shows that the median ratio between investment expenditures and current expenditures in the sample municipalities (average over the three-year period) is 5%, with this proportion reaching a maximum of 19%.

4.2 Econometric Model Analysis

The estimated parameters for each variable are shown

Table 3. Main Descriptive Statistics of the Research Variables

	Obs	Mean	DP	Min	25%	50%	75%	Max
Budgetary solvency	2,454	3.10	1.49	0.25	1.75	3.00	4.25	7.00
Sustainability	2,454	0.44	0.37	0.00	0.00	0.25	0.50	1.00
Flexibility	2,454	1.29	0.62	0.00	0.75	1.25	1.75	3.00
Vulnerability	2,454	1.37	0.73	0.25	0.75	1.25	2.00	3.00
Financial autonomy	2,454	0.22	0.10	0.05	0.15	0.21	0.27	0.52
Current balance	2,454	1.14	0.10	0.93	1.06	1.12	1.19	1.49
Indebtedness	2,454	0.23	0.21	0.00	0.08	0.16	0.29	1.07
Investment	2,454	0.06	0.03	0.01	0.04	0.05	0.08	0.19
Employed population	2,454	25.85	11.41	6.30	17.20	25.40	32.40	66.10
GDP*	2,454	8,540	14,300	452	1910	3,520	8,370	88,400
Population density	2,454	849.96	1,807.93	5.76	77.01	202.35	580.90	10,564.02
Elderly population	2,454	13.48	3.19	5.62	11.25	13.40	15.93	20.34

*In millions of reais.

in Table 4.

Table 4. Determinants of the Budgetary Solvency Index

	Coefficient	Robust standard error	p-value
Financial autonomy	0.1310	0.8518	0.878
Current balance	0.4891	0.3089	0.113
Indebtedness	-0.9503	0.2526	0.000
Investment	-2.7771	0.9775	0.004
Employed population	0.0198	0.0133	0.138
GDP	0.2146	0.1583	0.175
Population density	-0.0899	0.1142	0.431
Elderly population	-0.0042	0.0340	0.901
Constant	-3.2012	2.8307	0.258

Arellano–Bond test for zero autocorrelation in first-differenced errors: Prob > Z = 0.1530

Sargan test for overidentifying restrictions: Prob > χ² = 0.1682

The results were partially consistent with the study by Bisogno et al. (2019). Unlike the study conducted in Italy, the variables of financial autonomy and current balance did not show statistical significance (p=0.878 and p=0.113, respectively), and therefore, it was not possible to confirm the first and second hypotheses of the study.

The coefficients of the variables indebtedness and investment are negative and significant (p=0.000 and p=0.004, respectively) and confirm the third and fourth hypotheses of the research, as it was expected that the levels of indebtedness and investment would negatively affect budgetary solvency. The control variables employed population, GDP, population density, and elderly population were statistically insignificant, which demonstrates that budgetary solvency is influenced only by the independent variables and,

consequently, that the model was adequately controlled.

The Arellano-Bond test for zero autocorrelation in first-differenced errors (Prob>Z=0.1530) and the Sargan test for overidentifying restrictions (Prob > χ² = 0.1682) indicated that there is no second-order serial correlation and that the errors are homoscedastic, demonstrating that the moment conditions and the overidentifying restrictions are valid.

4.3 Robustness of the Econometric Model

The purpose of this section is to assess whether the obtained results are robust when analyzing the individual effect of each independent variable on budgetary solvency and when the three categories of budgetary solvency are considered as dependent variables: sustainability, flexibility, and vulnerability.

The first analysis shows the effect of each independent variable on budgetary solvency individually: budgetary solvency is analyzed with financial autonomy in equation 1, with current balance in equation 2, with indebtedness in equation 3, and with investment in equation 4.

The relationship of the independent variables with budgetary solvency is evaluated individually to determine whether the results are the same when these variables are included in the model together. This evaluation is relevant because there may be a relationship between the independent variables, given their purposes: the variables capture the sufficiency of current revenues to support current expenditures, the share of own-source revenue in current revenues, and the relationship between consolidated debt and current revenues.

Table 5. Robustness Test – Independent Variables

	Equation (1)		Equation (2)		Equation (3)		Equation (4)	
	Coef.	p-val.	Coef.	p-val.	Coef.	p-val.	Coef.	p-val.
Financial autonomy	-0.172	0.856						
Current balance			0.478	0.133				
Indebtedness					-1.163	0.000		
Investment							-2,825	0,006
Employed population	0.010	0.614	0.025	0.223	0.010	0.569	0.005	0.770
GDP	0.050	0.802	0.235	0.266	0.156	0.382	0.463	0.017
Population density	0.305	0.123	-0.178	0.297	-0.087	0.643	-0.392	0.075
Elderly population	-0.001	0.985	-0.047	0.267	-0.037	0.308	-0.045	0.248
Constant	-1.301	0.723	-3.162	0.395	-0.685	0.828	-5.792	0.107

The results of the equations, when analyzing the individual effects of each independent variable on budgetary solvency, are similar to those of the equation in which the independent variables are included together. As reported in Table 3, the variables of financial autonomy, current balance, and the control variables, except for GDP in equation 4, remain statistically insignificant, while the coefficients of the variables indebtedness and investment remain negative and significant (p=0.000 and p=0.006, respectively), with a slight difference in the magnitude of the coefficients.

Table 6 indicates that, when estimating sustainability (result 1) as the explained variable, the independent variables (except for indebtedness) and the control variables were statistically insignificant.

Table 6. Robustness Test – Budgetary Solvency Categories

	Result 1		Result 2		Result 3	
	Sustainability		Flexibility		Vulnerability	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Financial autonomy	0.2888	0.159	-0.3954	0.393	0.1905	0.650
Current balance	0.0978	0.185	0.0142	0.933	0.4009	0.008
Indebtedness	-0.2702	0.000	-0.5065	0.000	-0.2328	0.056
Investment	-0.2462	0.295	-1.9328	0.000	-0.7203	0.135
Employed population	0.0021	0.505	-0.0059	0.430	0.0210	0.001
GDP	0.0303	0.427	0.1181	0.245	-0.0032	0.967
Population density	0.0013	0.961	-0.0012	0.987	-0.0138	0.792
Elderly population	-0.0031	0.701	0.0179	0.352	-0.0089	0.600
Constant	-0.5600	0.415	-1.4100	0.428	0.0409	0.977

When the dependent variable is flexibility (result 2), the behavior of the coefficients of the independent and control variables follows the pattern of the main model, in which only the variables of indebtedness and investment have negative coefficients and statistically significant relevance.

In result 3 (vulnerability), the variables current balance and employed population show positive coefficients and statistical significance (p=0.008 and p=0.001, respectively), while all other variables were found to be statistically insignificant.

4.4 Discussion of the Results

The financial autonomy variable did not show statistical significance, either when included together with the other independent variables or when the individual effects of each independent variable on budgetary solvency were analyzed, contradicting the expectation of the influence of financial autonomy on the budgetary solvency of Brazilian municipalities with a population above 50,000 inhabitants.

It was expected that municipalities with a higher ratio of own-source revenue to current revenue, thus financially more autonomous and less dependent on transfers from other entities, would have greater budgetary solvency (Bisogno et al., 2019; Bocchino & Padovani, 2021; Brito & Brito, 2020; Trussel & Patrick, 2009). Possibly, the metric used to calculate this ratio, combined with the level of recording of tax receivables in Brazil, may explain this unexpected result.

Following Bisogno et al. (2019), the budgetary solvency metric adopted in this study is based on the accrual accounting system. Thus, indicator VII, which composes the dependent variable, corresponds to the ratio between tax accounts receivable and current budgetary accounts receivable. Financial autonomy (independent variable), in turn, is the proportion of revenues obtained from taxes in relation to total current revenues. In a fully established accrual accounting system, tax accounts receivable reflects the accounting movement of tax revenues.

The records in Siconfi for the sample during the study period, however, demonstrate a discrepancy between the recording in the patrimonial accounts 1.1.2.1.0.00.00 - Tax Credits Receivable (average record of 45% and standard deviation of 1%) and 1.1.2.5.0.00.00 - Tax Arrears (average record of 42% and standard deviation of 3%) and the recording in the budgetary accounts 1.1.0.0.00.0.0 - Taxes, Fees, and Improvement Contributions (average record of 100% and standard deviation of zero) and 1.2.0.0.00.0.0 - Contributions (average record of 95% and standard deviation of 1%) (Siconfi, 2022).

This discrepancy may have thus undermined the significant relationship between financial autonomy and budgetary

solvency. Furthermore, the greater dependence of Brazilian municipalities on resources from governmental transfers may have influenced budgetary solvency differently from what has been observed in other countries.

The second independent variable of the study is the current balance (the ratio between current revenues and current expenditures), which has a negative impact on the budgetary solvency of the public entity when it is not achieved (Bisogno et al., 2019; Costa & Morais, 2021; Mello & Slomski, 2009).

In this study, contrary to expectations, the independent variable current balance did not influence budgetary solvency, whether analyzed together with the other independent variables or individually, which may also be justified by the discrepancy between the recording of current revenues and the recording of receivables in the Brazilian municipalities of the sample.

Budgetary solvency in Brazilian municipalities with a population exceeding 50,000 inhabitants is negatively affected by the level of indebtedness. Therefore, the higher the level of indebtedness, the lower the budgetary solvency, as public entities with debts allocate part of their revenues to cover expenses related to the amortization and charges of the contracted debt (Bisogno et al., 2019; Macedo & Corbari, 2009; Suzart, 2012).

It is important to highlight that debt management practices and mechanisms may differ in the international context. In Italy, for example, municipalities may have direct access to different financing sources and are subject to stricter debt control mechanisms. In Brazil, loan sources generally rely on guarantees from the federal government to financial institutions to finalize the operation. Despite the noted variations, the impact of indebtedness on budgetary solvency in this research was the same as in the Italian context.

Similarly, the level of investment in the sampled municipalities negatively influenced the budgetary solvency of these municipalities, corroborating previous studies that indicate that investments reduce budgetary solvency, as the execution of these expenditures requires a large volume of resources, typically obtained through long-term credit (Benito & Bastida, 2004; Dantas et al., 2019; Ehalaiye et al., 2017; Vera, 2018).

When the categories of budgetary solvency (sustainability, flexibility, and vulnerability) are considered as dependent variables, there is convergence between the results of budgetary solvency and those of the flexibility category.

The only independent variable that demonstrated a relationship with sustainability was indebtedness. Sustainability refers to the ability of an entity to provide public services while meeting its obligations to creditors without increasing levels of indebtedness and taxation (Bisogno et al., 2019; García-Sánchez et al., 2012b; Zafra-Gómez et al., 2009abc). The negative impact of indebtedness on sustainability suggests that municipalities that rely on public debt to a greater extent have a lower capacity to provide public services.

Flexibility refers to the ability of municipalities to respond to changes in the economy through restructuring of sources derived from taxes and indebtedness (Bisogno et al., 2019; García-Sánchez et al., 2012b; Zafra-Gómez et al., 2009abc). The results reveal that flexibility is negatively affected by the level of indebtedness and investment, meaning that the higher the proportion of debts and long-term investment, the lower the net savings and the greater the amount of debt service and the annual variation in the accumulation of long-term credit operations, per capita.

Vulnerability reflects the level of independence of an entity in relation to transfers and donations received from other entities (Bisogno et al., 2019; García-Sánchez et al., 2012b; Zafra-Gómez et al., 2009abc).

The results for this category were significant only for the current balance variable, suggesting that medium and large Brazilian municipalities are more financially independent when the balance between current revenues and expenditures increases. Contrary to expectations, and aligning with the results found for budgetary solvency, there was no significant relationship between vulnerability and financial autonomy. This may possibly be explained by the low representativeness in the accounts that record tax receivables, which affects the ability to accurately measure the financial autonomy of municipalities.

5 Final Considerations

This study replicated in Brazil the work of Bisogno et al. (2019) entitled Budgetary solvency of Italian local governments: an assessment and investigated budgetary solvency as part of the financial condition in medium and large Brazilian municipalities. It was analyzed whether budgetary solvency is influenced by dependence on intergovernmental transfers, the balance between current revenues and expenditures, the commitment of realized revenue to public indebtedness, and the proportion between capital investments and current expenditures.

The results suggest that the solvency of medium and large Brazilian municipalities may decrease as the levels

of indebtedness and investment increase, while financial autonomy and current balance showed no statistically significant relationship with budgetary solvency.

These findings corroborate previous studies in different contexts but also highlight the particularities of the Brazilian scenario. Regarding academic implications, the study enhances the understanding of the application of budgetary solvency models in a distinct context, contributing to the international comparative literature. The results of this study also have practical implications for public managers, as they underscore the need for prudent management of municipal indebtedness and a rigorous evaluation of investment projects, prioritizing those that can generate economic results that justify the costs.

The limitations of this study primarily stem from the analyzed period, defined due to the recent adoption of accrual accounting in Brazilian municipalities. Another limiting factor is the restricted approach to budgetary solvency. Furthermore, issues with the potential to affect budgetary solvency, such as political interests, efficiency in the execution of public resources, and effective management of public policies, were not addressed and can be explored in future research.

It is recommended that subsequent studies investigate the causes of the underutilization of the accrual accounting regime in recording revenues, especially in smaller municipalities, proposing solutions to overcome this systemic limitation. Greater reliability of the data provided by Siconfi may enable the expansion of the sample stratum of municipalities in future analyses, and even the implementation of the model discussed here in Brazilian municipalities.

Additionally, it is suggested that future research include other dimensions of financial condition, such as cash solvency, long-term solvency, and solvency associated with the level of services. Another promising line of investigation would be to conduct analyses using financial indicators adapted to the budgetary system, considering the current stage of implementation of accrual accounting procedures in the asset accounts of municipalities, to compare the results with those obtained in this study. Finally, it is recommended to explore whether there is a relationship between the levels of indebtedness and investment in Brazilian municipalities, as well as their combined impact on budgetary solvency.

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