

Cost Behavior in Local Governments from the Theory of Public Finance Perspective

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Abstract

Purpose – This research aims to analyze in an unprecedented way the behavior of costs in local government, since the current literature is incipient and there are still doubts about the application of the cost stickiness phenomenon to the pure public sector.

Theoretical framework – The study approaches cost stickiness from the Theory of Public Finance perspective.

Design/methodology/approach – This is an unprecedented, exploratory study with robust panel data regression statistics. We analyzed 295 local governments in southern Brazil over a 16-year period, resulting in 141,600 observations.

Findings – All 32 models analyzed showed asymmetric behavior of public costs, with 75% being characterized as cost stickiness (47% sticky and 28% anti-sticky) and 25% as reverse cost (a new phenomenon identified, typical of the public sector, but which can also occur in the private sector).

Practical & social implications of research – The main theoretical and practical contributions are: I) proof that the contemporary approach to cost behavior applies to the pure public sector; II) proof that budget balance, a fundamental precept of the TFP, does not apply in practice; and III) identification of a new phenomenon, expanding the theoretical classification of cost behavior consolidated in the contemporary accounting approach, which can help managers in planning public actions.

Originality/value – The main contribution is the identification of a new phenomenon, called reverse cost, expanding the theoretical classification of cost behavior consolidated in the contemporary accounting approach.

Keywords: Cost behavior, cost stickiness, reverse cost, cost asymmetry, government costs.

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I Introduction

Since the mid-18th century, public finance has been an important subject of study (Musgrave & Peacock, 1958), for which the balanced budget is consolidated in the literature and practice of several countries (Edgeworth, 1897). However, the research focus has been on revenues, and the understanding of costs remains partially unclear (Bracci et al., 2015; Santos, 2008; Santos et al., 2017).

Musgrave's (1959) Theory of Public Finance (TFP), one of the most important theories focused on government management, has its origins in economics and focuses on management efficiency. In its approach to government functions, which establishes the purpose of the government's actions for using resources, it characterizes public costs as allocative, distributive, or stabilizing (Santos et al., 2017).

The TFP directs a large amount of government accounting standards in several countries and has been consolidated worldwide. In Brazil, for example, public accounting regulations follow the TFP's precepts and establish mandatory budget plans and their execution balance, including penalties for non-compliance. Among the public accounts associated with the TFP, those with a functional classification best represent the purpose of costs according to the government's areas of action. This research follows the international literature by using the term "public costs" as a synonym for executed budgetary expenditure.

In recent years, governments have deliberately increased costs in the public sector (Bracci et al., 2015; Mou et al., 2018). However, political and economic reforms aim to restructure public accounts, and some governments search for ways to reduce costs without even understanding their actual behavior (Kulmala et al., 2016). While in the public sector the budget result is measured in the period and balance is expected (total revenue = total cost), in the cost behavior theme, which comes from the private sector, the behavior is measured by the variation between periods (variation of costs in comparison with variation in revenue), in which the result can be symmetric or asymmetric. Thus, government cost behavior represents one of the main research gaps in the last two decades (van Helden & Uddin, 2016).

The cost behavior theme evolved from the traditional accounting approach (more focused on symmetric behavior) to the contemporary one (more focused on asymmetric behavior). In fact, some research

(Cohen et al., 2017; Hosomi & Nagasawa, 2018a, 2018b; Nagasawa & Nagasawa, 2021) states that the contemporary approach may not apply to the pure public sector (where resources are purely public, balanced budgeting and non-profit activities prevail). This understanding is mainly due to the fact that successive balanced budgets make asymmetric behavior unfeasible.

The possibility of asymmetric cost behavior is already consolidated in the private sector literature (Banker et al., 2018; Banker & Byzalov, 2014; Richartz & Borgert, 2014), but the discussion is incipient in the public sector. However, recent research (Joyce & Pattison, 2010; Kulmala et al., 2016; Mou et al., 2018) indicates that governments are not always able to maintain budget balance in times of crisis, which may show a behavior that is different from expected (which would be symmetric).

In the private sector, the cost stickiness phenomenon has been highlighted through research that has identified several determinants and is currently focused on explaining its consequences (Malik, 2012). Meanwhile, in the public sector, cost behavior still needs evidence, as the existing results are not conclusive or are not in accordance with the contemporary accounting approach (Campagnoni et al., 2021). Therefore, this research, whose purpose is to **analyze in an unprecedented way the cost behavior in local governments from the Theory of Public Finance perspective**, presents theoretical and empirical contributions so that the theme can be expanded, to also cover the public sector, without disregarding its peculiarities.

The public cost behavior theme is scarce and requires a different overview (Cohen et al., 2017). The use of tools and innovations from private management accounting can potentially be explored in public sector research (Lapsley & Wright, 2004), especially to understand how costs behave (Bracci et al., 2015; Kulmala et al., 2016; Lapsley & Wright, 2004; Santos, 2008; Santos et al., 2017), since specificities of the public sector, such as multiple activities, non-profit purposes, and independent records of revenues and costs, need to be observed in a particular way.

This research follows the proposal of Anderson et al. (2003) of calculating cost behavior using robust panel data regression statistics to analyze accounting data from 295 local governments in Brazil over a 16-year period (2005-2020), totaling 141,600 observations. All 32 models analyzed showed asymmetric behavior of public costs, with 75% being characterized as cost stickiness (47%

sticky and 28% anti-sticky) and 25% as reverse cost (a new phenomenon identified, typical of the public sector, but which can also occur in the private sector).

The contributions are relevant, as the research proves that the contemporary accounting approach (cost stickiness) can be applied to the pure public sector, it reveals the weakness of the fundamental precept of the TFP (budget balance), and it identifies a new phenomenon called reverse cost, which applies to both symmetric and asymmetric cost behavior, changing the consolidated accounting classification in the current literature.

2 Literature review

The theoretical basis of this research is supported by the combination of two distinct themes. The first deals with Musgrave's (1959) Theory of Public Finance and the second deals with Cost Behavior, in the contemporary approach of Anderson et al. (2003). The theoretical intersection point and focus of this research is government cost behavior, whose literature is incipient in both themes.

2.1 Theory of public finance

By creating the TFP, whose focus is on government management efficiency, Musgrave (1959) reinforced an already consolidated practice in governments, which was the assumption of a balanced budget. Based on this understanding, the cost behavior in the public sector is expected to be symmetric. However, recent research has raised suspicions of an imbalance, as Joyce and Pattison (2010) point out that governments are not always able to maintain budget balance in times of crisis and Kulmala et al. (2016), indicate that excessive outsourcing leads to an imbalance. Furthermore, Mou et al. (2018) state that, in times of economic crisis, an imbalance occurs in specific accounts, generating deficits that are subsequently offset by surpluses, rebalancing the public accounts. Such suspicions have not yet been confirmed, but they point to the possibility of asymmetric cost behavior in the public sector.

The TFP can be summed up in three approaches, also known as Musgrave's trilogy: government functions, public goods, and equity. At many points the approaches merge, as the assumptions of budget balance, the State's action in market failures, and fair taxation permeate them. But, in general, the government functions approach represents the purpose of public costs, the public goods approach involves stimulating the supply of goods and

services (not necessarily those of the State), and the equity approach focuses on fair taxation for the taxpayer in order to bear government costs. However, this research uses the government functions approach, which considers that all costs are generated to fulfill a purpose, that is, an allocative, distributive, or stabilizing function (Musgrave, 1959; 2008).

In the case of the **allocative function**, it is believed that private initiative does not always meet all of society's needs. There are goods and services that it does not offer or that are provided and/or performed in quantities below those demanded. According to Musgrave (1959; 1997; 2008), the State, through the allocative function, aims to overcome this deficiency in the market by complementing what is already offered or providing society with what is not provided by the market. The allocative function encompasses most public costs (Musgrave, 2008), but when the private sector is consolidated, the government may stop providing services, so the private sector takes control of them (Musgrave, 1973). Some authors mention security (Jordaan, 2013; Maciel, 2013), justice, inspection, executive sovereignty (administration), the legislative branch, infrastructure works, culture and history (Jordaan, 2013), social development (Fourie, 2009), education and health (Costa & Gartner, 2017; Fourie, 2009; Maciel, 2013; Sabina, 2011), welfare and work (Maciel, 2013), national defense and public order (Sabina, 2011) as allocative costs.

The State's **distributive function** is manifested by withdrawing part of the income or assets from several people or through the legal forms in which they organize themselves, in order to redistribute those incomes according to equity and social justice criteria (Sabina, 2011). These are policies aimed at distributing income, goods, or tax incentives (tax exemptions) to individuals or legal entities that for some reason are unable to compete in the market because of their vulnerable situation. Public welfare (Musgrave, 2008), social assistance (Costa & Gartner, 2017), and social security services (Musgrave, 1973) are mentioned as typical public services of the distributive function. A global example of a distributive function, which increased costs during a period of crisis, is the government assistance to individuals and companies that had their income reduced due to the COVID-19 pandemic.

The **stabilizing function** deals with the government's role in maintaining the economic balance of a nation or region. For this reason, the State acts to control supply and demand, seeking to reduce the negative effects of

inflation, trying to ensure full employment, economic growth (Giambiagi & Além, 2011), legal trust, and good internal and external relations (Sabina, 2011). Fiscal, monetary, exchange rate, trade, and sales policies are some of the mechanisms that are used to maintain economic stability (Musgrave, 1973). Therefore, during an economic crisis, even with the drop in revenue, public costs can increase and when the market is heated, they tend to decrease (Riani, 2012). The costs of managing the executive, legislative, and supreme court (Cloete, 1994; Sabina, 2011), the Central Bank (Costa & Gartner, 2017), and of maintaining the legislative, judiciary, and control branches (Jordaan, 2013; Sabina, 2011), are pointed to as stabilizers.

When analyzing cost behavior in the public sector from the perspective of the TFP, it is worth noting that, for Musgrave (1959), every public cost is part of a government function, and that the same public policy can involve several functions that complement but that do not overlap each other. It should be noted that budget balance is consolidated in the literature (Edgeworth, 1897; Musgrave, 1959; Robinson, 2015; Vargas, 2012), which would supposedly lead to symmetric behavior. However, the government has multiple functions, and an imbalance may occur in parts and not necessarily in its entirety (Joyce & Pattison, 2010; Kulmala et al., 2016; Mou et al., 2018), which could lead to asymmetric behavior in specific accounts.

2.2 Cost behavior in the public sector

Accounting studies on cost behavior have evolved from the traditional approach, which began with Benston in 1966, to the contemporary approach, which began with the seminal study by Anderson, Banker and Janakiranan, in 2003 (Reis & Borgert, 2018). Currently, the literature classifies cost behavior as symmetric and asymmetric, and in the case of asymmetry it is also characterized by the cost stickiness phenomenon, which encompasses the sticky (Anderson et al., 2003) and anti-sticky (Weiss, 2010) effect. The theme was developed based on observations from the private sector, where it is already consolidated, but it is still incipient in the public sector and there are doubts about its application, due to governmental peculiarities.

The behavior of costs is calculated based on the comparison of time periods, measuring the relationship between costs and volume of activities or revenues. The behavior is considered to be symmetric if the same

proportion and direction of cost variation is maintained in relation to the variation in revenues (e.g. when revenue increases by 1% the cost increases by 0.5%, and when revenue decreases by 1% the cost decreases by 0.5%). The behavior is considered to be asymmetric when symmetry is not maintained.

The contemporary approach, considered from the study by Anderson et al. (2003), is characterized by theoretical contributions in relation to asymmetric behavior. Anderson et al. (2003) proved that the proportion of cost variation, in relation to the variation in revenues, increases when revenues increase, but costs do not decrease in the same proportion when revenues decrease (this is called sticky cost). For example, revenues increase by 1% and costs increase by 0.5%, but if revenues decrease by 1%, costs do not decrease by 0.5%. Years later, Weiss (2010) proved that when revenues decrease costs do not always decrease in the same proportion that they increased, so the variation in costs is lower when revenues increase than when they decrease (this is called anti-sticky cost). For example, revenues increase by 1% and costs increase by 0.5%, but if revenues decrease by 1%, costs decrease by more than 0.5%.

According to Cohen et al. (2017), the cost stickiness phenomenon has not been consistently proven in the public sector, and that is perhaps because it is not applied to this sector. For Hosomi and Nagasawa (2018b), the contemporary approach developed by Anderson et al. (2003) can only be tested in public companies governed by private accounting standards and which have profit purposes, as the accounting standardization of the pure public sector does not allow this type of behavior in costs.

From 2017 onwards, the first studies in the public sector associated with the contemporary approach emerged, aiming to test the cost stickiness phenomenon. Only nine articles published between 2003 and 2021 were identified. Among those studies, only those of Cohen et al. (2017), Bradbury and Scott (2018), and Campagnoni et al. (2021) tested data from the pure public sector, which is the focus of this research. The study by Wu et al. (2020) was applied to local public bodies with a combined budget (public and private), while the studies of Hosomi and Nagasawa (2018a, 2018b), Nagasawa (2018, 2019), and Nagasawa and Nagasawa (2021) were applied to state-owned companies in Japan (which in that country, due to legal reasons, have typical characteristics of private companies). The limitations presented by several authors

reveal that the phenomenon still lacks consistent evidence in the pure public sector.

When testing the pure public sector, Cohen et al. (2017) studied local governments in Greece and found sticky and anti-sticky behavior, but they compared data from different sources and statements, with breaks in the time series and without accounting standardization. According to the authors, the study cannot be seen as conclusive to determine the cost stickiness phenomenon, as the data set does not allow such an analysis. Along the same lines, Bradbury and Scott (2018) analyzed New Zealand local governments and found sticky behavior, as well as finding that managers know this and take total cost rigidity into account when planning. The main limitation was that the study compared predicted with executed costs, forcing asymmetry, since the database biases the results.

Campagnoni et al. (2021) also tested the pure public sector, where they studied local governments in Brazil and found sticky behavior, but they associated this with the flypaper effect, which limits the research, as they are distinct phenomena. The authors state that their results should be used considering that the Anderson et al. (2003) approach was adapted in order to associate the flypaper phenomenon.

Wu et al. (2020) analyzed local schools in Taipei City, Taiwan, from the perspective of the Theory of Public Choice and found sticky behavior for schools with greater pressure for enrollment. The research is limited to the local education fund, which receives resources (public and private) according to the number of students, costs are incurred when necessary and there is no profit purpose. To measure the cost behavior, they used the number of students, instead of a proxy for revenue, and specific operating costs (excluding personnel, capital, and other costs with constant characteristics). According to the authors, their result is considered to be statistically weak for the cost stickiness model in the public sector, as the sample only covered a period of one term.

In the research by Hosomi and Nagasawa (2018a, 2018b), Nagasawa (2018, 2019), and Nagasawa and Nagasawa (2021), the database is made up of Japanese public companies that have government authorization to provide public services, follow the private accounting rules, seek profit, are managed by private administrators, and have their operating costs subsidized by the government, thus being considered public companies in the legislation of that country. According to those authors, it is not possible to apply the cost stickiness methodology in the

pure public sector due to the balanced budget, different standardization of public accounting, and non-profit purpose of the sector.

The literature still lacks contributions to the recognition of asymmetric behavior in the public sector, and there are doubts about the application of the cost stickiness phenomenon. Finally, the principle of budget balance prevails, in which successive periods result in the symmetric behavior of total costs in relation to total revenues.

3 Methodological procedures

Brazilian law adopts the term “budgetary expenditure” as equivalent to all expenditures authorized in the government’s budget plans. Thus, the total costs discussed by Anderson et al. (2003), for the purposes of this research, are equated to liquidated budgetary expenditures, mentioned by Machado and Holanda (2010) and used by Campagnoni et al. (2021). The theoretical-conceptual adaptation of costs, from the private to the public sector, was made to standardize the terminology of this research with that already used in international research dealing with the contemporary view of cost behavior and the TFP.

In Brazil, budget plans are previously approved by the legislative branch, revenues are projected and costs are determined based on them. Budget execution has an annual cycle which coincides with the fiscal year and the calendar year. The legislation establishes mandatory budget balance in planning and execution, with sanctions in the case of a public budget deficit. All Brazilian public entities are accountable for their budgets and their execution, and bookkeeping and accounting statements are standardized following a single chart of accounts and budget classifications established by the federal government (Brasil, 1988).

The standardization of Brazilian public accounting allows for the comparability of public accounts between all government levels, without methodological adaptations, whose costs are necessarily classified in one of the 28 existing budget functions (government areas of action), representing the largest public cost purpose grouping (Ordinance 42 – Brasil, 1999). Thus, from the perspective of the Theory of Public Finance, using an approach focused on government functions, the revenues collected and the costs recorded as executed (paid) in Brazilian public accounting are observed according to the functional accounting classification, at the budgetary function level.

Based on a predominantly quantitative and exploratory approach, the main procedure used was the documental survey with robust statistical analysis using panel data regression, employing the free R software (Appendix A). This research uses only accounting data from the pure public sector, which, according to Hosomi and Nagasawa (2018b), is characterized by exclusively public revenues and costs, non-profit purposes, and the requirement for balance in budget planning and execution.

For this research, we used accounting data from 295 local governments (municipalities) that are part of the Santa Catarina state territory, in southern Brazil, covering the period from 2005 to 2020 (16 years). We collected 141,600 pieces of information manually (Appendix B) from the Budget Execution Summary Report (*Relatório Resumido de Execução Orçamentária, RREO*) of each local government, made available in the Accounting and Fiscal Information System of the Brazilian Public Sector (*Sistema de Informações Contábeis e Fiscais do Setor Público Brasileiro, SICONF*), updated by inflation for the period.

Cost behavior was calculated according to the standard formula by Anderson et al. (2003), which captures the cost variation for each 1% variation in revenue, adapting it to the public sector accounts (Equation 1).

$$\log\left(\frac{Costs_{i,t}}{Costs_{i,t-1}}\right) = \alpha + \beta_1 \log\left(\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right) + \beta_2 dummy_{reduction} * \log\left(\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right) + \mu_{i,t} \quad (1)$$

Where:

Revenue: Total public revenue collected

Costs: Public costs executed by budgetary function

α : Constant slope

β_1 : Coefficient that measures the percentage increase in costs with a 1% increase in revenue

β_2 : Coefficient that measures the percentage reduction in costs with a 1% reduction in revenue

dummy_{reduction}: 1 (revenue_{i,t} < revenue_{i,t-1}) or 0 (revenue_{i,t} > or = revenue_{i,t-1})

i: Observed government

t: Reference year

t-1: Year immediately before

μ : Standard error

Revenue was used as an independent variable and costs as a dependent variable. The formula used is standard from the theoretical study by Anderson et al. (2003) and is already consolidated in the literature. The revenue and

cost accounts were adapted to those of the public sector. In the case of costs, the generic description was adapted according to the research hypotheses, with 32 analyses: one for general cost, three for costs grouped by government function, and 28 for costs by budget function accounts. Whose variable names appear in the analysis of results and Appendix B.

The literature does not show a direct association between the three functions of the TFP (allocative, distributive, and stabilizing) and the 28 cost accounts by budgetary function. Therefore, a focus group was held with experts who defined the best association to be made, which was used in this research.

Considering that, unlike what happens in the private sector's accounts, in the public sector not all budgetary function costs have registered values. A value of 1 was set for accounts without values registered in the period (so that in the calculation of cost variation between periods the result was consistent). This is because a public entity does not always carry out actions corresponding to all 28 functions every year, as the Constitution of the Federative Republic of Brazil [CRFB] (1988) establishes the competences of each entity.

The analysis of cost behavior is in accordance with the contemporary approach, which considers symmetric or asymmetric behavior as possible results. The direction of the variation is also analyzed, and in case of asymmetry, the cost stickiness phenomenon (sticky or anti-sticky) is identified.

The general research hypothesis is that, **even if there is symmetric behavior in the total budget execution, there is asymmetric cost behavior by functional classification accounts related to the characteristics of government functions, as defined by the TFP.** To better guide the analyses, the general hypothesis was broken down into three sub-hypotheses that complement each other (H1, H2, and H3), as shown in Table 1.

The limitations of this research do not interfere in the result of the government cost behavior shown here but they do guide the interpretations. Therefore, it is worth noting that: i) the theoretical approach of the TFP was used to support accounting standards in Brazil and in several countries around the world, but the explanations of behavior are not limited to it; ii) the time lapse of the empirical data, after the effective entry into force of Complementary Law 101 (2000), which imposes sanctions on unbalanced budgets, may have influenced the low levels of asymmetry; iii) the accounting

Table 1
Research sub-hypotheses

| Complementary hypotheses | Justification | Source |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| H1: The total cost behavior in the public sector is symmetric. | According to the TFP and Brazilian accounting standards, the budget result must be balanced, which in successive periods, by deduction, would result in symmetric cost behavior. | Musgrave (1959); Law 4.320 (Brasil, 1964); Constituição da República Federativa do Brasil (Brasil, 1988); Complementary law 101 (Brasil, 2000). |
| H2: The cost behavior by government function is asymmetric. | Despite the fundamental precept of the TFP being budget balance, the government cannot fail to exercise some of its functions, even if this implies maintaining/increasing costs in times of crisis. In the public finance literature, although not shown, there are signs that the result is not always balanced by government function, which in successive periods, by deduction, would lead to asymmetric cost behavior. | Musgrave (1959, 1973, 2008). Joyce and Pattison (2010); Kulmala et al. (2016); Mou et al. (2018); Anderson et al. (2003). |
| H3: The public cost behavior by functional classification accounts is asymmetric. | According to the TFP and the Brazilian accounting standards, the budget balance is calculated by the total of the period (total revenue = total cost), but adjustments are made in policies/actions of specific areas (recorded in the functional classification accounts). Unlike the private sector, public revenue and cost records are completely independent (they occur at different times). If adjustments occur in specific accounts, by deduction, the cost behavior is asymmetric, even if symmetric behavior is maintained in the total costs. | Musgrave (1973, 1997, 2008); Law 4,320 (Brasil, 1964); Ordinance 42 (Brasil, 1999); Anderson et al. (2003). |

Source: Prepared by the authors (2022).

data information was used because it is understood that the cost accounts by budgetary function represent the purpose of public costs and that the total revenue is often used as a proxy for the production volume; and iv) for prudence, the total cost per budgetary function was considered, but the results could be more expressive if the sources of funds (own and linked), the discretionary nature of the costs, the possibility of fiscal illusion, and the analytical accounts were considered separately or by economic category.

Regarding the functions of the TFP, local government is characterized as having allocation policies as its main attribution. Therefore, if this study is replicated at another governmental level in Brazil (state or federal), the representation of stabilizing and distributive costs may be greater.

4 Analysis and discussion of results

The TFP and legal standards for the public sector in Brazil establish that revenues and costs should maintain a balance in the period. However, based on the accounting data collected, it is observed that the costs are

on average 0.3% lower than the revenues (the median shows that they are 3.3% higher), as well as the results being dispersed among local governments. A total of 4,720 budget results were observed over the 16 years; only 288 (6%) confirmed the budget balance that is a fundamental presupposition of the TFP, and the majority demonstrate imbalances of up to 10%.

According to the TFP, public policies must be planned and implemented to meet the public interest and maintain the well-being of the population, according to the inherent functions of the government. Along these lines, and merely to provide an overview in compliance with the TFP, Figure 1 proportionally illustrates the average annual share of costs (2005-2020) of local governments associated with government functions.

The percentages, corresponding to the cost groups associated with the TFP's government functions, showed few annual fluctuations, which Musgrave (2008) corroborates when stating that most public costs are carried out to meet the allocative function of governments, which aims to correct economic failures in the provision of goods or services. Furthermore, Musgrave (1997) states

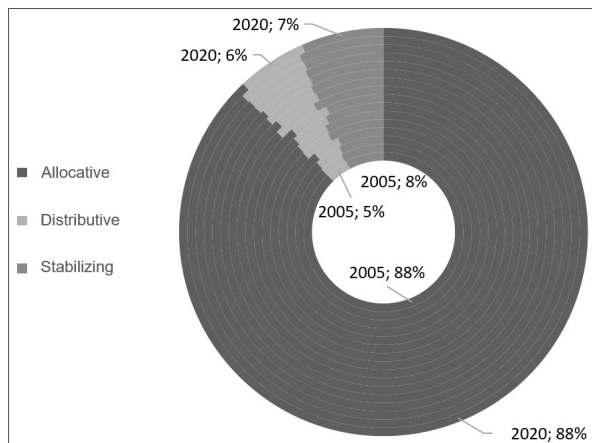


Figure 1. Representation of municipal public costs by government function of the TFP
Source: Prepared by the authors (2022).

that the stabilizing and distributive functions need to be organized by the central (federal) power to achieve its goals across the nation, even if the execution is done at the local level. Thus, the main function of government at the local level is allocative.

To analyze the cost behavior, we initially carried out tests to define the most appropriate statistical model and the coefficients to be applied in the standard formula by Anderson et al. (2003). Subsequently, the behavior results (contemporary approach) were calculated for each cost group (models defined for this research (one total cost, three costs grouped by government function, and 28 costs by budget function accounts) and analyzed from the perspective of the TFP.

For the general analysis of asymmetry, we used normality in the distribution of variables due to the wide set of observations used (a total of 141,120, with 4,395 for each cost model).

We performed a number of tests for the model assumptions in order to identify the serial correlation (Durbin-Watson test), heteroscedasticity (Breusch-Pagan test), most adequate data model (Hausman test), and suggested regression model (Breusch-Pagan Lagrange test). The tests identified that the residuals are not self-correlated (absence of bias); the variance of residual errors is heteroscedastic (does not maintain constancy), except in the Distributive and 22-Industry models, which are homoscedastic (maintain constancy); in all cost groups the data are more suited to running a random statistical model; and the use of panel data regression is justified in all behavior models in this research. Based on the initial

tests, the random model and the panel data regression technique were used to calculate the cost behavior, as in the approach of Anderson et al. (2003). Table 2 shows the adjusted coefficients for application in the calculation of each model and the significance result according to the T test.

In the p-value, considering all three coefficients (α , β_1 , β_2), it is observed that the Total, Allocative, Distributive, 06-Public Security, 08-Social Assistance, 12-Education, 15-Urbanism, 16-Housing, and 22-Industry cost models have the best significance.

The cost behavior in the public sector was measured based on the standard formula by Anderson et al. (2003) with adjustments of accounts to government specificities. Total revenue collected was used as a basis for comparison for all analyses and the costs were grouped as proposed in the methodological aspects of this research.

Table 3 shows the results of the government cost behavior, distributed according to complementary hypotheses H1, H2, and H3.

The general research hypothesis was confirmed, in that the specific public costs are asymmetric. Regarding the sub-hypotheses: H1 was rejected, contrary to what was expected based on the TFP literature and on the legal norms of the public sector; H2 and H3 were confirmed, with all models resulting in asymmetric behavior, showing that the contemporary accounting approach (cost stickiness) also applies to the pure public sector, and a new phenomenon was identified, different from those found so far in the accounting literature on cost behavior, which here was called reverse cost.

Economic studies provide evidence of a budget imbalance only during periods of economic crisis (Joyce & Pattison, 2010; Kulmala et al., 2016; Mou et al., 201), but according to this research, the imbalance occurred over the 16 years researched, contrary to the precepts of the TFP and the Brazilian legal norms. This is perhaps the main reason that led to the rejection of H1, contrary to the consolidated literature so far.

The asymmetric behavior by government function of the TFP (H2) resulted in a sticky effect for the costs associated with the allocative and distributive functions (government functions that are often regulated by contracts and laws and are difficult to reduce, even in periods of a decline in collections). However, in the case of the stabilizing function, the effect found does not match any of the possibilities from the contemporary literature, perhaps because it is not common in the private sector.

Table 2
Coefficients of the cost behavior formula

| Cost behavior model | Coefficients of the formula | | | | | |
|-----------------------------|-----------------------------|----------------------|-----------|----------------------|-----------|----------------------|
| | α | p-value ¹ | β_1 | p-value ¹ | β_2 | p-value ¹ |
| Total | 0.06202 | 0.000 | 0.33382 | 0.000 | -0.30163 | 0.000 |
| Allocative | 0.05914 | 0.000 | 0.35447 | 0.000 | -0.32924 | 0.000 |
| Distributive | 0.07326 | 0.000 | 0.32763 | 0.000 | -0.43986 | 0.000 |
| Stabilizing | 0.09451 | 0.000 | -0.00532 | 0.892 | 0.08954 | 0.350 |
| 01-Legislative | 0.08474 | 0.000 | 0.03191 | 0.783 | 0.08055 | 0.754 |
| 02-Judiciary | 0.03862 | 0.380 | 0.14119 | 0.531 | 0.84831 | 0.129 |
| 03-Essential to Justice | 0.00129 | 0.959 | -0.05319 | 0.708 | -1.00613 | 0.003 |
| 04-Administration | 0.07765 | 0.000 | 0.05553 | 0.197 | 0.00071 | 0.975 |
| 05-National Defense | 0.01424 | 0.646 | -0.21495 | 0.163 | -0.33110 | 0.362 |
| 06-Public Safety | 0.22891 | 0.000 | 0.38801 | 0.100 | -1.06850 | 0.070 |
| 07-International Relations | -0.00735 | 0.252 | 0.00038 | 0.998 | -0.02748 | 0.734 |
| 08-Social Assistance | 0.09844 | 0.000 | 0.15507 | 0.020 | -0.25629 | 0.121 |
| 09-Social Security | -0.00801 | 0.898 | 0.02721 | 0.900 | -0.43524 | 0.442 |
| 10-Health | 0.10503 | 0.000 | 0.04874 | 0.554 | -0.31834 | 0.161 |
| 11-Work | -0.06806 | 0.138 | 0.13477 | 0.551 | -1.57161 | 0.006 |
| 12-Education | 0.05967 | 0.000 | 0.27459 | 0.000 | -0.42637 | 0.003 |
| 13-Culture | 0.11131 | 0.046 | 0.57549 | 0.029 | -0.94233 | 0.158 |
| 14-Citizenship Rights | 0.12038 | 0.016 | -0.07176 | 0.781 | -0.17516 | 0.772 |
| 15-Urbanism | 0.05107 | 0.124 | 0.82639 | 0.000 | -1.30462 | 0.002 |
| 16-Housing | -0.16592 | 0.099 | 1.01378 | 0.044 | -2.51768 | 0.044 |
| 17-Sanitation | -0.11444 | 0.253 | 1.64861 | 0.001 | -3.23691 | 0.008 |
| 18-Environmental Management | 0.12378 | 0.114 | 0.36623 | 0.363 | 0.78511 | 0.441 |
| 19-Science and Technology | 0.02656 | 0.459 | -0.16795 | 0.356 | -0.31013 | 0.484 |
| 20-Agriculture | 0.04397 | 0.098 | 0.36496 | 0.008 | -0.08682 | 0.742 |
| 21-Agrarian Organization | -0.02357 | 0.244 | 0.05037 | 0.630 | -0.62898 | 0.012 |
| 22-Industry | -0.23829 | 0.014 | 1.34361 | 0.006 | -4.16379 | 0.001 |
| 23-Trade and Services | -0.02261 | 0.774 | 0.61823 | 0.127 | -2.59136 | 0.010 |
| 24-Communications | -0.06459 | 0.228 | -0.06824 | 0.832 | 0.77896 | 0.252 |
| 25-Energy | 0.00054 | 0.973 | -0.11942 | 0.705 | 0.03786 | 0.958 |
| 26-Transport | -0.10117 | 0.096 | 0.64943 | 0.029 | 1.06109 | 0.163 |
| 27-Sport and Leisure | 0.03774 | 0.284 | 0.59002 | 0.001 | -0.64039 | 0.121 |
| 28-Special Charges | 0.16993 | 0.000 | -0.34619 | 0.163 | 0.33317 | 0.580 |

¹ Represents the significance probability of the T test result; results less than 0.05 are considered very significant; results less than 0.15 are considered significant, and other results are considered less significant.

Source: Prepared by the authors (2022).

But it is something that can happen frequently in the public sector, and for the purposes of this research it was defined as the reverse cost effect.

Regarding the asymmetric cost behavior, Banker and Byzalov (2014) state that the cost stickiness phenomenon is identified in all cost categories and data sets, under the sticky (Anderson et al., 2003) or anti-sticky (Weiss, 2010) effect. Both effects consider that the cost increases when revenue increases, but this research identified that some public costs decrease when revenue increases (see explanatory note 5 in Table 2). This is explained by the

peculiarities of the sector and this research finds support in the TFP literature.

According to Musgrave (1959), the government's role is to serve the population or promote well-being through actions that generate costs that are financed with public revenues. The political strategies adopted to exercise government functions can sometimes increase costs while revenues decrease (Musgrave & Musgrave, 1976), especially when exercising the stabilizing function, which characteristically aims to return economic stability to the nation, which can be affected by social (Giambiagi & Além,

Table 3
Government cost behavior

| Hypotheses | Cost | % of cost variation | | Behavior | | Phenomenon (effect) | |
|------------|-----------------------------|------------------------------------------|-------------------------------|------------|------------------------------|-----------------------------|-----------------------------|
| | | with a 1% increase in revenue | with a 1% decrease in revenue | Type | Asymmetry level ¹ | | |
| H1 | Total | 0.33 | 0.03 | Asymmetric | 0.36 | <i>Sticky</i> | |
| H2 | Allocative | 0.35 | 0.03 | Asymmetric | 0.38 | <i>Sticky</i> | |
| | Distributive ^{3;4} | 0.33 | -0.11 | Asymmetric | 0.22 | <i>Sticky</i> | |
| | Stabilizing ² | -0.01 | 0.09 | Asymmetric | 0.08 | <i>Reverse</i> ⁵ | |
| H3 | Allocative | 04-Administration ⁴ | 0.06 | 0.06 | Asymmetric | 0.12 | <i>Sticky</i> |
| | | 05-National Defense ² | -0.21 | -0.55 | Asymmetric | -0.76 | <i>Reverse</i> ⁵ |
| | | 06-Public Safety ³ | 0.39 | -0.68 | Asymmetric | -0.29 | <i>Anti-sticky</i> |
| | | 10-Health ^{3;4} | 0.05 | -0.27 | Asymmetric | -0.22 | <i>Anti-sticky</i> |
| | | 12-Education ^{3;4} | 0.27 | -0.15 | Asymmetric | 0.12 | <i>Sticky</i> |
| | | 13-Culture | 0.58 | -0.37 | Asymmetric | 0.21 | <i>Sticky</i> |
| | | 15-Urbanism | 0.83 | -0.48 | Asymmetric | 0.35 | <i>Sticky</i> |
| | | 17-Sanitation ⁴ | 1.65 | -1.59 | Asymmetric | 0.06 | <i>Sticky</i> |
| | Distributive | 18-Environmental Management ³ | 0.37 | 1.15 | Asymmetric | 1.52 | <i>Sticky</i> |
| | | 19-Science and Technology ² | -0.17 | -0.48 | Asymmetric | -0.65 | <i>Reverse</i> ⁵ |
| | | 20-Agriculture | 0.36 | 0.28 | Asymmetric | 0.64 | <i>Sticky</i> |
| | | 24-Communications ² | -0.07 | 0.71 | Asymmetric | -0.64 | <i>Reverse</i> ⁵ |
| | | 25-Energy ² | -0.12 | -0.08 | Asymmetric | -0.20 | <i>Reverse</i> ⁵ |
| | | 26-Transport | 0.65 | 1.71 | Asymmetric | 2.39 | <i>Sticky</i> |
| | | 27-Sport and Leisure | 0.59 | -0.05 | Asymmetric | 0.54 | <i>Sticky</i> |
| | | 08-Social Assistance ³ | 0.16 | -0.10 | Asymmetric | 0.05 | <i>Sticky</i> |
| | | 09-Social Security ^{3;4} | 0.03 | -0.41 | Asymmetric | -0.38 | <i>Anti-sticky</i> |
| | | 16-Housing ³ | 1.01 | -1.50 | Asymmetric | -0.49 | <i>Anti-sticky</i> |
| | Stabilizing | 21-Agrarian Organization ² | 0.05 | -0.58 | Asymmetric | -0.53 | <i>Anti-sticky</i> |
| | | 01-Legislative ^{3;4} | 0.03 | 0.11 | Asymmetric | 0.14 | <i>Sticky</i> |
| | | 02-Judiciary ² | 0.14 | 0.99 | Asymmetric | 1.13 | <i>Sticky</i> |
| | | 03-Essential to Justice ² | -0.05 | -1.06 | Asymmetric | -1.11 | <i>Reverse</i> ⁵ |
| | | 07-International Relations ² | 0.00 | -0.03 | Asymmetric | -0.03 | <i>Anti-sticky</i> |
| | | 11-Work ³ | 0.13 | -1.44 | Asymmetric | -1.31 | <i>Anti-sticky</i> |
| | | 14-Citizenship Rights ³ | -0.07 | -0.25 | Asymmetric | -0.32 | <i>Reverse</i> ⁵ |
| | | 22-Industry ³ | 1.34 | -2.82 | Asymmetric | -1.48 | <i>Anti-sticky</i> |
| | | 23-Trade and Services ³ | 0.62 | -1.97 | Asymmetric | -1.35 | <i>Anti-sticky</i> |
| | | 28-Special Charges | -0.35 | -0.01 | Asymmetric | 0.36 | <i>Reverse</i> ⁵ |

¹ The asymmetry level is the difference between the expected symmetric point and the result of the cost variation when there is a 1% decrease in revenue. The positive sign means the direction (positive when the cost variation increased in relation to the symmetric point); ² Costs of private policies of other entities; ³ Costs of policies competing with other entities; ⁴ Costs with application percentage linked to revenue or with legislation that prevents its reduction in the short term; ⁵ *Reverse cost* is a new phenomenon that is different from those identified so far in the literature.

Source: Prepared by the authors (2022).

2011), political, or legal (Sabina, 2011) instability, and even with decreased revenue, the government must act.

The reverse cost phenomenon, identified initially in the costs associated with the stabilizing function (H2) and later in other accounts (H3), is characterized by a decrease in cost variation when revenue variation increases,

and is independent of the symmetric point when revenue decreases.

H3 was also confirmed, with asymmetric behavior for all specific accounts, where costs are recorded by purpose (by the Brazilian government's areas of activity). The 28 accounts were presented with identification of the government function to which they belong. In the cost

accounts associated with the allocative function, they were 75% sticky, 27% reverse, and 13% anti-sticky cases. It should be noted that in Brazilian local governments (mostly with less than 100,000 inhabitants), discretion is reduced, as their legal obligations commit a large part of the revenue. Therefore, reducing costs in periods of falling revenue is also difficult. In accounts with a distributive function, 75% have an anti-sticky effect and 25% have a sticky effect. According to the TFP, distributive policies are the first to be cut in times of crisis, which is consistent with the results shown, especially because in Brazil the distributive function is not the responsibility of local governments. In accounts with a stabilizing function, 45% of the accounts have an anti-sticky effect, 33% a reverse effect, and 22% a sticky effect. As already mentioned, these public costs are characterized by policies that aim to promote stability and, just like the distributive ones, they are not attributions of local governments either, although there is no impediment for them to take action.

The same government function can involve different areas of public action (Musgrave & Musgrave, 1976). Furthermore, in Brazil, the Constituição da República Federativa do Brasil (1988) establishes some private or competing responsibilities among public entities, which need to be observed in more in-depth research. Another important factor is that the public sector is highly regulated and it is not always possible to change policy immediately. In addition, as revenues and costs are recorded independently and in accordance with Complementary Law 101 (2000), the budget monitoring reports are bimonthly and the fiscal management reports are quarterly (grouped by synthetic accounts), a variation in specific revenue costs is not quickly noticed, given the 28 major areas of government action.

This research showed that the contemporary cost accounting approach applies to the pure public sector, and government costs are asymmetric. In addition to the cost stickiness phenomenon, there is the reverse cost phenomenon, and all the results can be explained by the particularities of the sector, which are widely discussed by the TFP.

5 Conclusions

This research analyzed in an unprecedented way the behavior of costs in local governments from the perspective of the Theory of Public Finance. The general research hypothesis, broken down into three complementary

sub-hypotheses (H1, H2, and H3), resulted in proof that the cost behavior in Brazilian local governments is asymmetric in all 32 proposed cost models, which are related to the characteristics of government functions, defined by the Theory of Public Finance.

Thus, the conclusions of this research lead to three relevant theoretical contributions:

- I. For all hypotheses (H1, H2, and H3), which used the standard formula of Anderson et al. (2003), the results proved that government costs are asymmetric. This finding contradicts studies with government samples, which question the possibility of using the contemporary approach for public sector costs (Cohen et al., 2017) or which claim that it does not apply to the pure public sector (Hosomi & Nagasawa, 2018a, 2018b; Nagasawa & Nagasawa, 2021). Considering the research stages on cost behavior highlighted by Malik (2012), at least the first one (evidence of the phenomenon) was carried out for the pure Brazilian public sector.
- II. Hypothesis H1, which assumes that the behavior of total costs in the public sector is symmetric, was not confirmed, since asymmetric behavior with a sticky effect was evidenced. Furthermore, it exposed the fragility of the budgetary balance, consolidated in the TFP literature and in the legal norms of several countries.
- III. Hypotheses H2 and H3, in addition to proving that the behavior is asymmetric and that it needs to be analyzed in a way that is specific to the public sector, revealed a phenomenon that is different from cost stickiness, called reverse cost. Both the traditional and contemporary approaches on cost behavior do not consider the possibility that the cost decreases when revenue increases, which may be explained by the origin of the theme (the private sector). However, when analyzing H2, we noticed that the variation in costs, associated with the stabilizing government function, decreases when revenue increases and increases when revenue decreases. For H3, similar behavior was observed, in which cost variations decrease when revenues increase and there is a positive or negative variation when revenues decrease.

It is worth mentioning that the identification of the reverse cost phenomenon is characterized by a decrease in cost variation when the variation in revenue increases, regardless of the expected symmetric point, which was proven by the analysis of the local governments covered in this research. This is a common phenomenon in the public sector that can be generalized to the pure public sector, but that may also occur in the private sector. In this research, it is explained by the TFP, since it is the government's role to act in the case of market failures and promote well-being (Musgrave, 1959), even if to do so, costs increase in periods of decreased revenue (Musgrave & Musgrave, 1976). In addition, in the Brazilian public sector, revenue and cost accounting is independent, differing from what occurs in the private sector in which the accounting records of both are linked.

The analysis and discussion of the results contribute to theoretical and practical aspects of government management, especially in relation to decision-making, planning and monitoring of public accounts. Thus, this research can serve as a basis to observe public costs in greater depth and it suggests different paths that can be followed in future research. But overall, we suggest standardizing the interpretations of the cost behavior classifications, in addition to explanatory factors and consequences of the behavior of public costs.

There is still a long path ahead in improving the cost behavior theme, and the literature is scarce regarding its application, particularly in government costs. Thus, even if limited to analyzing accounting data from local governments and the TFP perspective, this research presented relevant results that can be replicated or compared with any public group in Brazil, without methodological adaptations, since the accounting standard is the same for the entire Brazilian public sector. Minor adjustments may be necessary in accounts in the case of research in other countries. In addition, this study can serve as a basis for other national and international research, the results of which may be different depending on the contexts and particularities.

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Supplementary Material

Supplementary material accompanies this paper.

APPENDIX A - R Script and Results

APPENDIX B – Database

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2nd author: Critical revision of the manuscript; general orientation.