OPTIMIZATION OF PUBLIC SPENDING IN BRAZILIAN MUNICIPALITIES

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ABSTRACT

The objective of this study is to analyze the influence of the composition of municipal public expenditure in the promotion of economic growth, from 2001 to 2016. For this, the study analyzes 5,533 Brazilian municipalities. In order to examine the productivity (or unproductivity) of municipal public expenditure by function in relation to economic growth, the empirical models are based on the theoretical model of Devarajan, Swaroop and Zou (1996). All models were estimated by the fixed effects model. The results indicate that, in the three models analyzed (all municipalities, developed municipalities and undeveloped municipalities), the productivity of public expenditure was lower than the deadweight loss associated with the taxes required to fincance it. Beyond that, the results indicate that, in the developed municipalities, housing and urbanism expenditure and energy expenditure were productive, while legislative expenditure was unproductive. In the undeveloped municipalities, transport expenditure was productive, while judicial expenditure and health expenditure were unproductive. As an additional analysis, a nonlinear theoretical relationship of public expenditure to economic growth was analyzed. In underdeveloped municipalities, it is inferred a non-linear relationship in judicial expenditure and in education and culture expenditure. In developed municipalities, it is inferred a non-linear relationship in legislative expenditure and health and sanitation expenditure.

Keywords: Reallocation. Public Expenditure. Economic Growth. Municipalities.

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OTIMIZAÇÃO DO GASTO PÚBLICO NOS MUNICÍPIOS BRASILEIROS

RESUMO

O objetivo deste trabalho é analisar a influência da composição dos gastos públicos municipais na promoção do crescimento econômico, pois a classificação da função dos gastos permite avaliar o perfil do município frente ao crescimento econômico. Para tanto, o estudo analisa 5.533 municípios brasileiros no período de 2001 a 2016. Com o intuito de examinar a produtividade (ou improdutividade) dos gastos públicos por função municipal em relação ao crescimento econômico, os modelos empíricos se fundamentam no modelo teórico de Devarajan, Swaroop e Zou (1996). Todos os modelos foram estimados pelo modelo de efeitos fixos. Os resultados indicam que, nos municípios desenvolvidos, foram produtivos os gastos com habitação e urbanismo e com energia, e foram improdutivos os gastos com a função legislativa. Nos municípios não desenvolvidos, os gastos com transportes foram produtivos, enquanto os gastos com as funções judiciária e saúde foram improdutivos. Como análise adicional, examinou-se uma relação teórica não-linear dos gastos públicos com o crescimento econômico. Nos municípios não desenvolvidos, inferiu-se uma relação não linear dos gastos com as funções judiciária e educação e cultura. Nos desenvolvidos, inferiu-se uma relação não linear dos gastos com as funções legislativa e saúde e saneamento. Os resultados desta pesquisa corroboram as evidências apontadas no modelo teórico fundamentado. Diante desses resultados, sugere-se realocação na composição dos gastos públicos municipais brasileiros com o objetivo de alcançar uma maximização da contribuição de cada gasto no crescimento econômico.

Palavras-Chave: Realocação. Gasto Público. Crescimento Econômico. Municípios.

1 INTRODUCTION

Given the current Brazilian economic context, it is possible to observe that a debate is developing about the directions and proposals of fiscal policies capable of promoting the solvency of the public sector and the stability of the public debt. The main motivation stems from the unsatisfactory fiscal results and the upward trend of the public debt in recent years (Cardoso *et al.*, 2018).

To control the evolution of the Public Debt/Gross Domestic Product (GDP) ratio and the deterioration of federal public accounts, the enactment of the Fiscal Responsibility Law (LRF), which limited expenses and indebtedness, stands out. Another highlight is the approval of Constitutional Amendment No. 95/2016, whose main objectives is to reduce Brazil's economic instability through the adoption of individualized limits for federal primary expenditures for up to twenty years. Additionally, the discussion of the social security reform stands out, as a way to combat the fiscal imbalances arising from the pressure of the social security deficit and to counter the Brazilian demographic trends of the next decades (Giambiagi & Sidone, 2018).

In this scenario, there is an increasing demand for decisions that involve reduction and more productive allocation of Brazilian public spending, because

these are resources consumed by government strategic actions, recorded in the public budget, and that therefore constitute government fiscal policy instruments (Araújo, Monteiro & Cavalcante, 2010; Giuberti & Rocha, 2015; Neduziak & Correia, 2017).

In making such decisions, several questions emerge: Is it possible to promote economic growth even when high levels of public debt prevent the government from increasing the level of public spending for several years? Is it possible to promote economic growth by reallocating components of public spending? Given the aging of the Brazilian population and the consequent increase in spending on health and social protection, is it possible to decide which expenditures should be prioritized in the coming decades?

The significant public participation in the economy keeps the debate about these issues alive in the field of public finances. In summary, both public spending and economic growth are relevant to decision making, because the interpretative analysis of its variables shows the productivity of a fiscal policy on economic growth, enabling decisions capable of contributing to a more productive management and allocation of public resources. (Araújo, Monteiro & Cavalcante, 2010; Giuberti & Rocha, 2015; Sousa & Paulo, 2016; Neduziak & Correia, 2017).

Several studies have analyzed the impacts of fiscal policy on economic growth from an analysis of the productivity of public resource allocation in relation to growth (Aschauer, 1989; Barro, 1990; Cândido Júnior, 2001; Souza, 2007; Rocha & Giuberti, 2007; Souza et al., 2010; Divino & Silva Júnior, 2012; Sousa & Paulo, 2016; Neduziak & Correia, 2017; Lupu, 2018; Yilmaz, 2018).

Thus, this study proposes to analyze the following central question: How does the composition of public spending in Brazilian municipalities, based on the functional classification of public expenditure, promote economic growth? Based on this question, the assumption defended in this study emerges, which considers the possibility of promoting economic growth through the reallocation of municipal public spending (without increasing the level of spending).

Thus, such reallocation may be configured as an economic lever capable of influencing the current low-growth environment in Brazil. Moreover, it is considered the possibility of assisting in the decision-making process with regard to spending cuts or reductions in the coming decades, by showing the composition of public spending and highlighting the unproductive ones. In addition to this introduction, this study presents the theoretical framework in Section 2; the methodological procedures in Section 3; the results in Section 4; and the final considerations in Section 5.

2 LITERATURE REVIEW

Initially, the concepts of productivity and economic growth are basic in this context. Productivity is defined as the relationship between products and inputs (Farrel, 1957). The more products are realized with the use of a given quantity of input, the more productive it is (Lovell, 1993). In the public sector, productivity has the same meaning, productive public spending being that which delivers the most products to society with the use of certain inputs. In other words, productive public spending is that which, in the productivity function of the private sector, has a direct effect on the growth rate. There is empirical evidence that spending on

defense, education, health, housing, transportation, energy, and communication are classified as productive (Aschauer, 1989, Barro, 1991, Kneller, Bleaney, and Gemmell, 1999, Bleaney, Gemmell, and Kneller, 2001, and Bayraktar and Moreno-Dodson, 2010). There is also evidence that by raising private sector productivity, public spending can raise economic growth (Ram, 1986, Cashin, 1995).

Although the concept of economic growth is controversial in the social sciences (Scatolin, 1989), this paper considers its concept in the strict sense of an increase in per capita income, or basically a quantitative change in output (Harrod, 1972, Domar, 1946, Schumpeter, 1961).

Studies on the relationship between public spending and economic growth took off in the early 1990s, after the seminal study by Barro (1990) on the endogenous growth model and public spending. However, the starting point of this line of research was Aschauer (1989) who, in one of the first works on the productivity of public spending, found that public investment is a significant predictor of the productivity of this type of spending in relation to economic growth in the United States in the period between 1949 and 1985.

Despite some critical reviews (Gramlich, 1994), Aschauer's findings regarding the US economy have been confirmed by other authors (Heintz, 2010). Moreover, in more recent studies in other countries, it is also possible to observe the positive economic impact from public investment, such as in Turkey (Yilmaz, 2018), Colombia (Campo & Mendoza, 2018), Zimbabwe (Makuyana & Odhiambo, 2017), and Cameroon (Ntembe, Amin & Tawah, 2017).

In general, one can segregate the literature that analyzes the relationship between the composition of administrative expenditures and economic growth into two main groups. Those that investigate the composition of public spending by disaggregating it as capital and current spending (Barro, 1991; Devarajan et al., 1996; Bose, Haque & Osborn, 2007; Ghosh & Gregoriou, 2008), and those that focus on the functional composition of public spending such as health, education, and infrastructure (Bose, Haque & Osborn, 2007; Kneller & Misch, 2014; Makuyana & Odhiambo, 2017; Ntembe, Amin & Tawah, 2017; Lupu, 2018; Campo & Mendoza, 2018; Yilmaz, 2018).

In empirical terms, this relationship is evidenced in several results found by research over time. Barro (1990), extending the endogenous growth framework to include funded government services, concluded that when the share of government spending is low, government spending is positively linked to economic growth.

Following his studies, Barro (1991) observed that the expected link between government spending and economic growth did not occur when government consumption was negatively related to economic growth. Spending on consumption would have no direct effect on private capital productivity because it would reduce saving and growth through distorted effects on taxation and spending on government programs.

On the other hand, Devarajan *et al*. (1996) and Ghosh and Gregoriou (2008) found that in developing countries, current spending was positive and significantly associated with growth. Whereas, the results of Bose, Haque, and Osborn (2007) indicated that the effect of current spending was insignificant.

Devarajan *et al*. (1996) also observed that increases in capital expenditures have a negative effect on economic growth. This unexpected result highlighted that apparently productive expenditures, such as public investments, when overused, can become unproductive. Evidence also found by Fournier and Johansson (2016), when analyzing countries of the Organization for Economic Cooperation and Development (OECD). From another perspective, Kneller and Misch (2014) perceived that investment in infrastructure could improve the productivity of companies, since this type of investment would facilitate access to a larger number of suppliers.

Thus, when reviewing the literature, it is observed that the empirical analysis of the relationship between public spending and economic growth comprises a diversity of approaches, samples, and results. And, as already discussed, the studies are not consensual as to the nature of the impacts of fiscal policy on economic growth.

Given this diversity, Table 1 - adapted from Fernandes (2016) - briefly presents, in chronological order, international empirical research on public spending productivity, highlighting the selected sample, the period of analysis, the technique used, and the main results found.

Table 1
International Studies

Authors	Sample	Period	Technique	Main Results
Aschauer (1989)	United States	1949-1985	OLS	Public spending on infrastructure for roads, highways, airports, mass transit, sewers, water systems, etc. had explanatory power for productivity.
Barro (1991)	Countries	1960-1985	OLS	Government consumption expenditure was negatively related to economic growth, thus reducing private capital productivity.
Devarajan *et al.* (1996)	43 developing countries	1970-1990	OLS / Fixed effects	Increases in current spending had a positive effect on economic growth, while increases in capital spending had a negative effect. Furthermore, apparently productive expenditures, when used in excess, can become unproductive.
Kneller, Bleaney and Gemmell (1999)	Developed countries	1970-1995	OLS	The hypothesis that the variables had zero impact on growth was not rejected. In addition, increased productive spending significantly increased growth.
Bleaney, Gemmell & Kneller (2001)	OCDE Countries	1970-1995	LSDV	Productive spending was positively related to economic growth.

Authors	Sample	Period	Technique	Main Results
Arraes & Teles (2001)	Brazilian Regions	1981-1995	Fixed effects	Spending on education and culture, and then on health and sanitation and transportation, were the most positive on economic growth.
Herrera & Blanco (2004)	Brazil	1950-2000	ARDL	In the long run the income elasticity of the public capital stock was higher than that of the private sector
Rocha & Giuberti (2007)	Brazilian states	1986-2003	LSDV	All productive spending - capital, education, transportation, and communication - had a positive and statistically significant effect on growth, with the exception of health.
Bose, Haque & Osborn (2007)	30 developing countries	1970-1990	SUR	The share of government capital expenditures in GDP was positively and significantly correlated with economic growth. Government investment in education and spending on education were the only ones significantly associated with growth.
Ghosh & Gregoriou (2008)	Developing countries	1972-1999	GMM	Capital spending negatively associated with economic growth, unlike current spending, corroborating Devarajan, Swaroop, and Zou (1996).
Moreno-Dodson (2008)	Developing countries	1970-2006	OLS, SUR and GMM	Productive spending (spending on education and health and some economic spending such as transportation and communications) was the most relevant spending category for growth.
Cavallo & Daude (2008)	116 developing countries	1980-2006	GMM	Evidence of a robust crowding-out effect, public investment alone was sufficient to positively impact private investment. Spending on public works could easily be inefficient or have adverse effects on the private sector.
Rodrigues & Teixeira (2010)	Union, states and municipalities	1948-1998	OLS	Investment spending had the greatest positive effect on growth, in contrast to spending on consumption, subsidies, and transfers. The state sphere showed greater ability to boost economic growth.
Souza et al. (2010)	Brazil (consolidated data)	1980-2008	ARDL	Increases in productive public spending (housing, urban planning, industry, trade, services, communication, etc.) related to output growth in the long run.

Authors	Sample	Period	Technique	Main Results
Baynaktar & Moreno-Dodson (2010) e Moreno-Dodson & Baynaktar (2011)	Developing countries	1970-2005	OLS, SUR and GMM	Public spending can be a key determinant of growth through its productive and "core" components, which can also impact the private sector's production function
Bogoni, Hein & Beuren (2011)	Biggest cities from the Southern Region	2000-2004	Non-linear model	Spending on health, sanitation, education, culture, investment, housing, welfare, and social security had a positive relationship with growth. Thus, public spending can boost economic development.
Divino & Silva Jr. (2012)	Brazilian municipalities	1991-2000	OLS	In developing countries, municipalities with per capita incomes below the poverty line would be able to increase economic growth by spending more on current expenses than municipalities that are above the line.
Silva & Santolin (2012)	Brazilian states	1995-2006	GMM	Increasing public spending on infrastructure as a proportion of GDP would have a positive and significant impact on the economic growth of Brazilian states.
Ogundipe & Oluwatobi (2013)	Nigeria	1970-2009	Co-integration	Public spending has not contributed to economic growth, probably because of issues related to corruption, unprofitable projects and lack of continuity.
Kneller & Misch (2014)	South Africa	2002-2006	OLS	Public spending on health and infrastructure has improved the productivity of certain firms. Furthermore, changes in the composition of public expenditures can positively affect the productivity of certain firms.
Fournier & Johansson (2016)	OCDE Countries	2009-2013	OLS	The increase in the share of public investment in total government spending generated large growth gains.
Degenhart *et al.* (2016)	Largest municipalities in the North Region	2010	Multivariate non-linear model	The results showed a relationship between economic growth and public spending on Social Assistance, Health and Education.
Sousa & Paulo (2016)	States	1995-2010	Fixed effects	Aggregate spending in Brazilian states was positively related to economic growth. Furthermore, health care spending was unproductive at the aggregate level.

Authors	Sample	Period	Technique	Main Results
Makuyana & Odhiambo (2017)	Zimbabwe	1970-2014	ARDL	Public investment spending has had an impact on economic growth in the short term.
Ntembe, Amin & Tawah, (2017)	Cameroon	1977-2015	ARDL	Public investment spending has had an impact on economic growth, in the short and long term.
Piccoli, Baronchello & Nardi (2017)	Alto Vale do Rio do Peixe Municipalities	2013-2015	OLS	Spending on education, health, assistance, culture, urbanism, agriculture and security were considered productive and capable of generating positive externalities.
Neduziak & Correia (2017)	States	1995-2011	OLS and Fixed effects	Expenditures in administration and planning, the judiciary, housing and urbanism, and welfare and social security were productive; and expenditures in education and culture and the legislative, unproductive.
Campo & Mendoza (2018)	Colombia Departments (states)	1984-2012	OLS	Operating and investment expenses had a positive and significant effect on Colombia's GDP.
Lupu (2018)	East and Central Europe Countries	1995-2015	ARDL	Spending on education and health had a positive impact on the economy, while spending on defense, economic affairs, public services and social assistance had a negative impact.
Yilmaz (2018)	Turkey Provinces	1975-2001	OLS	Investment spending has had a positive impact on the economy. It was observed that the government over-invested in transportation and services, education, health, and security.

Legend: *Ordinary Least Square*; LSDV – *Least Square Dummy Variable*; SUR – *Seemingly Unrelated Regression*; GMM – *Generalized Method of Moments*; ARDL – *autoregressive-distributed lag model*.
Source: Authors.

From an empirical point of view, studies that have estimated the impact of public spending on economic growth generally provide evidence that the composition of spending is an important factor for growth (Devarajan *et al.*, 1996; Rocha & Giuberti, 2007; Carboni & Medda, 2011; Kneller & Misch, 2014; Sousa & Paulo, 2016; Neduziak & Correia, 2017; Lupu, 2018; Yilmaz, 2018).

In these studies, the results show that the structure of public spending has different effects on economic growth. For example, investments in infrastructure typically increase the stock of physical capital, which in turn impacts long-term growth (Johansson, 2016). Thus, spending on transportation, communication, and defense positively associates with economic growth. However, Bose, Haque, and

Osborn (2007) observed that this was not the case, as the sample studied showed opposing evidence.

Considering the different structures of public spending, the constant budget restrictions and the recurrent fiscal adjustments, it is observed that the identification of the contribution level that each expenditure component has on growth is a relevant information for decision making, which allows for the optimization of the allocation, without necessarily implying an increase in total public spending (Giuberti & Rocha, 2015; Neduziak & Correia, 2017).

The approach usually employed, as shown in the endogenous growth model of Barro (1990), is that of productive and unproductive expenditures. From an empirical perspective, productive spending positively affects economic growth, while unproductive spending does not. Therefore, a government expenditure is null if it does not affect private sector productivity; if it rivals private sector spending, it is considered unproductive; and if it positively affects long-run economic growth, it is considered a productive expenditure (Aschauer, 1989; Barro, 1990; Devarajan *et al.*, 1996; Rocha & Giuberti, 2007; Carboni & Medda, 2011; Kneller & Misch, 2014; Sousa & Paulo, 2016; Neduziak & Correia, 2017; Lupu, 2018; Yilmaz, 2018).

According to Devarajan *et al.* (1996), the classification of public spending as productive or unproductive should derive from the information revealed by the results of an econometric analysis. For the authors, one should not define, in principle, which components of public spending are productive or not. Thus, it is the econometric results that demonstrate the classification of public spending.

Furthermore, according to these authors, productive spending can become unproductive if it is excessive. This fact was also observed in the results found by Miller and Russek (1997), who demonstrated that increases in defense, health, and social security expenditures, which are normally productive, reduced economic growth in developing countries, since they represent a significant portion of the budget of these countries.

Thus, the literature shows that there is an optimal limit to the participation of each budget expenditure in promoting economic growth. Furthermore, the empirical evidence found indicates that it is possible, through the reallocation of public spending, to promote economic growth, even when it is impossible to increase the level of public spending over several years (Devarajan *et al.*, 1996; Rocha & Giuberti, 2007; Carboni & Medda, 2011; Sousa & Paulo, 2016; Neduziak & Correia, 2017; Lupu, 2018; Yilmaz, 2018).

In Brazil, the federative arrangement agreed upon in 1988 presents a decentralizing character, in view of the political and fiscal autonomy of the states and municipalities, with constitutional attributions and functions, highlighting the intensification of the volume of resources passed on to regional and local governments via intergovernmental transfers (Rezende, 2010).

Consequently, there was an impact on the achievement of a fiscal policy idealized by the Federal Government, given the incompatibility between macroeconomic stabilization policies and policies for the provision of goods and services, which are largely provided by subnational governments. Thus, there is a peculiar condition of the different stages of development of the federated units in

the search for the definition of fiscal policies that can contribute to the economic growth of the country (Macedo & Corbari, 2009; Sousa & Paulo, 2016).

The current Brazilian economic context of unsatisfactory fiscal results and upward trajectory of public debt, discussed above, is also reflected in subnational entities. In municipalities, according to Cardoso, Pansani, Serrano, and Wilbert (2018), there is a deterioration of public finances, whose diagnosis is commonly explained by the reduction in public revenues concomitant with the maintenance or increase in expenditures. According to the authors, this condition, if not reversed or controlled, will result in unsustainability of the fiscal situation in the long term, in municipal entities.

Considering this deterioration of municipal public finances, the peculiarities of the Brazilian federative arrangement, and the need for national macroeconomic stabilization, it is important to identify the level of contribution that each of the components of municipal public spending has on economic growth, in view of the relevance of this information for decision making.

3 METHODOLOGICAL PROCEDURES

3.1 Theoretical model

To achieve the objective of analyzing the influence of the composition of municipal public spending on the promotion of economic growth, we used the analytical model of Devarajan *et al.* (1996). The model allows evidence to show the difference between productive and unproductive expenditures, as well as the way in which a reallocation of these expenditures can affect the long-term economic growth rate. These authors conducted a study of 43 developing countries over a 20-year period, showing evidence that an increase in the current expenditure share has a positive and statistically significant effect on growth.

Therefore, a production function with three arguments is assumed: the private stock of capital (k), and two types of public spending, "g1" and "g2", (productive and unproductive, respectively). If the production function is of the *Constant Elasticity of Substitution* (CES) type, which refers to a measure to determine the degree of ease or difficulty with which producers substitute one factor of production for another when faced with the employment of the most diverse factors of production (Sousa & Paulo, 2016), then:

$$y = f(k, g_1, g_2) = [\alpha k^{-\zeta} + \beta {g_1}^{-\zeta} + \gamma {g_2}^{-\zeta}]^{\frac{1}{\zeta}} \quad (1)$$

Where: $\alpha > 0, \beta \geq 0, \gamma \geq 0, \alpha + \beta + \gamma = 1, \zeta$ (CES function parameters) ≥ -1

According to Barro (1990), public expenditures are assumed to be financed according to the following relationship:

$$\tau y = g_1 + g_2 \quad (2)$$

Where τy is a flat tax rate on income.

Thus, the share of total spending, $\phi\ (0 \leq \phi \leq 1)$, allocated to $g_1$is given by:

$$g_1 = \phi\tau y \qquad g_2 = (1-\phi)\tau y \tag{3}$$

The representative agent, according to consumption (c) and capital (k), will make government decisions in a way that maximizes his welfare:

$$U = \int_0^{\infty} u\,(c)e^{-\rho t}dt \tag{4}$$

Where ρ is the time preference rate.

Subject to:

$$\dot{k} = (1-\tau)y - c \tag{5}$$

The utility function is specialized to the isoelastic form in order to generate analytical solutions:

$$u(c) = \frac{c^{1-\sigma}-1}{1-\sigma} \tag{6}$$

Substituting (6) into (4) and maximizing subject to (1), (2), (3) and (5), we have the following consumption growth equation:

$$\frac{\dot{c}}{c} = \frac{\alpha(1-\tau)\{\alpha+(g/k)^{-\zeta}[\beta\phi^{\zeta}+\gamma(1-\phi)^{-\zeta}]\}^{-(1+\zeta)/\zeta}-\rho}{\sigma} \tag{7}$$

Considering that, throughout the steady state, τ is constant, $\frac{g}{y}$ will be given by the following equation:

$$\frac{g}{k} = \{[\tau^{\zeta} - \beta\phi^{-\zeta} - \gamma(1-\phi)^{-\zeta}]/\alpha\}^{1/\zeta} \tag{8}$$

Substituting (8) into (7) gives the growth rate of consumption (λ):

$$\lambda = \frac{\alpha(1-\tau)\left\{\frac{\alpha\tau^{\zeta}}{\left[\tau^{\zeta}-\beta\phi^{\zeta}-\gamma(1-\phi)^{-\zeta}\right]}\right\}^{\frac{1+\zeta}{\zeta}}+\rho}{\sigma} \tag{9}$$

By deriving a relationship between consumption growth rate (λ) and the share of government spending earmarked forg_1 (ϕ), from equation (9), we get:

$$\frac{d\lambda}{d\phi} = \frac{\alpha(1-\tau)(1+\zeta)[\alpha\tau^{\zeta}]^{-(1+\zeta)/\zeta}[\beta\phi^{(1+\zeta)}-\gamma(1-\phi)^{-1(1+\zeta)}]}{\sigma[\tau^{\zeta}-\beta\phi^{-\zeta}-\gamma(1-\phi)^{-\zeta}]^{-1/\zeta}} \tag{10}$$

Thus, one can infer that productive spending is that which increases the steady state growth rate. Therefore, from expression (10), one can observe g_1 as

productive when $\frac{d\lambda}{d\phi} > 0$. By assuming that $\lambda > 0$, then expression (10) will be positive if:

$$(1+\zeta)\left[\beta\phi^{(1+\zeta)} - \gamma(1-\phi)^{-(1+\zeta)}\right] > 0 \quad (11)$$

In this expression (11), $\zeta \geq -1$, then the expression (10) will be positive if $\frac{d\lambda}{d\phi} > 0$, if:

$$\frac{\phi}{1-\phi} < \left(\frac{\beta}{\gamma}\right)^{\theta} \quad (12)$$

Where: $\theta = 1/(1+\zeta)$, by measuring the elasticity of substitution. When looking at the condition (12), we have that the value of θ depends on the productivity of spending (β *and* γ) and the initial composition of expenses (ϕ for g_1 and $1-\phi$ to g_2). Thus, a spending recomposition will not influence GDP growth if the initial value of θ for elevate.

Therefore, the choice of ϕ can increase growth according to the following expression:

$$\frac{\phi^*}{1-\phi^*} < \left(\frac{\beta}{\gamma}\right)^{\theta} \Rightarrow \frac{\beta^{\theta}}{\phi^*} = \frac{\gamma^{\theta}}{1-\phi^*} \quad (13)$$

Where: ϕ^* is the optimal choice of spending composition, since both θ, and β and γ is the best option for expense composition, since both ϕ, if there is a ϕ^* corresponding to the highest possible productivity of the spend per used unit.

Empirically, to operationalize the analytical model proposed by Devarajan *et al.* (1996) in order to evaluate the relationship between the components of public spending in Brazilian municipalities from 2001 to 2016, we initially defined the following linear model:

$$Y_{i(t+1;t+5)} = \alpha_i + \delta_t + \beta' X_{it} + \mu_i \quad (14)$$

Where: $Y_{i(t+1;t+5)}$ is the average annual economic growth rate (GDP *per capita*) from the municipality i, over the five-year period (in order to reduce the possibility of endogeneity); α_i is the municipality-specific intercept; δ_t is the deterministic time trend that shows the evolution shared by the economies; β' is the coefficient of the independent variables; X_{it} is a vector representing all independent variables (public expenditures); and μ_i is the random error term.

The independent variables (X_{it}) were divided into two types: ratio of total expenditure to GDP for each municipality and period (GT_{it}/PIB_{it}) and vector that represents the ratio between public spending per function and total spending for each municipality and period (G_{it}/GT_{it}).

The inclusion of the GT_{it}/PIB_{it} ratio allows for controlling for the effects of the level and financing of spending on the growth rate (Devarajan *et al.*, 1996; Rocha & Giuberti, 2007; Neduziak & Correia, 2017).

The work of Rocha and Giuberti (2007) suggests that spending ratios and growth should have a non-linear relationship. According to the theoretical model of Devarajan *et al.* (1996), in developing countries, when the shares of productive spending are large, the relationship of spending to growth may become negative, because as the share increases, decreasing returns to scale are observed, and eventually the relationship between the two variables becomes negative.

Considering this theoretical non-linear relationship and the analysis of the development characteristics of Brazilian municipalities, the following additional quadratic specification is used, similarly to the procedures adopted by Rocha and Giuberti (2007), Divino and Silva Junior (2012) and Sousa and Paulo (2016):

$$Y_{i(t+1;t+5)} = \alpha_i + \delta_t + \beta' X_{it} + \beta'' X_{it}^2 + \mu_i \quad (15)$$

In which: X_{it}^2 is a vector that represents all independent variables (public expenditures) squared. According to Devajaran, Swarrop, and Zou (1996), if the quadratic regression proves to be significant, the determination of the optimal public spending ratio is verified by the maximum effect of the variable X at a given point. Deriving Y in relation to X, we have:

$$X^* = -\frac{\beta'}{2\beta''} \quad (16)$$

In which: X^* is the optimal level of spending that partially maximizes income growth *per capita* Y_i. The quadratic function was initially used because the authors who researched the subject used it. Another reason is that the impact of spending on growth is not always linear, because growth curves are naturally exponential. Therefore, we tested this form of the spending variables and found that in some cases the quadratic function is statistically significant, while the linear relationship is not.

3.2 Data and variables used

To achieve the proposed objective, the sample consisted of 5,533 municipalities: 5,044 classified as undeveloped and 489 classified as developed. Unlike Devarajan et al. (1996), which analyzed countries, the data in this study refer to municipalities, which are constant units of the Brazilian federation. This smaller granularity of analyzed units contributes to a better understanding of the country that makes up Brazil, after all, the total of all these municipalities results in the unique composition of the federation.

The classification of municipalities into developed and undeveloped was obtained through the Firjan Index of Municipal Development (IFDM 2018 - base year 2016). Municipalities with an index greater than (or equal to) 0.8 points are

considered developed, according to the Firjan Institute's own classification. As the index goes from 0 to 1, Firjan established in its methodology four development strata according to the IFDM score: high development (0,8 to 1,0), moderate development (0,6 to 0,8), regular development (0,4 to 0,6) and low development (0,0 to 0,4). The decomposition in this way, taking the highly developed municipalities, aimed to test whether the model applied, even though most of the sample were undeveloped municipalities.

In relation to economic growth, the concept adopted is the average growth of the five subsequent years, calculated by the municipal GDP's per capita provided by the Brazilian Institute of Geography and Statistics (IBGE). The data concerning municipal public spending (accounting records of budget execution by functional category) are available in the National Treasury (TN) data banks: Finance of Brazil (Finbra) and the Accounting and Fiscal Information System of the Brazilian Public Sector (Siconfi).

The classification by economic category (current and capital) is very broad in the public sector context, in which it is observed whether there is the formation of a capital good (capital expenditure) or not (current expenditure). For being very broad, the functional classification was preferred, which has a greater granularity and is more detailed than the classification by economic category.

Thus, the variable public spending per function, represented in the econometric specifications as X_{it} (vector that represents all independent variables) and detailed by the vector that represents the ratio between public spending per function and total spending (G_{it}/GT_{it}), is described, for each municipality and period, as follows:

- $legisl_{it}$ = ratio between spending on the *legislative* function and total expenditure;
- jud_{it} = ratio between spending on the *judiciary* function and total expenditure;
- adm_plan_{it} = ratio between spending on the *administration and planning* function and total expenditure;
- $agric_{it}$ = ratio between spending on the *agriculture* function and total expenditure;
- com_{it} = ratio between spending on the *communications* function and total expenditure;
- seg_pub_{it} = ratio between spending on the *public security* function and total expenditure;
- $educ\_cult_{it}$ = ratio between spending on the *education and culture* function and total expenditure;
- $energ_{it}$ = ratio between spending on the *energy and mineral resources* function and total expenditure;
- hab_urb_{it} = ratio between spending on the *habitation and urbanism* function and total expenditure;
- $ind\_com\_serv_{it}$ = ratio between spending on the *industry, commerce and services* and total expenditure;
- sau_san_{it} = ratio between spending on the *health and sanitation* function and total expenditure;
- ass_prev_{it} = ratio between spending on the *social security and assistance* function and total expenditure; and

– $trans_{it}$ = ratio between spending on the *transport* function and total expenditure.

The results of the test for the risk of collinearity of the independent variables demonstrated that the variance inflation factor (VIF) was lower than 10, and there was no evidence of multicollinearity, which can also be verified in the correlation matrix of the variables.

In order to verify the model's adequacy, specification tests were performed. To verify the adherence of the fixed effects model, the F-test (Chow's test) was performed. The F-test statistic, as well as its respective p-value indicated that the fixed effects model was better than the pool.

Next, the Hausman test was used to verify the consistency of the random effects. Once the test presented statistical significance, the ideal model verified was the fixed effects model. Thus, it was not necessary to perform the Breusch-Pagan LM test. To minimize the level of endogeneity, the dependent variable used was the average economic growth over the five-year period, as in Devarajan *et al.* (1996), Ghosh AND Gregoriou (2008), Rocha and Giuberti (2007) and Sousa and Paulo (2016).

In the Wald and Breusch-Pagan tests to check for heteroscedasticity, the null hypothesis of homoscedasticity of the residuals was rejected. Similarly, the null hypothesis of first order autocorrelation in the residuals of the Wooldridge test was rejected. Therefore, all the models presented were estimated with robust standard errors regarding heteroscedasticity and serial correlation (Rogers' standard errors).

To capture the effect of unobservable characteristics of each municipality, we used fixed effects model estimations. These estimates comprised the Brazilian municipalities that presented the necessary information on public spending and GDP. Thus, an unbalanced panel with fixed effects was used, analyzing 5,533 municipalities and totaling 58,677 observations. The best adjusted model was the fixed effect model with time control and without deflation of public spending and GDP. As control variables are difficult to be obtained continuously at the county level over an extended timeline, only a year dummy was used.

Finally, it was performed analysis by region (North, Northeast, Midwest, Southeast, South) to verify the existence of significant differences among them in the model applied. Since some regions are more economically developed, the results may demonstrate whether these differences are representative as to the optimization of public spending. No analysis of the political scenario was performed during the period analyzed because Brazil is a federation with 37 political parties, which makes this analysis difficult in the 5,533 municipalities (Tarouco e Madeira, 2013; Maciel, Alarcon e Gimenes, 2017).

4 RESULTS

Table 2 presents the descriptive statistics of the dependent and independent variables for sample and study period. It is observed that the municipalities in the sample, in the period from 2001 to 2016, had an average per capita economic growth rate over the five-year period of 6,65%.

Table 2
Descriptive statistics - mean of dependent and independent variables (% a. a.)

	Average Developed mun.	Average Non-developed mun.	Average All municipalities	[95% confid. interval.] All municipalities	
$Y_{i(t+1;t+5)}$	0.068	0.066	0.067	0.066	$Y_{i(t+1;t+5)}$
	(-0.002)	(-0.000)	(-0.000)		
GT_{it}/PIB_{it}	0.097	0.202	0.192	0.190	GT_{it}/PIB_{it}
	(-0.001)	(-0.001)	(-0.001)		
$legisl_{it}$	0.027	0.035	0.035	0.034	$legisl_{it}$
	(-0.000)	(-0.000)	(-0.000)		
jud_{it}	0.003	0.002	0.003	0.002	jud_{it}
	(-0.000)	(-0.000)	(-0.000)		
adm_plan_{it}	0.152	0.169	0.167	0.167	adm_plan_{it}
	(-0.001)	(-0.000)	(-0.000)		
$agric_{it}$	0.025	0.024	0.024	0.024	$agric_{it}$
	(-0.000)	(-0.000)	(-0.000)		
$educ\_cult_{it}$	0.280	0.316	0.313	0.312	$educ\_cult_{it}$
	(-0.001)	(-0.000)	(-0.000)		
hab_urb_{it}	0.108	0.090	0.092	0.091	hab_urb_{it}
	(-0.001)	(-0.000)	(-0.000)		
$ind\_com\_serv_{it}$	0.010	0.005	0.005	0.005	$ind\_com\_serv_{it}$
	(-0.000)	(-0.000)	(-0.000)		
sau_san_{it}	0.239	0.224	0.226	0.225	sau_san_{it}
	(-0.001)	(-0.000)	(-0.000)		
ass_prev_{it}	0.063	0.058	0.058	0.058	ass_prev_{it}
	(-0.000)	(-0.000)	(-0.000)		
$trans_{it}$	0.050	0.048	0.048	0.048	$trans_{it}$
	(-0.001)	(-0.000)	(-0.000)		
seg_pub_{it}	0.007	0.002	0.002	0.002	seg_pub_{it}
	(-0.000)	(-0.000)	(-0.000)		
$energ_{it}$	0.004	0.004	0.004	0.004	$energ_{it}$
	(-0.000)	(-0.000)	(-0.000)		
com_{it}	0.001	0.001	0.001	0.001	com_{it}
	(-0.000)	(-0.000)	(-0.000)		
Year Dummy	*Yes*	*Yes*	*Yes*	-	*Year Dummy*

Source: Own preparation based on data from the National Treasury and IBGE. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

A certain similarity is observed between the developed and undeveloped municipalities analyzed. However, it can be seen that spending on health and sanitation, housing and urban planning, assistance and welfare, transportation, agriculture, industry, commerce and services, and public security resulted in larger portions in developed municipalities. Meanwhile, spending on education and culture, administration and planning, legislative and energy resulted in larger portions in the undeveloped municipalities.

Regarding the most expressive expenditures by function in relation to total public spending, spending on education and culture, health and sanitation, administration and planning, housing and urbanism, and assistance and social security comprised 84.23% in developed municipalities and 85.72% in undeveloped ones.

Spending on education and culture and health and sanitation, as expected, represented the largest proportion of municipal public spending (51.90% in developed municipalities and 54.05% in undeveloped ones). This predominance of health and education over the other functional classifications results from the constitutional obligation of applying part of the tax revenues to such expenditures.

4.1 Linear estimations from the empirical model

The results of the linear estimations of the empirical model are presented in Table 3, showing the following models: (1) Linear model referring to municipalities taken together; (2) Linear model referring to developed municipalities; and (3) Linear model referring to undeveloped municipalities.

Table 3
Results of the linear estimations of the empirical model

	(1)	(2)	(3)
GT_{it}/PIB_{it}	-0,799***	-3,030***	-0,740***
	(0,161)	(0,359)	(0,154)
$legisl_{it}$	-0,139*	-0,974***	-0,115
	(0,0816)	(0,337)	(0,0835)
jud_{it}	-0,223***	-0,212	-0,227***
	(0,0844)	(0,309)	(0,0874)
adm_plan_{it}	-0,0138	0,0796	-0,0250
	(0,0299)	(0,0841)	(0,0319)
$agric_{it}$	0,0171	0,274	0,00773
	(0,0561)	(0,215)	(0,0579)
$educ\_cult_{it}$	0,00218	0,0182	0,00306
	(0,0316)	(0,112)	(0,0333)
hab_urb_{it}	0,0612*	0,171**	0,0598
	(0,0356)	(0,0863)	(0,0376)
$ind\_com\_serv_{it}$	0,0184	0,312	-0,0114
	(0,100)	(0,203)	(0,110)
sau_san_{it}	-0,0509*	-0,0292	-0,0610*
	(0,0297)	(0,0956)	(0,0314)
ass_prev_{it}	-0,0305	-0,184	-0,0231

	(1)	(2)	(3)
	(0,0457)	(0,149)	(0,0480)
$trans_{it}$	0,0820**	0,137	0,0738*
	(0,0396)	(0,0972)	(0,0417)
seg_pub_{it}	-0,226	-0,00635	-0,315
	(0,220)	(0,458)	(0,244)
$energ_{it}$	-0,0428	0,263**	-0,0537
	(0,114)	(0,113)	(0,138)
com_{it}	-0,400	-0,846	-0,284
	(0,309)	(0,931)	(0,323)
Constante	8,591***	9,536***	8,503***
	(0,0299)	(0,0513)	(0,0311)
Year Dummy	Sim	Sim	Sim
Observations	58.677	5.627	53.050
Municipalities	5.533	489	5.044
R-Squared	0,890	0,895	0,891
R2 - Overall	0,328	0,506	0,332

Source: Own preparation based on data from the National Treasury and IBGE. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In models (1), (2) e (3), the GT_{it}/PIB_{it} estimations presented negative and statistically significant values, revealing that, in the municipalities taken together or classified as developed and undeveloped, the productivity of municipal expenditures was lower than the dead weight generated by the amount of taxes needed to finance them. Furthermore, in all three models, all year *dummies* variables were statistically significant, indicating that there was a common factor explaining the growth rate of the municipalities. There were changes in the ranking of the municipalities as a function of the evaluations each year of the Firjan index, but there was no problem with outliers because the data and variables were treated, such as the neperian logarithm and the use of these year dummies.

Similar to the results found by Neduziak and Correia (2017) for the states, spending on the legislative function showed negative coefficients. However, only in the municipalities taken together (1) and in those classified as developed (2), presented significant coefficients.

Spending on the health and sanitation function showed negative coefficients in all three models, as well as in Sousa and Paulo's (2016) results for the states. However, only in the models for the municipalities taken together and the undeveloped municipalities were significant.

The results regarding health and sanitation expenditures in undeveloped municipalities corroborate the theoretical model from Devarajan *et al.* (1996), since, in developing countries, normally productive expenditures can become unproductive if carried out in excess.

In the expenditures with the transportation function, the three coefficients were positive, similarly to the results found by Rocha and Giuberti (2007) for the states. However, only in the models of municipalities taken as a whole and of undeveloped municipalities were they significant. In spending on public safety, it is observed that all coefficients (of the three models) were negative and not significant, as in Neduziak and Correia (2017).

Therefore, in the model of municipalities taken as a whole (1), it is observed that spending on the legislative, judicial, and health and sanitation functions negatively affected the per capita growth rate, indicating that they were unproductive. On the other hand, spending on housing and urban planning, and transportation affected positively, indicating that they were productive.

In the model for developed municipalities (2), spending on housing and urban planning and energy were productive, while spending on the legislative function was unproductive. For the undeveloped municipalities (3), spending on the judicial and health and sanitation functions negatively affected the per capita growth rate, indicating that they were unproductive. On the other hand, differently from the results of Devarajan *et al.* (1996), the expense with the transportation function impacted positively, inferring that it was productive. One of the reasons is the difference in samples, because Devarajan *et al.* (1996) studied 43 developing countries for 20 years, 1970 to 1990, while the present study analyzed sample of 5,533 Brazilian municipalities from 2001 to 2016. The sample of countries is different and the sample of municipalities from only one country, which may be the reason for several differences in the results. Moreover, the time period is a potential reason for differences between the studies. While until the 1990s road investment in Brazil was predominant (Santos, 2002), since the 2000s there has been intense investment in air transport, both in airport infrastructure and in public-private investment to make airways viable (Silva & Mourão, 2019). In addition, it is noted that the results presented in the undeveloped municipalities (3) were similar to the results of the model estimated for the entire sample (1), after all, 91% (5,044 of the total of 5,533) of the municipalities are classified as undeveloped by the IFDM.

4.2 Quadratic Estimates of the Empirical Model

The results of the quadratic estimations of the empirical model are presented in Table 4, showing the following models: (1) Quadratic model referring to municipalities taken together; (2) Quadratic model referring to developed municipalities; and (3) Quadratic model referring to undeveloped municipalities.

Table 4
Results of the quadratic estimations of the empirical model

	(1) Total	(2) Developed	(3) Non Developed
GT_{it}/PIB_{it}	-0,805***	-3,088***	-0,747***
	(0,164)	(0,372)	(0,157)
$legisl_{it}$	-0,0400	2,712***	-0,0326
	(0,132)	(1,018)	(0,126)
jud_{it}	-0,530***	-0,143	-0,551***
	(0,168)	(0,631)	(0,173)
adm_plan_{it}	-0,00912	0,203	-0,0358
	(0,0707)	(0,252)	(0,0743)
$agric_{it}$	-0,00243	0,515	-0,0116
	(0,0836)	(0,382)	(0,0856)
$educ\_cult_{it}$	-0,274***	-0,657	-0,252**
	(0,102)	(0,555)	(0,105)
hab_urb_{it}	-0,0481	0,0166	-0,0523
	(0,0663)	(0,214)	(0,0697)

	(1) Total	(2) Developed	(3) Non Developed
$ind\_com\_serv_{it}$	0,0879	0,369	0,0764
	(0,172)	(0,364)	(0,189)
sau_san_{it}	0,105	0,456*	0,0723
	(0,0787)	(0,267)	(0,0819)
ass_prev_{it}	-0,0798	-0,290	-0,0792
	(0,0979)	(0,306)	(0,103)
$trans_{it}$	0,156**	0,103	0,153**
	(0,0607)	(0,219)	(0,0630)
seg_pub_{it}	-0,132	0,328	-0,324
	(0,376)	(0,742)	(0,439)
$energ_{it}$	0,0756	0,383	0,157
	(0,150)	(0,363)	(0,216)
com_{it}	-0,379	-1,876	-0,164
	(0,479)	(2,300)	(0,511)
${legisl_{it}}^2$	-0,535	-67,27***	-0,214
	(1,564)	(18,85)	(1,370)
${jud_{it}}^2$	1,686**	0,300	1,704**
	(0,679)	(3,103)	(0,684)
${adm\_plan_{it}}^2$	0,0988	-0,275	0,136
	(0,133)	(0,592)	(0,137)
${agric_{it}}^2$	0,424	-1,987	0,456*
	(0,268)	(1,840)	(0,255)
${educ\_cult_{it}}^2$	0,480***	0,991	0,462***
	(0,145)	(0,960)	(0,147)
${hab\_urb_{it}}^2$	0,642**	0,436	0,681**
	(0,270)	(0,559)	(0,288)
${ind\_com\_serv_{it}}^2$	-0,185	-0,266	-0,284
	(0,773)	(1,858)	(0,848)
${sau\_san_{it}}^2$	-0,137	-0,912*	-0,0735
	(0,142)	(0,477)	(0,146)
${ass\_prev_{it}}^2$	0,631	0,330	0,714
	(0,436)	(1,210)	(0,462)
${trans_{it}}^2$	-0,0693	0,128	-0,0675
	(0,188)	(0,630)	(0,194)
${seg\_pub_{it}}^2$	-0,268	-4,001	0,593
	(1,808)	(5,297)	(2,019)
${energ_{it}}^2$	-0,536	-0,440	-2,577
	(0,361)	(0,711)	(2,273)
${com_{it}}^2$	0,925	35,74	-0,321
	(3,677)	(60,72)	(3,736)
Year Dummy	Yes	Yes	Yes
Observations	58.677	5.627	53.050
Municipalities	5.533	489	5.044
R-Squared	0,891	0,897	0,892
R2 - Overall	0,326	0,505	0,330

Source: Own preparation based on data from the National Treasury and IBGE. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Again, the results presented in the undeveloped municipalities were similar to the results of the model estimated for the entire sample. In specifications (1) and (3), the economic growth rate was shown to be a decreasing function of spending on the judicial function and an increasing function of this variable squared, which allows us to infer a non-linear relationship between this spending and municipal economic growth.

Spending on the judicial function was associated with a decrease in the economic growth rate, whose optimal limit, according to the estimated parameters, would be approximately 16%, both for the municipalities taken as a whole, and for the undeveloped municipalities. That is, from approximately 16% onwards, there would be practically no more returns from the increase in spending on the judicial function on the GDP *per capita* growth rate.

When analyzing the average of this expense in the entire sample (Table 2), it was found that, during the period analyzed, the amounts allocated were well below this percentage. Therefore, this unproductivity could be related to the insufficient amount of resources allocated. However, spending on the judicial function is typical of the States and of the Union, in view of the Brazilian federative characteristics, as set forth in the Federal Constitution (see, for example, art. 92, art. 128, art. 132, and art. 134), which justifies the small proportions allocated in the municipalities.

In specifications (1) and (3), the economic growth rate was also shown to be a decreasing function of spending on education and culture and an increasing function of this variable squared. Thus, it is possible to infer a non-linear relationship between this expenditure and municipal economic growth, as in Rocha and Giuberti (2007).

Spending on the education and culture function was associated with a decrease in the economic growth rate. According to the estimated parameters, the optimal limit would be approximately 28%, both for municipalities taken as a whole and for undeveloped municipalities.

When analyzing the average of this spending across the sample (Table 2), it was noted that the average proportion, in the period from 2001 to 2016, exceeded this optimal threshold in the undeveloped municipalities. Therefore, the results regarding spending on education and culture in the undeveloped municipalities confirm the theoretical model of Devarajan *et al.* (1996), which shows that apparently productive expenditures can become unproductive if carried out in excess.

Only in the developed municipalities, specification (2), the economic growth rate was shown to be an increasing function of spending on the legislative and health and sanitation functions and a decreasing function of these variables squared, which allows us to infer a non-linear relationship of these expenditures with municipal economic growth. On the other hand, spending on housing and urban planning and transportation positively affected growth, inferring that they were productive. Therefore, the major contribution is that the expenditures that affect negatively can be excluded or reduced in the public accounts, i.e., the expenditures that are considered unproductive. This finding is relevant in the management of public resources, which are limited.

Spending on the legislative function was associated with an increase in the economic growth rate, whose optimal limit, according to the estimated parameters, would be approximately 2% for developed municipalities. That is, from approximately 2% onwards, there would be practically no more returns from increasing the ratio between spending on the legislative function and total spending on the of the economy PIB *per capita* growth rate.

When analyzing the average of this expenditure throughout the sample (Table 2), it was noted that the average proportion, in the period from 2001 to 2016, exceeded this optimal limit, in the developed municipalities, as it presented the average value of 2.75%. It was also inferred a non-linear relationship in spending on the health and sanitation function, similarly to the results found by Sousa and Paulo (2016). This expenditure was associated with an increase in the economic growth rate, whose optimal limit, according to the estimated parameters, would be approximately 25% for developed municipalities.

When analyzing the average of this expenditure throughout the period from 2001 to 2016 (Table 2), it was noted that the average proportion of developed municipalities did not exceed this optimal limit, presenting a value of 23.87%. The results regarding health and sanitation spending in developed municipalities corroborate with Devarajan *et al.* (1996), who found that in developing countries apparently productive expenditures can become unproductive if carried out in excess. This fact is observed in the present study, since the coefficient was significant at 10%. (-0,912*). Therefore, answering the research objective, the composition of public expenditures from Brazilian municipalities promotes economic growth when expenditures of functions considered productive are made, as was the case of the significant functions presented in Table 4, observing the groups of developed and undeveloped municipalities.

In short, some spending is considered productive, mainly due to the object that is constituted by the spending (public defense is constituted by spending on defense, education is constituted by spending on defense, and so on). These expenditures should be prioritized in the public administration, and the expenditures considered unproductive should be cut until they evolve to be finally removed from the government budget. Finally, the analysis by region (North, Northeast, Center-West, Southeast, South) did not show significant differences. This analysis was done individually by region, because the use of dummy did not allow us to evaluate the variables due to collinearity problems.

5 FINAL CONSIDERATIONS

In the current economic context in Brazil, it is possible to observe the development of a debate on the directions and proposals of fiscal policies that promote the solvency of the public sector and the stability of the public debt. This study proposed to analyze how the composition of public spending in Brazilian municipalities, based on the functional classification of public expenditure, promoted long-term economic growth, considering the classification of municipalities into developed and undeveloped.

The estimates showed negative and statistically significant values for total spending over GDP, revealing that, in the municipalities taken together or classified as developed and undeveloped, the productivity of municipal spending

was lower than the deadweight generated by the amount of taxes needed to finance it.

Regarding unproductive expenditures, it should be noted that the results found (in the linear and quadratic estimations) may be due to circumstantial characteristics of the period examined, or may indicate the Brazilian reality of misallocation of public resources.

In the model of municipalities taken as a whole, spending on the legislative, judiciary, and health and sanitation functions negatively affected the per capita growth rate, indicating that they were unproductive. On the other hand, spending on housing and urban planning and transportation affected positively, inferring that they were productive. Therefore, the major contribution is that the expenditures that affect negatively can be excluded or reduced in the scope of public accounts. This finding is relevant in the context of public resource management, which is limited.

In the model of developed municipalities, spending on housing and urban planning and energy were productive, and spending on the legislative function was unproductive. For the undeveloped municipalities, spending on the judicial and health and sanitation functions negatively affected the per capita growth rate, indicating that they were unproductive. Spending on transport had a positive impact, indicating that it was productive.

Furthermore, the results presented in the undeveloped municipalities were similar to the results of the model estimated for the entire sample. This similarity possibly stems from the composition of the sample: of the 5,533 municipalities analyzed, 5,044 are classified as undeveloped by the IFDM. The decomposition of the sample in this way, taking the highly developed municipalities, was the intention of the study to test whether the model differed between these highly developed municipalities and the others.

As an additional analysis, considering a theoretical non-linear relationship of public expenditures with economic growth, a quadratic specification was also used. Analyzing all the municipalities in the sample and the undeveloped ones, a non-linear relationship was inferred between spending on judicial functions and on education and culture with economic growth. In developed municipalities, we inferred a non-linear relationship between spending on legislative functions and health and sanitation with economic growth.

Therefore, both in the linear and quadratic estimations, the results of this research corroborate the evidence pointed out in Devarajan *et al.* (1996), since they show different levels of public spending productivity between developed and undeveloped municipalities. Thus, the results were consistent with these authors' study for countries. In view of these results, a recomposition of Brazilian municipal public spending is necessary in order to maximize the contribution of each expenditure to national economic growth. Future researchers may conduct studies proposing models that enable this analysis.

It is noteworthy that, by integrating accounting information on public spending, from the functional classification of public spending, with economic performance, measured by the macroeconomic aggregate of Gross Domestic Product (GDP) per capita, this research linked Accounting with Economics,

allowing an examination and an optimized debate of Brazilian municipal public finance.

However, the focus was primarily on the informational potential of public accounting data in public finance. Therefore, the reasons and stimulating (or inhibiting) consequences of aggregate public spending on economic growth were not highlighted.

As for the scope and quality, we highlight the limitations of data availability and the use of a theoretical model, as a way of simplifying a complex reality. The assumption that there is no casual relationship between the dependent variable and the public spending variables, for example, is configured as a limitation. Therefore, the results and conclusions of this study are restricted to the cutout of the analysis scenario.

It should also be emphasized that the results refer to the set of municipal governments, only classified as developed or undeveloped, and therefore do not apply to individual cases. Furthermore, there was possibly an influence of the relevance of certain municipalities in the composition of the variables studied.

Despite these limitations, the results are considered to be robust, given the coherence of the procedures adopted with the precursor studies, adapting the methodological procedures to the theoretical and empirical frameworks already established in the literature.

For future research, we suggest identifying the reasons for the results found in this study regarding the identification of the composition of municipal public spending and regarding the relationship between the composition and economic growth; investigating other periods, trying to capture, for instance, crisis effects; investigating the composition of municipal spending considering a more detailed classification of municipalities (not only into developed and undeveloped) and/or deepening the debate on fiscal federalism in the analysis of the results of the relationship between municipal public spending and economic growth, given the heterogeneity of Brazilian municipalities; investigate other factors that have an impact on public spending formatting choices and that may influence the relationship between the composition of public spending and economic growth, such as education, birth rate, mortality, unemployment rate, and life expectancy; and investigate the productivity of municipal spending, considering environmental aspects (exploitation of natural resources), regional aspects, human development aspects, among others.

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Contributions	André Luiz Marques Serrano	Layane Gonçalves Furtado	Lucas Oliveira Gomes Ferreira
1. Idealization and conception of the research subject and theme	✓	✓	
2. Definition of the research problem	✓		
3. Development of Theoretical Platform		✓	✓
4. Design of the research methodological approach	✓		
5. Data collection		✓	✓
6. Analyses and interpretations of collected data			✓
7. Research conclusions			✓
8. Critical review of the manuscript	✓		
9. Final writing of the manuscript, according to the rules established by the Journal.			✓
10. Research supervision	✓		