

The allocation of government spending and economic growth: a panel data study of Brazilian states

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The effect of the allocation of government spending on the economy is currently a subject of interest given the fiscal budget constraints facing governments due to fiscal crises or adjustments. This paper thus seeks to study the effects of the allocation of government spending on the GDP behavior of Brazilian states from 1995 to 2011. Using a conventional FE (Fixed Effect) panel data model, this paper’s main results are as follows: (i) administration and planning, (ii) judicial, (iii) housing and (iv) social assistance spending were found to be productive, while (i) education and culture and (ii) legislative spending were found to be unproductive. In addition, some evidence has been found that the introduction of public borrowing rules by the Fiscal Responsibility Law has been beneficial to the economic growth of Brazilian states.

Keywords: government spending; economic growth; Brazilian states.

Alocação dos gastos públicos e crescimento econômico: um estudo em painel para os estados brasileiros

Tendo em vista as restrições orçamentárias impostas aos governos, em contextos de crises e ajustes fiscais, faz-se necessária a discussão acerca do efeito da alocação dos gastos públicos sobre o estado da economia. Nesse sentido, o presente ensaio busca discutir os efeitos da alocação do gasto público sobre o comportamento do PIB real dos estados brasileiros. Para tanto, foi utilizado um painel convencional de Efeitos Fixos (EF), no período de 1995/2011. Os gastos em: (i) administração e planejamento, (ii) judiciário, (iii) habitação e urbanismo e (iv) assistência e previdência mostraram-se produtivos e os gastos em: (i) educação e cultura e (ii) legislativo mostraram-se improdutivos. Foram encontradas evidências de que a Lei de Responsabilidade (LRF) tem sido benéfica ao crescimento econômico dos estados brasileiros.

Palavras-chave: gasto público; crescimento econômico; estados brasileiros.

La alocación de los gastos públicos y crecimiento económico: un estudio de datos en panel aplicado a los estados de Brasil

El presente trabajo analiza los efectos de la alocación del gasto público sobre el crecimiento económico de los estados de Brasil en el período de 1995-2012. La investigación se realizó mediante el análisis de datos en panel. Los resultados muestran que los gastos con el: (i) ejecutivo, (ii) judicial, (iii) habitación y (iv) bienestar social impactaron el crecimiento económico positivamente, mientras que los gastos en: (i) educación y (ii) legislativo no tuvieron impacto productivo sobre el crecimiento económico. Además, la introducción de reglas fiscales a través de la “Ley de Responsabilidad Fiscal” ha sido beneficiosa al crecimiento de los estados.

Palabras clave: gastos públicos; crecimiento económico; estados de Brasil.

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1. INTRODUCTION

Is it possible for the government to promote long-term economic growth by reallocating (or reshaping) government spending? This question is relevant because states and other federal entities are facing fiscal adjustments that often make it impossible to increase spending beyond a certain limit, which also occurs when the relationship between spending and GDP becomes stagnant or decadent.

Government spending has increased significantly over time and is far from being easily understood. In terms of the justification for the presence of the government in the economy and society, it is difficult to determine if more government intervention will, in fact, influence the GDP of countries, states and municipalities. In the international field literature, there are many theoretical and empirical studies that address the effects of government spending on economic growth. Barro (1990), for example, develops a model in which the government's presence in the economy produces two effects, one good and one bad, related respectively to the offering of public goods and the taxing of production.

Some studies point out that in developed countries higher government spending is associated with more modest growth due to the typical impediments of the state bureaucratic structure. However, this argument does not constitute an imperative, given that not all components of government spending will have an equal impact on the rate of economic growth. Many of these studies, in line with Barro (1990), have focused on the relationship between government spending and the long-term rate of growth.

If we analyze this historically, the evolution of the composition of government spending in Brazil has changed greatly over time. The ratio of "educational spending/operating expenses" declined in magnitude from 21% in 1997 to 16% in 2011, while the ratio of "health spending/operating expenses" increased from 8% in 1995 to 13% in 2011. During this time many fiscal events affected the Brazilian economy, such as the Fiscal Responsibility Law or LRF, which imposed rules and established budgetary limits to increases in government spending.

In this sense, this study seeks to analyze the effect of the allocation of government spending on the rates of growth of Brazil's states and capital territory. As an analytical reference we will use the model proposed by Devarajan, Swarrop and Zou (1996). A strong point of this model is that it does not consider *a priori* which forms of spending are productive (promote positive effects on GDP) or unproductive (promote negative effects on GDP), letting the data speak for itself. For our econometric analysis we will use a conventional Fixed Effects (FE) panel made up of Brazil's 26 states and the Federal District from 1995 to 2011.

2. THE ALLOCATION OF GOVERNMENT SPENDING AND ECONOMIC GROWTH

There is still no consensus in terms of how to alter the composition of government spending as well as the capacity of the public sector in administrating the fluctuations of the economic cycle. The economic literature has recently been resurrecting Keynesian arguments in terms of the possibility of using spending instruments during periods of recession, as compared to moments of expansion in terms of production. Intuitively, this argument is related to the use of short-term fiscal policy without taking into account its effect on the economic system over the long term.

It is interesting to note that the answer to this question is of interest not only to public policy makers, in terms of the conceptualization of stabilization strategies, but also to *decision makers* in the implementation of policy when it is imbued with normative theoretical models that are almost always in conflict. Comparing the Real Business Cycle (RBC), New Classical and Dynamic Stochastic General Equilibrium (DSGE) models offers a good example of how qualitative forecasts can vary, mainly in relation to the fiscal transmission mechanisms involved.

RBC models generally foresee a decline in consumption in response to an increase in government spending. On the other hand, the Keynesian inspired IS-LM model argues that consumption should increase, thereby further accentuating the effects of increased public expenditure. Naturally, the reason behind this conceptual and empirical difference resides in the way in which consumers react to fiscal policy behavior.

In RBC models, with fixed prices, consumption decisions involve time horizons based on intertemporal budgetary restrictions; these models suggest that, under the aegis of Ricardian equivalence, fiscal policy will be inefficient if it intends to stimulate economic activity. On the other hand, according to the IS-LM model, consumers do not make their decisions in a “Ricardian” manner, with consumption being only a function of present liquid earnings. Thus, the effect of an increase in government spending depends on the way in which consumers are expected to behave according to one tradition or the other.

New Classical inspired models argue that increasing spending financed through a lump sum tax¹ will have a negative effect on wealth, leading to: (i) a decrease in private consumption; (ii) an increase in job openings and a decrease in marginal work productivity and real wages, which will result in lower levels of production and employment. However, the multiplier will be less than one due to the crowding out effect in terms of private consumption. The recent development of DSGE models, which incorporate the micro-fundamentals of market failures, the intertemporal optimization of representative agents and changes in preferences, is of interest due to the results of these models which do not correspond to those of RBC and Keynesian inspired models.

The entire debate concerning fiscal policy transmission channels for economic activity permeates the attempt to capture elements that explain this controversy in terms of cyclical responses to fiscal policy, which are of interest when we are seeking to reduce economic fluctuations. Of great relevance in this debate is the question of how important the allocation of government spending is in terms of economic growth.

2.1 WHAT DOES THE INTERNATIONAL LITERATURE SAY?

According to Feldstein (1980), government deficits do not represent an unequivocal way for fiscal policy to affect aggregate demand, because they can influence private consumption through expectations. Thus a permanent increase in government spending or taxes that do not “finance” this spending can result in a contraction of the economic cycle. Consumers react to a fiscal change by altering their subjective probability distributions in relation to the overall possibilities of future government

¹ The rate of lump sum taxes is independent of income level. Theoretically they are taxes that do not distort the economy’s relative prices (they are efficient).

taxation and spending. Feldstein's analysis (1980) leads us to believe that the reaction to a particular change in the conduct of fiscal policy will depend on the expectations associated with this change, which may result in the nullifying of its effects.

In this sense, Alesina and Ardagna (1998) investigate the hypothesis of the non-linearity of fiscal policy, meaning the extent to which expansionary or contractionary impacts on discretionary policy can affect economic agents. The expansionary effects of fiscal adjustments can be felt through the wealth effect on consumption related to cuts in spending that are viewed as permanent. In this sense, a reduction in taxation will be perceived as a permanent increase in the consumer's disposable income. In a forward looking context, private demand will increase. In the same way, an increase in taxation can result in expansionary effects. This will occur if consumers perceive this increase in taxation as temporary due to a possible change in the conduct of future fiscal policy in the opposite direction, which will mean lower taxation. The wealth effect may be even more pronounced if this fiscal consolidation occurs during periods of elevated government spending.

Some determinants of the non-linearity of fiscal policy are pointed out in the literature such as the composition of government spending and fiscal consolidation. It appears to be a stylized fact that the composition of spending is associated with the balancing of public finances. According to Alesina and Perotti (1995, 1996), fiscal adjustments based on tax increases, especially direct taxation, are not very effective in controlling an increase in public debt. On the contrary, successful fiscal adjustments are achieved through cutting spending, particularly the most rigid components of spending, which include, for example, social security and government wages and employment.

Based on that, it makes sense to ask whether the government is capable of promoting long-term growth by reallocating spending, given that it may confront a large debt that will make fiscal adjustments necessary to maintain a stable level of debt, thus reducing its supposed anticyclical impact. Policy makers would thus be faced with a trade-off between various expenditures to maintain a given level of economic growth. The origins of this dilemma can be traced back to Barro (1990), whose endogenous model of growth emphasizes the importance of the alignment between public and private capital.

Like every political and academic debate, the question of the impact of reorganizing the composition of government spending on economic growth has never reached the outlines of a consensus. Acosta-Ormaechea and Morozumi (2013) have not found any significant relationship between the reallocation of spending on defense, infrastructure, health and social programs and long-term growth in GDP. However, when this reallocation occurs through increasing education spending, a robust association has been found. This association is even more robust when education spending takes the place of social spending. In this sense, Gemmel, Kneller and Sanz (2014) show that increases in the share of social spending may be associated with more modest recent growth in the GDP of OECD countries.

Similar research has analyzed the impact of government spending on education on the rate of economic growth. *A priori* it would be expected that an increase in education spending would promote a corresponding increase in sustained GDP growth through the accumulation of human capital; economic theory supports this relationship (Lucas, 1988). However, empirical results are far from

reaching a consensus in terms of this relationship. Easterly and Rebelo (1993) observe that greater spending on public education is associated with greater levels of income inequality and, depending on the specific type of econometrics used, the relationship between education and economic growth is not robust.

This lack of empirical support may be due to there being a more complex relationship between these two variables. In other words, government spending on education improves economic growth while taxes have the opposite effect, resulting in an ambiguous net effect. This ambiguity would be the result of the way in which the government finances educational spending – taxing income. This is why the financing of government spending should be taken into account in these empirical estimates, since the adjustments to the overall equilibrium related to taxation will be present (Blankenau, Simpson and Tomljanovich, 2007).

Basu and Bhattacharai (2009), on the other hand, find a very weak correlation between growth and government spending on education, which suggests a non-linear U-shaped relationship between the two variables. For developed countries, government spending on education initially promotes a positive effect on economic growth, while in poorer countries, initial government spending on education may inhibit long-term growth. Thus in countries which have historically done little in terms of education, the crowding out effect of government spending on private spending in education will dominate the complementary effect, resulting in low GDP growth.

Another component of government spending that has been investigated in the literature is infrastructure, which also does not appear to present a consensus. According to Dabla-Norris and partners (2012), not all investment in infrastructure is directly related to higher rates of growth, because investments of this nature are related to the efficiency and quality of the spending. A low return on a public investment resulting in inefficiency and low quality may be due to (i) the asymmetry of information in the implementation of projects, (ii) the wasting of resources and (iii) a lack of technical expertise. Thus, the spending of resources does not necessarily imply an expansion of physical capital, like the construction of a highway that leads nowhere (Acosta-Ormaechea and Morozumi, 2013).

In this sense, Agénor and Neanidis (2006) and Agénor (2010) develop a long-term model in which public investment in infrastructure is the key to growth, concluding that the degree of efficiency in public infrastructure becomes non-linear in relation to the accumulation of public capital, which means that redirecting spending towards infrastructure projects will only be productive when the spending is very efficient. On the other hand, Aschauer (1989) finds a positive significant relationship between public investment in infrastructure (streets, avenues, airports, sewers and other items) and improvements in economic productivity and growth.

It is also important to emphasize the role played by health, defense, and social assistance spending in terms of long-term growth trends. The field literature on economic growth has been giving more and more attention to the health factor as one of the great promoters of increased individual productivity (Weil, 2014; Bhargava et al., 2001; Bloom, Canning and Sevilla, 2004; Bloom and Canning, 2005). The main channels through which health exerts an impact on the economy are related to (i) an increase in the population's physical and mental vigor, (ii) more healthy days at work and (iii) human capital. Agénor (2010), Alderman, Behrman and Hoddinott (2005) also point out that government

spending on health is of primary importance since it directly influences individual productivity and thus GDP growth. Health spending contributes not only to labor productivity but also to the quality of education, improving the cognitive aspects related to the ability to learn and school attendance, and inducing in turn an increase in registrations.

On the other hand, Gemmel, Kneller and Sanz (2014) and Agénor (2010) point out that government spending directed towards social assistance in particular has presented counterproductive behavior. They argue that social spending has passed the inflexion point in the productivity curve. Meanwhile, in terms of defense, Barro (2004) and Acosta-Ormaechea and Morozumi (2013) have not found a significant relationship between spending in this area and economic growth, even though the relationship between these variables can occur through spending on defense investments that protect private property.

The studies that focus exclusively on the analysis of the composition of government spending and its influence on growth (Haque, 2004; Agénor and Neanidis, 2006; Acosta-Ormaechea and Mozorumi, 2013; Albertini and Roulleau-Pasdeloup, 2014; Afonso and Jalles, 2013; and Gemmel, Kneller and Sanz, 2014), cite the seminal work of Devarajan, Swarrop and Zou (1996) which undertakes an analysis of developing nations. Using data from 43 countries over a period of 20 years, these authors demonstrate that an increase in overall government spending is positive and significant in relation to economic growth, even though capital expenditures have presented contrary signals in comparison to the other areas. This is explained by the fact that, when it occurs in excess, spending that has proved productive may become unproductive, and this can be observed in health, education, transport, communication and capital expenditures.

Finally, analyzing the OECD countries, Afonso and Jalles (2013) find a very interesting result from the point of view of reallocating spending. While spending on education and health is productive in terms of economic growth, meaning they further GDP growth, income taxes, public employee salaries, interest payments on debt, and government consumption and subsidies promote the opposite effect, inhibiting growth in these countries. In the same way, spending on social security and well-being appear to be less productive than spending on health and education.

2.2 WHAT DOES THE BRAZILIAN LITERATURE SAY?

For the Brazilian economy we find studies about the composition of government spending in relation to growth trends. Most of these studies concentrate on the impact of aggregate spending on growth or the impact of some particular component on economic growth.

Cândido Jr. (2001) analyzes empirically the relationship between government spending and economic growth in Brazil from 1947 to 1995. The results suggest two channels for the transmission of government spending to the private sphere: (i) spending on infrastructure, education and health which directly affect the use of private physical capital and labor (beyond national laws and security which indirectly influence the environment in which these decisions are made) and (ii) the effect of aggregate government spending that appears to reach an optimal threshold in terms of economic growth, with there being strong evidence that low productivity occurs beyond a certain limit. This result is expected because there are limits to the increases in revenues that finance spending. If the

productivity of government spending does not grow beyond the revenue limit, this will certainly help diminish GDP.

Meanwhile Herrera and Blanco (2006) verify the quality of fiscal adjustments made since 1999 and their impact on long-term growth trends. Periods of successful stability coincided with periods in which fiscal policy was more flexible in increasing the primary surplus, given that maintaining the surplus demonstrated government commitment. Since part of the adjustments were achieved through increasing tax receipts and reducing capital expenditures, this occurred in conjunction with an increase in spending on social security and social assistance. In this way, Brazil would be able to obtain gains by increasing investment in infrastructure, but the resulting increases in taxation would have pernicious effects on economic growth.

The literature has emphasized that government spending on investment when efficient can play an important high profile role in the country's long-term growth, independent of the sphere that is being analyzed (federal, state or municipal). Rodrigues and Teixeira (2010) verify which of these spheres most influenced Brazilian economic growth during the period from 1948 to 1998 considering the following spending categories: (i) consumption, (ii) subsidies and (iii) transfers. They found that the states were the entities that most affected growth with investment being the most important component, which therefore should be prioritized. In compensation, spending on consumption, subsidies and transfers should be avoided, given that the public sector is not very productive in managing these areas.

Furthermore, in accordance with the spending productivity argument, Da Silva and Triches (2014) verify the impact of government spending on production from 1980 to 2005. Spending on communications, transport, health and sanitation is considered to be productive. They found significant estimates for these variables from the statistical point of view. On the other hand, they did not find significant estimates for spending on defense, national security and education, despite their theoretical importance in terms of growth. Therefore, improvements in transport infrastructure and the quality of health and basic sanitation, for example, imply greater rates of GDP growth.

Rocha and Giubert (2007) is a pioneering work on the effect of the composition of spending on the Brazilian economy. The study's goal is to determine which components of government spending influenced Brazilian growth during the period from 1986 to 2003. Some of their findings are notable: first of all, they find a positive and significant relationship between defense, education, transport and communications spending and the rate of growth; secondly, they find that the relationship between capital expenditures and the rate of growth is significant and apparently non-linear and, finally, the relationship between primary expenditures and the rate of economic growth is significant and apparently non-linear. In relation to what was expected *a priori*, only health spending is found to be insignificant.

Following the work of Rocha and Giubert (2007), Divino and Silva Jr. (2012) developed a very similar study that studied Brazilian municipalities. Their findings demonstrate that aggregate government spending positively influences the economic growth of municipalities as does the number of years of schooling and life expectancy at birth. On the other hand, initial income, income inequality and the number of homicides present a perverse effect of GDP growth. In terms of spending, for

municipalities below the poverty line, spending on maintenance is found to be more productive than capital expenditures. This result may be attributed to the fact that economic growth is of primary importance to poorer municipalities.

Therefore, there does not seem to be a consensus within the Brazilian or international literature in terms of the effects of the allocation of government spending on economic growth. An important point in this debate, which will serve as a backdrop theoretically as well as empirically, is the relationship observed between productive and unproductive spending on economic growth, or in other words, the debate which considers the effects of the allocation of government spending on the rate of economic growth.

3. THE THEORETICAL MODEL

The discussion presented in the previous section calls attention to the importance of the composition of government spending in relation to economic growth. This section will present our basic model with the objective of synthesizing the causal relationships necessary for developing this study's empirical analysis. This analysis will use the analytical model of Devarajan, Swarrop and Zou (1996) as a reference for two reasons:

- (i) they do not establish *a priori* which forms of spending are productive or unproductive. The data speaks for itself;
- (ii) the model analyzes the effects of the composition of government spending on the rate of economic growth for any unit of analysis (countries, states, municipalities, etc.).

The analytical structure expresses the difference between productive and unproductive spending and the way a reallocation of this spending may affect steady-state growth rates. It assumes a production function with three arguments: the private stock of capital “k” and two types of government spending “g₁” and “g₂”, productive and unproductive spending respectively. If the relationship between the variables assumes the CES (Constant Elasticity of Substitution) functional form, we have:

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

where:

$$\alpha > 0, \beta \geq 0, \gamma \geq 0, \alpha + \beta + \gamma = 1, \zeta \geq -1$$

According to Barro (1990), the government finances its spending according to the following relationship:

$$\tau y = g_1 + g_2 \tag{2}$$

where:

$$g_1 = \phi \tau y, g_2 = (1 - \phi) \tau y, 0 \leq \phi \leq 1 \tag{3}$$

With being the given parameters, the representative agent maximizes its utility function according to consumption “c” and capital stock “k”:

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

subject to:

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

where ρ is the intertemporal discount rate.

The representative agent will maximize a CRRA (Constant Relative Risk Aversion)² type utility function:

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

Substituting (6) in (4) and maximizing, subject to (1), (2), (3) and (5), we arrive at the consumption growth equation:

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

Assuming that in a steady state, taxation is the constant it follows that “g/k” is a constant that assumes:

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

Substituting (8) in (7), we obtain the rate of growth of consumption “λ” as being:

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

Differentiating the equation (9) in relationship to parameter ϕ we have the relationship between the rate of growth in the steady state and the portion of spending determined to be g_1 (productive spending):

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

From expression (10), we can infer that any component of government spending will be productive when its relative increase implies an increase in the steady-state growth rate. Thus, component g_1 will be productive if, and only if, $\frac{d\lambda}{d\phi} > 0$. For this to occur, the parameters of the model need to satisfy several conditions. Assuming that $\lambda > 0$, the right side of the equation (10) will be positive if:

² The use of utility functions belonging to the Hyperbolic Absolute Risk Aversion (HARA) class is well established in the economic literature, given that they are particularly convenient in mathematical modeling and empirical estimation (Ingersoll Jr., 1986). A group of special cases can be understood using the HARA function, including: (i) the quadratic utility function; (ii) the exponential utility function and (iii) the isoelastic (or Constant Relative Risk Aversion) utility function.

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

If $\zeta \geq -1$ for $\frac{d\lambda}{d\phi} > 0$, the expression (11) should satisfy

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

The parameter $\theta = 1/(1 + \zeta)$ measures the elasticity of the substitution. According to this condition (12), we can see that the value of this parameter depends not only on the parameters that measure productivity (β and γ) but also on the initial composition of the spending. In this way, a reallocation of spending will not be productive if the initial value of share “ θ ” is very high. Therefore, whether a given form of spending is productive will depend on the relationship between the elasticity coefficient and the initial value of the spending; or in other words, the reallocation of spending will not influence GDP growth if the initial value of share (θ) is high.

4 THE ECONOMETRIC MODEL

4.1 THE ECONOMETRIC SPECIFICATION

The econometric specification adopted to test the relationship between the per capita rate of growth and the allocation of government spending uses the previously mentioned endogenous growth model of Devarajan, Swarrop and Zou (1996) as a reference. The model produces an equation in which the rate of GDP per capita growth “ g_{it} ” varies as a function of the ratio of Spending/GDP “ G/Y ” as well as a vector of the relative spending “ G_k/G ,” both indexed to unit “ i ” over period “ t .” The inclusion of the term “ G/Y ” seeks to control for the level effect as well as the financing of the spending on the rate of growth (Devarajan, Swarrop and Zou, 1996; Blankenau, Simpson and Tomljanovich, 2007).

A control “ φ_{it} ” vector of variables, consistent with the empiricism involved, should be included to achieve the best econometric specification. The overall model thus assumes the following form:

$$g_{it} = \Delta y_{it} = \delta_1 \left(\frac{G}{Y} \right)_{it} + \sum_k \delta_{2,k} \left(\frac{G_k}{G} \right)_{it} + \mu_i + \theta_t + \varphi_{it} + \varepsilon_{it} \tag{13}$$

Where: “ y_{it} ” is the log of GDP per capita of the unit of cut “ i ” over period “ t ,” “ g_{it} ” is the rate of GDP growth, “ Y ” is the level of GDP, “ G ” is total government spending and G_k is the spending of the k th component; μ_i and θ_t correspond, respectively, to the idiosyncratic effect of each state and a dummy temporal variable. Finally, ε_{it} denotes the error term.

For the rate of GDP per capita growth, a period of 4 years is considered ideal to measure growth (Devarajan, Swaropp and Zou, 1996; Rocha and Giuberti, 2007; Acosta-Ormaechea and Morozumi, 2013). Given period “ t ,” we have opted to use a moving growth average of the four following periods. In addition to being a more appropriate measure of long-term growth, it makes it possible to control possible sources of endogeneity (simultaneity) in the model.

It is ideal to control the effects of other variables on the rate of economic growth in the states. With this in mind, we have also included rates of population growth and unemployment. These variables have already been included in various empirical studies of growth (Gemmel, Kneller and Sanz, 2014 for example).

We have also included a dummy variable for the Financial Responsibility Law (LRF) to evaluate the effect of the imposition of rules on government spending. Since the implementation of the LRF coincided with the beginning of the economic boom in the decade beginning in 2000, a dummy temporal variable has been inserted in the model to control for the economic cycle effect, making the LRF variable more accurate in measuring the effect of the imposition of budgetary rules.

4.2 THE DATA

The results that appear below are based on three data sources that cover the period from 1995 to 2011. The fiscal data was extracted from the Brazilian Treasury's database through the Budgetary Execution item. The rate of economic growth (a proxy for long-term growth) was obtained based on GDP per capita data supplied by the Brazilian Institute of Geography and Statistics (IBGE). The population growth and unemployment rates were extracted from Datasus, the IT Department of SUS (Brazil's Unified Health System). The statistics package Stata was used to perform the econometric calculations.

The 26 states and the Federal District of Brazil were used for the equation's empirical estimate (13). The Brazilian Treasury uses spending nomenclature that is distinct from that used by international empirical works. According to the concept of Budgetary Execution, the figures for expenses are categorized as: (i) legislative; (ii) judicial; (iii) administration and planning; (iv) agriculture; (v) communications; (vi) national defense and security; (vii) regional development; (viii) education and culture; (ix) energy and mineral resources; (x) habitation and urban planning; (xi) industry, commerce and services; (xii) foreign relations; (xiii) health and sanitation; (xiv) labor; (xv) social assistance and social security; and (xvi) transport.

Since spending on Foreign Relations, Labor, Communications, Energy and Mineral Resources and Regional Development is relatively low in budgetary terms and in some cases much information is missing, we use the following categories: (i) administration and planning, (ii) legislative, (iii) judicial, (iv) transport, (v) public safety, (vi) industry, commerce and services, (vii) education and culture, (viii) habitation and urban planning, (ix) social assistance and social security and (x) health and sanitation. This data can be found in the Brazilian Treasury website under the Budgetary Execution item.

Here is a description of each variable used in the empirical model:

rategdpgrowth = rate of GDP per capita growth for each state. This series was constructed taking into account the following four periods.

spendinggdpratio = the ratio of total spending/GDP for each state.

administration_and_planning = ratio of the spending on "administration and planning" divided by total spending.

legislative = ratio of legislative spending divided by total spending.

judicial = ratio of judicial spending divided by total spending.

transport = ratio of transport spending divided by total spending.

public_safety = ratio of public safety spending divided by total spending.

industry_commerce_service = ratio of industry, commerce and service spending divided by total spending.

education_culture = ratio of education and culture spending divided by total spending.

habitation_urban_planning = ratio of habitation and urban planning spending divided by total spending.

social_assistance_social_security = ratio of social assistance and social security spending divided by total spending.

health_sanitation = ratio of health and sanitation spending divided by total spending.

ratepopgrowth = rate of population growth.

rateunemployment = rate of statewide unemployment.

lrf = dummy variable which defines the Financial Responsibility Law (LRF).

First we constructed a Fixed Effect (FE) and Random Effect (RE) panel data model. To achieve the best model specification, we performed the Hausman test to verify which would be the most appropriate data structure. If the model suggested by the Hausman test was the Random Effect (RE) model, we would have proceeded with the Breusch-Pagan test which compares the REs with the Ordinary Least Squares (OLS). Otherwise we would conclude that the Fixed Effect (FE) model would be ideal.

5. EMPIRICAL RESULTS

To verify the appropriateness of the model, we performed specification tests. First the Hausman³ test verified which was the most appropriate data structure, RE or FE. If the model suggested by the Hausman test was the Random Effect (RE) model, we would have proceeded with the Breusch-Pagan test which compares the REs with the Ordinary Least Squares (OLS).

According to Wooldridge (2002), the FE estimator will always produce consistent estimators no matter which model is used; however, this estimator may not necessarily be the most efficient. On the other hand, the RA estimator will be not only consistent, but also the most efficient, if the RE model is the appropriate model. Table 1 presents the results of the Hausman test and the estimated econometric model.

TABLE 1 HAUSMAN TEST AND THE FE MODEL FOR SPENDING BY FUNCTIONAL CATEGORY

Hausman Test	130.73*		
<i>prob > chi2</i>	0.00		
<i>gdpgrowthrate</i>			
<i>spendinggdpratio</i>	0.0107*	1996	0.0023
	(0.005)		(0.0095)
<i>administration_and_planning</i>	0.0168*	1997	-0.0032
	(0.0049)		(0.0097)
<i>legislative</i>	-0.0363*	1998	0.0107
	(0.0107)		(0.0103)
<i>judicial</i>	0.0147*	1999	0.0262*

Continue

³ The Hausman test verifies whether there is a significant difference between the FE and RE estimators. If the Hausman test is not significant, the RE model should be used.

	(0.0044)		(0.0106)
<i>transport</i>	-0.0017	2000	-0.0528*
	(0.0027)		(0.0151)
<i>public_safety</i>	0.001	2001	omitted
	(0.0039)		
<i>industry_commerce_service</i>	-0.0006	2002	0.032*
	(0.0039)		(0.0122)
<i>education_culture</i>	-0.0242*	2003	0.0668*
	(0.0125)		(0.0125)
<i>habitation_urban_planning</i>	0.0041**	2004	0.0973*
	(0.0023)		(0.0130)
<i>social_assistance_social_security</i>	0.0096*	2005	0.1252*
	(0.0044)		(0.0135)
<i>health_sanitation</i>	0.0062	2006	0.1596*
	(0.0072)		(0.0137)
<i>rateunemployment</i>	0.0158*	2007	0,1922*
	(0.0064)		(0.0146)
<i>ratepopgrowth</i>	0.092*		
	(0.0549)		
<i>lrf</i>	0.0907*		
	(0.0169)		
<i>constant</i>	0.924		
	(0.8307)		
n. obs.	308		
Festat	118.78		
R2			
within	0.9206		
between	0.0586		
overall	0.1469		

Source: Elaborated by the authors.

* variable with less than 5% significance.

** variable with less than 10% significance.

null variable not significant.

standard error between parentheses.

Given that the Hausman test was statistically significant, the ideal model to analyze the relationship between the allocation of government spending and economic growth is the Fixed Effects model. Thus, there is no need to perform the Breusch-Pagan LM test.

The annual variables are the output of the temporal dummy inserted in the model to control for the effect of the economic cycle. First we can state that the total spending/GDP ratio has a positive impact on the states' rate of growth with the usual level of significance. Therefore, for every 1% increase in this ratio, we can expect a 0.0107% increase in GDP.

The spending on the three spheres of government presents significant parameters from the statistical point of view. Spending on administration and planning and judiciary spending were found to be productive, while legislative spending presented unproductive behavior. In terms of public administration spending, an increase of 1% led to an increase of 0.0168% in the rate of growth and in terms of judicial spending the figure was 0.0147%. A 1% increase in legislative spending resulted in a decline in GDP of 0.0363%.

The figures for transport, public safety, and industry, commerce and service spending were not significant, leading us to believe that spending of this nature, related to public infrastructure, has not affected the economic growth of the states.

One result that draws our attention is that spending on education and culture was found to be unproductive (having a negative parameter). In this way, a variation of 1% in education and culture spending was associated with a decline in state GDP on the order of 0.0242%. The unproductiveness of education spending may be related to high costs of education and low returns, a situation which is characteristic of developing countries, when compared to countries with a lower education/GDP ratio and high returns from education (Blankenau, Simpson and Tomljanovich, 2007). Another factor that could be influencing this result is the fact that this variable is not pure given that the Brazilian Treasury only publishes figures for the sum of education and culture spending.

On the other hand, spending on habitation and urban planning along with social assistance and social security was also statistically significant and productive in terms of economic growth. An increase in 1% in terms of habitation and urban planning spending promoted a 0.0041% increase in growth, while social assistance and social security spending promoted a 0.0096% increase in growth in the Brazilian states. These results may be associated with the nature of this spending. Social spending promotes greater physical and mental vigor within the population, thus increasing productivity and healthy days of work (Weil, 2014; Bhargava et al., 2001; Bloom et al., 2004, Bloom and Canning, 2005).

Finally, let us examine the result for the LRF dummy variable. Since the fixed effects of time were controlled for in this model by the inclusion of a temporal dummy variable, thus making it possible to control for the effect of the economic cycle on this model, we found that the imposition of rules by the LRF have been in general productive in terms of the growth of the Brazilian states.

6. CONCLUSIONS

This study seeks to answer how the long-term growth of the Brazilian states and the federal district has responded to the allocation of government spending through an analysis of this spending by functional category. Many previous studies have tried to answer this question in one form or another, without arriving at a consensus. Obviously, the results presented here do not represent the last word on this subject, which must be examined further in the future, given the scarcity of studies of this nature in the Brazilian literature.

Our objective has been to analyze the effects of the composition of government spending on the rates of growth of Brazilian states from 1995 to 2011. Based on the specification criteria, the most appropriate model for this empirical analysis has been determined to be a Fixed Effects model. Here are some of the most important results:

- (i) The ratio of total spending/GDP presented a positive and significant correlation with the growth

of Brazilian states. This result means that a 1% increase in total government spending leads to a 0.01% increase in economic growth for these states.

- (ii) In relation to spending within the three spheres of government — executive or administrative, legislative and judicial, only legislative spending was found to be unproductive. A 1% increase in legislative spending was associated with a 0.0363% reduction in the rate of the states' GDP growth. On the other hand, a 1% increase in public administration spending promoted a 0.0168% increase in the growth, while judicial spending promoted a 0.0147% increase in growth.
- (iii) Transport, public safety, industry, commerce and service spending was not significant. They are, in general, types of infrastructure spending which do not present any relationship to state economic growth.
- (iv) Spending on education and culture proved to be unproductive in these terms. A 1% increase in this area was associated with a reduction in state economic growth on the order of 0.0242%. It is important to point out that it is not always possible to find a clear and robust relationship between education and growth, given that it depends on the way the spending is carried out by the public authorities and/or the econometric specification adopted, which may be linear or quadratic, etc. However, alternative specifications were tested and there was no signal inversion for this variable parameter, which leads us to the hypothesis that the quality of the execution of education spending has been low.
- (v) Spending on habitation and urban planning along with social assistance and social security proved to be productive in terms of economic growth. A 1% increase in habitation and urban planning spending was associated with a 0.0041% increase in growth, while a 1% increase in social assistance and social security spending promoted a 0.0096% increase in the growth of Brazilian states.
- (vi) The results for the dummy LRF variable demonstrated that the imposition of fiscal rules has been beneficial in terms of promoting an environment conducive to greater economic growth.

The results overall are consistent with other contributions to the literature on the theoretical and empirical side of the spectrum. Using the terminology of productive and unproductive government spending, we can say that total government spending has been productive, at least for the period from 1995 to 2011.

Some variables related to the basic functioning of the government in the economic area present robust positive behavior in terms of GDP, examples being spending of a social nature (habitation and urban planning along with social assistance and social security), which are types of spending that promote greater biological vigor within the population, improving productivity and the number of healthy days of work.

Finally, the positive impact of the introduction of rules through the LRF stands out. This result may mean that before this introduction of governmental budgetary restrictions, these entities spent more than was optimal. The implementation of these rules for the allocation of government spending has facilitated a correction in terms of budgetary distortions with the aim of fostering positive effects on economic growth along with more balanced governmental budgets.

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