

Fiscal decentralization and economic growth: evidence from Brazilian states

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Resumo

Este artigo investiga a relação entre a descentralização fiscal e o crescimento econômico nos estados brasileiros de 1996 a 2015. Primeiro estimamos um Método Generalizado de Momentos (GMM) e identificamos uma relação positiva entre os indicadores de descentralização fiscal e crescimento econômico e vemos que a indústria e setores de serviços são os mais influenciados pela descentralização fiscal. Finalmente, para verificar os canais de transmissão, construímos indicadores de desempenho e eficiência do setor público para cada estado, e verificamos que esses indicadores também possuem uma relação positiva com os indicadores de descentralização.

Palavras-Chaves: Descentralização; Crescimento Econômico; estados brasileiros.

Abstract

This paper investigates the relationship between fiscal decentralization and economic growth in Brazilian states from 1996 to 2015. We first estimate a Generalized Method of Moments (GMM) and identify a positive relationship between the indicators of fiscal decentralization and economic growth and see that the industry and services sectors are the most influenced by fiscal decentralization. Finally, to verify the transmission channels, we construct indicators of performance and efficiency of the public sector for each state, and we verify that these indicators also have a positive relationship with the indicators of decentralization.

Keywords: Decentralization; Economic growth; Brazilian states.

JEL classification: E02, O11, O23

Área 16 – Descentralização, planejamento regional e desenvolvimento

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1. Introduction

Over the past few decades, numerous countries have changed their institutional settings as a form of allocating more political power and fiscal autonomy to subnational governments. According to Oates (1999), the basic argument in favor of such decentralization is that it improves the efficiency of the public sector and promotes long-term economic development because to subnational governments are more acquainted with the local conditions and preferences.

The seminal works of Samuelson (1954) and Samuelson (1955) on the economic theory of decentralization, as well as the works of Tiebout (1956) and Oates (1972), served as the basis for the creation of the economic theory related to fiscal federalism. In his model of “voting with the feet,” Tiebout (1956), forwarded the idea of decentralization, arguing that the existence of a decentralized government would facilitate the mobility of families between regions, and thus, given their preferences and the utility, these families could choose the regions in which the public supply of goods and services would fit in their baskets of goods.

In addition, Oates (1999), following what Hayek (1945) has said, argues that higher levels of fiscal decentralization can achieve higher levels of social well-being. If the demands for public goods differ, then equal levels of public goods and services offered by a national government will be inefficient. Thus, the greater the demand for public goods, the greater the benefits of fiscal decentralization. This diversification also allows citizens to move to communities that better match their demands for public goods and services, and rates of local taxes. Thus, the “screening of individuals of Tiebout” increases the efficiency of subnational governments in the allocation of its resources.

Following the introduction of the 1988 Federal Constitution, Brazil has experienced a movement toward decentralization by delegating to the federated entities the responsibility to formulate and implement public policies, focusing on the particularities of local demands. Thus, administrative functions were distributed among the three levels of government, and states and municipalities began to be able to distribute taxes to regional and local development. However, given the heterogeneity of the country and the great inequalities in its various regions, decentralization may not have been as effective as expected.

This research has a twofold objective: firstly, verify whether a positive relationship exists between fiscal decentralization and the economic growth of the Brazilian states during 1996 and 2015¹; and secondly, to test the relationship between government performance in social areas (education and health) and fiscal decentralization for the same years. This paper serves as a contribution because is one more discussion about the impacts of fiscal decentralization on economic growth and for being the only article that debates this issue in Brazil.

This leaves the question of how fiscal decentralization affects economic growth. According to the theory of fiscal federalism, subnational autonomy ensures efficient allocative results, which can in turn result in higher rates of economic growth (TIEBOUT, 1956; OATES,

¹The years were chosen under justification to be the most trustworthy period for econometric inference

1972, 1972). Similarly, following Brueckner (2006), more fiscal autonomy may be associated with higher levels of product per unit of labor and higher rates of growth.

The relationship between fiscal decentralization and economic growth, however, is complex. In recent years, many studies have tried to test the effect of decentralization on the growth of the economies and, despite the widespread theoretical recognition of this effect, few have succeeded in proving this relationship. Using panel data for 46 countries for the period 1970–1989, Davoodi e Zou (1998) measured the sub-national fiscal decentralization as a sub-local part of total government expenditure. The authors found a negative relationship between fiscal decentralization and economic growth for developed countries and no relation for developing countries.

Among the studies that find positive evidence for the relation in question is the study by Akai e Sakata (2002). Through decentralization measures like indicators of public revenue, production, autonomy, and production-recipes the authors tested the effect of fiscal decentralization on economic growth using data from 50 U.S. states for the period 1992–1996. The study provided evidence that decentralization contributes to economic growth, suggesting that recent movements by developed countries toward fiscal decentralization can stimulate their economic growth.

Using data of 23 OECD countries in the period 1972–2005, Gemmell, Kneller e Sanz (2013) determined that the decentralization of spending tends to be associated with less economic growth, while the decentralization of revenue has been linked to greater economic growth. Filippetti e Sacchi (2016) finally examined the relationship between fiscal decentralization and economic growth in different institutional contexts for 21 OECD countries for the period 1970–2010. The authors found evidence that the decentralization of the property tax leads to greater economic growth when it is associated with high administrative and political decentralization.

Numerous factors may explain the controversial results found in the empirical literature. For example, according to Voigt e Blume (2012), the public institutions in geral can be complex, and not be fully observed. As Salmon (2013) points out, the heterogeneity of the jurisdiction can be difficult to capture, or as Filippetti e Sacchi (2016) indicate, the political and administrative dimension may not be properly considered. It is also important to emphasize that the configuration of how some forms of decentralization affect economic efficiency by distorting the efficient allocation of resources might be another explaining factor (MARTINEZ-VAZQUEZ; LAGO-PEÑAS; SACCHI, 2017).

Recently, Ligthart e Oudheusden (2017) observed the relationship between fiscal decentralization and economic growth for 56 countries from various continents during the period 1990–2007. The results indicate that this relationship remains valid after controlling for possible endogeneity problems using instrumental variables based on the origin of the common legal system and country size. This result do not seem to be able to reject fiscal decentralization being exogenous, but neither are concrete evidence of causality arising from fiscal decentralization for

economic growth.

Taking data samples between 2001 and 2011, [Ma e Mao \(2018\)](#) studied the effects of decentralization on China's economic growth after the provincial-managing-county (PMC) reform. They found that that the reform increased the average annual GDP growth rate by 1.4 percentage points over the period of study. The reform abolished the subordinate fiscal relationship between prefectures and municipalities, transferring much of the fiscal and spending authority from the prefecture to the county. Finally, perhaps the best explanation for the fact is that the studies use different data, techniques, and specifications of decentralization, which produces divergent results.

In addition to the academic context, fiscal decentralization is a topic that has been much discussed in political and economic debates on the world's scenario. In recent decades, fiscal decentralization has been used as a means by which economies can achieve higher economic efficiency. In fact, such speech concerning efficiency has been used by countries such as the United States, China, Great Britain, and Spain as justification for their movement toward decentralization.

The work performs an exercise similar to those applied by [Ma e Mao \(2018\)](#) and [Akai e Sakata \(2002\)](#). We highlight the incipient debate about fiscal decentralization in developing economies, with results demonstrating that fiscal decentralization in Brazil has positive effects on the growth of Brazilian states and that decentralization has a positive relationship with social performance indicators. This second result provides evidence that decentralization is associated with greater efficiency in state intervention. Thus, efficiency is the channel transmission between fiscal decentralization and increased economic growth.

Beyond most of articles controlling the effects of endogeneity between variables, the hypothesis of endogeneity are reinforced by [Ligthart e Oudheusden \(2017\)](#), which finds no evidence that it is possible reject the hypothesis that economic growth and fiscal decentralization is not endogenous². It is worth noting that in addition to serving as evidence in the world context about the relationship between economic growth and fiscal decentralization, this article appears as the pioneer discourse on the subject in a national context.

This paper is divided into six parts, including this introduction. The second section provides a brief overview of the process of fiscal decentralization in Brazil before presenting some recent data related to the subject. The third section presents the methodological aspects, the article-basis, and the indicator calculation process. In the fourth part, the results of decentralization are presented, as is the econometric estimation in the fifth part. Finally, the paper concludes by presenting final considerations and bibliographical references.

²The author also cites some papers that also find similar results

2. Institutional background

The phenomenon of fiscal decentralization is characterized by budgetary autonomy and collection of the federated entities, even beyond the partition of taxes, government transfers, and public spending between the federal-, state-, and municipality-levels.

Since its colonial period, Brazil was managed in a centralized manner. Even after the proclamation of the republic, the central government still had the power to administer resources for the implementation of state activities. Since the 1930s, however, after a significant expansion of its public function, the federal government began to share some of its financial resources and administrative capacity with the state and municipal levels of government. During the military regime (1964–1985), and especially after the Constitution of 1967, the concentration of fiscal resources, the generation of financial resources and the formulation of public policies were expanded by the federal government, significantly reducing the autonomy of subnational governments.

Since the 1980s, as a result of this concentration of resources in the Union, enforced by the dictatorship, a series of conflicts began among the federal, state, and municipality governments. During the process of the country's democratization, thus, the movement of Brazilian decentralization aimed to strengthen the political and financial aspects of the states and municipalities. With the 1988 Federal Constitution, the Brazilian federation was transformed, as was its structure, purpose, and fundamentals. However, as *Giambiagi e Além (2008)* indicate, since the Brazilian decentralization process was conducted not by the central government but by the states and, principally, by municipalities; as a result, no national plan for decentralization was produced. The result was an uncoordinated process.

Decentralization in Brazil is a complex process, since the country is characterized by severe socioeconomic and geographic inequalities, which are reflected in different capacities. The reconciliation between decentralization and social inequality reduction, therefore, is the primarily challenge to decentralization. Thus, in Brazil, this process is related more to participation in the national transfers than to the increase of its tax and revenue capacity. Table 1, below, presents the distribution of average earnings for county and state according to the major regions of Brazil, for the period 1985–2015.

The tax revenues based on the information presented in Table 1 indicate that the municipalities and Brazilian states showed a significant change in their collected values. Compared to the values before the Federal Constitution of 1988, the municipal tax revenues showed growth in four of the five Brazilian regions, particularly the north and northeast regions. As for the state tax revenues, the performance of the northern regions is highlighted. However, in the period from 1995 to 2015, despite these variations, the total of shares of tax revenues in state and municipal revenues remained at similar levels – and sometimes even lower than the beginning of the period. Although the existing tax revenue tends to grow, this is connected to the increasing financial dependency of subnational governments.

Table 1

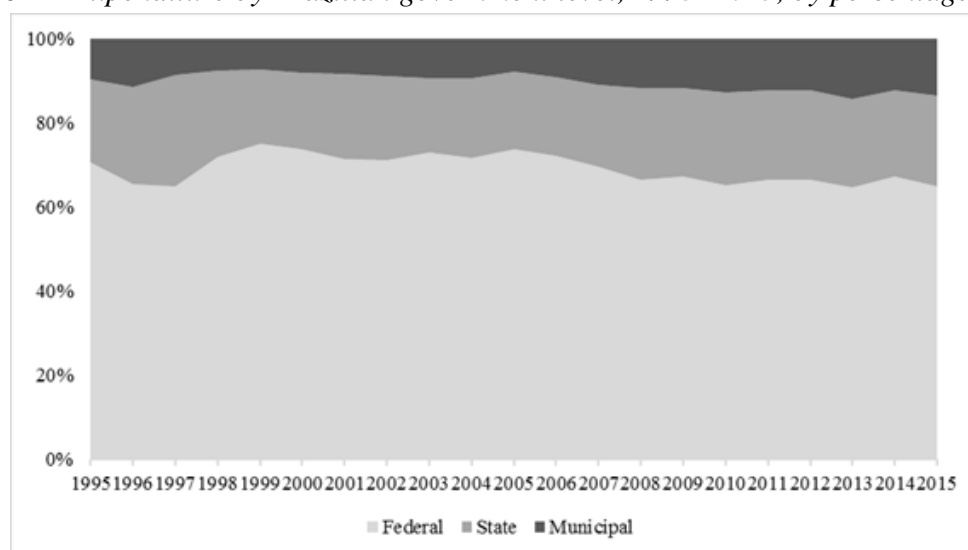
Distribution of municipal and state average revenues according to the great regions of Brazil, 1985–2014, by percentage

MUNICIPALITIES	Tax Revenues					Current Transfers				
	85-94	95-99	00-04	05-09	10-15	85-94	95-99	00-04	05-09	10-15
Brazil	11.37	22.66	18.08	18.07	19.48	60.26	60.92	65.67	66.86	64.13
Midwest	9.53	24.84	12.11	12.98	15.71	66.83	75.12	74.28	72.31	71.90
Northeast	6.90	12.12	9.54	9.68	18.05	60.56	79.25	79.27	80.74	84.70
North	5.80	13.27	9.35	10.33	31.69	56.73	76.73	77.45	79.05	86.47
Southeast	22.04	26.43	23.81	23.84	19.75	50.59	52.64	58.44	59.42	49.62
South	12.57	19.86	15.19	15.41	17.40	66.57	67.31	65.41	65.88	71.21
STATES	85-94	95-99	00-04	05-09	10-15	85-94	95-99	00-04	05-09	10-15
Brazil	79.14	65.59	63.35	62.34	61.91	18.66	24.22	22.31	24.53	22.43
Midwest	59.79	50.11	58.70	62.58	58.44	31.08	40.97	27.74	22.75	20.98
Northeast	56.38	50.25	47.28	45.79	48.49	34.64	43.69	39.48	43.19	40.26
North	45.18	42.68	41.85	41.15	41.61	62.08	49.87	48.53	48.87	44.35
Southeast	82.70	77.23	72.10	71.02	70.09	9.07	13.13	11.95	13.99	11.94
South	84.69	62.59	67.33	67.21	68.29	10.50	18.34	19.61	22.35	19.90

Source: Own elaboration based on data from the National Treasury Secretariat.

The observed scenario is different concerning transfer revenue. In 1985, the current transfers of the Brazilian municipalities accounted for about 60% of the total municipal revenue, while in the final period of the analysis (2010–2015), these accounted for 64%. However, by observing the major regions in detail, much more significant variations are visible. Furthermore, in the less developed northeast and north regions, there is a greater weight of current transfers. In these regions, the weight of transfers passes the 80% level, while in the southeast region, participation is about 50%. As for the states, the portion related to the tax revenue remained constant from 1985 to the period 2010–2015, despite small variations. We can see too that the concentration of tax revenues in the more developed regions is counterbalanced by a system of transfers of taxes, which favors mainly the less developed regions.

Figure 1 – Expenditure by Brazilian government level, 1995–2015, by percentage.



Source: Own elaboration based on data from the National Treasury Secretariat.

Figure 1 demonstrates that in the initial period, 1995, the federal government controlled approximately 71% of aggregate expenditure, while state and municipal governments controlled about 20% and 9%, respectively. In 2015, the share of federal government expenditure was 66%, while the share of state governments was approximately 23% and, finally, the expenses of the municipal governments accounted for about 11% of the total. The sizes of state and local governments therefore changed, reflecting a trend of decentralization in the sense that the sub-national expenditure increased its share of the total. However, it is important to be careful in making such claims, as the concept of decentralization is quite complex and includes numerous other dimensions.

3. Methodology

3.1 Measuring decentralization

Although the fiscal decentralization is a subject thoroughly discussed in political and scientific spheres, there remains no consensus of which quantitative measures are suitable to measure the process. To make this empirical study interpretable and consistent with previous studies, our analysis is based on the study of Akai e Sakata (2002).

The approach most frequently used measures the autonomy of these entities from their revenues or expenses. However, some exceptions should be made. The expenditure of subnational governments may be financed by transfers from higher governments and, thus, the share of the lower government expenditures in total expenses do not necessarily reflect the level of authority of the smaller government. In addition, even if the portions of revenue or expenses are small, the subnational government may be considered fiscally decentralized, provided that the sufficient resources for the expenses of this government are originally allocated to it. Therefore, it is important that the level of autonomy be used as a proxy for fiscal decentralization.

However, as mentioned previously, several studies have used portions of the subnational revenue and expenditure as indicators of fiscal decentralization. Since it is difficult to develop a single completely satisfactory measure, we considered five measures of fiscal decentralization, that we taking into account the research of Akai e Sakata (2002) as the support. The five indicators are detailed below:

- **Autonomy Indicator 1 (A1):** Set for each subnational government as the portion of its revenue that comprises the total revenue, excluding transfers. This indicator approaches the true fiscal independence of the subnational government.
- **Autonomy Indicator 2 (A2):** Defined for each subnational government as the portion of its revenue that comprises the total revenue. This indicator gets closer to the actual independence of subnational government.
- **Revenue Indicator (RI):** Defined for each subnational government as the portion of each local revenue that comprises the total revenue (the sum of all local revenues).

- Production Indicator (PI): Defined for each subnational government as the portion of local expenditure that comprises the total expenditure (the sum of all local expenses).
- Production Revenue Indicator (PRI): Defined for the mean of RI and PI results.

3.2 Control and Transmission Variables

To obtain a measure of the performance and efficiency of the public sector, it is necessary to add several indicators that compose public sector obligations. Based on the paper by Afonso, Schuknecht e Tanzi (2005), it is possible to use the public performance indicator (PSP), the public expenditure indicator (PEX), and the public sector efficiency indicator (PSE). The performance indicators are measured by the weighted average result of the indicators, where the indicators in year i in state j are divided by the national average. The expenditures are divided by the average in relation to their respective sectors, that is, year i and state j . Finally, the efficiency meter divides the result of the PSP by the PEX. In this case, we don't use PSE, only the PSP:

$$PSE_{nj} = \frac{PSP_{nj}}{\frac{\sum_{n=1}^n PSP_i}{n}} \quad (1)$$

Thus, the ratio between each state and the sum of n government areas (the areas formed by an arithmetic mean of the syndicators) comprise the efficiency indicator. Values greater than 1 represent efficiency, while values less than 1 represent inefficiency. The indicator of efficiency in education is composed of the average years of schooling, school attendance (7–14, 15–17), and illiteracy rate for each state.

The second indicator for performance is average wasted years. This indicator represents the difference between the life expectancy at birth and the average age at which people die of each state.

$$Waste_{ij} = \overline{EXP_{ij}} - \overline{D_{ij}} \quad (2)$$

First, the four indicators of fiscal decentralization used in this study contribute to economic growth, as stated by Oates (1972), showing a positive effect on the dependent variable. The data used for the construction of indicators were obtained through the Secretariat of the National Treasury. Degree of trade openness, Gini index, population, homicide rate, dummy variable for election, and occupied population were inserted in the model as control variables. According to the existing literature, it is possible to make predictions concerning some of these variables.

Chart 2

Definition of variables and reason for inclusion

Explanatory variable	Variable	Reason for inclusion	Source
Mainly Variables			
Revenue indicator	RI	Ratio between the state revenue <i>i</i> and the consolidated revenue	STN
Production Indicator	PI	Ratio between the expenditure of state <i>i</i> and the consolidated expenditure	STN
Production and Revenue Indicator	PRI	Weighted average between Revenue and Production indicator	STN
Autonomy Indicator 1	A1	The ratio between the states own revenue and its total revenue, excluding transfers	STN
Autonomy Indicator 2	A2	The ratio between the states own revenue and the total of its revenue.	STN
Controls Variables			
Degree of commercial opening	OPNESS	Ratio between the trade balance result and GDP	Comex Stat/MDIC
Gini Index	GINI	Gini Index for income concentration	IPEADATA/IBGE
Population	POP	Population value	IBGE
Occupied population	POP OCUP	Number of people who are employed	IBGE
Dummy Election	ELECTION	1 if it has been year of election	-
Homicide Rate	HOM	Homicide rate per 100 thousand inhabitants	IBGE
Transmission Variables			
School effectiveness	PSE	Efficiency indicator created from school attendance, years of schooling and illiteracy rate variables	IPEADATA/IBGE
Wasted years	DESP	Indicator create from the difference between the life expectancy and mean age of death	IBGE/DATASUS

Source: Own elaboration of the authors.

3.3 Empirical strategy

3.3.1 Generalized method of moments (GMM)

To address the endogeneity in the models, the estimation used was the one proposed by Arellano e Bond (1991) using instrumental variables from lags of the endogenous variable in differences. The estimator Arellano-Bond is constructed by applying the first difference to remove the effects of the level of the panel and using instruments to provide conditions of momentum. In this way, it becomes possible to accommodate large self-regressive parameters and large proportions of the variance in the effect of panel level to the variance of the idiosyncratic error.

According to Blundell e Bond (2000), the Arellano-Bond estimator has weaknesses with respect to the lagged-level instruments, because the persistent autoregressive process or the ratio of variance of panel effects and idiosyncratic error becomes too large.

Thus, the model we use has adjusted the dynamic data estimators panel from the estimator used by Arellano e Bover (1995) and Blundell e Bond (2000), which was designed for data with many panels and few periods and which assumed that no autocorrelation exists in the idiosyncratic errors and does not require the initial condition that the independent variables do not have a correlation with the first difference of the first observation of the dependent variable.

The authors affirm that the lag of the variables is good tools to correct the endogeneity. In addition, the model allows the freedom to freely control the selection of variables that can be treated to avoid endogenous effects. In this way, the estimator of Arellano-Bover and Blundell-Bond presents the estimated model as follows:

$$y_{it} = \sum_{j=1}^p \alpha_j y_{it-j} + X_{it}\beta_1 + w_{it}\beta_2 + v_i + \epsilon_{it}, \quad i = 1, 2, \dots, N \quad t = 1, 2, \dots, T_i \quad (3)$$

where α_j are the p parameters to be estimated, x_{it} is a $1 \times k_1$ vector of strictly exogenous covariates, β_1 is a $k_1 \times 1$ vector of parameters to be estimated, w_{it} is a $1 \times k_2$ vector of predetermined or endogenous covariates, β_2 is a $k_2 \times 1$ vector of parameters to be estimated, v_i are the effects on the level of the panel (which may be correlated with the covariates) and ϵ_{it} are in whole sample with variance σ_ϵ^2 .

From Akai e Sakata (2002) and with some adaptations, the regression model of this work can be expressed as

$$\Delta GDP_{i,t} = LnGDP_{i,t} - LnGDP_{i,t-1}, \quad i = 1, \dots, 27 \quad t = 1995, \dots, 2015 \quad (4)$$

$$\Delta GDP_{i,t} = \sum_{j=1}^p \alpha_j \Delta GDP_{i,t-j} + LnX_{it}\beta_1 + LnW_{it}\beta_2 + v_i + \epsilon_{it} \quad i.i.d. \sim \mathcal{N}(\mu, \sigma^2) \quad (5)$$

In the equation above, i refers to state i to the quantities of year t ; $LnGDP_{i,t}$ represents the natural logarithm of GDP, so that the left side of the equation represents the rate of growth of

the GDP of each state; the inside of the model wit represents the endogenous indicators of fiscal decentralization, degree of commercial opening, and Gini and X_{it} (the exogenous variables); finally, v_i is the effects at the panel level, while u_{it} is the error term.

The data concerns annual frequency in the period between 1996 and 2015, where the rate of growth of GDP is the dependent variable of the model. ⁴.

3.4 Preliminary Analyzes

Table 2 shows the results of the descriptive statistics of the data used in the paper for the years between 1996 and 2015 ⁵. The results show that only the growth rate of the services sector, homicide rate, population and employed population present extensive values between the minimum and maximum or distant from the average. For the control variables, the natural logarithm was applied to stabilize the series.

Table 2

Averages, standard deviations, and definitions of the variables used.

Variables	Mean	Std. Dev.	Min	Max
Dependent Variables				
Δ GDP	0.124593	0.064578	-0.07	0.33
Δ Agriculture	0.123953	0.270231	-0.62	2.29
Δ Industry	0.131147	0.243828	-0.43	2.40
Δ Services	0.151147	0.205321	-0.50	4.03
Mainly Variables				
A1	0.809024	0.092698	0.14	1.00
A2	0.498713	0.173038	0.09	0.87
PI	0.007712	0.012192	0.0006	0.13
RI	0.007681	0.012195	0.000533	0.14
PRI	0.007697	0.012186	0.000546	0.13
Control Variables				
Opness	0.145475	0.127781	0.01	0.59
POP	6762641	8029421	254499	44000000
Gini	0.55241	0.049231	0.42	0.69
Homicide Rate	28.13537	13.15587	4.50	71.40
Occupied population	2952986	3778686	70996	22000000
Transmission Variables				
Education	0.993385	0.094177	0.77	1.21
Life Wastage	14.17927	4.705991	5.19	30.25

Source: Own Own elaboration based on data from the STN, IBGE, and MDIC

For education, we expect a positive effect, since the proxy variable used is the average years of study, and higher levels of this rate lead to higher levels of qualification and, thus, of

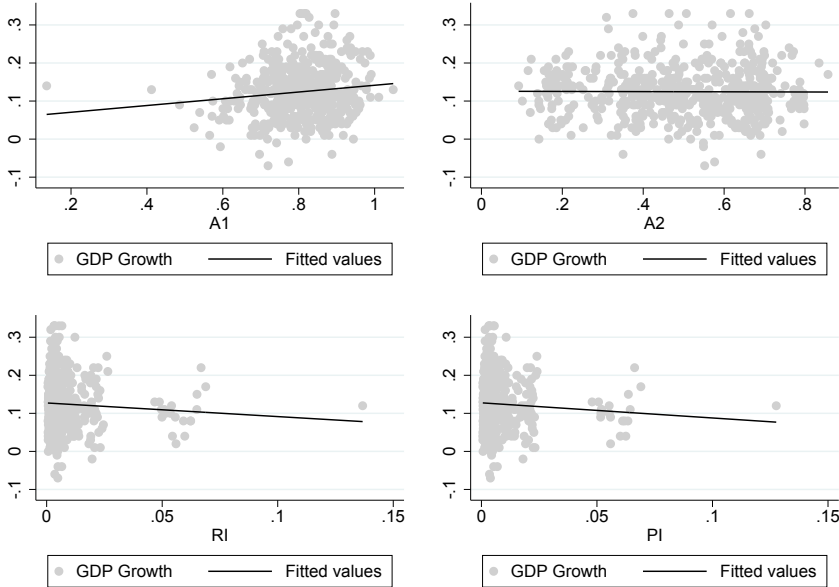
⁴When necessary, the collected data was deflated, as the literature recommends.

⁵The defined period is due to the large distortions of the economic growth rate before the Real Plan's system, and the last results of some variables only extended to 2015.

economic activity. It is expected that the degree of trade openness will contribute positively to the dependent variable. As for the Gini index, given that higher values of the coefficient indicate higher levels of income concentration, the effect of this variable on the dependent variable is expected to be negative. Finally, for the population and the employed population, the effect is expected to be positive, given that models often point out that the population that contributes to economic growth.

The next important step is to analyze the correlation among the indicators of decentralization, the explanatory variables, proxies of fiscal decentralization, and economic growth, the dependent variable. Figure 2 presents the average rate of GDP growth associated with the four indices of decentralization for the study period used in this work.

Figure 2
Economic growth and indicators of autonomy of the Brazilian states, 1996–2015.



Source: Own elaboration of the authors using Stata software, based on data worked in the research.

For the indicators RI and PI, the simple linear association between economic growth and the autonomy indices appears to demonstrate the existence of a negative relationship between the degree of fiscal decentralization and the economic growth of Brazilian states in the period from 1996 to 2015. However, the insight provided by Figure 2 should be treated with caution, since it is well known that economic growth does not depend exclusively on the degree of decentralization of the economy, and the possible variables omitted may influence the negative relationship observed.

Thus, to test the real importance of fiscal decentralization on economic growth in Brazilian states, we estimate the model presented in Equation 5 and present their main results in the

following section.

4. Results and discussion

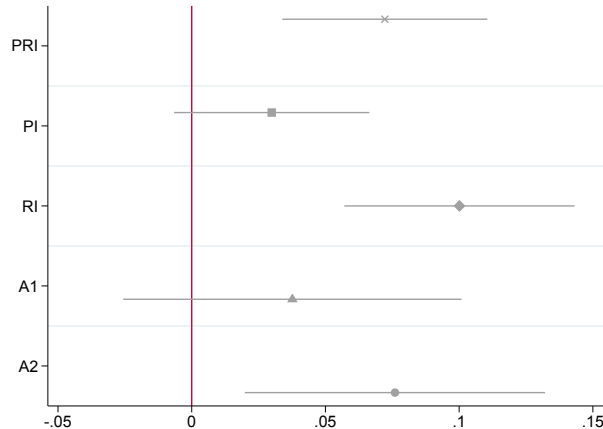
The following chapter discuss the main results obtained through the estimates based on the previous discussion.

4.1 Main Results

Recently, the effect of taxation enforcement on economic growth has been the subject of empirical studies, so that the issue has become the focus of debates about possible government reforms. To contribute to the discussion, the present work uses four types of indicators in addition to control variables that measure fiscal decentralization in order to try to understand the relationship between decentralization and economic growth in Brazilian states.

Figure 3 presents the relationship between the variables studied in this article. The results are based on data from Stata software for the estimation of the data model in a dynamic panel (GMM).

Figure 3
Results for coefficients of decentralization.



Source: Own elaboration of the authors using Stata software, based on data worked in the research.

Within the estimates, the variables for education, population, employed population, Gini index, degree of trade openness, and life expectancy were considered exogenous to the model, while the variable of fiscal decentralization was endogenous. All independent variables are in natural logarithm, so the coefficients are interpreted in elasticity.

Using instrumental models with a lag in the dependent variable, we have as a result that the specification test indicated that there was no residual correlation of the second order and that the instruments are valid for all the estimated models.

According to the results, the main finding of this study is that the indicators of fiscal decentralization A2, RI, and PRI are positive and statistically significant to the economic growth of the states in the period of analysis, especially the revenue indicator RI. As in the studies of Akai e Sakata (2002) and Gemmell, Kneller e Sanz (2013), we found evidence of a positive effect of these measures of fiscal decentralization on economic growth. However, unlike this and the work of Qiao, Martinez-Vazquez e Xu (2008), we found no evidence of an effect of fiscal decentralization on economic growth when measured in terms of expenditure, the PI variable. We can thus see that the variable used to measure decentralization influenced our result, confirming the works cited in this paper.

Regarding the control variables, we found a positive and significant effect of trade openness on economic growth. This result diverges from the literature, since it shows that the increase of the coefficient contributes to the increase of the economic growth. Similar results were found by Rodríguez-Pose e Ezcurra (2010), Filippetti e Sacchi (2016) and Ligthart e Oudheusden (2017).

In addition, it is also important to highlight the positive and significant effect of the Gini index on economic growth. This result was not in line with expectations, since it shows that the increase of the inequality contributes positively to economic growth. The positive outcome, however, can be understood as an incentive to the effort. According to Mirrlees (1971), the possibility of earning a higher income makes the individual strive harder. In this way, inequality contributes to higher levels of productivity. In fact, in this sense, the result found here corroborates the result found by Forbes (2000), in which an increase in the level of income inequality has a positive relation to a country's economic growth.

Subsequently, the Sargan test was conducted to identify super identifying restrictions. The results demonstrate that the model tested does not reject the hypothesis that the restrictions are valid, leading to the conclusion that the instruments used are valid, that is, not correlated with the error term and are, therefore, correctly excluded from the equation estimated, allowing the existence of the model. The test of Arellano-Bond seeks to show the autocorrelation for p differences in the error term. The results show that, for the first difference in the error term, the probability of not rejecting the null hypothesis of no autocorrelation is approximately zero. That is, the model does not have evidence of specification error.

The results from Table 3 are presented in a more simplified form in 3, in which it is possible to see that among the indicators used in the estimation, the indicator RI is the variable that best fits the explanations of economic growth (that is, obtained the highest statistical significance and degree of reliability). We thus chose this indicator to represent a decentralization in the next steps.

4.2 Analysis by sector

Historically, the Brazilian economy has undergone a major structural change. According to Silva, Filho e Komatsu (2016), since the 1950s the service sector has become the sector in which the greatest share of gross value was added. The data presented by the PNAD shows that the growth of this sector led to reduced participation of agriculture on GDP, while the industry had its stable participation.

According to Jacinto e Ribeiro (2015), productivity of services (with the exception of commerce) is high and showed growth between the mid-1990s and the end of the 2000s. In this sense, the expansion of the participation of services in employment had the effect of increasing the aggregate productivity of the economy.

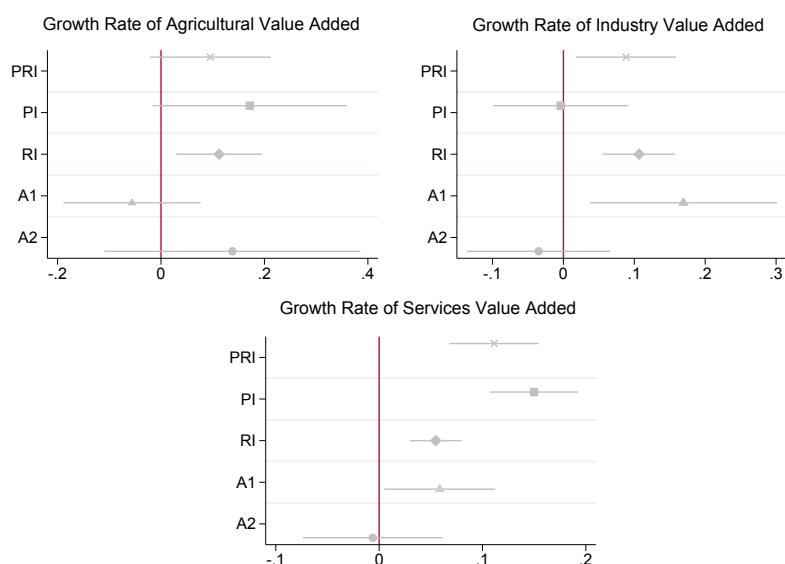
The results indicate strong performance of the three sectors, indicating that it may be in this sector that fiscal decentralization generates the greater positive effects on the Brazilian economy. Filho e Fishlow (2017) affirm that the interaction between research, technology, and productivity has been relevant to explain economic growth.

Thus, for the Brazilian states during the period of analysis, decentralization boosts the economic growth of Brazilian sectors. This result strengthens the results found by Ma e Mao (2018), who evidenced the contribution of fiscal decentralization to industrial economic activity. This is known to have positive effects on economic growth.

All the cases show that the RI index has a positive correlation with the agriculture, industry, and services. The following figure briefly presents these results.

Figure 4

The impact of decentralization on economic growth of various sectors.



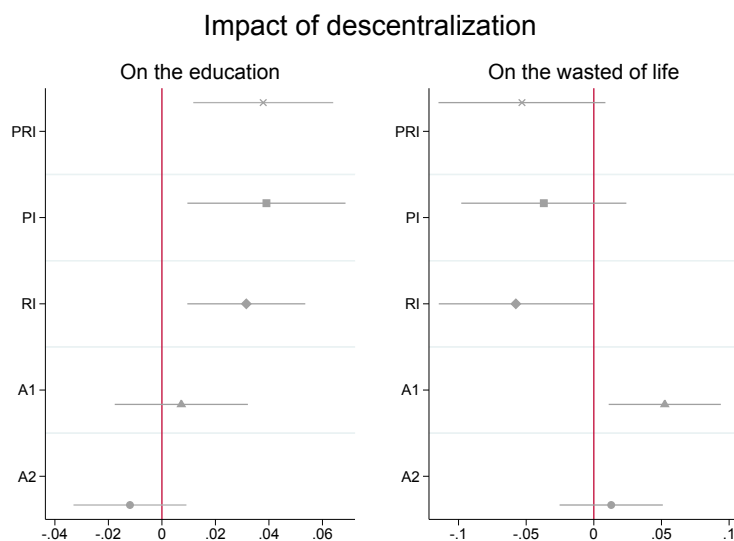
Source: Own elaboration of the authors using Stata software, based on data worked in the research.

4.3 Decentralization transmission channels

Finally, we try to identify whether fiscal decentralization affects the efficiency indicators used and, for the positive case, how this effect occurs. The figure 5 below presents the results found for this regression:

Figure 5

Relationship between decentralization and the efficiency index



Source: Own elaboration of the authors using Stata software, based on data worked in the research.

The indicators of school efficiency and lost years presented statistically significant and expected results. The positive coefficient for school effectiveness demonstrates that the more decentralized the state is, the greater its educational efficiency. That is, decentralization contributes to increasing school efficiency.

The significant and negative result found for the indicator of lost years indicates that this indicator and fiscal decentralization are inversely related: that is, the more decentralized the state is, the lower the indicator of lost years, either because of increased life expectancy at birth or the fall the average age at death, or good results for both.

The evidence found and presented in Figure 5 reinforces the results previously presented in Figure 4, and both are in agreement with the main results presented in Figure 3. The indicators of school efficiency and lost years represent variables of human capital, and we know that these are important for individual productivity.

Thus, the evidence found in this study points to the contribution of fiscal decentralization to the accumulation of human capital. Moreover, as stated, evidence of the positive effect of decentralization on industrial sector growth has also been found. The accumulation of human

capital is known to generate positive externalities on the economy. Therefore, according to the results, we can infer that decentralization contributes positively to the economic growth of the states through the accumulation of human capital, which in turn transmits positive effects via economic growth of the Brazilian industrial sector. It is also worth noting that the lower value of the years of life lost generates a longer life for the agents: that is, agents tend to increase their productivity time.

5. Final Considerations

Fiscal decentralization is a relevant issue and much debated in the economic literature. In the case of Brazil, this topic became more relevant after the implementation of the 1988 Constitution, in which the states and municipalities gained more freedom in the provision of public goods and services. Thus, the present work proposed to identify the relationship, if any, between fiscal decentralization and economic growth for the Brazilian states.

Through four measures of decentralization proposed by Akai e Sakata (2002), the estimation performed found positive and significant effects for the variable of decentralization A2, which measures the decentralization as the ratio of states' revenues to their total revenues. The positive result agrees with the expected theoretical support.

This result shows that fiscal decentralization is an important instrument for achieve higher growth rates. In addition, the positive relationship between the rate of growth and the human capital and the degree of trade openness show the types of policies that can be taken to achieve better results in the long term.

These results are important, as they contribute to the debate on public policies concerning higher rates of economic growth. Policymakers should improve the mechanisms for decentralization so as to identify means of strengthening the tax structure and solving the problems of expenditure and revenue redistribution of the government.

Thus, future efforts that aim to contribute to greater decentralization of the federative entities of the country can also contribute to its economic growth. It is important to note, however, that such evidence should be treated with caution, since the causes behind this positive effect of decentralization on growth are not known.

Therefore, the present study can lead to further studies to find evidence of the causes that lead fiscal decentralization to positively affect the GDP of the Brazilian states. Confirming the causes with greater accuracy would enable more efficient public policies.

Finally, some questions deserve to be investigated to improve the understanding of the relationship between the growth rate and fiscal decentralization in the Brazilian states. The first is the incorporation of new, more accurate indicators in relation to growth rate. The second is simulations of the impacts of the rate of growth through the expansion of the transfers or the tax base itself that should be conducted. Finally, the case of fiscal decentralization should be analyzed at the municipal level in Brazil.

References

- AFONSO, A.; SCHUKNECHT, L.; TANZI, V. Public sector efficiency: an international comparison. *Public choice*, Springer, v. 123, n. 3-4, p. 321–347, 2005.
- AKAI, N.; SAKATA, M. Fiscal decentralization contributes to economic growth: evidence from state-level cross-section data for the united states. *Journal of urban economics*, Elsevier, v. 52, n. 1, p. 93–108, 2002.
- ARELLANO, M.; BOND, S. Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The review of economic studies*, Wiley-Blackwell, v. 58, n. 2, p. 277–297, 1991.
- ARELLANO, M.; BOVER, O. Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, Elsevier, v. 68, n. 1, p. 29–51, 1995.
- BLUNDELL, R.; BOND, S. Gmm estimation with persistent panel data: an application to production functions. *Econometric reviews*, Taylor & Francis, v. 19, n. 3, p. 321–340, 2000.
- BRUECKNER, J. K. Fiscal federalism and economic growth. *Journal of Public Economics*, Elsevier, v. 90, n. 10, p. 2107–2120, 2006.
- DAVOODI, H.; ZOU, H.-f. Fiscal decentralization and economic growth: A cross-country study. *Journal of Urban economics*, Elsevier, v. 43, n. 2, p. 244–257, 1998.
- FILHO, J. E. R. V.; FISHLOW, A. Agricultura e indústria no brasil: inovação e competitividade. Instituto de Pesquisa Econômica Aplicada (Ipea), 2017.
- FILIPPETTI, A.; SACCHI, A. Decentralization and economic growth reconsidered: The role of regional authority. *Environment and Planning C: Government and Policy*, SAGE Publications Sage UK: London, England, v. 34, n. 8, p. 1793–1824, 2016.
- FORBES, K. J. A reassessment of the relationship between inequality and growth. *American Economic Review*, American Economic Association, v. 90, 09 2000. Disponível em: <<http://gen.lib.rus.ec/scimag/index.php?s=10.2307/117312>>.
- GEMMELL, N.; KNELLER, R.; SANZ, I. Fiscal decentralization and economic growth: spending versus revenue decentralization. *Economic Inquiry*, Wiley Online Library, v. 51, n. 4, p. 1915–1931, 2013.
- GIAMBIAGI, F.; ALÉM, A. C. D. de. *Finanças públicas: teoria e prática no Brasil*. [S.l.]: Elsevier Brasil, 2008.
- HAYEK, F. A. The use of knowledge in society. *The American economic review*, JSTOR, v. 35, n. 4, p. 519–530, 1945.
- JACINTO, P. d. A.; RIBEIRO, E. P. Crescimento da produtividade no setor de serviços e da indústria no brasil: dinâmica e heterogeneidade. *Economia Aplicada*, SciELO Brasil, v. 19, n. 3, p. 401–427, 2015.
- LIGTHART, J. E.; OUDHEUSDEN, P. van. The fiscal decentralisation and economic growth nexus revisited. *Fiscal Studies*, Wiley Online Library, v. 38, n. 1, p. 141–171, 2017.

MA, G.; MAO, J. Fiscal decentralisation and local economic growth: Evidence from a fiscal reform in china. *Fiscal Studies*, Wiley Online Library, v. 39, n. 1, p. 159–187, 2018.

MARTINEZ-VAZQUEZ, J.; LAGO-PENÑAS, S.; SACCHI, A. The impact of fiscal decentralization: A survey. *Journal of Economic Surveys*, Wiley Online Library, v. 31, n. 4, p. 1095–1129, 2017.

MIRRELES, J. A. An exploration in the theory of optimum income taxation. *Review of Economic Studies*, John Wiley and Sons, v. 38, 04 1971. Disponível em: <<http://gen.lib.rus.ec/scimag/index.php?s=10.2307/2296779>>.

OATES, W. E. Fiscal federalism. *Journal of Women s Health*, 1972.

OATES, W. E. An essay on fiscal federalism. *Journal of economic literature*, JSTOR, v. 37, n. 3, p. 1120–1149, 1999.

QIAO, B.; MARTINEZ-VAZQUEZ, J.; XU, Y. The tradeoff between growth and equity in decentralization policy: China's experience. *Journal of Development Economics*, Elsevier, v. 86, n. 1, p. 112–128, 2008.

RODRÍGUEZ-POSE, A.; EZCURRA, R. Is fiscal decentralization harmful for economic growth? evidence from the oecd countries. *Journal of Economic Geography*, Oxford University Press, v. 11, n. 4, p. 619–643, 2010.

SALMON, P. Decentralization and growth: what if the cross-jurisdiction approach had met a dead end? *Constitutional Political Economy*, Springer, v. 24, n. 2, p. 87–107, 2013.

SAMUELSON, P. A. The pure theory of public expenditure. *The review of economics and statistics*, JSTOR, v. 36, n. 4, p. 387–389, 1954.

SAMUELSON, P. A. Diagrammatic exposition of a theory of public expenditure. *The review of economics and statistics*, JSTOR, p. 350–356, 1955.

SILVA, C. M.; FILHO, N. M.; KOMATSU, B. Uma abordagem sobre o setor de serviços na economia brasileira. *São Paulo: Insper*, 2016.

TIEBOUT, C. M. A pure theory of local expenditures. *Journal of political economy*, The University Press of Chicago, v. 64, n. 5, p. 416–424, 1956.

VOIGT, S.; BLUME, L. The economic effects of federalism and decentralization—a cross-country assessment. *Public Choice*, Springer, v. 151, n. 1, p. 229–254, 2012.

A Appendix

Table 3

Main results of the estimation - 1996-2015.

Estimator: GMM	Equations				
Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)
Δ GDP L1.	0.04 (0.03)	0.01 (0.02)	0.01 (0.02)	0.00 (0.02)	0.03 (0.02)
A1	0.04 (0.03)	- -	- -	- -	- -
A2	- -	0.08** (0.03)	- -	- -	- -
RI	- -	- -	0.10*** (0.02)	- -	- -
PI	- -	- -	- -	0.03 (0.02)	- -
PRI	- -	- -	- -	- -	0.07*** (0.02)
Opness	0.03*** (0.01)	0.02 (0.02)	0.04** (0.02)	0.02 (0.02)	0.04** (0.02)
GINI	0.20* (0.03)	0.17*** (0.03)	0.29*** (0.03)	0.22*** (0.03)	0.28*** (0.04)
POP	-0.03 (0.03)	-0.05 (0.04)	-0.12*** (0.05)	-0.03 (0.03)	-0.07* (0.04)
Homicide Rate	0.02 (0.01)	0.01 (0.03)	0.03* (0.02)	0.02 (0.03)	0.01 (0.03)
Dummy Election	0.00 (0.00)	0.00 (0.00)	-0.01*** (0.00)	0.00* (0.00)	-0.01*** (0.00)
Occupied population	0.00 (0.00)	0.01 (0.00)	0.00*** (0.00)	0.00 (0.00)	0.00 (0.00)
Constant	0.75* (0.45)	0.85 (0.62)	2.63*** (0.85)	0.80* (0.47)	1.79*** (0.64)
Observations	513	513	513.00	513	513
Wald Test	115.01	92.14	344.71	151.81	364.18
Number of Instruments	470	470	470	470	470
Sargan Test Chi2	24.88	25.27	24.83	26.44	25.14
Prob>Chi2	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Arellano-Bond Test					
Order 1	-4.11*** (0.00)	-4.15*** (0.00)	-4.14*** (0.00)	-4.16*** (0.00)	-4.23*** (0.00)
Order 2	-1.73* (0.08)	-1.77* (0.07)	-1.52 (0.12)	-1.89** (0.05)	-1.59 (-0.11)

* Significant at 10% ** Significant at 5% and *** Significant at 1%.

Own elaboration of the authors using Stata software, based on data worked in the research