Fiscal decentralization and economic growth: evidence from Brazilian states

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Abstract

This paper investigates the relationship between fiscal decentralization and economic growth in Brazilian states from 1996 to 2015. Using five decentralization measures and the GMM-System model to address the endogeneity problem, we have identified a positive relationship between the indicators of fiscal decentralization and economic growth and observed that the industry and service sectors are the most affected by this decentralization. Our results suggest that local governments with more autonomy make states more efficient, thus increasing economic growth.

Keywords: decentralization, economic growth, Brazilian states, GMM-System

1 INTRODUCTION

Over the past few decades, developing countries have changed their institutional settings as one way of allocating more political power and fiscal autonomy to sub-national governments. Their policies follow the normative theory, which suggests that it is possible to improve the efficiency of the public sector and promote long-term economic development by decentralizing fiscal power. The familiarity of sub-national governments with local conditions and preferences is one of the key factors supporting this theory (Ma and Mao, 2018; Shah, 2006; Gadenne and Singhal, 2014; Jametti and Joanis, 2016).

The Brazilian Federal Constitution from 1988 provided a favorable movement towards decentralization, by delegating to the federated entities the responsibility to implement public policies, focusing on the particularities of local demands. Thus, the Constitution has separated the administrative functions into three levels of government, allowing states and municipalities to distribute taxes to promote local development. However, given the heterogeneity of the country and its great inequalities, decentralization may not have been as effective as expected.

From a theoretical perspective, there are mixed results regarding how governments could achieve the best outcome. Qiao, Ding and Liu (2019) argue that fiscal decentralization negatively affects the size of the government itself but that higher levels of democracy will mitigate these effects of fiscal decentralization. According to Christl, Köppl-Turyna and Kucsera (2020), it promotes public efficiency. Here, tax rules combined with decentralization impair efficiency, a phenomenon known as the ratchet effect. Finally, Colombo and Martinez-Vazquez (2020) relate higher levels of decentralization of expenditures and revenues to lower public levels of spending and R&D. There is also the work by Thanh and Canh (2020), showing that fiscal decentralization has had a positive effect on economic growth in regions where public governance is of high quality.

This article contributes to the literature on fiscal decentralization by addressing the specific issue of a developing country with characteristics conducive to fiscal decentralization. Aligned with the scenario of approaching a large developing country, we want to understand how it affected the growth rate of GDP in

Brazilian states between 1996 and 2015. Unlike most applied research, five decentralization measures have been used and while the endogeneity problem has been handled with the GMM-System model. In addition, we have advanced the debate on understanding the heterogeneous effects on economic sectors.

Our results show that decentralization has promoted the economic growth of Brazilian states, which is a result that corresponds to theoretical studies. The results suggest the main mechanism in this is the strengthening of fiscal autonomy. It should be emphasized that indicator PI is the most positively signed, implying a strong effect from the expenditure side on economic growth. In addition, the results show a greater effect on the service sector.

We must conduct our estimations carefully since economic growth and fiscal decentralization usually present endogeneity problems. Ligthart and van Oudheusden (2017) and Thanh and Canh (2020) reinforced this, with no evidence to reject the hypothesis that economic growth and fiscal decentralization are not endogenous[1]. As well as providing evidence about the relationship between economic growth and fiscal decentralization in the world context, our work is a pioneer on the subject in a national context.

This paper has seven parts, including this introduction. The following section summarizes the process of fiscal decentralization in Brazil and also presents recent data related to it. The third section presents an overview of empirical studies that address fiscal decentralization. In section four, we present the methodological aspects used in the article and describe the variables. In the fifth part, we discuss the main results and those by sector. The last section contains final considerations.

2 BACKGROUND

During the 1960s and 1970s, the Brazilian political system had fiscal centralization as its administrative model. Since the 1980s, however, after a significant expansion of public functions, the federal government has shared its financial resources and administrative responsibilities with the states and municipalities. During the process of democratization, the movement of decentralization increased, and, with the Federal Constitution from 1988, the Brazilian federation changed. However, as Araujo and Siqueira (2016) stated, this process was uncoordinated since the central government did not manage it properly. Therefore, sub-national governments controlled it and benefited from the new rules.

Decentralization in Brazil is a complex matter due to the serious socioeconomic and geographic inequalities that characterize the country. Regions such as the North and Northeast have, historically, greater inequality and lower economic growth. The simple process of decentralization does not necessarily allow local governments to be self-sufficient. Therefore, reconciling decentralization and reducing social

[1] The authors cite papers with comparable results.

inequality are the main challenges. In Brazil, the latter was conducted mainly by the increase in national transfers and not from an increase in its tax collection capacity. In table 1, the percentage of municipal and state revenue is shown, according to the major regions of Brazil, in the period from 1985 to 2015.

Table 1

Distribution of municipal and state average revenues according to the regions of Brazil, 1985-2015, by percentage

Municipalities	**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

Note: Data from the National Treasury Secretariat.

The tax revenues shown in table 1 reveal that the Brazilian municipalities and states had a meaningful change in their collected values. Compared to those before the Federal Constitution of 1988, the municipal tax revenues registered growth in four out of five Brazilian regions, particularly North and Northeast. We can highlight the North region, which obtained high state collections. Even reaching high rates, from 1995 to 2015, states and municipalities maintained their tax collection at similar levels, in total revenue.

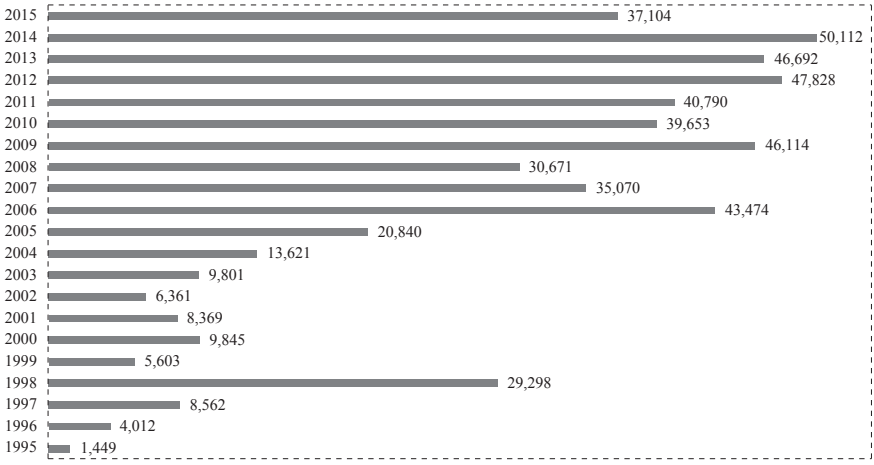
The observed scenario is different concerning revenue from government transfers. In 1985, current transfers from Brazilian municipalities accounted for about 60% of the total municipal revenue, while in the last period of the analysis (2010-2015), they accounted for 64%. However, when the regions are observed, much more significant variations are visible. In the less developed ones (North and Northeast), there is a greater weight of current transfers, over the 80% level, while in the Southeast region, the participation is about 50%. As for the states, the portion related to the tax revenue remained constant from 1985 to 2015, despite slight variations.

When comparing such results with the tax revenues, it is possible to notice an inverse relationship. A system of tax transfers favors the less developed regions and counterbalances the concentration of tax revenues in the most developed

ones. Besides, most municipalities do not possess a revenue that can sustain their demands. However, they have experienced significant growth during the period in question, as shown in figure 1.

Figure 1

Evolution of the average of municipal own tax collection, 1995-2015, R$ million



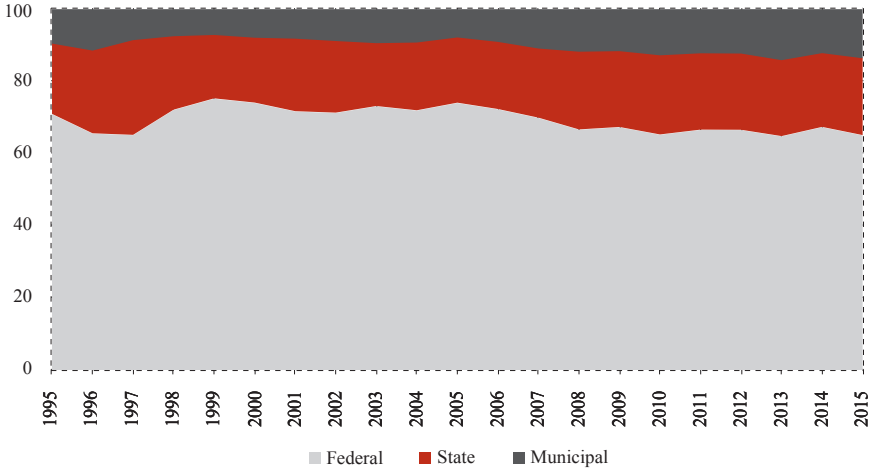
Note: Data from the National Treasury Secretariat.

In the period between 1995 and 2015, the growth of municipal revenue was rapid. However, from the second half of the last decade, the average level of municipal tax collection showed less significant variations, suggesting a stabilization. In figure 2, we show the expenditure per level of the Brazilian government, from 1995 to 2015.

We demonstrate that, in the initial period (1995), the federal government controlled approximately 71% of the 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 the 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 other dimensions.

Figure 2

Expenditure per level of the Brazilian government, 1995-2015, by percentage



Note: Data from the National Treasury Secretariat.

3 OVERVIEW OF FISCAL DECENTRALIZATION

Empirical studies on the effects of fiscal decentralization on economic growth present mixed results. Part of the literature believes that the relationship between them is direct (Davoodi and Zou, 1998), while others argue that such a relationship is indirect, depending on the quality of the institutions (Libman, 2010; Huynh and Tran, 2021).

This ambiguity may be related to the different methodologies and measures of decentralization used since there is no consensus in the literature on which method best measures the fiscal independence of sub-governments (Martinez-Vazquez and McNab, 2003). To better understand these controversial results, we have separated this review into two parts. The first will present works addressing the connections between fiscal decentralization and economic growth, and the second will show those that used different measures of decentralization.

3.1 FISCAL DECENTRALIZATION AND THE EFFECTS ON ECONOMIC PERFORMANCE

Before discussing the most recent works addressing the research question approached here, let us start with the theoretical and empirical literature that underlies them. A small portion of the literature has considered cross-country evidence on the impact of fiscal decentralization on economic growth. Once again, it is worth noting that these studies have reached mixed conclusions on the subject. From the literature that relates fiscal decentralization to the economic growth of specific countries, we highlight the works by Akai and Sakata (2002), Jin, Qian and Weingast (2005) and Young (2000). Akai and Sakata (2002), through decentralization measures, such as indicators of public revenue, expenses, and autonomy, evaluated this theme using data from 50 American states, from 1992-1996. They provided

evidence that decentralization contributes to economic growth, suggesting that recent movements by developed countries towards may stimulate this effect.

Jin, Qian and Weingast (2005) addressed how decentralization in other parts of the country directly impacts the increase in provincial protectionism. They used data from 1982 to 1992, from 30 provinces in China, to show that fiscal decentralization was positively related to the regional growth of GDP per capita, non-farm employment, and non-state industrial production, controlling for provincial tax rates and forcing the growth of regional work. In this way, the authors found that administrative decentralization had a significant positive correlation with local fixed investment, the proportion of local government as compared with central government investment, growth of non-farm employment, and non-state industrial production. To justify the results, the authors revealed that due to amended tax contracts between local and central governments, the first were allowed to withhold a larger fraction of the tax revenues collected from 1982 to 1992, than in the previous decade. Similarly, Young (2000), also studying China, argued that fiscal decentralization has contributed to economic growth in a general form, due to its success in dealing with control and incentive problems. These studies seem to agree that the overall effects of fiscal decentralization were positive in China.

Turning now to cross-country empirical literature, Davoodi and Zou (1998), using panel data for 46 countries, from 1970 to 1989, 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 ones. In the same way, Martinez-Vazquez and McNab (2003) and Iimi (2005) have found positive impacts of decentralization on the growth of a combined set of countries. However, these studies did not focus on developing countries. Using an instrumental variable technique and data on 51 countries, from 1997 to 2001, to describe the effect of decentralization on economic growth, Iimi (2005) discovered that the sub-national share of total government expenditure is significantly and positively correlated with per capita growth.

On the decentralization of revenues and expenditures, Rodríguez-Pose and Ezcurra (2011) observed a negative and meaningful relationship between revenue, expenditure decentralization, and economic growth, in a set of 21 OECD countries, between 1990 and 2005. Baskaran and Feld (2013), analyzing the effect of income and expenditure autonomy on economic growth, also among OECD countries, between 1975 and 2008, reported a negative effect. In a different study, Gemmell, Kneller and Sanz (2013), from a panel dataset of OECD countries, confirmed that expenditure decentralization tends to be associated with lower economic growth, while revenue decentralization is associated with higher growth.

More recently, Bojanic and Collins (2021), in a work on OECD countries, found a significant positive relationship between expenditure and revenue, but not with

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economic performance. Thus, there is still no consensus on the impact of federalism on economic growth. Göcen, Bayhanay and Göktaş (2017) revealed that, for OECD countries, the impact on growth depends on the econometric strategies used and the measurement criteria.

3.2 DECENTRALIZATION, ECONOMIC GROWTH, AND DIFFERENT VARIABLES

The different decentralization measures used, and other variables that make up the model may explain the controversial results found in the empirical literature. Therefore, it is also important to highlight how the forms of decentralization affect economic efficiency by distorting the efficient allocation of resources.

Filippetti and Sacchi (2016) used the following variables for decentralization: Tax Decentralization (TD), representing tax revenues of local governments due to the total fiscal revenue of the general government; Income Tax Decentralization (TDI), which is the local government income tax due to total general government tax revenue; Property Tax Decentralization (TDP), which is the local government property taxes due to total general government tax revenue; TD_1, which is the proportion of total local government tax revenue regarding the general government tax revenue; and the regional authority index.

Recently, Ligthart and van Oudheusden (2017) observed the relationship between fiscal decentralization and economic growth for 56 countries from various continents, from 1990 to 2007. The authors used instruments based on characteristics such as the original characteristics of the countries, their descentralization system, size, and geographic position. They have concluded that countries with similar characteristics experience a similar process of fiscal decentralization. The results indicated that this relationship remains valid after controlling for endogeneity problems using instrumental variables based on the origin of the common legal system and country size. They do not seem to be able to reject fiscal decentralization for being exogenous, but there is no concrete evidence of causality arising from it for economic growth.

Taking data samples from 2001 to 2011, Ma and Mao (2018) studied the effects of decentralization on Chinese economic growth after the province-managing-county (PMC) reform. Using dummy variables for the moments before and after the reform, they found that it increased the average annual growth rate of GDP by 1.4% over the period studied. The reform abolished the subordinate fiscal relationship between counties and municipalities, transferring much of the fiscal and spending authority from the municipality to the county.

All the articles in this review have the same identification problem: economic growth is impacted by decentralization, but the latter can also be affected by the former. Furthermore, most works use the GMM or Instrumental Variables model to deal with this. Its implementation aims to address endogeneity since decentralization is contemporaneous with other processes, such as infrastructure development. Among the works that more deeply analyze the problem of endogeneity

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present in the estimates, we highlight those by Aritenang and Chandramidi (2022) and Canavire-Bacarreza, Martinez-Vazquez and Yedgenov (2020).

Unlike this work, that of Aritenang and Chandramidi (2022) applied regional distribution indices, spatial cluster analysis, convergence analysis (GMM and spatial models), and spatial econometrics to Indonesian district-level panel data to address the endogeneity present in the model, since studies indicate that geographic proximity, spatial links, and repercussions have major impacts on economic growth. As in the paper previously mentioned, Canavire-Bacarreza, Martinez-Vazquez and Yedgenov (2020) used the Geographic Fragmentation Index (GFI) and country size as instruments for fiscal decentralization.

4 METHODOLOGY

4.1 MEASURING DECENTRALIZATION

Although fiscal decentralization is a political issue common to many countries, the term is not clear enough, even in the fields of political science and public administration. It is a comprehensive system that includes a framework for decentralizing expenditure, revenue, and corresponding responsibilities to a lower level of government (Dunn and Wetzel, 1998). In this way, it encompasses the decentralization of fiscal expenditures and fiscal revenues. To study its relationship with economic growth, we will follow the metrics adopted by Akai and Sakata (2002), Fu (2010), and Zhang, (2016). First, one should bear in mind that the authority associated with decision-making was allocated according to the legal relationships between the upper and lower levels of government.

Given this, the standard approach to measuring the allocation of authority is to make use of accounting measures such as income and expenses. However, subnational government expenditures may be financed by transfers from higher levels of government and, therefore, their expenditures do not necessarily reflect the level of authority of local governments.

Furthermore, even if the revenue or expenditure shares are small, the sub-national government can be considered fiscally decentralized, whether it was originally allocated sufficient resources for its own expenses. Therefore, the level of autonomy must be used as a proxy for fiscal decentralization. However, as mentioned earlier, studies have used subnational revenue and expenditure shares as indicators of fiscal decentralization. As it is difficult to develop a unique and completely satisfactory measure, we have considered five different ones based on studies by Akai and Sakata (2002), Fu (2010), and Zhang (2016). They are detailed below:

- Autonomy Indicator 1 (A1) was defined, for each sub-national government, as the fraction of their total revenue generated by tax collection or received by intergovernmental transfer. Other revenues, such as credit operations, are not accounted for.
- Autonomy Indicator 2 (A2) was defined, for each sub-national government, as the fraction of their tax revenue. This indicator is close to the true

fiscal independence of sub-national governments, as it only accounts for their capacity for tax autonomy.

- The Revenue Indicator (RI) reflects the share of the total revenue of each state regarding the consolidated revenue (total collected from all government entities in the country).
- The Production Indicator (PI) reflects the share of the total expenditure of each state regarding consolidated expenditure (the sum of all local expenditures).
- The Production Revenue Indicator (PRI) was defined by the average of the RI and PI indicators.

There are two problems with using accounting information to obtain accurate measures of decentralization, as the authors point out.

First, expenditure by lower levels of the government may be financed by intergovernmental grants from higher levels. Hence, the share of expenditure in the total budget does not necessarily reflect the level of authority allocated to a lower-level government because, to some extent, its grant relates to expenditure authorized by a higher-level government. Therefore, it is inappropriate to regard expenditure shares as necessarily an accurate measure of shares of authority. Given the allocation of lump-sum grants, neither do revenue shares necessarily reflect shares of authority. This is because the authority associated with the spending of the lump-sum grant is attributed to the lower-level government.

Second, even if expenditure shares or revenue shares are small, authority is fiscally decentralized provided that sufficient resources for public spending are originally allocated to the lower-level government; that is if autonomy is achieved. Therefore, autonomy should be considered one of the indicators of fiscal decentralization (Akai and Sakata, 2002).

Because of this, the authors have concluded that to obtain a convincing general result and respond to discussions outside the economic field, it is necessary to build indicators of fiscal decentralization that reflect various points of view. According to them, when the grantor directs the purposes for which the funds are to be used in detail, the grants must be allocated to the level of government that collects the revenues, allowing that the revenue share (A1) in the total budget measures the degree of authority. As for A2, as lump-sum or unconditional donations must be attributed to the level of government that conducts the expenditures, the share of expenditures in the total budget is also an approximation of the degree of the fiscal authority. As A1 and A2 are extreme cases of decentralization, the PRI is an option that combines both. The RI and PI reflect the fiscal autonomy of the local government, considering how public spending at a lower level of government is financed on its revenue or expenditure.

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4.2 EMPIRICAL STRATEGY

4.2.1 GENERALIZED METHOD OF MOMENTS (GMM)

In this paper, we explore how variations in decentralization across Brazilian states affect their growth. Variations in fiscal policies, as measured by the proposed indices of decentralization, are likely to be correlated with local capacity, institutions, and other confounders. The rules governing the degree of fiscal decentralization in Brazil according to the Constitution from 1988 allow states and municipalities the freedom to collect taxes locally, but also to boost their revenue from transfers from the federal government. For this reason, it is possible to visualize that several factors can affect growth and are related to decentralization, making it impossible to reject the hypothesis of the presence of endogeneity in the models.

To address this endogeneity, Arellano and Bond (1991) proposed an estimate using instrumental variables from the difference between the current period and the lag of the endogenous variable. That is, this estimator applies the first difference to remove panel-level effects and uses instruments to provide momentum conditions. In this way, it is possible to accommodate large autoregressive parameters and variance ratios in the panel-level effect for the idiosyncratic error variance.

However, as shown by Blundell and Bond (2000), the Arellano-Bond estimator presents weaknesses concerning lagged-level instruments. Due to persistent autoregressive processes or variance ratio of panel effects and idiosyncratic error, it becomes very large. Thus, the model we used fits the panel of estimators of dynamic data of the estimator used by Arellano and Bover (1995) and Blundell and Bond (2000), which was designed for data with many panels and few periods, assuming that there is no autocorrelation in idiosyncratic errors and that it does not require, in the initial condition, that the independent variables do not correlate with the first difference of the first observation of the dependent variable. In this way, the Arellano-Bover and Blundell-Bond estimator presents the estimated model as follows

$$y_{i,t} = \sum_{j=1}^{p} \alpha_j \, y_{it-j} + X_{it}\,\beta_1 + W_{it}\,\beta_2 + v_i + \varepsilon_{it} \; i.i.d. \sim N\left(\mu, \sigma^2\right) \tag{1}$$

where α_j are the p parameters to be estimated, x_{it} is a 1 x k_1 vector of strictly exogenous covariates, β_1 is a k_1 x 1 vector of parameters to be estimated, w_{it} is a 1 x k_2 vector of predetermined or endogenous covariates, β_2 is a k_2 x 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 it is i.i.d. in the whole sample, with mean μ and variance σ^2. Adapted from Akai and Sakata (2002), we can express the regression model as

$$\Delta GDP_{i,t} = LnGDP_{it} - LnGDP_{i(t-1)}, i = 1,\ldots,27; t = 1995,\ldots,2015 \tag{2}$$

$$\Delta GDP_{i,t} = \alpha_j + \Delta GDP_{i(t-j)} + LnX_{it}\beta_1 + LnW_{it}\beta_2 + v_i + \varepsilon_{it} \rightarrow i.i.d. \sim N\left(\mu, \sigma^2\right) \tag{3}$$

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In the equation above, *i* refers to the state changing in each year *t*; $LnGDP_{it}$ represents the natural logarithm of GDP, so that our variable of interest is represented in terms of the GDP growth rate of each state. Our model will explain economic growth from the endogenous indicators of fiscal decentralization, and degree of trade openness; Gini index and a X_{it} vector contain the exogenous controls. Finally, vi represents the panel-level effects, while uit is the error term.

Here, we have emphasized that the use of lags may not be the most appropriate for the problem of endogeneity since the series presents a strong temporal persistence. However, given the limitations in the definition of more appropriate instruments, we understand that the GMM-System meets the research needs.

4.3 DATA SOURCES

Our data compiles a set of social, economic, and public fiscal data, composing a panel of the Brazilian states from 1995 to 2015. Firstly, our four indicators of fiscal decentralization were obtained through the Secretariat of the National Treasury. By law, all spheres of government must disclose their income and expense accounting information.

The degree of trade openness, Gini index, population, homicide rate, and employed population were inserted in the model as control variables. To control adverse effects within the public budget, we have also included an electoral dummy. The data used for collecting the Gini Index, population and the employed population were obtained from the Brazilian Institute of Geography and Statistics (IBGE), while the degree of trade openness was taken from the data of the statistics of foreign trade (AliceWeb – MDIC). Variables that could improve our estimates, such as literacy rate, human capital, and investment could not be included because of the limited public data available.

Table 2

Definition of variables and reason for inclusion

Explanatory variable	Variable	Reason for inclusion	Source
Main variables			
Revenue indicator	RI	Ratio between the state revenue *i* and the consolidated revenue	STN
Production indicator	PI	Ratio between the expenditure of state *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 own revenue of the states and their total revenue, excluding transfers	STN
Autonomy indicator 2	A2	The ratio between the own revenue of the states and the total of their revenue	STN

Explanatory variable	Variable	Reason for inclusion	Source
Control variables			
Degree of commercial opening	OPNESS	Ratio between the trade balance result and GDP	Comex Stat
Gini Index	Gini	Gini Index for income concentration	IPEADATA/ IBGE
Population	POP	Population value	IBGE
Employed population	POP OCUP	Number of people who are employed	IBGE
Dummy election	ELECTION	Dumymy variable indicating state election years	Superior electoral court (TSE)
Homicide rate	HOM	Homicide rate per one hundred thousand inhabitants	IBGE
School effectiveness	PSE	Efficiency indicator created from school attendance, years of schooling, and illiteracy rate variables	IPEADATA/ IBGE

The characteristics of the variables are summarized below, in table 2. The data[2] concern annual frequency from 1996 to 2015, where the rate of growth of GDP is the dependent variable of the model.

To obtain a measure of the performance and efficiency of the public sector, it is necessary to add several indicators that compose their obligations. Drawing on Afonso, Schuknecht and Tanzi (2005), it is possible to use the public performance indicator (PSP), the public expenditure indicator, and the public sector efficiency indicator (PSE). We have measured them by their weighted average, where the indicators in the year *i* and state *j* are divided by the national average. The average concerning their respective sectors divides the expenditures, the year *i* and state *j*. Finally, the efficiency meter can be described as follows

$$PSE_{nj} = \frac{PSP_{nj}}{\frac{\sum_1^n PSP_j}{n}} \tag{4}$$

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 one represent efficiency, while those inferior to one represent inefficiency. We have composed the efficiency indicator using the variables of average years of schooling, school attendance in primary and secondary education, and illiteracy rate for each state.

[2] When necessary, the collected data was deflated, as the literature recommends.

4.4 DESCRIPTIVE STATISTICS

In table 3, we show the results of the descriptive statistics of the data used in the paper for the years between 1996 and 2015[3]. The results show that only the growth rate of the services sector, homicide rate, population, and employed population present dispersion between the minimum and maximum in relation to the mean. For the control variables, we have applied the natural logarithm to stabilize the series.

Investigating the economic growth of the states, we could see that the service sector drives this growth the most, which is the sector with the largest share of GDP in all Brazilian states. Over the years, the agricultural and industrial sectors have reduced their participation regarding GDP. This was mainly due to national and state policies that allowed the scenario to become more favorable for the growth of the service sector. Another factor that we could observe is that, on average, this value is large when we analyze Brazil in a general overview. This happens because states considered economically very small grew until the last year of our sample.

Table 3

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				
Education	1.00	0.094177	0.77	1.21
Openness	0.145475	0.127781	0.01	0.59
POP	6,762,641	8,029,421	254,499	44,000,000
Gini	0.55241	0.049231	0.42	0.69
Homicide rate	28.13537	13.15587	4.50	71.40
Occupied population	2,952,986	3,778,686	70,996	22,000,000

Note: All data collected are at the state level of Brazil and aggregate of the period of our analysis.

For Autonomy Indicators 1 and 2, the scenarios are different. As presented in table 3, on average, states have revenue gains of 30% when we include federal transfers, with considerable weight in the state budget. When dealing with the RI and PI indicators, it is possible to observe that, on average, the variables are remarkably similar.

[3] The defined period is due to the large distortions of the economic growth rate before the system of the Real Plan, and the last results of variables only extended to 2015.

However, this analysis needs to be performed carefully, since both indicators may have different meanings; for example, as an attempt to boost the local market, a federal state may increase its level of spending in relation to other states and federative entities, even if its revenue does not grow by the same amount. If this same state has not reached its goal of economic growth, it is possible that this expenditure has caused only a crowding out effect and, therefore, it is being inefficient.

To evaluate the real importance of fiscal decentralization on economic growth in Brazilian states, we have estimated the model in equation 5 and presented our main results in the following section.

5 RESULTS AND DISCUSSION

We will now discuss the main results obtained through the estimates based on the previous discussion.

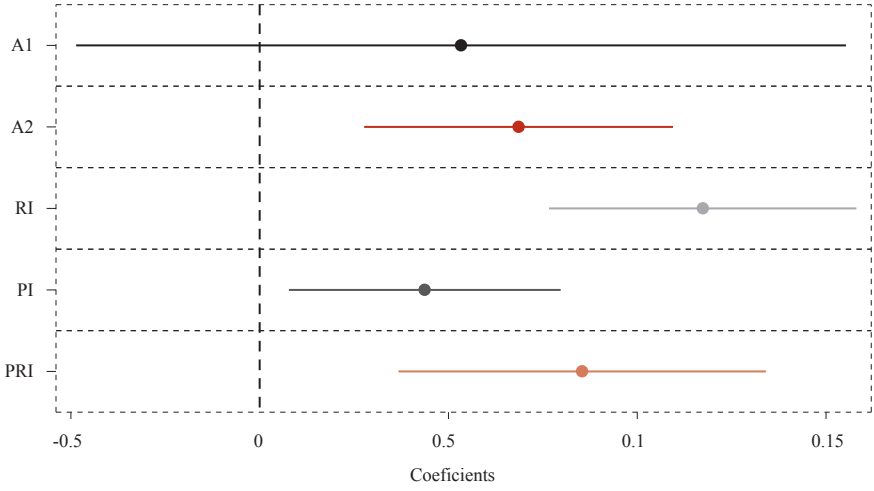
5.1 MAIN RESULTS

Recently, the effect of taxation enforcement on economic growth has been the subject of empirical studies, becoming the focus of debates on government reforms. To contribute to the discussion, this research uses four types of indicators besides control variables that measure fiscal decentralization to understand its relationship with economic growth in Brazilian states.

In figure 3, we present the relationship between the variables studied in this article. The results are based on data from the Stata software package for the estimation of the data model in a dynamic panel (GMM).

Figure 3

Results for coefficients of decentralization



Note: The colored lines represent the standard error. See table A1 in appendix for more details.

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Within the estimates, the variables for population, employed population, and life expectancy were considered exogenous for the model, while the variable of fiscal decentralization, Gini index, and degree of trade openness were endogenous. The dynamic GMM specification uses its lags as instruments for correcting endogeneity, therefore we have included the variables that were most indicated to be endogenous and checked if they are valid together, using the Sargan and Arellano-Bond tests.

According to the results, our main finding is that the indicators of fiscal decentralization A2, PI, RI, and PRI are positive and statistically significant to the economic growth of the states in the analyzed period, especially RI. As in the studies by Akai and Sakata (2002) and Gemmell, Kneller and Sanz (2013), we have found evidence of a positive effect of these measures of fiscal decentralization on economic growth. However, unlike Qiao, Martinez-Vazquez and Xu (2008), we have found no evidence of any effect of fiscal decentralization on economic growth when measured in terms of autonomy, which is the A1 variable. We can thus see that the variable used to measure decentralization influenced our result.

All coefficients of the estimations are interpreted as elasticity. Therefore, we can interpret that a 1% increase in the autonomy of states is capable of increasing GDP growth by 8%. Regarding the control variables, we have found a positive and significant effect of trade openness on economic growth. This result diverges from the literature since it shows that the increase in the coefficient contributes to the increase in economic growth. Comparable results were found by Rodríguez-Pose and Ezcurra (2011), Filippetti and Sacchi (2016), and Ligthart and van Oudheusden (2017).

In addition, we must highlight the positive and significant effect of the Gini index on economic growth. This result was not in line with our expectations, since it shows that the increase in inequality contributes positively to economic growth. According to Mirrlees (1971), the possibility of earning a higher income makes the individual strive harder. In this way, it contributes to higher levels of productivity. In this sense, the result corroborates those by Forbes (2000), in which an increase in the level of income inequality has a positive relation to the economic growth of a country.

Subsequently, the Sargan test was conducted to identify overidentification constraints. Using instrumental models with a lag in the dependent variable, we have as a result that the Sargan and Arellano-Bond tests indicated that there was no residual correlation of the second order and that the instruments are valid for all the estimated models (see appendix for more details). The results have demonstrated that the model evaluated 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 estimated equation, allowing the existence of the model. The Arellano-Bond test 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.

The results in table A1 are presented in a more simplified form, in which it is possible to see that, among the indicators used in the estimation, RI is the variable that best fits the explanations of economic growth (that is, it has obtained the highest statistical significance and degree of reliability). We have thus chosen this indicator to represent decentralization in the next steps.

5.2 ANALYSIS BY SECTOR

Our next step was to evaluate which sectors of the economy are responsible for the observed positive effect of decentralization on economic growth. Tables A2, A3 and A4, in the appendix section, present these results.

Historically, the Brazilian economy has undergone a major structural change. Since the 1950s, the service sector has become the one with the greatest share of gross value added. The data presented shows that this growth led to reduced participation of agriculture and stable participation of industry in GDP.

According to de Andrade Jacinto and Ribeiro (2015), the productivity of services (except for 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 the robust performance of the three sectors, indicating that it may be in the service sector that fiscal decentralization generates the greatest positive effects on the Brazilian economy. In fact, Christl, Köppl-Turyna and Kucsera indicated that fiscal decentralization increases efficiency and 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 all sectors. This result corroborates those of Ma and Mao (2018), who evidenced the contribution of fiscal decentralization to industrial economic activity. This is known to have positive effects on economic growth. This result is valid for the Arellano-Bond tests for all sectors, except for some estimates that had the AR (2) coefficient significant at 10%.

The results show that greater autonomy in state revenue is positively associated with higher agricultural growth rates. At the same time, states with greater autonomy linked to transfers from the general government are associated with higher rates of growth in the industry. And, finally, the autonomy and revenue variables indicate positive effects on the growth rate in the service sector, but the expenditure variable is negatively associated with this growth. These results are briefly presented in figure 4.

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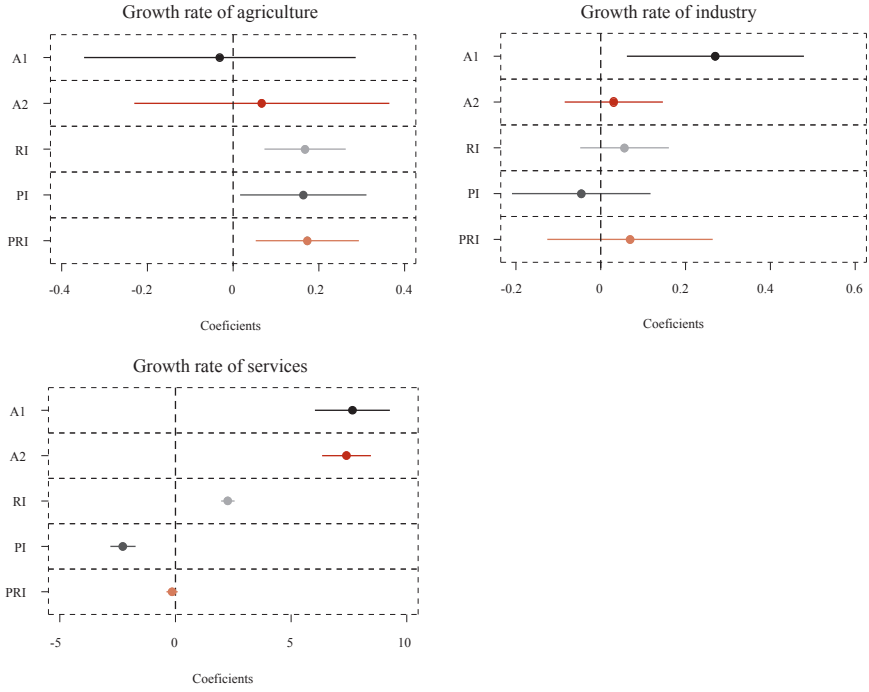
FIGURE 4

The impact of decentralization on the economic growth of various sectors



Note: The colored lines represent the standard error. See tables A2, A3 and A4 for more details.

6 FINAL CONSIDERATIONS

Fiscal decentralization is a relevant issue in the economic literature. In Brazil, this topic became more relevant after implementation of the Constitution in 1988, in which states and municipalities gained more freedom to provide public goods and services. Thus, this work aimed to identify the relationship between fiscal decentralization and economic growth in Brazilian states.

Through five measures of decentralization proposed by Akai and Sakata (2002), the estimation performed found positive and significant effects for the variable of decentralization A2, which measures decentralization as the ratio between state revenue, derived from transfers and own revenue, and total revenue. The result also showed a significant result for the revenue, expense and PRI indicator. The positive result agrees with the expected theoretical support.

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

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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 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 a 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, this study can lead to further endeavours to identify the causes of the positive effects of fiscal decentralization on the GDP of Brazilian states. Confirming such causes with greater accuracy would enable more efficient public policies. Finally, some issues deserve to be further investigated to improve the understanding of the relationship between the growth rate and fiscal decentralization in Brazilian states. The first is the incorporation of newer and more accurate indicators in relation to the growth rate. The second one involves simulations of the impacts of the growth rate through the expansion of transfers or the tax base itself. Some variables, such as literacy rate, human capital, and investment should be incorporated, but because of data limitations, this was not possible. More findings are needed to explore their effect on economic growth. Lastly, the case of fiscal decentralization should be analyzed at the municipal level in Brazil.

Disclosure statement

The authors declare that there is no conflict of interest.

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APPENDIX

Table A1

Main results of the estimation, 1996-2015

Estimator: GMM	**Equations**				
Variables	**(1.1)**	**(1.2)**	**(1.3)**	**(1.4)**	**(1.5)**
Δ GDP L1.	0.01	-0.00	0.04	0.02	0.03
	(0.38)	(-0.16)	(1.24)	(0.74)	(1.09)
A1	0.05	–	–	–	–
	(1.03)	–	–	–	–
A2	–	0.07***	–	–	–
	–	(3.29)	–	–	–
RI	–	–	0.12***	–	–
	–	–	(5.65)	–	–
PI	–	–	–	0.04**	–
	–	–	–	(2.38)	–
PRI	–	–	–	–	0.09***
	–	–	–	–	(3.44)
Education	-0.14	-0.05	0.29**	0.08	0.15
	(-1.13)	(-0.61)	(2.56)	(0.96)	(1.03)
Openness	0.03**	0.02	0.05***	0.03**	0.04**
	(2.37)	(1.53)	(2.73)	(2.04)	(2.23)
Gini	0.19***	0.14***	0.34***	0.24***	0.27***
	(4.95)	(4.41)	(8.79)	(7.43)	(7.81)
Pop	-0.03	-0.05*	-0.14***	-0.05	-0.10**
	(-1.50)	(-1.65)	(-3.90)	(-1.60)	(-2.39)
Homicide rate	0.00*	0.00	-0.00	0.00	0.00
	(1.72)	(0.85)	(-0.17)	(0.88)	(0.33)
Occupied population	0.00	0.01*	0.00	0.00	0.00
	(0.98)	(1.67)	(0.78)	(0.47)	(0.72)
Dummy election	-0.00	-0.00*	-0.01***	-0.01***	-0.00**
	(-1.37)	(-1.90)	(-4.40)	(-3.36)	(-2.20)
Constant	0.72**	0.93**	3.14***	1.29**	2.35***
	(2.08)	(2.19)	(4.39)	(2.35)	(2.83)
Observations	513	513	513	513	513
Wald Test	178.48	260.44	397.17	354.57	270.53
No. of instruments	286	439	286	286	286
Sargan Test Chi2	25.28	24.97	24.62	25.81	25.37
Prob > Chi2	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Arellano-Bond Test					
Order 1	-4.23***	-4.14***	-4.40***	-4.18***	-4.34***
Prob > z	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Order 2	-1.80*	-1.88*	-1.35	-1.79*	-1.57
Prob > z	(0.08)	(0.07)	(0.12)	(0.05)	(0.11)

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

TABLE A2

Main results of the estimation for Agriculture Value Added, 1996-2015

Estimator: GMM	**Equations**				
Variables	**(1.1)**	**(1.2)**	**(1.3)**	**(1.4)**	**(1.5)**
Δ GDP L1.	-0.04	-0.06	-0.05	-0.04	-0.05
	(-0.79)	(-1.23)	(-1.64)	(-1.40)	(-1.53)
A1	-0.03	–	–	–	–
	(-0.19)	–	–	–	–
A2	–	0.07	–	–	–
	–	(0.44)	–	–	–
RI	–	–	0.17***	–	–
	–	–	(3.47)	–	–
PI	–	–	–	0.16**	–
	–	–	–	(2.18)	–
PRI	–	–	–	–	0.17***
	–	–	–	–	(2.82)
Education	0.30	0.44	1.22***	1.12***	1.22***
	(0.48)	(0.75)	(2.99)	(2.70)	(2.84)
Openness	0.04	0.04	0.06	0.05	0.05
	(0.64)	(0.59)	(1.45)	(1.06)	(1.21)
Gini	0.17	0.24*	0.40***	0.29***	0.37***
	(1.46)	(1.67)	(3.27)	(2.69)	(3.17)
Pop	-0.09	-0.07	-0.16	-0.13	-0.15
	(-0.48)	(-0.35)	(-1.24)	(-0.97)	(-1.13)
Homicide rate	0.01***	0.00	0.00	0.00	0.00
	(2.90)	(1.34)	(1.21)	(1.03)	(1.19)
Occupied population	-0.00	-0.01	-0.02	-0.03	-0.03
	(-0.00)	(-0.16)	(-0.23)	(-0.38)	(-0.31)
Dummy election	-0.02	-0.03***	-0.02**	-0.02	-0.02*
	(-1.60)	(-3.42)	(-1.97)	(-1.20)	(-1.70)
Constant	1.61	1.56	4.18***	3.69**	4.02**
	(0.65)	(0.56)	(2.68)	(2.13)	(2.38)
Observations	513	513	513	513	513
Wald Test	32.27	58.71	57.19	63.72	55.09
No. of instruments	286	286	286	286	286
Sargan Test Chi2	22.77	18.23	20.79	20.85	24.50
Prob > Chi2	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Arellano-Bond Test					
Order 1	-3.68***	-3.51	-3.67***	-3.77***	-3.73***
Prob > z	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Order 2	-1.41	-1.97**	-1.65*	-1.36	-1.52
Prob > z	(0.15)	(0.04)	(0.09)	(0.17)	(0.12)

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

TABLE A3

Main results of the estimation Industry Value Added, 1996-2015

Estimator: GMM	**Equations**				
Variables	**(1.1)**	**(1.2)**	**(1.3)**	**(1.4)**	**(1.5)**
Δ GDP L1.	-0.18	-0.08	0.56	-0.06	0.51
	(-0.68)	(-0.20)	(0.96)	(-0.15)	(1.03)
A1	0.27**	–	–	–	–
	(2.54)	–	–	–	–
A2 -	–	0.03	–	–	–
	–	(0.52)	–	–	–
RI -	–	–	0.06	–	–
	–	–	(1.05)	–	–
PI -	–	–	–	-0.05	–
	–	–	–	(-0.55)	–
PRI -	–	–	–	–	0.07
	–	–	–	–	(0.69)
Education	-0.18	-0.08	0.56	-0.06	0.51
	(-0.68)	(-0.20)	(0.96)	(-0.15)	(1.03)
Openness	0.04**	0.00	0.08**	0.04*	0.09**
	(1.98)	(0.20)	(2.40)	(1.91)	(2.36)
Gini	0.72***	0.66***	0.79***	0.81***	0.86***
	(10.21)	(6.80)	(5.04)	(7.50)	(4.87)
Pop	-0.01	-0.00	-0.15*	-0.01	-0.17
	(-0.16)	(-0.01)	(-1.68)	(-0.12)	(-1.63)
Homicide rate	0.00	0.00	0.00	0.00*	0.00
	(1.03)	(0.47)	(0.45)	(1.89)	(0.81)
Occupied population	0.03***	0.04***	0.03***	0.02***	0.05
	(6.34)	(6.56)	(4.32)	(3.25)	(0.89)
Dummy election	0.00	-0.00	-0.00	-0.01*	-0.00
	(0.15)	(-0.06)	(-0.09)	(-1.95)	(-0.78)
Constant	0.38	0.03	2.90*	0.20	3.14
	(0.54)	(0.04)	(1.67)	(0.12)	(1.45)
Observations	513	513	513	513	513
Wald Test	651.69	795.83	482.41	404.99	306.72
No. of instruments	286	286	286	286	286
Sargan Test Chi2	21.58	24.61	21.11	22.20	20.44
Prob > Chi2	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Arellano-Bond Test					
Order 1	-3.04***	-2.86***	-3.00***	-2.94***	-2.96***
Prob > z	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Order 2	-1.87*	-1.84*	-2.04**	-1.93*	-2.32**
Prob > z	(0.06)	(0.05)	(0.04)	(0.05)	(0.02)

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

Table A4

Main results of the estimation Services Value Added, 1996-2015

Estimator: GMM	**Equations**				
Variables	**(1.1)**	**(1.2)**	**(1.3)**	**(1.4)**	**(1.5)**
Δ GDP L1.	-0.07***	-0.07***	-0.07***	-0.08***	-0.07***
	(-31.90)	(-27.23)	(-37.12)	(-17.04)	(-44.84)
A1	7.65***	–	–	–	–
	(9.25)	–	–	–	–
A2 -	–	7.40***	–	–	–
	–	(13.73)	–	–	–
RI	–	–	2.27***	–	–
	–	–	(15.23)	–	–
PI	–	–	–	-2.27***	–
	–	–	–	(-8.15)	–
PRI	–	–	–	–	-0.15
	–	–	–	–	(-1.19)
Education	-7.14**	-0.82	2.30	-9.64***	-3.41**
	(-2.05)	(-0.50)	(1.02)	(-4.98)	(-2.10)
Openness	-1.00***	-0.77***	-0.71***	-1.34***	-0.99***
	(-4.59)	(-3.80)	(-4.44)	(-9.90)	(-8.02)
Gini	-6.92***	-8.43***	-1.53***	-5.01***	-3.43***
	(-10.96)	(-9.55)	(-4.36)	(-11.40)	(-7.04)
Pop	0.60	-3.28***	-1.55***	2.56***	0.78**
	(0.46)	(-6.45)	(-3.41)	(3.92)	(2.25)
Homicide rate	0.00	0.00	0.00	0.03*	0.01
	(0.13)	(0.32)	(0.43)	(1.96)	(1.40)
Occupied population	0.65***	0.95***	0.43***	0.51***	0.40***
	(3.39)	(6.22)	(4.21)	(5.22)	(4.53)
Dummy election	-0.55***	-0.47***	-0.69***	-0.66***	-0.63***
	(-10.28)	(-7.00)	(-13.49)	(-10.98)	(-18.43)
Constant	-22.27	36.00***	28.08***	-64.55***	-22.18***
	(-1.26)	(4.29)	(3.85)	(-6.02)	(-3.74)
Observations	513	513	513	513	513
Wald Test	17,021.67	14,106.26	19,232.38	26,595.50	87,624.82
No. of instruments	286	286	286	286	286
Sargan Test Chi2	26.30	26.53	26.6256	26.82	26.77
Prob > Chi2	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Arellano-Bond Test					
Order 1	-1.17	-1.18	-1.14	-1.16	-1.15
Prob > z	(0.24)	(0.23)	(0.25)	(0.24)	(0.24)
Order 2	-1.45	-1.45	-1.54	-1.56	-1.55
Prob > z	(0.14)	(0.14)	(0.12)	(0.11)	(0.12)

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