# FISCAL DECENTRALIZATION AND REGIONAL INEQUALITY IN BRAZIL

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**Abstract**

This article analyses the relationship between fiscal decentralization and regional inequalities in Brazil. The paper utilizes aggregated data for the period from 1980 to 2014 and shows a negative correlation between the process of fiscal decentralization and regional inequalities in Brazil. The empirical estimates were made using dynamic panel data models with data for the 27 Brazilian states over a period of 20 years (1995-2014). The results show that the policy of fiscal decentralization has been an important instrument for reducing income inequality among states. We also highlight the role of educational policies as instruments to reduce inequalities.

Keywords: fiscal decentralization; regional inequalities; Brazilian states.

JEL: H10, H77, R11, R58

**Resumo**

Este artigo analisa a relação entre a descentralização fiscal e as desigualdades regionais no Brasil. O documento utiliza dados agregados para o período de 1980 a 2014 e mostra uma correlação negativa entre o processo de descentralização fiscal e as desigualdades regionais no Brasil. As estimativas empíricas foram feitas usando modelos de dados em painel dinâmico com dados para os 27 estados brasileiros em um período de 20 anos (1995-2014). Os resultados mostram que a política de descentralização fiscal tem sido um instrumento importante para reduzir a desigualdade de renda entre os estados. Destacamos também o papel das políticas educacionais como instrumentos para reduzir as desigualdades.

Palavras-chave: descentralização fiscal; desigualdades regionais.

## Introduction

Fiscal decentralization is a recurring theme in the economic literature as a mechanism capable of improving public sector efficiency. According to Oates (1972), decentralization allows a better understanding of the population's preferences, allowing a greater efficiency in the allocation of public resources. As per Tiebout (1952), decentralization stimulates competition among federated jurisdictions, which can generate innovations and improve the well-being of the population.

However, there are countless criticisms of decentralization, one of which concerns the distribution of resources within the federation. Prudhomme (1995) suggests that a stronger central government, namely, a more centralized public sector, improves the distribution of resources among regions as it tends to channel resources from the richer regions to the poorer regions.

Per Canaleta, Arzoz and Gárate (2004), there are two lines of argument that guide the debate on the relations between decentralization and regional inequalities, the first one oriented to the theory of public choices, which suggests decentralization as a mechanism to reduce regional disparities and as another key to strengthening the central government to reduce regional disparities. Dash (2014) points out that the relationship between decentralization and regional inequality is an empirical question. Further, the study states that this relationship is not direct and is associated with the specific context of each country.

In Brazil, the fiscal decentralization occurred with the promulgation of the Federal Constitution of 1988. The new federative pact increased the participation of subnational governments (states and municipalities) in the distribution of resources collected and in the incurrence of public expenditure. Among the characteristics of the tax system and the fiscal federalism adopted in Brazil, it is noteworthy that there is a strong fiscal imbalance vertically. This naturally induces intergovernmental transfer mechanisms. In this federative arrangement, there is a reduction in the role played by the States and an increase in the functional importance of the municipalities.

In the 1990s, the States experienced a severe financial crisis. Among other factors, this crisis of the states originated in the federative redesign by the Constitution of 1988 and from the stabilizing policies adopted by the federal government from 1995 onwards. The need for States to adapt to the new economic reality has further reduced their managerial capacity. Between 1991 and 2000, the internal debt of the states went from approximately 7.2% to 15% of the national GDP[1].

In the 2000s there was a relative improvement in state finances, with an increase in fiscal effort and a significant reduction in the relative debt of the states (in 2010 it represented 11.5% of the national GDP). These results were partially due to the imposition of new institutional arrangements, such as the Fiscal Responsibility Law (LRF) and Law No. 9,496/97, that mandated new directions for fiscal policy in the states. Araújo and Paes (2015) showed that the average fiscal effort of the states increased by 32% in the period from 1995 to 2010; the authors emphasized that the

1. Central Bank of Brazil.

fiscal performance achieved in the 2000s was a result, among other factors, of the institutional adjustments imposed on the states in the late 1990s.

On the other hand, we have the socioeconomic characteristics of Brazil, which highlight the strong economic imbalance between the five regions that make up the country. In 2014, the share of GDP by regions was 5.3%, 9.4%, 13.9%, 16.4% and 54.9% in the North, Central-West, Northeast, South and Southeast regions, respectively. Regional inequalities have been identified by other economic and social indicators. For example, the percentage of illiterate people (aged 15 or over) in Brazil in 2014 was 8.27%, whereas in the South region it was only 4.39% and in the Northeast region it was 16.81%. These socioeconomic differences between regions may be reversible; however, they are inherent to the historical process of economic formation in Brazil.

In this context, the objective of this paper is to analyse the relationship between fiscal decentralization and regional inequalities in Brazil. Specifically, it seeks evidence that the fiscal policy of decentralization, heavily intensified in the re-democratization of the country, has some effects on the problem of regional inequality. To do so, we report some stylized facts and produce some estimates. The results show that fiscal decentralization in Brazil contributes to reducing inequalities. The paper contributes to the empirical literature because it is a specific discussion about the Brazilian economy.

The article has the following structure: The next section provides an overview of fiscal decentralization and regional inequality in Brazil. In the third section, we present the data and the methodology. In the fourth section, the results are discussed, and the fifth section provides the conclusions of the article.

## 2. Fiscal decentralization and regional inequalities in Brazil (some indicators)

Fiscal decentralization in Brazil was closely associated with the process of re-democratization that began in the late 1970s, and both were consolidated with the promulgation of the Federal Constitution in 1988. Among the tax changes imposed by the new Constitution, we highlight the redistribution of fiscal control and the strengthening of mechanisms for intergovernmental transfers. The new federative design has given subnational governments new bases of collection; however, the expansion of fiscal obligations has made the current growth of local governments'' own revenue insufficient. Thus, the changes have not corrected the fiscal imbalances; further, the role of intergovernmental transfers has been overestimated.

Table 1 shows the change of the participation of subnational governments in revenue collection. We highlight the strong growth of the Brazilian tax burden that increased by approximately 37% in the period from 1980 to 2010. This growth is a direct consequence of the tax reform mandated by the Constitution of 1988[2]. In a little more than thirty years, the states increased their share in the tax burden by 60% and their total revenue by 17%. Although the share of municipalities in the tax burden is small, it grew by 130%.

In sharing the tax burden, the states were responsible for the collection of the "Tax on the Circulation of Goods and Services" (ICMS), which is the main excise tax. In 2014, ICMS revenue was equivalent to 6.82% of GDP and represented 82% of the

2. Although no new types of tax were created, there was a significant increase in rates by allowing the creation of new tariffs and contributions that favored the growth of the tax burden.

tax revenue of the states. Thus, the vertiginous growth of the role of the States in the composition of the tax burden is reflected specifically in the collection of ICMS.

Table 1. Changes in the tax burden and share by level of government.

| Description | 1980 | 1985 | 1990 | 1995 | 2000 | 2010 | 2014 |
|---|---|---|---|---|---|---|---|
| **Tax burden (% of GDP)** | 24.50% | 23.83% | 30,50% | 29.76% | 32,55% | 33.53% | 33.47% |
| **Federal** | 18.30% | 17,33% | 20,53% | 20.01% | 22,52% | 23.15% | 22.91% |
| **States** | 5.30% | 5.92% | 9,02% | 8.32% | 9,02% | 8.53% | 8.48% |
| **Municipalities** | 0.90% | 0.58% | 0,95% | 1.43% | 1,53% | 1.85% | 2.07% |
| **Share in Total Collection** | | | | | | | |
| **Federal** | 74.70% | 72.74% | 67,32% | 66,00% | 69,19% | 67,45% | 68,47% |
| **States** | 21.60% | 24.83% | 29,57% | 28,60% | 26,54% | 26,5% | 25,35% |
| **Municipalities** | 3.70% | 2.43% | 3,11% | 5,40% | 4,52% | 6,05% | 6,19% |
| **Budget Spending (% of GDP)** | | | | | | | |
| **States** | 5.34% | 10,02% | 14,03% | 12,01% | 12,84% | 13,55% | 12,53% |
| **Municipalities** | 2.42% | 3,25% | 3,48% | 7,67% | 6,83% | 5,21% | 7,55% |

Source: National Treasury Secretariat (STN) and Brazilian Institute of Geography and Statistics (IBGE).

Decentralization can also be observed in the case of expenditure because of the role played by transfers that increase the revenue available to subnational governments. In Table 1, we observe that the participation of states and municipalities is greater in the execution of expenses than in the collection of revenues. The major net beneficiaries of the transfers are the municipalities. In 2014, municipalities accounted for 7.55% of GDP whereas their tax revenue was only 2.09% of GDP.

Data from the National Treasury Secretariat (STN) show the importance of intergovernmental transfers in the budget of subnational governments. In 1989, the tax revenue (local revenue) of Brazilian municipalities represented approximately 9% of the total municipal expenditure; in 2014, this percentage was approximately 27%. However, revenues from intergovernmental transfers increased from 64% to 74% of total municipalities' expenditure. In 1989 and 2014, state revenue accounted for 56% and 61% of total state expenditure, respectively, whereas transfer revenue rose from 14% to 22% of total state expenditure.

The data describe the fiscal decentralization that took place in Brazil, evidencing a reduction in the participation of the Federal Government in the collection and execution of the expenditure. Araujo and Siqueira (2016, p. 4) point out that "the decrease is due to the loss of tax base and the strengthening of intergovernmental transfer mechanisms instituted by the 1988 Constitution."

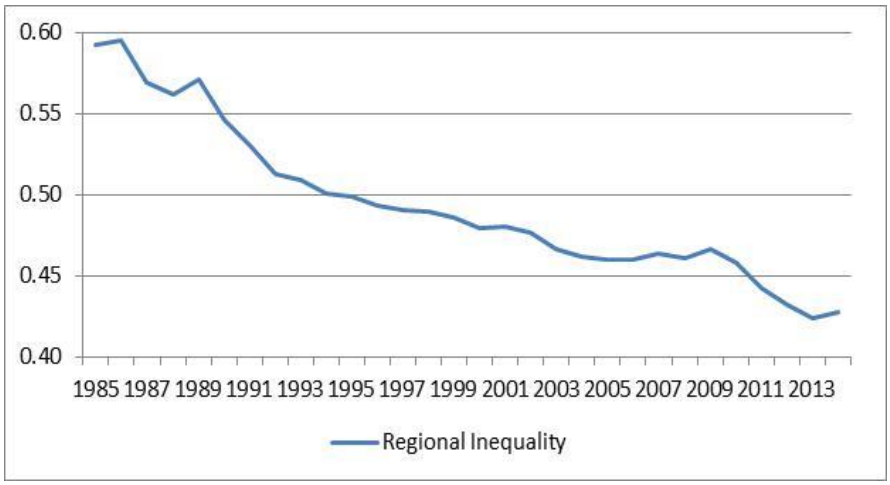
The tax reform implemented by the 1988 Constitution had the clear objective of broadening the fiscal autonomy of states and municipalities by giving them new fiscal powers. Another point highlighted was the need to correct the strong regional disparities[3]. Figures 1 and 2 show the change in the value of the indicator of regional

3. The Constitution expanded the Municipal Participation Fund (FPM) and the State Participation Fund (FPE), which are modalities for transfers of resources from the Federal Government to subnational governments.

inequalities[4] for Brazil and their negative correlation with the indicator of fiscal decentralization[5], respectively.

In the period between 1985 and 2014, the total reduction in regional inequality was 28%. This period presents two strong inflections: the first one between 1985 and 1991 (in this period the reduction was 10%) and the second between 2009 and 2013 (the reduction was 9%). It is possible to gauge visually that there is an inverse relationship between fiscal decentralization and regional inequality. The data suggest that the reduction of regional inequality is associated with the growth of fiscal decentralization; this understanding is consistent with the theory of public choices. However, this relation does not take into account the influence of other variables. In the next section, we will present our methodology and the data used in the empirical analysis.

Figure 1. Change of Regional Inequalities.




Source: Own elaboration.

4. The inequality indicator is the coefficient of variation (CV) weighted by the population. According to Ezcurra and Pascual (2006), this measure of dispersion can be written as:

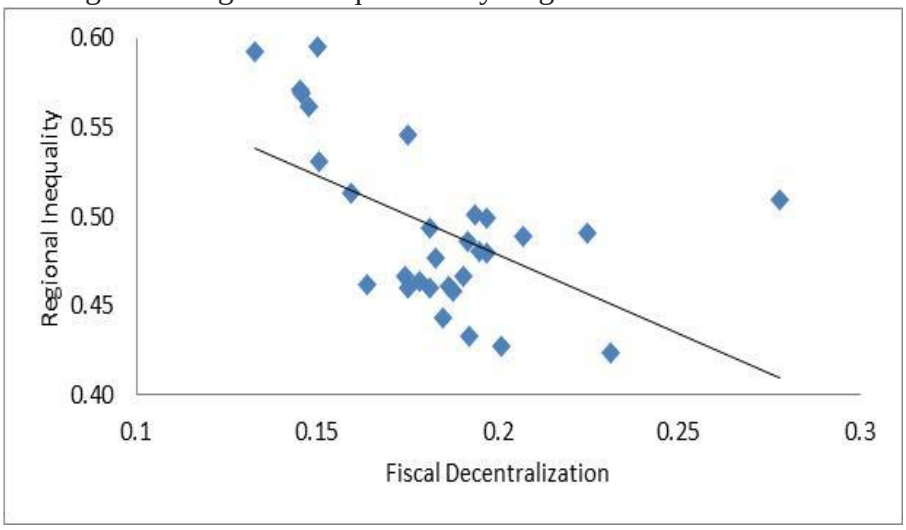
$$CV_t = \frac{1}{\mu_t}[\sum_{i=1}^{n} p_{it}(x_{it} - \mu_t)^2]^{1/2},$$

where $x_{it}$ and $p_{it}$ are the GDP per capita and the proportion of Brazil's population in the $i^{th}$ unit of the federation in year t, respectively, and $mu_{tl}$ is defined as::

$$\mu_t = \sum_{i=1}^{n} p_{it} x_{it}$$

5. The indicator of fiscal decentralization is the proportion of the expenditure of the subnational governments (states and municipalities) in the national GDP.

Figure 2. Regional Inequalities by Regional Decentralization.




Source: Own elaboration.

## 3. Methodology and data

The data used in this research concern the period from 1995 to 2014. This period is chosen due to the absence of disaggregated (reliable) data for subnational governments for years prior to 1995. To measure the inequalities between the states of the federation, we use the indicator of the relative per capita income ($I_{it}$)[6], given by:

$$I_{it} = \left|\frac{x_{it}}{y_t} - 1\right| \qquad (1),$$

where $x_{it}$ is the per capita GDP of the $i^{th}$ state of the federation in year t, and $y_t$ is national GDP per capita in year t. This indicator captures income disparities across states. In a scenario of perfect equality, the value of the indicator would be zero.

Fiscal decentralization (FD) is measured by the share of state spending in the total public sector expenditure:

$$FD_{it} = \frac{z_{it}}{Z_t} \qquad (2),$$

where $z_{it}$ is the budget expenditure of the $i^{th}$ state in year t and $Z_t$ is the consolidated expenditure[7] of the public sector.

We chose this indicator because of the importance of intergovernmental transfers as the main fiscal decentralization mechanism in Brazil. Transfers increase the

6. See Bonet (2006), Qiao, Martinez-Vazquez and Xu (2008), and Kyriacou et al. (2016).

[7] Consolidated public expenditure, ie sum of expenditures in the three level of government (Federal, State and Municipal).

share of state expenditure regardless of whether their own revenue increases (as described in section 2).

The relationship between interregional inequality and fiscal decentralization will be estimated using the panel data technique (FE, RE, FGLS, and SYS-GMM Estimators) and the following model:

$$I_{it} = \alpha + \beta FD_{it} + \delta W_{it} + \varepsilon_{it} \quad i = 1, \dots, N; t = 1, \dots, T \qquad (3),$$

$$\varepsilon_{it} = \mu_i + \nu_{it} \qquad (4),$$

where $W_{it}$ is the sociodemographic variables vector. W is composed of the following variables: inequality of human capital, size of the industrial sector, and population. The indicator of human capital inequality is calculated by the relative differences in the average years of education of the population (over 25 years old) in each state. The size of the industrial sector is given by the industry share (industrial GDP) in the total GDP of each state.

According to Mincer (1958), Schultz (1964), and Becker (1964) it is possible to make a direct association between economic growth and human capital. Therefore, we assume that interregional income inequalities are positively influenced by the indicator of human capital inequalities.

In structuralist theory[8], industrialization is the main means for reducing regional inequalities. Thus, we assume that increasing industry participation in the state economy should reduce income inequality.

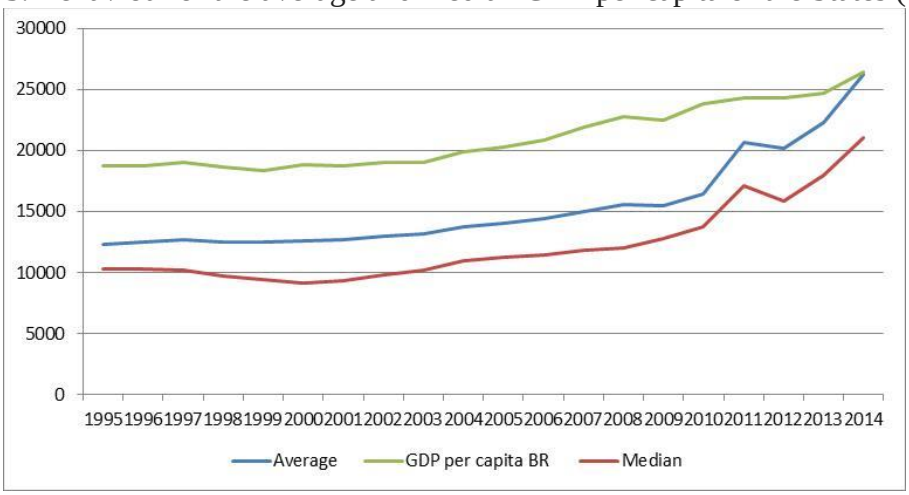
## 4. Results

In a preliminary analysis, we observe the behaviour of the average GDP per capita of the states. Figure 3 shows that, on average, the per capita GDP of the states has approached the Brazilian per capita GDP. However, this seemingly strong reduction of inequality is not confirmed by the median of the state's per capita GDP, which, throughout the period, has remained below the average per capita GDP.

The fact that more than 50% of the States have a per capita income lower than the average income is mainly due to the high economic heterogeneity among the Brazilian regions. The Federal District (Brasília–the capital of the country) has the highest GDP per capita throughout the period, and the states of Piauí and Maranhão are the poorest in terms of GDP per capita. In 2014, the per capita GDP of the Federal District was 6 times the size of per capita GDP of the state of the poorest. Although this difference is very large, it is 38% smaller than that observed in 1995.

8. See Furtado (1959) and Prebish (1962).

Figure 3. Behaviour of the average and median GDP per capita of the States (in R$).




Source: Own elaboration.

Continuing with the exploratory analysis, we verify the correlation between the variable that captures the inequality ($I_{it}$) and the variable that captures the fiscal decentralization ($FD_{it}$). We estimated the Spearman correlation coefficient and pooled regression model using Ordinary Least Squares (OLS).

The results, presented in Table 2, show evidence of a negative and statistically significant association between income inequality and fiscal decentralization and that approximately 11% of the variation in inequality may be explained by fiscal decentralization. This result, even if simplistic, allows us to theorise that the behaviour of income inequalities between states can be influenced by the changes in fiscal decentralization.

Table 2. Correlation Analysis.

| Spearman correlation coefficients | Inequalities ($I_{it}$) |
|---|---|
| Fiscal Decentralization ($FD_{it}$) | -0.328*** |
| Observations | 540 |
| Ordinary Least Squares (OLS - Pooled)[#] | |
| Fiscal Decentralization ($FD_{it}$) | -0.298*** |
| Constant | -2.661*** |
| Observations | 540 |
| $R^2$ | 0.112 |
| Prob>F | 0.000 |

***Significant at 1%. [#]Std. Err. adjusted for 27 clusters in id.

In Table 3, we present a better analysis of the relationship between the variables studied. We report here the results of the estimation of the data model in a dynamic

panel (GMM-SYS estimators)[9]. In the estimates, we considered the variables "Human Capital", "size of the industrial sector", and "population" as exogenous. The variable "tax decentralization" was considered endogenous. We used instrumental models with one and three lags in the dependent variable. The specification tests indicated that there was no second-order residual correlation and that the instruments were valid for all estimated models. All variables are in natural logarithm values, so the estimated coefficients represent the elasticity.

An extension of the analysis was made by modifying the data the database. Estimates were made for an average of 4 years and without the data of the two states that presented the highest and lowest inequality indicators, which were the Federal District and Rio Grande do Sul, respectively.

In all the estimated models, the coefficient of fiscal decentralization was negative and statistically significant. The consistency of this result clearly confirms the theory presented in the descriptive analysis of the data (Figure 2 and Table 2). Thus, we can infer that the mechanisms of fiscal decentralization provide a reduction in regional inequalities.

In the works of Bonet (2006) and Liu et al. (2017), the effects of fiscal decentralization were positive, namely, higher values are associated with higher inequality. Bonet (2006) emphasized that the fiscal decentralization criteria applied in Colombia prioritized fiscal stability. In the case of China, Liu et al. (2017) associated the positive effects with the large dimension of fiscal decentralization, noting that there is an exaggeration in the attributions of China's subnational governments[10].

On the other hand, Dash (2014) and Kyriacou et al. (2016) show that fiscal decentralization reduces regional inequality in India and in a set of countries (both developed and developing), respectively. Dash (2014) underscores the importance of decentralization to the poorer states of India, and Kyriacou et al. (2016) introduce the need to incorporate the quality of each Government as a key variable in the analysis.

The relevant literature, despite the different methodological strategies, clearly associates the effect of decentralization with the particularities of each country. As described in Section 2, the main mechanism of fiscal decentralization in Brazil is intergovernmental transfers. Among them, we highlight for each state the FPE characterized as an unconditional redistributive transference. As an example, in 2015, the amount of FPE transferred to the States was 1.02% of the Brazilian GDP, and the North-eastern state (the poorest region) received approximately 52% of the total resources transferred.

The control variables we used are also statistically significant. As expected, human capital inequality has an inverse relationship with regional inequality. Many papers use human capital as a variable to explain income inequality. Overall, the results show an inverse relationship between inequality and human capital. In this study, we used a different approach: we measured an indicator of relative inequality of human capital. The result confirms the theory that relative human capital gains result in relative income gains. Thus, greater income inequalities between states can be reduced by implementing policies that promote the reduction of human capital inequalities.

The secondary sector participation in the economy did not present the result we expected. Barros (2011), analysing the data on the participation of the industrial sector

9. Estimates using FE, RE and FGLS were also performed. The results are reported in the attached table.

10. Liu et al (2017) also show that fiscal equalization efforts reduce inequalities.

in the Brazilian regions, showed that there was a "catch-up" of the industrial sector; however regional inequalities were not reduced. The author concluded that there was no empirical support for the ECLAC ideas that attempt to explain the regional inequalities in Brazil. Our results confirm the non-empirical evidence of the hypotheses defended by Furtado (1959).

Finally, we find that the coefficient of population size has an inverse relation with the growth of regional inequalities. Although this is not a variable that presents a clear theoretical relation to inequalities, we can assume population size as a proxy for the size of the market. That can, within certain limits, justify its importance.

Table 3. Main Results.

| Estimator: GMM-SYS | Annuals | | Average | Annuals |
|---|---|---|---|---|
| Dependent Variable ($I_{it}$) | (1) | (2) | Four-year averages (3) | Without the states with higher and lower average ($I_{it}$) (4) |
| Independent Variables | One-year lags | Three-year lags | One-year lags | One-year lags |
| Inequalities ($I_{it-1}$) | 0.701*** | 0.700*** | 0.039 | 0.778*** |
| Inequalities ($I_{it-2}$) | --- | 0.105*** | --- | --- |
| Inequalities ($I_{it-3}$) | --- | -0.116*** | --- | --- |
| Fiscal Decentralization (FD) - Expenditure Total Share | -0.073*** | -0.0703*** | -0.114** | -0.070*** |
| Human Capital Indicator (HCI) | 0.025** | 0.038*** | 0.059*** | 0.025** |
| Industrial Sector Size | 0.121*** | 0.113*** | 0.286*** | 0.171*** |
| Population | -0.297*** | -0.293*** | -0.732*** | -0.365*** |
| Constant | 3.842*** | 3.842*** | 9.636*** | 4.980*** |
| Observations | 507 | 455 | 108 | 469 |
| Sargan Test | | | | |
| chi2 | 25.744 | 24.174 | 21.018 | 23.480 |
| Prob>chi2 | (1.000) | (1.000) | (0.136) | (1.000) |
| Arellano-Bond Test | | | | |
| Order 2 | 1.089 | -0.0345 | -1.105 | 0.554 |
| Prob > z | (0.276) | (0.972) | (0.913) | (0.578) |
| Order 3 | -0.907 | 1.5476 | --- | 0.165 |
| Prob > z | (0.364) | (0.121) | --- | (0.8687) |

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

### *4.1. Checking the robustness*

To check the robustness and sensitivity of the relationship between regional inequality and fiscal decentralization, we estimate the same model by changing the measures of inequality and decentralization.

The new measure of inequality uses Equation 1; however we use per capita household income as a variable. Regarding the decentralization indicator, we used the proportion of the state revenue in the total revenue. The tables below show the results of the new estimated models.

We observed that for the alternative inequality measure, the estimated coefficient for the decentralization indicator remains statistically significant and preserves an inverse relation with the measure of inequality (Table 4). Thus, the previous interpretations do not change. Estimating the model with the alternative decentralization indicator (Table 5), we observe a change of magnitude of the coefficient; however, the interpretations also do not change.

These results show that the estimates presented in Table 3 are consistent and not sensitive to changes in the measure of the indicators.

Table 4. Robustness - sensitivity to inequality measure.

| Estimator: GMM-SYS# | Annuals |
|---|---|
| **Dependent Variable ($I_{it}$ Alternative)** | (1) |
| Independent Variables | One-year lags |
| Fiscal Decentralization (FD) - Total Expenditure Share | -0.065** |
| Observations | 507 |
| Sargan Test<br>chi2<br>Prob>chi2 | <br>20.023<br>(1.000) |
| Arellano-Bond Test<br>Order 2<br>Prob > z | <br>1.182<br>(0.237) |

** Significant at 5% level. #including constant and control variables (not shown).
All the variables are in logarithm values.

Table 5. Robustness - sensitivity to decentralization measurement.

| Estimator: GMM-SYS# | Annuals |
|---|---|
| Dependent Variable ($I_{it}$) | (1) |
| Independent Variables | One-year lags |

| | |
|---|---|
| **Fiscal Decentralization (FD) – Total Revenue Share** | -0.223*** |
| Observations | 507 |
| Sargan Test<br>chi2<br>Prob>chi2 | <br>25.383<br>(1.000) |
| Arellano-Bond Test<br>Order 2<br>Prob > z | <br>1.103<br>(0.270) |

*** Significant at 1%.level. #including constant and control variables not shown.
All the variables are in logarithm values.

## Conclusions

Fiscal decentralization is a relevant topic and much debated in the economics literature. For the Brazilian economy, the political administrative structure implemented with the Constitution of 1988 exalts the role of fiscal decentralization. This work sought to

investigate the relationship between fiscal decentralization and regional inequalities, which is a subject rarely explored in Brazil.

The main result shows that fiscal decentralization is an important instrument for reducing regional inequalities. Another important result is the positive relationship between human capital inequality and regional inequalities.

These results may contribute to the debate about public policies aimed at reducing regional inequality. Policy makers should seek to improve decentralization mechanisms by strengthening the tax structure that prioritizes redistribution problems. In regards to educational policy, it is not sufficient only to raise the education rates of the poorest states, but also to promote higher educational growth rates than those of the richer states.

Finally, there are some issues that deserve to be investigated in order to improve the understanding of the relationship between regional inequalities and fiscal decentralization in Brazil. First, the incorporation of new indicators and decentralization measures associated with government quality. Poor government quality can reduce the efficiency of redistribution mechanisms by reducing the positive effects of decentralization. Another important issue is the simulation of the impacts of alternative mechanisms of decentralization through transfers or expansion of the own tax base. Further, for Brazil, it is also possible to analyse decentralization at the municipal level.

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## Appendix

Table B. Other estimators.

| Dependent Variable ($I_{it}$) | Estimators | | |
|---|---|---|---|
| **Independent Variable** | FE[a] | RE[a] | FGLS[b] |
| **Fiscal Decentralization (FD) - Expenditure Total Share** | -0.131** | -0.081 | -0.044*** |
| **Human Capital Indication (HCI)** | -0.016 | 0.011 | 0.027** |
| **Industrial Sector Size** | -0.263 | -0.235 | -0.110*** |
| **Population** | -1.055*** | -0.106 | -0.007 |
| **Constant** | 14.303*** | 0.175 | -1.019 |
| **Observations** | 533 | 533 | 533 |
| **Hausman Prob>chi2** | 0.000 | | |

[a](Std. Err. adjusted for 27 clusters in id). [b] (Panels heteroskedastic and common AR(1)).
** Significant at 5% and ***Significant at 1%. All the variables are in logarithm values.