Municipal expenditures using own-source revenues and resilience of territorial inequalities in health[1]

Despesa municipal com receitas próprias e resiliência das desigualdades territoriais em saúde

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Abstract

The objective of this study is to assess the importance of municipal expenses executed with own-source revenues for the maintenance of the territorial inequalities between resources allocated by Brazilian municipalities in the health sector, in spite of the redistributive effects attributed to the vertical transfers of the Brazilian National Health System. The formation of municipal own-source revenues is strongly impacted by regional economic inequalities, corresponding to almost 60% of the resources allocated by municipalities to health in recent years. Based on the Tree Edge Removal method, the total expenditures and those executed with own-source revenues by the municipalities were spatially distributed, thereby enabling identification of clusters from 2005 to 2015 in both cases. Central and dispersion measures were calculated for the two types of expenditure in this interval for the clusters. In the end, we found municipal expenditures with own-source revenues show levels of inequality which are significantly higher than those of the total municipal health expenditure, and even more significant is that these inequalities increase in time with higher intensity in the case of the former. Since municipalities are the main implementers of public health policy, results suggest higher levels of territorial equity will necessarily require adjustments in fiscal federalism in this sector.

Keywords: Fiscal Federalism; Inequalities in Health; Municipal Budgets; Tree Edge Removal.

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Resumo

O objetivo deste estudo é dimensionar a importância das despesas municipais executadas com receitas próprias para a manutenção das desigualdades territoriais entre recursos alocados pelos municípios brasileiros no setor da saúde a despeito dos efeitos redistributivos atribuídos às transferências verticais do Sistema Único de Saúde. Correspondendo a quase 60% dos recursos alocados à saúde pelos municípios nos últimos anos, a formação das receitas próprias municipais é fortemente impactada pelas desigualdades econômicas regionais. Com base no método da Árvore Geradora Mínima, as despesas totais e as executadas com receitas próprias pelos municípios foram distribuídas espacialmente, permitindo identificar a formação de clusters para o período compreendido entre 2005 e 2015 em ambos os casos. Para os clusters foram calculadas medidas centrais e de dispersão para os dois tipos de despesa neste intervalo. Ao final, constatamos que as despesas municipais com receitas próprias apresentam níveis de desigualdade significativamente superiores aos da despesa municipal total em saúde e, mais que isto, que estas desigualdades aumentam no tempo com intensidade superior no caso da primeira. Em sendo os municípios os principais implementadores da política pública de saúde, os resultados sugerem que maiores níveis de equidade territorial irão requerer, necessariamente, ajustes no federalismo fiscal neste setor.

Palavras-chave: Federalismo Fiscal; Desigualdades em Saúde; Orçamentos Municipais; Árvore Geradora Mínima.

Introduction

This study seeks to measure the importance of municipal expenditures with own-source revenues to maintain the territorial inequalities between the resources allocated by Brazilian municipalities in the health sector, despite the redistributive effects attributed to the vertical transfers of the Brazilian National Health System (SUS). According to data from the Public Health Budgeting System (*SIOPS*) (Brasil, 2018), the formation of municipal own-source revenues is strongly impacted by the high levels of regional economic inequality corresponding to almost 60% of the resources allocated by municipalities in health in recent years, leaving doubts about the true capacity of the SUS financing mechanisms to reduce asymmetries between local health expenditures. Since municipalities are the main implementers of public health policy, the results found at the end of this study suggest higher levels of territorial equity will necessarily require adjustments in fiscal federalism in this sector.

A significant part of the literature on fiscal federalism recognizes the role of central governments or broader levels of government in providing public goods which require economies of scale, resolving inefficiencies arising from local decisions overflowing to nearby jurisdictions or in performing the redistributive function (Oates, 1999).

This is highly relevant in the case of countries with significant regional and social disparities, such as Brazil, where the federal level is characterized as being in the best position to exercise redistributive competencies in order to overcome deficiencies and ensure a balance between levels of economic development and social context of subnational jurisdictions (Oates, 1999; Rezende, 2010). According to this view, it would be essential to adjust the distribution of revenues and expenditure obligations to subnational governments in the case of decentralized public policies, making it possible to carry out their functions and ensure a national standard of services for all citizens, regardless of the residence region. However, as will be argued herein, it is not clear this is occurring in Brazilian public health policy.

SUS was structured based on an institutional set which provided for decentralization and articulation of the sectoral action of entities related to the three levels of government that make up Brazilian federalism in the manner established by the Federal Constitution of 1988. In this articulation, the roles were defined so that policy formulation would be at the Union level and, at the same time, at the state and municipal levels (in their respective jurisdictions), while the municipalities would be responsible for their implementation (Arretche, 2012). Under a state marked by huge socio-economic inequalities and insufficient allocation of financial resources (Lima, 2007; Marques; Mendes, 2012; Ugá; Porto; Piola, 2014), and considering the pretensions of policy universalization, the municipalities increased their expense levels executed with their own resources destined to the actions and public services for health (*ASPS*) (Araújo; Gonçalves; Machado, 2017; Piola et al., 2013). Data available in *SIOPS* indicate that in spite of the constitutional determination for a minimum allocation of 15% of own-source revenues for health (direct taxation added to the obligatory intergovernmental transfers of the Union and the states), the Brazilian municipalities allocated an average of 24.2% to this sector in the year 2017 (Brasil, 2018).

On the other hand, even if there is a public health expenditure decentralization process under the Constitutional Amendment 29/2000 (Afonso, 2016; Piola et al., 2013), the transfers of the Brazilian National Health System (SUS) have played a key role in horizontal fiscal equalization (Baião; Cunha; Souza, 2017). As the second main source of funds for the expenditures executed by Brazilian municipalities, the transfers of SUS – either directly from national and state funds, agreements, and repurchase agreements (Soares; Melo, 2016) – presented redistributive effects (Arretche, 2010; Baião; Cunha; Souza, 2017), despite the maintenance of openly asymmetric patterns in the territorial distribution of health expenditures (Lima, 2007). However, it seems the limited achievements in the field of health financing have been much more related to their aggregate growth than to their redistributive effect, where there are still strong disparities between the federation units (Piola; França; Nunes, 2016; Simonassi; Cândido Júnior, 2005).

Data provided by the *SIOPS* for the decade following the implementation of the Constitutional Amendment 29/2000, covering the years 2005-2015 (Brasil, 2018), confirm great regional disparities between the budgetary capacities of the main implementers of the services offered by SUS, namely the municipalities. While per capita values transferred by the SUS to municipalities in the Northeast remained above national per capita, those in the South and Southeast were positioned below this average. Conversely, in the case of per capita expenditures derived from the municipalities' own-source revenues, the amounts spent in the Northeast were only about two thirds of the national per capita, while those in the South were always higher, and those in the Southeast exceeded the national per capita by almost 30% over the same period.

Taking into account this framework, it is possible the discrepancy in forming own revenues among Brazilian municipalities is a very important explanatory factor for inequalities in local health expenditure, which could be compared by comparing the distribution of municipal expenses with own revenues with that presented by total municipal expenditure. After all, what would be the spatial distribution profile of these two types of local expenditures? Would its comparison point to greater territorial inequalities in the case of own revenue expenditure? And if so, are the inequalities between the municipal spending levels for health declining, maintaining, or rising in recent years, vis-a-vis those found for total municipal expenditure?

Although the taxable base that leads to forming own-source revenues for health is especially vulnerable to regional economic inequalities, few studies have recently been devoted to studying this component (Araújo; Gonçalves; Machado, 2017; Machado; Guim, 2017), which is (as already mentioned) the main source in producing municipal health revenues. In order to contribute to the answers to the questions formulated above, this study aims to compare the territorial distribution patterns of total per capita expenditures and per capita expenditures with own-source health revenues for the Brazilian municipalities, in order to scale the contribution of the latter in the formation of local inequalities at the municipal level. Additionally, it incorporates the objective of projecting trends regarding the increase, maintenance, or reduction of perceived inequalities over time for both cases.

Method

The data used in this study refer to the total per capita and own expenses of Brazilian municipalities for the years 2005, 2010, and 2015. Expenditure using own-source revenues are those that were used directly from revenues collected by municipalities (*IPTU, ISS, ITBI, ITR*) plus compulsory intergovernmental transfers from the Union and the states resulting from IPI, ICMS, IPVA, and IRRF collections (Brasil, 2018). Total expenditures refer to all expenses incurred under the responsibility of municipalities, meaning those that used their own resources and the vertical transfers of the Brazilian National Health System (SUS). The per capita calculation aims to ensure the comparability of expenses between municipalities with differentiated financial contributions. All data is available on the *SIOPS* website.[2]

Time frame was set to cover a decade from the first year after the transition period from the implementation of the EC 29/2000 (from 2000 to 2004), leaving out the last years (2016 and 2017) when a reasonable volume of pending and adjustments in the information provided by the municipalities is expected. The option to elect one year at the beginning (2005), one in the middle (2010) and the other at the end of the period (2015) was due to the fact that including all years within the interval would be exhaustive in terms of the number of analyzes required, without producing substantive gains in information since it is not expected random abrupt changes would occur for the three selected years with the high number of mobilized analysis units.

Expenditure values using the IGP-M/FGV index were deflated to make it possible to compare municipal expenditures over time, with current values in 2005 and 2010 being chosen for the amount referring to 2015 (present). All data processing was performed in R language. Therefore, the "deflate" package was used for deflation of the total and own expenditure of the municipalities (Meireles, 2018).

The chosen method was the Tree Edge Removal (TER) (Assunção; Lage; Reis, 2002). Although the Local Indicators of Spatial Association (LISA) enables to identifyconglomerates which are similar to each other according to a certain attribute, TER allows to insert one more condition in search of spatial patterns: all the grouped municipalities are neighbors and the variability of this attribute in space is the smallest possible. As a result, we can obtain the formation of relatively homogeneous and spatially continuous regions, thus generating a regionalization in other words, of the municipality's own expenses and of the total expenses per capita on health in the case of this work. To do so, the TerraView program was used, which is a free software developed by the National Institute of Space Research (*INPE*) and which implements the SKATER function (*Spatial 'K'luster Analysis by Tree Edge Removal*).

In short, we sought to identify continuous areas whose intraregional differences were smaller than the interregional differences (Boudeville, 1959; Perroux, 1967), which enables us to define places that presented similar health expenditures in time and space, but were not necessarily equal, resulting in a regionalization of municipal health expenditures.

The TER application begins by creating graphs through the centroids of the polygons, something similar to a graphical formalization of the neighborhood matrix, so that there is at least one path that connects each one of the municipalities. In other words, connections are established between basic territorial units from which the regions will be constructed, with each of these connections being part of the contiguity of the territories. Therefore, the created graphs are spanning trees.

Each of the spanning tree edges has a cost related to how different the territory is in relation to the others connected to it, and this cost can be calculated from one or more attributes of the territorial units (i and k). In turn, this cost represents the dissimilarity between the two polygons (municipalities) and is expressed through a combination of the variables of the territorial units through Euclidean distances of m variables.

$$Cost_{i,k} = \sqrt[2]{\sum_{j=1}^{m} \left(x_{ij} - x_{kj}\right)^2}$$

2 Disponível em: <https://bit.ly/39rhH4X>. Acesso em: 24 jul. 2020.

Finally, the Tree Edge Removal is produced through reducing the graph by "pruning" the edges, keeping only the minimum cost connections between the units, and therefore minimizing the cost of the connection between the regions, but without losing the contiguity between them. Homogeneous conglomerates are determined from these costs. Number of conglomerates is arbitrary, depending on a visual analysis and the "pruned" edges throughout the iterative process (Assunção; Lage; Reis, 2002).

From setting the clusters to total per capita expenditure and own per capita expenditure according to the selected years in the 2005-2015 period, central measures and dispersion of descriptive statistics were used to enable a comparative analysis between them.

Therefore, considering the objectives of this study - to compare patterns of territorial distribution of municipal expenditures carried out with own-source revenues and total expenditures and to project trends regarding the evolution of perceived inequalities over time - we assume the units of analysis, the municipalities, are not isolated in space and it is possible to identify patterns that are repeated among those that maintain proximity to each other. Also, based on the redistributive character of SUS transfers described in the first section of this paper, we assume the behavior of the variables "expenses with own revenues" and "total expenses" can be different from each other, not only in space but also in time, which may present different variations in trends and paces, which led us to choose a separate analysis for each one. Finally, we believe the method applied here, when inserting the spatial dimension in the debate, is more suitable for the treatment of territorial inequalities than other descriptive strategies based on deviations from central measures or, even, that previously aggregate the units of analysis by regions in order to compare them, covering internal asymmetries to the latter and leaving the formation and evolution of clusters unnoticed.

Results

The clustering procedure of contiguous areas in homogeneous regions enabled to identify clusters for per capita expenditure with own-source revenues and for total per capita expenditure spent by Brazilian municipalities on health services in the years 2005, 2010, and 2015. In other words, it explained similar structures existing in the data set which were able to connect neighboring municipalities in function of the expenses in healthcare services.

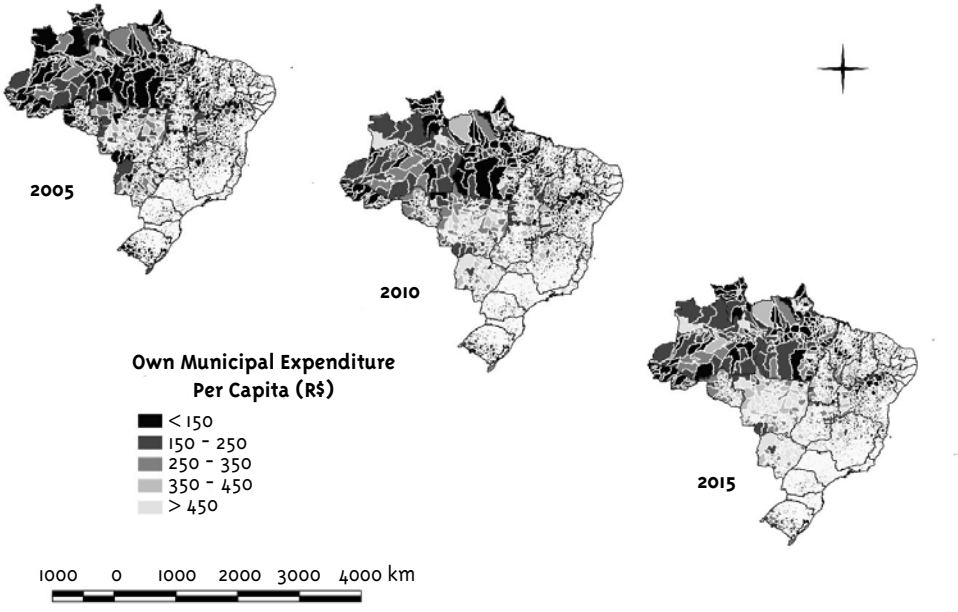
A previous analysis of the data is necessary before presenting the results obtained from applying the TER. Figures 1 and 2 below respectively present the own expense and the total health expenditure of the Brazilian municipalities. The figures provide a description of the expenditure variation in the said time horizon. Spending ranges were defined a priori, and the same values were used in each of the years. It should be emphasized they are different among the types of expenditure since the total expenditure per capita is substantially higher than the own-source expense.

There is a clear increase in spending between 2005 and 2015 for both own and total expenditure, regardless of the region. The increase in own-source spending in the five-year period of 2005-2010 mainly in the center-south of the country is clear due to the change in the ranges, predominating in colder tones. On the other hand, a transition from warm colors to softer tones begins in the North and Northeast. The progress in the center-south continues in the second half of the decade, so that many municipalities in Mato Grosso, Mato Grosso do Sul, and São Paulo now allocate at least R$450.00 to their own health expenses. However, the variation in the North and Northeast was more discreet, although there are few municipalities with expenses exceeding R$250.00 per person. Minas Gerais is an interesting case because it reflects national inequality. Although much of the state has an expense of at least R$350.00, the same cannot be said for those who are part of the north and northeast of the state, with expenses of less than R$250.00 per person.

The evolution pattern of total expenditure per capita (Figure 2) is very consistent with that analyzed in Figure 1. However, some differences are perceptible and deserve to be mentioned. The shift of tones from left to right in the Figure is more pronounced. It is clear how total expenditure grew between 2005-2015, mainly in the Midwest. There were already several municipalities with expenses

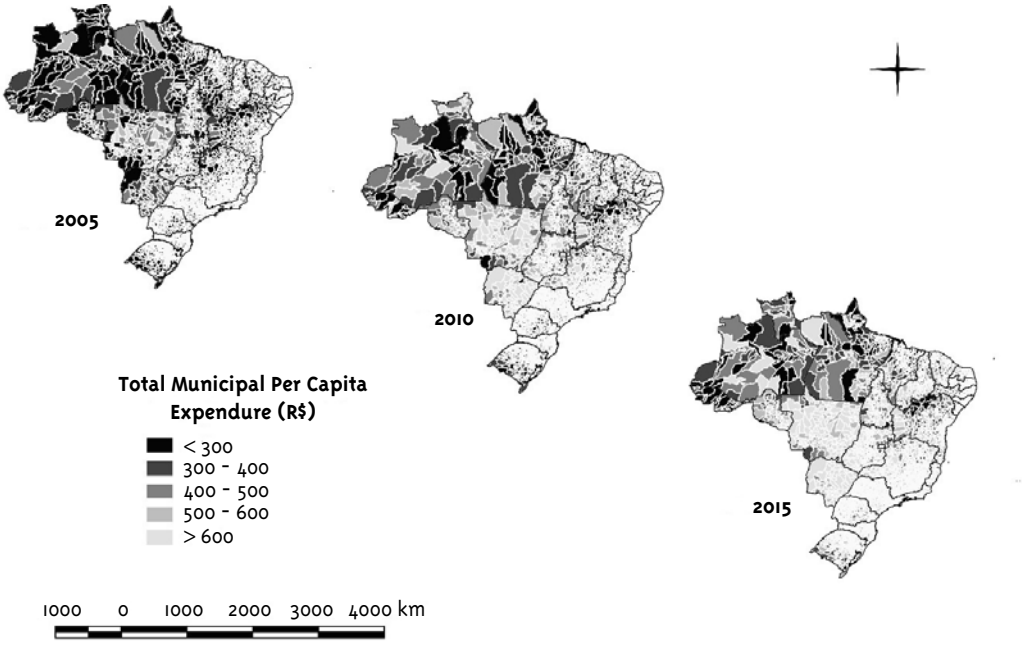
above R$500.00 per person in the Northeast, putting it in the same range as much of the center-south of the country. The same happened in the North. Another issue is that the increase in spending in Minas Gerais apparently accelerated between 2010-2015, as the differences between the north of the state and the other regions in 2010 decreased in the second five-year period of the analyzed horizon.

Figure 1 – Evolution of own-source municipal expenditure per capita, Brazil, 2005-2015



Source: Brasil (2018)

Figure 2 – Evolution of total municipal expenditure per capita, Brazil, 2005-2015



Source: Brasil (2018)

In summary, regional disparity is evident in the Brazilian territory, either in own or total health expenditure. On the one hand, there is the North and Northeast whose own health expenditure (Figure 1) is lower than in much of the center-south. On the other hand, the same pattern remains in total expenditure (Figure 2) with decreasing differences, but not to the extent of mitigating spatial heterogeneity.

From the data presented above, six possible clusters were identified for each type of considered expenditure. Although the number of conglomerates is arbitrary, several attempts have been made. The same result was always obtained even with a greater number of clusters; three groups of main municipalities, with the others being considered outliers. These were municipalities that themselves formed a single conglomerate. Although formed by only one or a few municipalities, they were not aggregated to their neighbors because they had distinct per capita expenses from the others, so that the cost to group them to these neighbors was greater than the cost of keeping them separate.

The clusters formed for the data of the per capita expenses with own-source revenues were: center, center-north, center-south, Paulânia, Borá, and São Gonçalo do Rio Baixo. Note that the last three are positioned as outlier clusters. Next, the following clusters were constituted using the data of total per capita expenditure: center, center-north, center-south, Buritama, Macaé, and São João da Barra, with the extreme cases being the last three.

The three largest clusters from center, center-north, and center-south were given the same name in the case of own per capita expenditure and their total per capita expenditure, given the similar position on the map (Table 1). However, the number of municipalities covered and the boundaries between them differ significantly. For the former, the center cluster consists of 289 municipalities, while there are only 66 for the second, constituting 5.2% and 1.9% of the Brazilian municipalities being incorporated, respectively. The number of municipalities that make up the center-north and center-south clusters also differ according to expenditure type. The center-north consists of 2,920 (52.4%) and 2,291 (41.1%) municipalities, respectively, while the center-south incorporates 2,356 (42.3%) and 3,188 (57.3%).

Table 1 – *Clusters* by type of expenditure by municipalities and number of municipalities

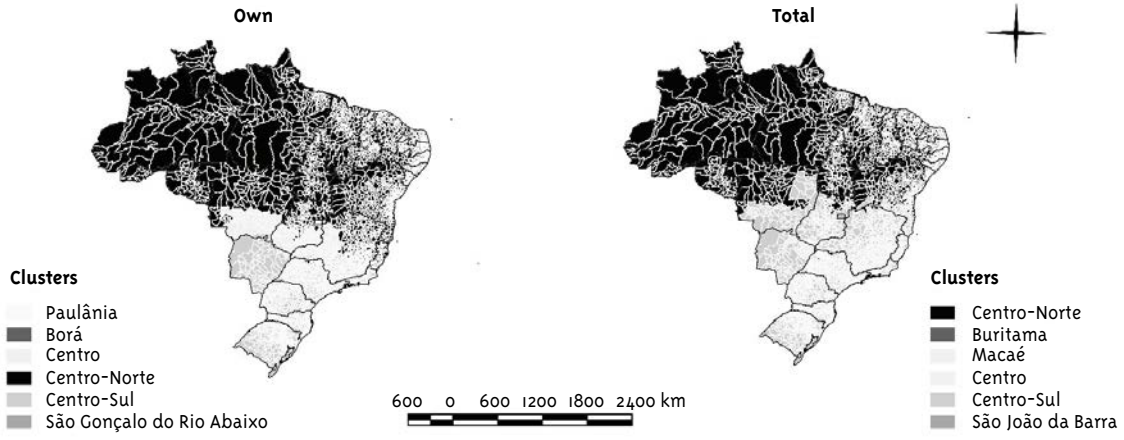
Type of expenditure	*Clusters*	Number of municipalities	% of municipalities
Expenditure with own-source revenues	Center	289	5.2%
	Center-North	2,920	52.4%
	Center-South	2,356	42.3%
	Paulânia	2	0.04%
	Borá	1	0.02%
	São Gonçalo do Rio Abaixo	1	0.02%
Total expenditure	Center	66	1.9%
	Center-North	2,291	41.1%
	Center-South	3,188	57.25%
	Buritama	20	0.36
	Macaé	3	0.05
	São João da Barra	1	0.02

Source: Brasil (2018)

Figure 3 shows the clusters for the period 2005-2015, according to the two types of expenses. In addition to incorporate the largest contingents of municipalities, the center-north and center-south clusters present significant variations in terms of spatial coverage when considering each type of per capita expenditure. The center-north occupies a smaller area in the total per capita expenditure than in the case of own per capita expenditure, having its borders aligned shortly before the south of Bahia and continuing in a small extension in the north of Goiás, in addition to part of the north and center of Mato Grosso. The center-south almost covers the rest of the country, only giving space to the center cluster, constituting a small transition zone in eastern Mato Grosso do Sul, which extends to its borders to Mato Grosso, Goiás, west Minas Gerais and northwest São Paulo.

The center-north occupies a relatively larger area regarding its own expenses, which includes Espírito Santo, much of Minas Gerais, in addition to the northern portion of Goiás and Mato Grosso. In turn, the center-south covers Rio de Janeiro, almost all of São Paulo, and Mato Grosso do Sul, as well as the south of Minas Gerais. In the latter case the center cluster constitutes a transition zone in the south of Mato Grosso and Goiás and west of Minas Gerais, complemented with patches in the north of São Paulo. In this case what is being considered here as a transition zone has a greater proportion than for total expenditure.

Figure 3 – TER for municipal expenditure per capita on health with their own revenues and total, Brazil, 2005-2015



Source: Brasil (2018)

Therefore, both indicate the existence of a clear health spending pattern in Brazil as a country divided into two, center-north and center-south, with a transition zone between them, which is more pronounced in total health expenditure. The next step was to perform some descriptive statistics (central and dispersion measures) of these clusters to understand what finally represented this regionalization introduced in Figure 3 in relation to health expenditures between 2005 and 2015 (Table 2). The analysis was concentrated in the three main clusters given its relevance to answer the questions formulated in this study.

The comparison of the mean per capita values between the center-north and center-south for own-source health expenditure over the interval points to similar logic, but with different intensities. There is an expenditure growth in time in both, but it is larger in the center-south, while the center-north expenditure grew by approximately 34% in the first five years of the decade (R$180.31 to R$242.03), and in the center-south it was almost 43% (R$302.26 to R$432.98). Furthermore, there was a reduction in the evolution of spending in both regions between 2010-2015, but again with different intensities. The center-south region, which already had a higher

average expenditure, increased this expenditure by around 25% in the period. Meanwhile, growth in the center-north region was only almost 16%, therefore increasing the inequalities between them within the analyzed time horizon. The central region, herein classified as a transition zone, presented growth of approximately 36% (R$376.67 to R$511.04) and 19% (R$511.04 to R$610.23) between 2005-2010 and 2010-2015, respectively. Therefore, higher than those of the center-north region, but lower than those of the center-south region.

Since average values are affected by extreme values, the comparison between medians is an important complementary resource, although in this case it signaled similar trends, both in respect to the distance between values presented for the main clusters and the tendency of the same distance over time. About own per capita expenditure, the median of the center-south exceeded the center-north median in the three analyzed years: 74%, 87%, and 109%, in 2005, 2010, and 2015, respectively. The median for the analysis of the mean also grew more in this region: 46% between 2005-2010, and 30% between 2010-2015. Moreover, growth in the center-north was always lower (36% and 16%). The difference in the analysis took place in the comparison between the central and south-central regions. Growth in the center in the first five years was approximately 44% and 20% in the second, indicating that even though it was more similar to the center-south region between 2005-2010, between 2010-2015 it had a more similar evolution to that of the center-north.

Discrepancies between clusters for the own expenditures were significantly higher than those found for total revenue expenditure, although municipalities were not grouped together, as discussed here. It is relevant to bear this in mind. Total per capita expenditures in the center-south exceeded the center-north by 30%, 36%, and 43% (respectively in 2005, 2010, and 2015). Growth was also higher in the center-south, while spending increased by 48% between 2005-2010, and by 26% between 2010-2015 in the region, while there was a variation of 43% and 19% in the center-north in the same periods. The relative position of the center region was distinct, always greater than the center-south, independent of the year analyzed. This could be largely explained by a selectivity of the municipalities that make up this transition band, since there are only 66. Results of the medians are very similar, as in the own health expenditure. Considering the purposes of this study, it was decided not to analyze them, but all values are in Table 2 (above).

Table 2 – Descriptive statistics of clusters estimated through application of TER for own and total health expenditures, municipalities of Brazil, 2005-2015

Estimated Cluster	Mean	Median	Med. / Mean	SD	Minimum	Maximum	IQR	Num. Municip.	Population
Own expenditure on health									
2005									
Paulânia	1,625.86	1,625.86	1	1,222.07	761.72	2,489.99	864.13	2	85,893
Borá	1,248.52	1,248.52	-	-	1,248.52	1,248.52	-	1	821
Center	376.67	304.48	1.24	240.53	88.73	1,613.36	242.32	289	8,451,000
Center-North	180.31	146.84	1.23	121.43	0.12	2,256.11	104.96	2,920	83,655,879
Center-South	302.26	255.08	1.18	162.71	1	1,473.37	178.57	2,356	91,741,487
São Gonçalo do Rio Abaixo	569.36	569.36	-	-	569.36	569.36	-	1	855

continued...

Table 2 – Continuation

Estimated Cluster	Mean	Median	Med. / Mean	SD	Minimum	Maximum	IQR	Num. Municip.	Population
Own expenditure on health									
2010									
Paulânia	1,643.96	1,643.96	1	1,063.77	891.76	2,396.16	752.2	2	110,583
Borá	1,962.36	1,962.36	-	-	1,962.36	1,962.36	-	1	826
Center	511.04	439.45	1.16	275.17	171.91	1,861.47	321.66	289	9,007,871
Center-North	242.03	199.35	1.21	159.97	1	2,532.77	136.52	2,92	87,639,834
Center-South	432.98	372.68	1.16	215.58	1	2,167.82	242.28	2,356	94,398,315
São Gonçalo do Rio Abaixo	1,590.51	1,590.51	-	-	1,590.51	1,590.51	-	1	973
2015									
Paulânia	1,366.66	1,366.66	1	1,316.94	435.44	2,297.88	931.22	2	129,899
Borá	2,692.81	2,692.81	-	-	2,692.81	2,692.81	-	1	836
Center	610.23	531.33	1.15	310.49	124.25	2,004.83	352.62	289	9,832,579
Center-North	281.71	232.07	1.21	177.51	31.56	2,376.37	155.64	2,92	94,375,89
Center-South	543.1	485.29	1.12	251.70	98.26	2,443.21	290.83	2,356	100,129,737
São Gonçalo do Rio Abaixo	3,037.66	3,037.66	-	-	3,037.66	3,037.66	-	1	10,588
Total expenditure on health									
Center-North	301.19	273.03	1.1	147.36	0.24	2,394.31	138.66	2,291	64,898,387
Buritama	838.81	772.6	1.09	257.04	539.85	1,586.04	170.72	20	70,74
Macaé	1,818.1	1,631.92	1.11	959.93	964.88	2,857.48	946.3	3	182,261
Center	604.75	568.26	1.06	257.75	196.53	1,587.68	266.58	66	693,363
Center-South	392.74	351.81	1.12	181.82	1	2,304.69	206.07	3,188	118,070,273
São João da Barra	888.5	888.5	-	-	888.5	888.5	-	1	28,611
2010									
Center-North	429.85	393.33	1.09	182.28	1	2,716.41	154.2	2,291	68,232,165
Buritama	1,131.66	1,123.31	1.01	227.87	794.9	1,714.12	247.07	20	76,515
Macaé	1,891.18	1,642.84	1.15	677.14	1,373.27	2,657.44	642.08	3	226,220
Center	919.02	897.43	1.02	314.64	379.12	1,852.95	350.79	66	717,684
Center-South	583.44	529.38	1.1	235.67	1	2,510.38	260.45	3,188	121,883,975
São João da Barra	1,529.74	1,529.74	-	-	1,529.74	1,529.74	-	1	30,606

continued...

Table 2 – Continuation

Estimated Cluster	Mean	Median	Med. / Mean	SD	Minimum	Maximum	IQR	Num. Municip.	Population
Total expenditure on health									
2015									
Center-North	513.20	465.89	1.1	214.72	127.39	2,845.34	200.75	2,291	73,656,455
Buritama	1,383.17	1,339.86	1.03	328.62	840.15	2,095.25	480.04	20	80,811
Macaé	2,150.19	2,415.50	0.89	497.16	1,576.66	2,458.42	440.88	3	272,336
Center	1,058.73	1,075.56	0.98	291.18	525.85	1,800.04	427.65	66	796,842
Center-South	734.74	670.84	1.1	295.22	179.33	3,152.09	328.93	3,188	129,638,502
São João da Barra	4,113.33	4,113.33	-	-	4,113.33	4,113.33	-	1	34,583

Source: Brasil (2018)

The ratio between mean and median provides a parameter for measuring the levels of data dispersion for different analyzed sets, pointing to the systematically greater internal inequalities in the case of own expenses for the main regions over the interval. The center cluster was different from the others for total expenditures, presenting lower levels of interregional inequality, with a tendency to reduce the differences being more accentuated between 2005 and 2015. The center-south and center-north presented levels close together. However, the differences in these regions practically remained constant over the decade, presenting only a slight fluctuation. Internal inequalities for own expenditures were slightly higher in the center-north, while they fell slightly over time in other clusters, suggesting greater and persistent levels of internal inequality between the municipalities of the first region.

Standard deviations again pointed to sharply higher internal variances for own per capita expenditure compared to total expenditures across all clusters. For the total expenditure, the proportion of the standard deviation in relation to the average per capita decreased over the interval for the center region, while it remained flat in 2015 for the center-north and center-south after a reduction between 2005 and 2010. More specifically, the center's standard deviation accounted for 43% of the average per capita in 2005, falling to 34% in 2010 and 28% in 2015. Meanwhile, this proportion fell from 49% to 42% in the center-north, remaining there until 2015, which also occurred with the center-south, although this percentage started at 46% and remained at 40%.

For own expenditure, the same percentages were always higher for the center-north and center clusters than for the center-south, revealing higher levels of intraregional inequalities in both. Specifically, for own-account expenditures, the center-north and center standard deviations were 67% and 64% of average per capita in 2005, respectively, while the proportion was 54% in the center-south. Furthermore, the first two clusters (center-north and center) were 68% and 73% in 2010, while the center-south was 65%, which then became 67% and 66% in the case of 2015, respectively, compared to 60%.

Finally, as a proportion of the medians between the first and third quartiles, the analysis of the interquartile range offers an interesting measure for the convergence level between the data. Once again, the highest dispersion levels for own per capita expenditure figures were confirmed, in comparison with total per capita expenditure figures, pointing to greater intraregional inequalities in the first case. In addition, the center-south cluster had divergence levels for the total expenditure which were sharply higher than those of the center-north and center, both oscillating downwards between 2005 and 2010 and upwards in 2015. On the other hand, while the center-north practically maintained the same level of internal inequality, the center-south and center clusters showed gradual and consistent reduction over the time interval.

Discussion

One of the main challenges of Brazilian fiscal federalism has been to reduce socioeconomic cleavages among the constituent units, since disparities in public expenditure tend to be difficult to reverse given the concentration of tax bases in specific areas of the territory which affect revenue distribution (Rezende, 2006). Considering this problematic context, this study tried: (1) to find out if the municipal expenditures with own-source revenues would be a relevant factor to explain locational inequalities in the municipal expenditures on health; (2) to know the territorial distribution profile of this type of expenditure, vis-a-vis the one presented by total municipal expenditure on health; (3) to know the evolution of inequalities related to own expenditure over time compared to inequalities in total municipal expenditure.

In general terms, the results found were consistent with the understanding that municipal expenditures with own resources is a highly relevant factor in elucidating the resilience of territorial inequalities in health conditions and service delivery standards (Albuquerque et al., 2017). It is well known the constitutional and legal choices which have conditioned the formation and distribution of public health revenues between the government levels have imposed "political-administrative decentralization, with a single direction in each sphere of government" (Law 8,080/1990, article 7, subsection IX), under which "emphasis was placed on the decentralization of services to municipalities." The latter have thus assumed a key role in executing the expenditures on *ASPS*, having significantly expanded their relative share in public sector financing. As it is an open component to local autonomy, the allocation of these resources could be an important element to remedy problems arising from the scarcity of resources.

At this point, the results of our study offer a counterpoint to this last expectation. First, municipal expenditures using their own revenues is presented as a highly salient fact to explain the territorial inequalities in total municipal health expenditures, since they exceeded the latter under the different requirements mobilized in this study over the analyzed interval. Second, the two main identified clusters (center-north and center-south) which together cover well over 90% of the Brazilian municipalities, clearly showed greater inequalities among themselves, as well as greater internal asymmetries in the case of their own expenditures than total municipal health expenditure. Last, the territorial inequalities for own expenditures on health have not only increased over the analyzed period, which is also worrying with total municipal expenditure, as they did so with a markedly higher intensity than the latter.

The territorially concentrated effect on the distribution of own-source revenues on health care could be explained by two reasons. First, since there is no homogeneity in the municipalities' ability to generate direct tax revenues, it would be expected the sum of own resources to be invested in health would differ between them. Following this logic, inequalities in municipalities' own health expenditure are more directly associated with the differences between local tax capacities than with the decisions of the governors, as conditioned by federal regulation (Vazquez, 2014). The second reason arises from the precariously redistributive character of the obligatory constitutional transfers for the municipalities, according to the rules that govern Brazilian fiscal federalism. By taxing urban property, services, and property transfers, municipalities directly collect only about 7% of the country's taxes, although the increase in mandatory constitutional and legal transfers, including the Municipal Participation Fund (*Fundo de Participação dos Municípios – FPM*) and other shareholdings, increase the municipal revenue to 19% of the taxed volume (Afonso, 2016). But despite their unconditional and redistributive nature, studies have shown mandatory constitutional transfers have made little contribution to fiscal equalization, unlike other types such as conditional and voluntary transfers (Arretche, 2010; Soares; Melo, 2016; Vazquez, 2014). Under such conditions, municipalities allocate their own health expenditures at unequal levels which are significantly higher than the general allocation pattern considering the other sources of SUS income (Arretche, 2010), which offers part of the explanation for the resilience of territorial inequalities in health conditions and service provision patterns (Albuquerque et al., 2017).

On the other hand, results strongly suggest the presence of an attenuating factor of the effect that the local inequalities of their own expenses produce on the territorial distribution pattern of the total municipal expenses: the SUS transfers and their corrective or, at least, mitigator effect over locational differences.

In general, conditional transfers can promote national cohesion around national policies, as well as contribute to the reduction of fiscal inequities (Lima, 2017; Soares; Melo, 2016; Vazquez, 2014). In the case of health policy, the transfers come mostly from the federal government, even though transfers from the states are identified. As the main implementers of the SUS, the municipalities were beneficiaries of that transfers, which in the beginning were focused on inducing necessary organizational structures for decentralizing SUS management, such as municipal health funds or councils (Basic Operational Regulation 01/1993). However, its scope was gradually broadened in the later regulations contemplating equalizing initiatives, such as the Fixed Basic Care Floor (*Piso de Atenção Básica Fixo, PAB-Fixo*) or the Compensation of Regional Specificities (*Compensação de Especificidades Regionais*) (incorporated in 2013 into the *PAB-Fixo*), or the diffusion of structuring services for the care network, such as the Family Health Strategy (*ESF*), the Psychosocial Care Centers (*CAPS*) or the Mobile Emergency Care Service (*SAMU*). As a result, conditional transfers structured by SUS have contributed to reducing fiscal imbalances in health financing, as Vasquez (2014) pointed out. For example, some studies have pointed out in some areas such as basic health care and health surveillance, the Northeast and North were better considered than the more developed regions of the country, which even occurred for some population groups of municipalities in the case of Medium and High Complexity resources (*MAC*) (Machado; Guim, 2017; Piola; França; Nunes, 2016).

However, such effects may have been limited by the predominance of local adherence logic to federal programs over explicitly redistributive criteria, which has occurred in countries where federal transfers seek to correct discrepancies in local availability of per capita resources. It is in this direction that Rezende (2010), for example, points to the fact that in health there is no agreement on parameters which allowed linking different levels of demand for services and per capita values to be allocated to different regions of the country, unlike in education where per capita values based on school enrollments define the complementation of state and municipal resources for basic education. The health sector would therefore suffer from this obstacle, which "increases the difficulty of correcting the imbalances between the location of the financial guarantees and the corresponding location of the demands to be met" (Rezende, 2010, p. 83).

Thus, even though there are positive effects for the SUS transfers, the aggregate effect of the mechanisms of municipal health revenue formation leaves a worrying balance on its potential to overcome territorial inequalities over time. Municipalities located in less developed regions (North and Northeast), with spending levels which are clearly below resource-rich locations (South and Southeast), face great obstacles in order for their service networks to become better structured, with a strong association between the availability of resources and regional supply concentration and production of services (Lima, 2007; Rezende, 2010).

Conversely, this study presents limitations which signal a necessary deepening around the research agenda dedicated to fiscal federalism in health. First, there is a lack in exploring the spatial distribution of municipal revenues from SUS transfers, with the necessary disaggregation between its various components: by source (whether federal or state), by the instruments used (fund-to-fund, agreements or transfer contracts), or by type of condition (service offer, results, or demographic and health criteria), which will help to identify more clearly which of its components have clear redistributive effects. Second, this study did not explore the presence of other factors which may produce additional effects in the sense of putting pressure on municipal health expenditure, such as economies of scale in smaller municipalities, or the proportion of personnel expenses in municipal budgets. Filling these gaps is necessary so that the partial view of this study becomes more comprehensive.

References

AFONSO, J. R. Federalismo fiscal brasileiro: uma visão atualizada. *Caderno Virtual*, Brasília, DF, v. 1, n. 34, 2016.

ALBUQUERQUE, M. V. et al. Desigualdades regionais na saúde: mudanças observadas no Brasil de 2000 a 2016. *Ciência e Saúde Coletiva*, Rio de Janeiro, v. 22, n. 4, p. 1055-1064, 2017.

ARAÚJO, C. E. L.; GONÇALVES, G. Q.; MACHADO, J. A. Os municípios brasileiros e os gastos próprios com saúde: algumas associações. *Ciência e Saúde Coletiva*, Rio de Janeiro, v. 22, n. 3, p. 953-963, 2017.

ARRETCHE, M. Federalismo e igualdade territorial: uma contradição em termos? *Dados*, Rio de Janeiro, v. 52, n. 3, p. 587-620, 2010.

ARRETCHE, M. *Democracia, federalismo e centralização no Brasil*. Rio de Janeiro: FGV/Fiocruz, 2012.

ASSUNÇÃO, R. M.; LAGE, J. P.; REIS, A. E. Análise de conglomerados espaciais via árvore geradora mínima. *Revista Brasileira de Estatística*, Rio de Janeiro, v. 63, n. 220, p. 7-24, 2002.

BAIÃO, L. B.; CUNHA, A. S. M.; SOUZA, F. S. R. N. Papel das transferências intergovernamentais na equalização fiscal dos municípios brasileiros. *Revista do Serviço Público*, Brasília, DF, v. 68, n. 3, p. 583-610, 2017.

BOUDEVILLE, J. R. La región económica. *Económica*, La Plata, v. 5, n. 17-20, p. 51-157, 1959.

BRASIL. Ministério da Saúde. SIOPS: Sistema de Informações sobre Orçamentos Públicos em Saúde: indicadores municipais. Brasília, DF, 2018. Disponível em: <https://bit.ly/2CJ6XD3>. Acesso em: 27 nov. 2018.

LIMA, L. D. Conexões entre o federalismo fiscal e o financiamento da política de saúde no Brasil. *Ciência e Saúde Coletiva*, Rio de Janeiro, v. 12, n. 2, p. 511-522, 2007.

MACHADO, J. A.; GUIM, A. L. S. Descentralização e igualdade no acesso aos serviços de saúde: o caso do Brasil. *Revista do Serviço Público*, Brasília, DF, v. 6, n. 1, p. 37-64, 2017.

MARQUES, R. M.; MENDES, A. A problemática do financiamento da saúde pública brasileira: de 1985 a 2008. *Economia e Sociedade*, [s. l.], v. 21, n. 2, p. 345-362, 2012.

MEIRELES, F. deflateBR: deflate nominal Brazilian reais. *R package version 1.1.2*. [S. l.]: deflateBR, 2018. Disponível em: <https://bit.ly/39pqmEP>. Acesso em: 24 jul. 2020.

OATES, W. E. An essay on fiscal federalism. *Journal of Economic Literature*, Nashville, v. 37, n. 3, p. 1120-1149, 1999.

PERROUX, F. *A economia do século XX*. Porto: Herder, 1967.

PIOLA, S. F.; FRANÇA, J. R. M.; NUNES, A. Os efeitos da Emenda Constitucional 29 na alocação regional dos gastos públicos no Sistema Único de Saúde no Brasil. *Ciência e Saúde Coletiva*, Rio de Janeiro, v. 21, n. 2, p. 411-422, 2016.

PIOLA, S. F. et al. *Financiamento público da saúde*: uma história à procura de rumo. Rio de Janeiro: Instituto de Pesquisa Econômica Aplicada, 2013. (Texto para Discussão, n. 1846).

REZENDE, F. *Desafios do federalismo fiscal*. Rio de Janeiro: Editora FGV, 2006.

REZENDE, F. Federalismo fiscal: em busca de um novo modelo. In: OLIVEIRA, R. P.; SANTANA, W. (Org.). *Educação e federalismo no Brasil*: combater as desigualdades, garantir a diversidade. Brasília, DF: Unesco, 2010. p. 71-88.

SIMONASSI, A.; CÂNDIDO JÚNIOR, J. O. Econometria não paramétrica e expectativa de vida nos municípios do Nordeste: uma aplicação do estimador de Nadaraya-Watson. In: FÓRUM BNB DE DESENVOLVIMENTO: ENCONTRO REGIONAL DE ECONOMIA DA ANPEC, 10., 2005, Fortaleza. *Anais...* Fortaleza: Banco do Nordeste, 2005.

SOARES, M. M.; MELO, B. G. D. Condicionantes políticos e técnicos das transferências voluntárias

da União aos municípios brasileiros. *Revista de Administração Pública*, Rio de Janeiro, v. 50, n. 4, p. 539-562, 2016.

UGÁ, M. A. D.; PORTO, S. M.; PIOLA, S. F. Financiamento e alocação de recursos em saúde no Brasil. In: GIOVANELLA, L. et al. *Políticas e sistema de saúde no Brasil*. Rio de Janeiro: Fiocruz, 2014. p. 395-425.

VAZQUEZ, D. A. Mecanismos institucionais de regulação federal e seus resultados nas políticas de educação e saúde. *Dados*, Rio de Janeiro, v. 57, n. 4, p. 969-1005, 2014.

Authors' contribution

Quaresma designed and conducted the methodological procedures. Machado coordinated the study. All the authors collaborated with the theoretical review, analyzed the results, and wrote the article.

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