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Decentralization and Productivity of the Public Health Service in Brazil

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Abstract

Most of the scientific literature reveals that the process of fiscal decentralization is a potential inducer of efficiency and productivity in the public sector. However, some authors have questioned whether the process in Brazil would be generating waste of public resources and raising problems in the quality of services provided. This paper utilizes the Malmquist index using Data Envelopment Analysis (DEA) and econometrics with panel data to assess the relationship between fiscal decentralization and productivity performance of the public health service in Brazil, as well as to provide an overview of the dynamics of regional productivity in the sector. The results indicate that the decentralization of health spending has a negative relationship on the productivity of these services, but fiscal responsibility has a greater influence on the performance of the local governments.

Keywords: Health, Decentralization of Expenditures, Productivity, Fiscal Responsibility

JEL Classification: H51, H77, I18

1. Introduction

Worldwide, the systems of health care are an increasing concern of society in the political and socioeconomics dimensions. In Brazil, the National Health System (NHS) experiences increasing pressure to improve its performance, especially about the costs and quality. The central feature of this system is the universality, in which the supplies of health services occur in a decentralized way by local governments. Oates (1977, 2005) notes that the fiscal decentralization process generates a number of benefits to society, given that local governments can provide goods and services more efficiently, which are more relevant to local preferences and demands.

On the other hand, Prud 'Homme (1995), Seabright (1996) and Chalfun (2004) highlight that decentralization can create difficulties for the economic stabilization policies and policy coordination among jurisdictions. In an analysis of the Brazilian case, Campos (1998) points out that the NHS is a system designed to decentralize the provision of the Brazilian public health service towards local governments. However, Campos (1998) emphasizes the unpreparedness of subnational governments to assume the responsibilities of health care due to lack of technical resources (including the shortage of doctors and other health professionals for all municipalities[3]), nepotism, corruption etc.

In this context, this article examines the effects of decentralization of health services on the technical productivity of this sector in Brazil and provides an overview of the dynamics of regional productivity in health care services.

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[3]In 2013, the Brazilian government created the *ProgramaMaisMédicos*(More Doctors Program) through Law n. 12,871/2013 with the aim to decrease the shortage of doctors mainly in poorlocalities and cities far from major centers.

In the country, several studies, as Sousa and Stosic (2003), Gasparini and Ramos (2004), Afonso and Aubyn (2005) Fariaet al. (2008), Marinho (2009), Sousa et al. (2007) andAlmeida and Gasparini (2011) measure the efficiency of the provision of public goods and services. However, this study advances on two aspects of this issue. First, it focuses explicitly on the relationship between changes in productivity in the public health service and decentralization. In addition, it offers a regionalized analysis of the dynamics of productivity, considering indicators of technological change and efficiency.

2. Provision of health in Brazil and the NHS

The Federal Constitution of 1988 (FC1988) made several changes to Brazilian fiscal federalism. Cities were recognized as members of the federation on a par with the states and had a major role in the provision of local services. However, the financial strengthening of municipalities has taken place much more through increasing their participation in constitutional transfers rather than by increasing their capacity to tax.

According to Clementino (1998), fiscal free-rider is an example of the lack of political will of local governments to effectively use the potential tax instruments at their disposal, given the high political cost of doing so when compared to the possibility of obtaining transfers.

However, the excessive contribution of federal transfers to subnational governments inhibits the conditions for autonomy and more democratic practices in local governments. These fiscal free-riders receive a large volume of transfers, which can lead to fiscal irresponsibility and dependence when compared to the other members of the Federation. The FC1988established the NHSand the Law n. 8,080 of 1990 regulated this system. Among the principles guiding the actions that are part of the NHS, regulations emphasize the process of political and administrative decentralization, with a single focus of management in each sphere of government and an emphasis on decentralization of services to municipalities, regionalization and the hierarchy of network health services. According to the Ministry of Health (2000, p. 6), the NHS provided a "redistribution of resources and responsibilities among the federal states based on the understanding that the central level, the Union should only do what the local level cannot". Thus, it is the municipal government that provides basic health care; state governments administer and coordinate operations of average complexity, leaving the federal government responsible for determining the basic policies of the sector and to guarantee the highly complex services and costs.

Taking into account the policy of decentralization, since the late 1990s the Ministry of Health has been giving more responsibility to local governments in NHS management and strengthening the transfer of resources from one fund to another which gives priority to comprehensive health care at the expense of fees for services rendered. The transfer from fund to fund is a strong mechanism of decentralization, since resources are transferred regularly and automatically, directly from the National Health Fund to the account of individual states health funds, the Federal District and municipalities.

Table 1: Brazil – Federal NHS Resources by Municipality (R$ million) – 1997 to 2006

	1997	1999	2001	2003	2005	2006
Total Transfers (1)	2,139	5,902	9,625	14,101	21,241	21,900
Medium & High Complexity	2,139	3,574	5,865	8,341	12,827	12,879
Primary Care	0	2,328	3,624	4,520	6,076	6,787
Strategic Actions	0	0	135	1,239	2,338	2,233
Remuneration for Services Produced (2)	5,324	5,003	4,811	3,314	0	0
Total Resources (1+2)	7,463	10,905	14,436	17,415	21,241	21,900

Source: Authors'elaboration from MS/DATASUS.

Table 1 provides information about the federal resources transferred to municipalities from the NHS from 1997 to 2006.

Two key aspects can be observed: first, the remuneration for services not included as revenue for most subnational governments from 2005, and second, total transfers, especially for medium and high complexity services, achieved rapid growth through consolidating decentralization of spending on health and greater autonomy of local governments in their management.

3. Method

To achieve the set goals, two stages divide this empirical analysis. The first builds a dynamic index of productivity growth for public health services using data from the municipalities aggregated at the state level. This index ascertains the best relations of efficiency and technical changes obtained during the period between 1996 and 2007. To calculate this indicator, we utilize the Malmquist index of productivity computedby Data Envelopment Analysis (DEA). The second stage evaluates the relationship between the indicator of productivity growth in health (calculated in the previous stage) and variables related to Brazilian fiscal federalism and other relevant socioeconomic factors.

3.1 Stage 1: Dynamic Analysis of Productivity in Public Health

Malmquist (1953) introduce the concept of productivity index (m_o) and later refined by several works, including Caves et al.(1982), Färe et al. (1994a) and Thrall (2000). This index represents the growth of total factor productivity (TFP) of decision making units (DMU), which reflect two components: efficiency change and technological change over time.

Färe*et al*. (1994a) calculate the Malmquist productivity index using a geometric mean of two reasons: the first uses as a reference the frontier of the period *t* and then the frontier of the period *t +1*. This indicator is a geometric mean of two ratios of function distance[4], considering the technical frontier at different moments and the relationship between outputs (*y)* and inputs (*x)*. Thus, $m_o>1$ reveals a positive evolution of TFP between periods *t* and *t +1*, while $m_o<1$ indicates a decline in TFP. Equation 1 expresses the Malmquist index[5]:

$$m_o(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} \times \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right]^{1/2}. \quad (1)$$

Equation 2 shows the Malmquist index decomposed into change of technical efficiency (*TE*) and technological change (*TC*):

where, $TE = \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)}$ and $TC = \left[\frac{d_o^t(x_t, y_t)}{d_o^{t+1}(x_t, y_t)} \times \frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_{t+1}, y_{t+1})}\right]^{\frac{1}{2}}$.

The DEA approach calculates the functions distance*d(.)*. In short, to calculate m_o it is necessary to resolve four linear programming problems[6]:

$$[d_o^t(x_t, y_t)]^{-1} = max_{\phi,\lambda}\phi \quad s.a. \quad -\phi y_{it} + Y_t\lambda \geq 0, \quad x_{it} - X_t\lambda \geq 0, \quad \lambda \geq 0 \quad (3)$$

$$[d_o^{t+1}(x_{t+1}, y_{t+1})]^{-1} = max_{\phi,\lambda}\phi \quad s.a. \quad -\phi y_{i,t+1} + Y_{t+1}\lambda \geq 0, \quad x_{i,t+1} - X_{t+1}\lambda \geq 0, \quad \lambda \geq 0 \quad (4)$$

[4]The function distance shows the degree of efficiency of DMU in relation to the frontier technical reference.

[5]The subscript "o" in m_o and $d_o$means that the measure is oriented to output.

[6]For the case of variable returns to scale, it needs to insert an additional constraint of convexity ($\sum\lambda = 1$).

$$[d_o^t(x_{t+1}, y_{t+1})]^{-1} = max_{\phi,\lambda}\phi \quad s.a. \quad -\phi y_{i,t+1} + Y_t\lambda \geq 0 \quad x_{it+1} - X_t\lambda \geq 0 \quad \lambda \geq 0 \qquad (5)$$

$$[d_o^{t+1}(x_t, y_t)]^{-1} = max_{\phi,\lambda}\phi \quad s.a. \quad -\phi y_{it} + Y_{t+1}\lambda \geq 0 \quad x_{it} - X_{t+1}\lambda \geq 0 \quad \lambda \geq 0 \qquad (6)$$

where: *y* is a*MxI* vector of outputs; *x*is a *Kx1*vector of inputs; *Y* is a*NxM*matrix ofoutputsfor all *n* DMUs; *X* is a *NxK*matrix of inputsfor all *n* DMUs; λ is a vector weighting*Nx1* and ϕ is a scalar.The equations 3 and 4 evaluate the DMUswith the corresponding technology available. In the equations 5 and 6 production plans in a given period are compared with the technology of another moment in time, so that ϕneed not be greater than or equal to 1, as expected when calculating the efficiency in the current period (output oriented-resolution).

In this work, the Malmquist index admits variable returns to scale (VRS). This model evaluates distinct units that generate a large quantity of products and are likely to have diminishing returns, those producing low outputs, and possibly operating with increasing scale returns. Moreover, the analysis orientation to the *outputs*, where one tries to find the largest proportional increases in production given the use of *inputs*. To calculate the rate of productivity growth between 1996 and 2007, we adopt the Malmquist method of assessment with adjacent periods, i.e.: $m_0(x_{t+1},y_{t+1},x_t,y_t)$, $m_0(x_{t+2},y_{t+2},x_{t+1},y_{t+1})$, ..., $m_0(x_{t+n},y_{t+n},x_{t+n-1},y_{t+n-1})$.

Table 2 shows the initial set of variables selected to compose the productivity index. As the number of variables included as inputs and outputs is relatively large, it becomes essential to adopt a method to select the most relevant information for the study. Thus, we chose a principal component analysis (PCA), which is a statistical method commonly used when attempting to examine multivariate data.

Table 2: Variables Selected for Evaluation of Productivity of Public Health

Inputs		*Outputs*	
Code	**Variable**	**Code**	**Variable**
I1	Number of public hospital beds	*O1*	Total number of hospitalizations
I2	Number of doctors	*O2*	Total number of medical consultations
I3	Number ofnurses	*O3*	Number of clinical pathology tests
I4	Number ofauxiliary nursing	*O4*	Number of imaging exams
I5	Number oftechnical nursing	*O5*	Totalnumber of births
I6	Number of dentists		
I7	Number ofnutritionists		
I8	Number of pharmacists		

After examining the data through the PCA method, the first three main dimensionsexplainaround 98% of the variation in the global set of inputs.As for the products, the first two variables respond by almost 99.7% of output variation. Therefore,*(I1*, *I2, I3)* define the input vector and (*O1, O2)*expresses the output vector in this article.

3.2 Stage 2: Econometrics with Panel Data

The procedures described in the first stage allow for the calculation of the rates of productivity growth in the provision of public health for the period under analysis. Then, the equation 7 describes the model final estimated by panel data with random effects:

$$m_{it} = \beta_0 + \beta_1 \dot{Ds}_{it} + \beta_2 \dot{Cf}_{it} + \beta_3 \dot{Fr}_{it} + \beta_6 \dot{Po}_{it} + \beta_7 \dot{Ed}_{it} + \sum_{j=1}^{4} \alpha_j Reg_j + \beta_{10} dum_{Sc} + e_{it} \qquad (7)$$

where: m_{it} =TFP growth of public health; Ds = Decentralization of spending on public health; Cf = Cash flows, obtained by the ratio of own tax revenue and expenditure budget totals; Fr =Fiscal responsibility, given by the ratio of tax revenue and total revenue; Po = Poverty rate; Ed = Educational attainment, represented by proportion of population with 8 or more years of schooling.

In notation, the subscript *i* denotes the different DMUs and *t* denotes time. The dot above the variables expresses growth rates. The Reg_j are dummies for each region of Brazil, dum_{SC} represents another binary variable that includes the units that have changed the scale.

The signal of β_1, which represents the decentralization process, will indicate which argument is more appropriated for the Brazilian case: if $\beta_1>0$, the arguments in favor of decentralization are validated; if negative, the critics of the process in Brazil, like Campos (1998), will have more one signalization, when considering the period analyzed and current method.

The sources of data in this last stage areNational Treasury Secretariat (STN), Institute of Applied Economic Research (IPEA) and Ministry of Education from EDUDATA. The data covers the years 1995 to 2007. Nevertheless, in Stage 2 the evaluation is done by growth rates of all variables and the year 1996 becomes the starting point of analysis. Decentralization of the health service becomes more evident from the regulation of SUS under Laws 8,080 and 8,142 of 1990 as well as through the largest transfer of resources from fund to fund to subnational governments, especially from the approval of the NHS Basic Operational law of 1996. This has developed a dynamic analysis from this date.

4. Results

To calculate the Malmquist productivity index it was assumed that the technology employed by Brazilian cities has variable returns of scale, considering both the technical and socioeconomic heterogeneity of them. In general this indicator was negative, with an effective growth in only three years. To better display the results Table 3 shows the values grouped by region.

Table 3: Brazil and Regions – TPF growth of Public Health (in %) – 1996 to 2007

DMU	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	96-07
North	-2.20	-3.96	-1.39	-3.74	-2.93	-1.77	-0.63	0.95	-4.77	1.71	-2.97	1.04	-1.72
Northeast	-2.52	-4.71	-3.63	0.53	2.01	0.67	0.15	-1.47	-7.07	-0.94	0.98	-3.22	-1.60
Southeast	-6.85	3.82	1.26	-1.75	0.47	-0.21	-0.53	-0.95	-2.30	-0.76	-0.19	-4.11	-1.01
South	-0.14	-0.61	-0.14	-0.63	0.00	0.15	-0.44	-0.21	-16.39	-1.46	1.55	-0.97	-1.61
Midwest	-4.57	-5.28	-2.84	-2.63	-3.82	4.29	1.78	-3.69	-13.43	-1.83	-0.02	-4.75	-3.07
Brazil	**-4.14**	**-0.46**	**-0.80**	**-1.18**	**0.25**	**0.28**	**-0.17**	**-1.02**	**-6.67**	**-0.79**	**0.18**	**-3.03**	**-1.46**

Source: Authors' calculations.

In general, Table3 points out that health services showed a negative growth rate in productivity. On average, the rate of productivity growth was -1.46% for the entire national territory. The region with the lowest absolute percentage of decrease was the Southeast with about -1%. On the other hand, the Midwest, with -3%, was the region that showed reduced productivity of factors on public health. It is noteworthy that in 2004 there was a sharp decline in the growth of the Malmquist productivity index for the South and the Midwest, -16.39% and -13.43% respectively.

Taking into account the decomposition of the Malmquist index proposed by Färe*et al.* (1994b), Table 4 shows the average values from 1996 to 2007 of this index decomposed by Brazilian states and regions. In summary, such results indicate the decrease of productivity for all 27 units during the period analyzed[7].

[7]When the results of MT, ME and m_0 are greater than a unity there is a favorable change. When they are less than one there is an adverse alteration.

Table 4: Brazil, Regions and States – Decomposed Malmquist Index Average between 1996 and 2007

Region	TE	TC	m_o	Region	TE	TC	m_o
North	1.008	0.978	0.983	**Southeast**	1.008	0.986	0.990
Rondônia	1.000	0.979	0.979	Minas Gerais	1.000	0.995	0.995
Acre	1.059	0.962	1.001	Espírito Santo	1.037	0.983	1.011
Amazonas	1.028	0.951	0.972	Rio de Janeiro	1.032	0.942	0.958
Roraima	1.000	0.936	0.936	São Paulo	1.000	0.998	0.998
Pará	1.000	0.993	0.993	**South**	0.991	0.992	0.984
Amapá	1.000	0.995	0.995	Paraná	1.000	0.998	0.998
Tocantins	0.984	0.975	0.958	Santa Catarina	0.980	0.986	0.967
Northeast	1.003	0.982	0.984	Rio Grande do Sul	0.988	0.991	0.980
Maranhão	1.000	0.988	0.988	**Midwest**	1.025	0.955	0.969
Piauí	0.987	0.955	0.942	Mato Grosso do Sul	1.000	0.984	0.984
Ceará	0.991	0.996	0.988	Mato Grosso	0.995	0.982	0.977
Rio Grande do Norte	1.000	0.977	0.976	Goiás	1.030	0.950	0.971
Paraíba	1.025	0.964	0.982	Distrito Federal	1.075	0.907	0.942
Pernambuco	1.021	0.967	0.981				
Alagoas	1.018	0.949	0.965				
Sergipe	0.986	0.974	0.962				
Bahia	1.000	1.001	1.001	**Brazil**	1.005	0.983	0.985

Source: Authors' calculations.

Table 4evidences that there was an average decline of productivity in Brazil of 1.5% in that period. When looking at individual results, it is noted that the Espirito Santo had the highest total productivity growth in the sample, 1.1% on average, and that the change of efficiency to this location was mainly responsible for this result. Besides Espirito Santo, just two other places had a positive indicator, namely: Acre and Bahia, which together obtained a small 0.1% growth in productivity. The places with the worst average performance were Roraima, Piauí and Distrito Federal, with a decrease of 6.4%, 5.8% and 5.8% respectively. At the regional level, all the locations had a Malmquist score lower than one (1) indicating that there was a decline in productivity in the provision of health services provided by the public sector. The Midwest was the region that showed the greatest decrease in productivity (-3.1%) much higher than the average for Brazil (-1.5%).

The major problem showed by this analysis relates to the fact that all the locals, except Bahia, had a negative result in its technical change (TC), a sign that the technological frontier has not moved favorably within the range analyzed.

On the other hand the change in efficiency (TE) has had a much better performance than TC, since only about 26% of the local governments from Brazil had a negative score of change in efficiency. We observed that average between the years 1996 and 2007, the TC component dictated the behavior established for the yield index of public health in the country. Both TC and m reveal a downward trend at the lower end of the range. On the other hand, the TE component showed a more positive performance in the analysis.

4.1Econometric Evidences

Table 5indicates the estimation results of the econometric model, which present the marginal effects of explanatory factors from the dynamics of productivity on public health in Brazil. After holding various estimations, with the inclusion or exclusion of socioeconomic and control variables, a final model that showed greater robustness was reached. It should be noted that estimation of this model showed a satisfactory fit, indicating that the variables incorporated explain adequately the phenomenon under study.

Table 5: Factors Associated to the Dynamics of Productivity of Public Health

Variables	Coefficients	Standard Deviation	t-Statistic (prob.)
Federal Questions			
Ds	-0.0017***	0.0009	-1.91 (0.06)
Fr	0.1263*	0.0117	10.78 (0.00)
Cf	0.1350*	0.0198	6.80 (0.00)
Socioeconomic Factor			
Po	-0.3249*	0.0117	-27.87 (0.00)
Control variable			
Ed	0.1854*	0.0252	7.37 (0.00)
Brazilian macro regions			
North	2.6715*	0.4503	5.93 (0.00)
Northeast	3.0262*	0.7635	3.96 (0.00)
Southeast	10.2140*	1.5619	6.54 (0.00)
South	9.4414*	0.9323	10.13 (0.00)
Dummy of technological change	-7.0935*	1.0988	-6.46 (0.00)
Constant	-3.0654*	0.6790	-4.51 (0.00)
Number of Observations	312		
Number of Groups	26		

Source: Author's calculations.

The estimation results described in the table above have been achieved considering the model of regression on panel data of random effects.

The choice was based on the Hausman test, which revealed that the random effects estimator is consistent and efficient when compared with the fixed effects estimator. The total number of observation in panel is 312, with 26 units evaluated over a period of 12 years.

The dummy referring to the technological aspect of the municipalities as a factor in controlling the volume produced showed that decentralization caused by NHS can negatively affect the provision of public health, revealing that the size of the hospital influences the productivity indicator. The purpose of the incorporation of this dummy was to control the issue of change in the technological pattern from the decentralization of health. The model without this binary variable also captured the productivity of the DMUs that had no change in their returns to scale in the period.

Table 5 corroborates the intuition that large hospitals with decreasing returns to scale tend to have a higher level of productivity than the units of lower scale. From a regional perspective all the dummies were significant and the indicator of the productivity of public health care possessed a better relationship with the localities in South and Southwest, compared to the ones in the Northeast, North and Midwest. This result is interesting as it highlights that the performance of health care provisions is influenced by their geographical position, a clear sign of the great technical and socioeconomic disparities faced by Brazilian macro regions.

Another interesting feature that helps to better understand regional differences in productivity concerns the design of Brazilian fiscal federalism. As it is shown in Table 5, governments belonging to the North and Northeast have high dependence on transfers from the Union. Thus, as indicated by positive and significant coefficients of fiscal responsibility variables (Fr) and cash flows (Cf), where the DMUs that depend less on transfers tend to have greater accountability and efficiency in the provision of public goods.

The literature on health economics indicates that environmental factors, particularly socioeconomic factors, directly influence the productivity and efficiency of goods and services provided by the public sector. In this context it is interesting to note the marginal effect of the growth in the proportion of the poor (Po) on the performance of health services.

The results show that the greater level of education tends to generate less pressure on public health care through another channel: people with more education have higher profitability, which creates the possibility of them being covered by private health plans.

Concerning federal issues, the results showed that the performance of the DMUs in health provision has an inverse relationship with the decentralization of expenditures. It confirms the pessimistic expectations about the decentralization process as experienced by Brazil. The marginal effect found refers to the problems of sub-national governments in the country (either of a technical nature or a waste of resources), which probably caused the increased decentralization of expenditures, has not had the expected effect of increasing the productivity of health services.

It should be remembered, however, that Brazilian municipalities are undergoing a process of both technical and operational change. The decrease in productivity resulting from the decentralization of public health may be justified in terms of changes in returns to scale, as in recent years there has been a strong regionalization of service delivery. Another important fact captured in the estimates is that localities that have more fiscal responsibility and increased cash flows produced better results. Thus, federal units that do not have a typical behavior of fiscal free-rider tend to have better performances, given that they tend to worry more (people in positions of power and taxpayers) about the allocation of resources, which creates greater returns in efficiency and quality. We also emphasize that the most independent of intergovernmental transfers, therefore with a more adequate balance between benefits and burdens, can waste less resources in the provision of public health than those locations that keep the balance in disequilibrium.

5. Final Remarks

This study has tried to respond to whether increased decentralization of public health spending favored or not the productivity of this service in the Brazil. Given the facts presented, it was observed that the performance of the public health services reveals a negative relationship with the indicator of decentralization of spending in the area. This result was contrary to the vision in the so called decentralization theorem, which emphasizes gains in social welfare and efficiency when products are provided by local governments.

In this context, the critical view of Campos (1998) on the high level of wastage, technical and administrative insufficiency, corruption, nepotism and other problems faced by the management of local governments in Brazil can be a possible explanation for the results found.

Nevertheless, one must keep in mind that the process of decentralizing the provision of public health in Brazil has brought strong technological changes, as evidenced by the change of the returns to scale. Therefore, this technical move may have acted to impose at first a lower level of productive performance, since the hospitals have become more spatially decentralized and started to operate with increasing returns to scale, which might further generate greater resource and productivity savings.

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