Government Spending on Early Childhood in Brazil: Equity and Efficiency Challenges

Ignácio Tavares de Araújo Júnior
Departamento de Economia, UFPB
ignacio.tavares@gmail.com

Aléssio Tony de Cavalcanti de Almeida
Departamento de Economia, UFPB
alessiotony@gmail.com

Resumo

Este artigo estuda os principais determinantes do nível e da eficiência do gasto público municipal no desenvolvimento da primeira infância (ECD) no Brasil, um tipo de despesa pública de caráter redistributivo. Ao mesmo tempo em que fornece uma estimativa para os gastos em, esta análise evidencia quão redistributivo tem sido a despesa pública ECD no Brasil e o papel de variáveis fiscais e políticas sobre a distribuição das despesas voltadas para crianças nos municípios brasileiros. Os resultados mostram que os gastos em ECD são negativamente relacionados com a desigualdade de renda observada no município, não confirmando uma das previsões da teoria do eleitor mediano. Variáveis relacionadas ao ambiente político e fiscal, como a capacidade de gasto e volatilidade da receita tem impacto considerável sobre os gastos do ECD. Ademais, os resultados sugerem que as preferências dos políticos para gastar mais em ECD são relacionadas às necessidades locais. Na a análise de eficiência, os resultados mostram que os municípios que operam em um melhor ambiente socioeconômico (maior renda per capita e menor desigualdade per) pode alocar de forma mais eficiente os seus recursos para a primeira infância.

Palavras-Chave: Primeira infância; Gasto Público; Eficiência.

Abstract

This paper studies the main drivers of the level and efficiency of municipal spending in Early Childhood across Brazilian municipalities. At the same time that provides an estimate for ECD spending, this analysis evidences how redistributive has been the public ECD spending in Brazil and the role of fiscal and political variables on the distribution of expenses geared to children across Brazilian municipalities. The study also highlights important local features that explain why some municipalities attain better outcomes than other using the same amount of resources. The results show that ECD spending is negatively related to income inequality, do not confirming one of the predictions of the median voter theory. Political and fiscal variables, like spending capacity and revenue volatility have considerable impact on ECD spending. With respect the responsiveness to local needs, ECD spending is higher in the municipalities which presented higher illiteracy rates in 2000, suggesting, politicians preferences were linked to the perceived local needs for ECD services. In the efficiency analysis, the results show that the municipalities operating in a better socioeconomic environment (higher per capita income e lower inequality) can more efficiently allocate their resources to early childhood.
Key-words: Early Childhood Development; Public Spending; Efficiency.

JEL: H51, H52, H53.

AREA DA ANPEC: **ÁREA 5 - ECONOMIA DO SETOR PÚBLICO**

1. Introduction

Investments geared towards Early Child Development (ECD) should be a priority policy in developing countries. As pointed out by Heckman and Masterov (2007), ECD policies can increase productivity in the economy and reduce inequality. According to the authors, investing in young children who grow up in disadvantaged environment is a rare public policy with no equity-efficiency trade-off. Other studies, like Campbell *et al.* (2008), Berlinski et al. (2009), Burger (2010), Nores and Barnett (2010) and Belfield and Kelly (2013), also evidence the impact of early childhood interventions on cognitive skills and health outcomes.

In Brazil, since the nineties, indicators related to early childhood development significantly improved. The child mortality rate[1], for example, decreased, on average, from 46.6 in 1991 to 18.8 in 2010; almost all children between 6 and 14 years old were in school in 2010 and the school attendance for children up to 5 years old has significantly increased. In effect, according to Evans and Kosec (2012), Brazil's government policy over the last 20 years can be broadly characterized as "prochild", given the new laws approved benefiting children[2] and the creation of FUNDEF and FUNDEB which increased the education revenue in Brazilian Municipalities.

Given the decentralized structure for offering pre-primary and primary education and basic health services, in Brazil municipal governments are the major responsible for ECD services provision. The national government programs benefiting the children represent just a small portion of the services provided to this population. To show this, in 2012 81% of all enrollments in the first to fifth grade are in public schools are under municipal management[3]. Moreover, students up to 10 yeas (daycare, pre-primary and first primary) account for 70% of total enrollment in municipal schools. Concerning the public health care services, approximately, 92% of all consultations and medical procedures up to age group of ECD were managed by municipal governments in 2012. In fact, this increase of the services towards the children is reflected in municipal public spending. According to the National Treasury Office (Secretaria do Tesouro Nacional), the municipal spending in ECD services rose almost 90% between 2004 and 2012. It is worth noting that at the same time that some municipalities present very low mortalities rates other municipalities in Alagoas and Maranhão, for example, present child mortality (under 5 year) rate like 50.94 and 49.26[4]. Furthermore still in 2010, 76.5% of children between 0 and 3 years old in Brazil were not attending school. For families in the lowest decile of household earnings, this rate is 83%.

This context of increase of ECD spending and the existence of localities and individuals demanding additional effort from municipal governments in the provision of more and better services towards the children motivates new researches to understand how responsive has been ECD spending to inequality and local needs across Brazilian municipalities. Despite the theoretical predictions of the median voter theory on how large must be redistributive public spending according to local high income inequality, there are some empirical studies not supporting the positive relationship between redistributive public spending and inequality, like Peroti (1996) and Mello & Tiongson (2006). Assessing whether the differences of ECD spending across municipalities reflects the differences on inequalities or not helps to understand how public spending is contributing to reduce the differences of interpersonal income inequality in Brazil.

Moreover, even if the ECD spending is oriented by local needs, the local government programs for the children may not attain its goals. Campos (1998) points out that the decentralization process in Brazil are subject to several risks, given the unpreparedness of municipal governments in terms of administrative capacity, shortage of technical resources, corruption etc. A clear consequence of such unpreparedness is the reduction of efficiency of public spending, including those geared towards ECD services. In this scenario, even with the sophisticated normative basis created in Brazil in the last twenty years for funding ECD spending, more resources to education and health not necessarily would induce improvements for children.

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[1] Rate of death of infants and children under the age of five per 1000 live births.

[2] Statute for Children and Youth and Law of Directives and Bases of National Education (LDB).

[3] According to the Censo Escolar data, from the Ministry of Education.

[4] These are the Municipalities of Brejo de Areia(Alagoas) and Roteiro(Maranhã). Based on the Atlas do Desenvolvimento Humano, PNUD, 2014.

Then, besides providing an estimate for ECD spending, this study presents an econometric exercise aiming to know the drivers of ECD spending across Brazilian municipalities. This analysis can provide evidences on how redistributive has been the public ECD spending in Brazil and the role of fiscal and political variables on the distribution of expenses geared to children across Brazilian municipalities. This paper also aims to assess the efficiency level of municipal expenditures on ECD services for education and health care in Brazil, as well to study the determinants of this efficiency. For the determinants of efficiency level, we consider, particularly, factors relating to socioeconomic characteristics, institutional dimension and locational issues of Brazilian municipalities.

In addition to this introduction this paper has six more sections. The following section describes the used methodology to calculate ECD spending across Brazilian municipalities. The third section presents the methodology to study the determinants of ECD spending, the efficiency analysis of municipal ECD spending across Brazilian municipalities and the investigation of the determinants of efficiency of ECD spending. In the fourth section, the results are discussed. The last section presents some conclusions.

2. An estimate for the municipal ECD spending in Brazil

Estimating public ECD spending in sub-national or national level is a challenging task, mainly due to the difficulty to know whether the spending exclusively benefits children or not. The classification of Public Spending by Function and Sub-Function indicates which services and goods the government offers, but does not enables evaluating which individuals benefit from the public spending. Although more detailed, the Public Spending by program, when it is available, neither provides sufficient information to know whether the spending is being targeted to children only. For example, in the spending demonstrations of the Federal Government in Brazil, the spending in the Family Health Program (PSF) it is not split by age or by social group. According Vargas & Sabatiñes (2010), in Latin America Countries, given the difficulties for obtaining data on ECD investments, the usual indicator for ECD spending is just preprimary spending.

Contributing to bridge this information-gap, this study provides an estimate of ECD public spending across Brazilian municipalities, considering the definition for ECD age group children between 0 and 14 years old. The adopted strategy in this study relies on the assumption that total ECD spending comprises relevant actions in Education, Health and Social Assistance sectors. In this study, the public spending on ECD of Brazilian municipalities will be estimated using data gathered from a yearly publication of the Brazilian National Treasury Office (STN) called *Finanças do Brasil* or simply FINBRA. This database presents information on annual receipts and expenditures of Brazilian Municipalities. The functions and sub-functions are the same as the earlier considered and the period will be the same (2004-2012). Specifically, it will be considered the spending data reported in the Functions Education, Health, Social Assistance. In Brazil, all municipalities adopt the same classification of public spending by function and sub-function. Then there is some basis for comparability across municipalities for the public spending in these three areas.

In the Function Education, the sub-function **Pre-primary** (*Educação infantil*) comprises all spending on education of children between 0 and 5 years old. The spending subcategory **Primary** (*Ensino fundamental*) includes expenses on education of children and adolescents between 6 and 14 years old. In the Function Health, the sub-functions **Primary Health-Care** (*Atenção Báscia*) and **Food and Nutrition** were considered to calculate the ECD spending. In the sub-function are reported expenses with the Family Health Program, as pointed out earlier, an important program for reducing infant mortality rate in Brazil. In the sub-function Food and Nutrition it can be include any program that aims to reduce or eliminate nutritional deficits. The actions may also aim to guide the population about nutritional values of foods, and supplement food deficiencies among population or among specific groups such as children at school age, nursing mothers and their infants.

In the function Social Assistance, the sub-function **Child Assistance** (*Assistência à Criança*) may be considered an ECD spending. This sub-function may comprise the actions undertaken to support and protect children and adolescents, providing care for the attainment of their basic needs.

It is worth noting that, the spending reported in the sub-functions Primary Health Care and Food and Nutrition are not exclusive for children. In order to estimate the portion of the spending oriented to

children, the expenditure of the sub-function Primary Health Care will be weighted by the share of consultations of children up to fifteen years old[5] in the number of consultations of PSF during the period 2004-2012. This approach captures the fact that the number of consultations of children in the PSF has been growing over the years, and supposedly the resourses geared towards the population under analysis. Equation 1 presents how ECD spending will be calculated by municipality in Brazil

$$S_{it}^{ECD} \approx W_{it} \times (PH_{it} + FN_{it}) + IE_{it} + PE_{it} + SA_{it}, \qquad (1)$$

Where: $\boldsymbol{S_{it}^{ECD}}$ = Estimate of Total Spending on ECD of the municipality i in period $\boldsymbol{t}$; $\boldsymbol{W_{it}}$ = Share of consultations for individuals up to 15 years old in the municipality i in period $\boldsymbol{t}$; $\boldsymbol{PH_{it}}$= Public Spending in the sub-function Primary Health Care of the municipality i in the period $\boldsymbol{t}$; $\boldsymbol{FN_{it}}$ = Public Spending in the sub-function Food and Nutrition of the municipality i in the period $\boldsymbol{t}$; $\boldsymbol{IE_{it}}$= Public Spending in the sub-function Pre-Primary Education of the municipality i in the period $\boldsymbol{t}$; $\boldsymbol{PE_{it}}$ = Public Spending in the sub-function Primary Education of the municipality i in the period $\boldsymbol{t}$; $\boldsymbol{SA_{it}}$ = Public Spending in the sub-function Child Assistance of the municipality i in the period $\boldsymbol{t}$.

To take into account regional prices differences, the ECD spending by municipality will be deflated to 2011 using regional INPC price index. To avoid accounting inconsistencies and due to the incompatibility of the data of different sources, some municipalities were excluded from the sample. In summary, the main reasons for exclusion were: We excluded municipalities which presented zero values for education and health spending; the municipalities that declared expenditure on education or health care higher than total spending were also disregarded; as the estimation of ECD spending involves connections of the financial information of municipalities with data on the number of consultations for the ECD age group, this process also resulted in a loss of information. The municipalities which presented small number of consultations per year, compared to the other similar municipalities were excluded from the sample.

Table 1 shows the total ECD spending across Brazilian Municipalities between 2004 and 2012. The values were deflated and are expressed in 2011 prices. Within these period, ECD spending increased from R$ 43.70 billion to R$ 81.75 billion, which represents a growth of 87% in eight years. In spite of this high growth rate of ECD spending, the share in the total spending in Brazilian municipalities stays around 24% between 2004 and 2012 (see Table 1). It means that other public expenses have also grown in same the proportion. Hence, apparently the expansion of municipal ECD spending seems to be just a part of a process of public spending raise rather than as expansion in recognition of the potential contributions that ECD spending growth can bring about.

Table 1: Municipal ECD spending in Brazil: Total, share on local spending and composition

Year	Total Municipal ECD spending (R$ billion)	Share of ECD spending on total municipal spending (%)	Composition of ECD spending of Brazilian Municipalities (%)		
			Education	Health	Social Assistance
2004	43.70	24.00	84.6	12.5	3.0
2005	43.61	25.28	85.3	11.7	3.0
2006	51.67	24.19	85.3	11.9	2.8
2007	63.49	24.36	87.5	10.0	2.5
2008	66.44	24.33	87	10.7	2.4
2009	75.03	25.20	87.2	10.5	2.3
2010	83.45	24.56	87.1	10.4	2.5
2011	80.1	24.50	87.9	9.8	2.4
2012	81.75	23.98	88.0	9.7	2.3

[5] The number of attended patients was gathered in DATASUS database. DATASUS is a data system supported by the Ministry of Health, which register information (including age) on the patients collected by all attention health units. The official information about consultations is available in nine age group: under 1 year old; between 1 and 4 years old; between 5 and 9 years old; between 10 and 14 years old; between 15 and 19 years old; between 20 and 39 years old; between 40 and 49 years old; between 50 and 59 years old; above 59 years old.

Source: STN, INEP, DATASUS and CENSUS, Authors elaboration.

According to Table 1, spending on education accounts for 88% of total ECD spending in 2012, followed by health and social assistance expenditures. The data also reveal that, the share of education spending increased 3.4 percentage points within the period. The impact of the FUNDEB in 2007 is visible in this data. In effect, after 2006 the share of Education Spending raised by 2.2 percentage points. Concomitantly Health spending participation decreased almost 2 percentage points.

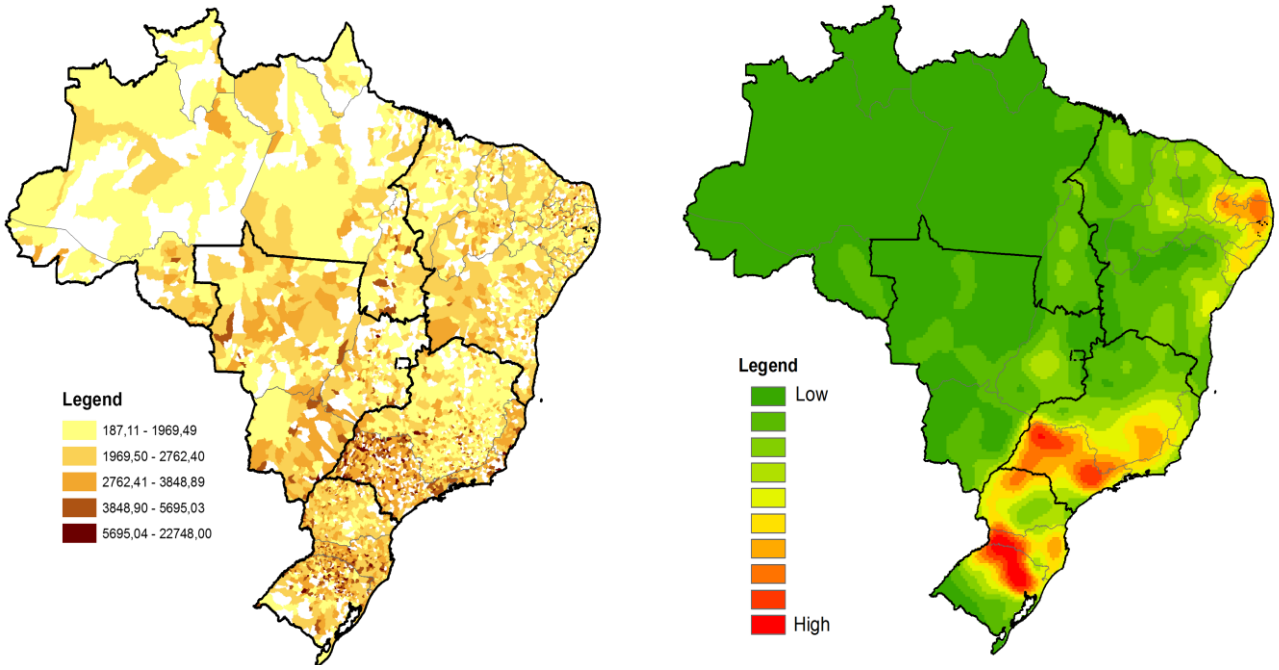
Table stands for the descriptive statistics of per child ECD spending across municipalities. North region presents the smallest average of per child ECD spending (R$ 2,569 per child or US$ 1,167) in Brazil, followed by Northeast region (R$ 2,945 per child or US$ 1,339). Both regions present the highest poverty rates in Brazil and high income inequality (see Table). Contrasting with this situation, in the South region, where poverty and inequality is low, it is noticed the largest average of per child ECD spending.

Table 2: Descriptive statistics for ECD spending and social indicators

Region	Mean (R$)	Minimum (R$)	Maximum (R$)	Standard deviation	Poverty rate (2010)	Gini index (2010)
North	2,568.78	7,247.12	589.53	1,075.26	27.53	0.514
Northeast	2,945.18	9,198.44	758.42	842.42	30.83	0.542
Southeast	3,401.75	22,748.00	997.27	1,758.95	8.03	0.505
South	3,714.86	14,153.06	1,303.16	1,449.28	7.49	0.468
Midwest	3,127.13	15,686.54	396.25	1,319.45	6.74	0.531
Total	3,252.44	22,748.00	396.25	1,409.37		

Source: Authors elaboration from STN and CENSUS.

Figure 1: Municipal ECD spending per child: average and Kernel Density



Source: STN and CENSUS, Authors elaboration.

These regional differences in ECD spending are depicted Figure 1. The map portrays the per child ECD spending across the considered Brazilian municipalities. In the North region, a great part of municipalities spend less than R$1,969.49 per year in ECD. In the southern municipalities, the frequency of municipalities spending more than R$3,848,89 becomes considerably higher. The kernel density map (Figure 1) shows where are concentrated the municipalities with the highest per child ECD spending, considering the distance among municipalities and the spending level. In the States of São Paulo, Rio

Grande do Sul and Santa Catarina we can observe the largest concentration of high-ECD spending municipalities.

3. Methodological approach

3.1 Determinants of ECD Municipal Spending

The literature on the determinants of public spending grounded on the median voter theorem (see Sanz & Velasquez (2002) and Mendes & Sampaio (2006), Rocha et al. (2012)) suggests a number of local characteristics to be included as explanatory variables, like population, median income, tax rates and other controls. Besides considering all these variables, the responsiveness of ECD spending to local needs for ECD provision will be analyzed. The local needs will be represented by outcomes associated to the scarcity of ECD services provision[6]. This approach relies on the hypothesis that marginal utility of public goods is decreasing. Put differently, despite heterogeneity of individuals' preferences, the population would be better off if, for example, mortality rate among children and illiteracy rate are the smallest as possible. The diminishing marginal utility hypothesis means that the scarcer are the ECD services, the more preferable will be the additional provision ECD related public services. Because these preferences are supposed to be shared with politicians, the public ECD expenditures would be larger where the provided ECD services is not enough to generate the desirables health and education outcomes. Based on these arguments Skidmore and Deller (2008) argues that Public Spending may converge to a common level (absolute convergence) or to different levels (conditional convergence).

Following the adopted approach of Mello and Tiongsnon (2006) to capture the relationship between redistributive government spending and inequality, the current ECD spending will be explained by the lagged levels of income inequality represented by the gini coefficient. To capture some non-linearity on the relationship between public spending and inequality, as proposed by Bénabou (2000).

The political environment of the municipality will be represented in the model by some characteristics of the mayor like education level, whether he was reelected or not, political party affiliation and whether the municipality receives revenues from agreements with federal and state government. These last two variables may suggest to what extent the national and sub-national political alliances would result more revenues to the municipality, besides those prevue by law. Variables measuring fiscal decentralization of the municipality, like spending capacity, will also be included in the model.

Three models will be estimated. In the first one, the total per child ECD spending in (in logarithm) is the dependent variable. In the second and third models, the estimates will show the determinants of per child ECD spending in Education and health. Equation 2 presents the general structure of the models to be estimated.

$$\ln s_i^{ECD} = \beta_0 + \beta_1 \ln N_i + \beta_2 \ln {N^2}_i + \beta_3 \ln y_i + \beta_4 gini_i + \beta_5 gini_i^2 + \gamma \boldsymbol{L} + \sum_{j=6}^{n} \beta_i X_{ji} + \varepsilon_i \quad (2)$$

Where s_i^{ECD} is the average per capita ECD spending, ln *N* is the local population in 2010, y_i is the median per capita income, *gini* is the gini coefficient in 2000 of the municipality *i.* The vector L indicates the local needs for ECD spending. In the first equation, the vector L contains the illiteracy rate among 11 to 14 years old individuals in 2000, an outcome of the provision of education to children in the municipality; mortality rate among children up to five years old in 2000 and poverty rate among children. For the education spending equation, L is the illiteracy rate among 11 to 14 years old individuals in 2000 and for the health spending equation, L is the mortality rate among children up to five years old in 2000. In all cases, if the parameter estimate γ is positive, thus ECD spending is acting to reduce welfare inequality across Brazilian municipalities. If the estimate for this parameter is negative, thus ECD spending may be widening welfare inequality, once the municipalities presenting the largest mortality, illiteracy and poverty rates are those who has been spent less in ECD provision.

[6] The responsiveness of public investment to local needs was studied by Faguet (2004).

The variable X_i is a vector containing political and fiscal decentralization variables and controls which includes variables like age structure of population, demographic density and distance to capital and dummies for each State.

Table 3 stands for the explanatory variables and their sources. The analysis will be carried out using the average of estimated Education and Health ECD expenditures between 2007 and 2011 previously estimated. Then, the results capture the fact that a given municipality traditionally spends more on ECD services. The data on Education spending was deduced from the FUNDEB transfers. Remembering the distribution of the FUNDEB depends on the number of enrolments in Basic Education system. Disregarding the FUNDEB resources, the Education spending level becomes more dependent on the municipal administration decisions. Some of the explanatory variables are for 2010 (given CENSUS information) and 2011. Continuous covariates, like spending capacity, transfers from Federal and State government were also averaged over the period 2007-2011.

The tree versions of Equation 2 will be estimated using two stage least squares, considering that 2000 municipal median income is an instrument for 2010 median income. This is because 2010 municipal median income may be an endogenous variable, partially determined by public spending. The instrument is correlated to 2010 median income, however is not determined by current public spending.

Table 3: Description of variables for the regression models

Variables	Period	Source
Dependent		
ECD spending on Education per child (Average of the last five years)	2007-2011	CENSUS and STN
Total ECD spending per child (Average of the last five years)		
ECD spending on Health Care per child (Average of the last five years)	2007-2011	CENSUS and STN
Covariates		
Population and Population^2	2010	CENSUS
Median income	2000	CENSUS
Gini Index and squared GINI	2000	CENSUS
Lagged variables		
Mortality rate	2000	CENSUS
Poverty rate among children	2000	CENSUS
Illiteracy rate	2000	CENSUS
Education and Health policies		
Average rate of enrollment	2011	IBGE
Number of consultations of children up to 5 years	2007-2011	DATASUS
Number of Dentists/1,000 habitants	2011	IBGE
Political variables		
Re-elected mayor	2007-2011	IBGE
Mayor education	2009-2011	IBGE
Primary formation		
Secondary formation		
Tertiary formation		
Equal Federal Government Party	2009-2011	IBGE
Equal State Government Party	2009-2011	IBGE
Margin of victory in the election	2008	TSE
Earmarked Transfers from Federal Government	2007-2011	STN
Earmarked Transfers from State Government	2007-2011	STN
Voter turnout		
Fiscal Decentralization		
Share of taxes (locally tax collection/total revenue)	2007-2011	STN
Revenue volatility	2007-2011	STN
Spending capacity (total municipal spending/locally tax collection)	2007-2011	STN
Controls variables		
Group age (composition)	2010	CENSUS
Population equal or below5 years old*		
Population between 6 and 10 years old		
Regional dummys (south-east as reference	-	Authors elaboration
Urbanization rate		
Distance to State's capital	2010	CENSUS

Source: Authors Elaboration.

3.2. Efficiency of ECD municipal spending in Brazil

Data Envelopment Analysis (or DEA) approach will be used to calculate efficiency scores of municipal ECD public spending. DEA is as successful approach to calculate efficiency, and, as pointed out by Cooper, Seiford and Zhu (2011), DEA method is widely used in various sectors and products in different countries. The DEA method, introduced by Charnes, Cooper and Rhodes (1978), uses a nonparametric approach for calculating the efficiency frontier. The DEA method measures the relative performance of similar Decisions Maker Units (DMU) comparing the ratio between outputs[7] and inputs, generating a single indicator of performance for each DMU. In our work, the municipalities are defined as DMU, due to municipal government is the main responsible by supply of basic services to ECD.

The DEA model to be used in this study is an extension of DEA containing an iterative resampling process[8], known as bootstrap (see Simar and Wilson, 1998, 2000, 2011). This DEA technique minimizes the bias in the estimation of the efficiency indicator and allows the construction of confidence intervals for the efficiency score, as can be seen in Equation 3. From a K resampling process, the efficiency score for each DMU is calculated K times, providing an estimator $\hat{\theta}_k^{*DMU_0}$ (with $k = 1, \dots, K$), in which this score is calculated by pseudo observations from bootstrap approach: $\hat{\theta}^{*DMU_0} = K^{-1} \sum_{k=1}^{K} \hat{\theta}_k^{*DMU_0}$. Obtained the set of bootstrap values, the confidence interval (CI) of the true θ can be estimated by the empirical distribution of the estimates of pseudo efficiency scores, and then the bootstrap approximation for the true CI is given by:

$$\Pr\left(\hat{\theta}^{DMU_0} - \hat{\delta}^{DMU_0} \leq \theta^{DMU_0} \leq \hat{\theta}^{DMU_0} + \hat{\delta}^{DMU_0}\right) \approx 1 - \alpha \qquad (3)$$

Where: θ is the "true" efficiency indicator, $\hat{\theta}$ is an estimate of the efficiency indicator, $\hat{\delta}$ is the margin of error estimated by bootstrap process, α is the significance level. Based on the confidence interval estimator for efficiency $CI[\theta, (1 - \alpha)] = \hat{\theta} \pm \hat{\delta}$, obtained using the resampling process, it is possible to calculate a robust efficiency index less sensible to outliers in the data. Moreover, it is also possible to find the size of the bias of the efficiency estimate: $BIAS_k(\hat{\theta}) = E(\theta^*) - \hat{\theta}$.

The Equations 4 and 5 define the production functions for education and health services[9]. The description of the inputs and outputs included in the production function is in Table , where the outputs indexed with "a" were inverted (this was done to maintain the positive relationship between inputs and outputs). In all cases, the vector of inputs ($\vec{x}$) is formed by only one variable, which corresponds to the health and education ECD spending per child in average of last five years (2007 to 2011). All data are at municipal level. The period of the input variables cover the years 2007 to 2011 and the output variables are for 2011. We will use average expenditure on ECD over the years in order to consider the consistency of the resources invested in the area, as well as to take into account the fact that the investments do not generate immediate effects on ECD outcomes.

Education Production Function: $\vec{y}(ALS_i, AMS_i, RTSA_i, SII_i, TFT_i) = x\left(S_{Ei}^{ECD}\right)$ (5)

Health Production Function: $\vec{y}(IMTR_i^a, CMTR_i^a) = x\left(S_{Hi}^{ECD}\right)$ (6)

Given the heterogeneity among Brazilian municipalities, we assume that the production function exhibit variable returns to scale (VRS). VRS enables evaluating the differences between DMUs which have great quantity of inputs/outputs (likely operating with decreasing returns) and DMUs with few inputs/outputs (operating, e.g., with increasing returns). Furthermore, the efficiency score for each DMU has been calculated in an output-orientated perspective. The choice for output-orientated DEA, supposes that municipalities can improve efficiency obtaining higher output levels for a given level of per child

[7] Here, the output term is more generic, because it corresponds also the outcomes variables like learning indicator for education and mortality rates for health sector.

[8] We use the package for Frontier Efficiency Analysis with R (FEAR) to calculate the efficiency scores – see more details in Wilson (2008).

[9] The efficiency analysis is carried out considering only health and education ECD spending. Social Assistance spending was excluded because more than 1,421 municipalities did not report this type of expenditure or reported zero real (R$ 0.00), and many locations also declared child assistance costs close to zero.

expenditure. In an input-oriented perspective, efficiency would be improved, for example, reducing per child ECD spending, for a certain output level.

The choice of the variables that represent the outputs of the production functions for ECD services was based on Vegas & Santibañes (2010), which enhance three key outcomes generated by ECD policies: cognitive development, socio emotional development and physical well-being and growth. Table presents the input and outputs to be used in the efficiency analysis. The variables that are included as outputs in the educational production function have three dimensions: learning, enrollment and school quality. The first dimension is represented, respectively, by language and mathematic scores in *Prova Brasil* in the fifth grade of Primary school. The dimension of pre-primary coverage is composed by the rate of school attendance for children between 0 and 5 years old, which indicates the public sector attention with the kindergarten and pre-school[10]. The last educational dimension is formed by proportion of teachers with third degree in the pre-primary and elementary school and school infrastructure index, including variables like lab, gym, library and computers for students[11]. We consider mortality rates as outcomes in the Health production function (see Table for more details).

Table 4: Description of inputs and outputs used in the efficiency analysis[12]

		Variables	Source (Responsible)
		Input	
Education	**$SECD_E$**	ECD spending on Education per child (average of the last five years – 2007 to 2011)	Finbra (STN) and *Census* (IBGE)
		Output	
		Learning indicators	
	ALS	Average of Language score in 5th grade of Elementary school in a national test	*Prova Brasil* (INEP)
	AMS	Average of Math score in 5th grade of Elementary school in a national test	*Prova Brasil* (INEP)
		Pre-primary coverage	
	RTSA	Rate of school attendance for children between 0 and 5 years old	Census (IBGE)
		Indicators of School quality	
	SII	School infrastructure index, including variables like lab, gym, library, computers for students etc.	Authors calculation from *Censo Escolar* (INEP)
	TFT	Proportion of teachers with third degree in the Pre-primary and Elementary school	*Censo Escolar* (INEP)
		Input	
Health care	**$SECD_H$**	ECD spending on Health Care per consultations (average of the last five years, 2007 to 2011)	Finbra (STN) and SIA (DATASUS)
		Output	
		Mortality indicators	
	IMTR	Infant mortality rate (Deaths per 1,000 Live Births) - under 1 year old	*Sistema de Informações sobre Mortalidade* (SIM) and *Sistema de Informações sobre Nascidos Vivos* (SINASC)
	CMTR	Child mortality rate (Deaths per 1,000 Live Births) - under 5 years old	SIM and SINASC

Source: Authors elaboration.

[10] As shown by Conti, Heckman and Urzua (2010), investments in preprimary education has positive effects on student academic performance in other stages of education, including health benefits for individuals. Therefore, there is no trade-off between the expansion of care in preprimary education and school outcomes in primary education.

[11] To calculate the SII index was used the following procedure: $SII_{ns}^{m} = \frac{1}{S}\sum\left(\frac{\sum_{n=1}^{N} Z_n}{\max(\sum_{n=1}^{n} Z_n)} \times 100\right)$. Where: N is the total number of infrastructure items; S represents the total number of schools in the municipality m; Z é a binary variable, with $Z = 1$ if there is the resource to aid learning, $Z = 0$ otherwise. The index ranges from zero (not exist any resource to aid learning) to one hundred (there are all resources). For SII were considered the existence of the following: science lab, computer lab, sports court, special care room, library, reading room and facilities for people with special needs, computers available for students and internet.

[12] The variable rate of underweight children with less 2 years old (weight below the third percentile - lower curve - of the weight curve for each specific age) can't be included in the production function (Equation 3), because this variable had a great number (2,013 observations) of missing values.

The excluded outliers are those units located in the area above the average plus (or less) 2.575 standard deviation of the average health and education spending. Imposing this restriction to the data, the number of DMUs used to calculate efficiency on education is 3,977 municipalities, representing about 72% of all Brazilian municipalities. In this sample, the annual average of per child ECD expenditure on education is R$ 2,158.83. The number of municipalities for evaluating the technical efficiency of health services is 3,737 units, and the average of per child ECD spending on health (basic attention) is approximately R$ 259.87.

3.3 Determinants of Efficiency

In the econometric approach to be used here, we consider variables related to institutional, socioeconomic and locational issues of municipalities. As it was seen throughout this study, socioeconomic and locational issues influence the provision of services for early childhood. According to Naritomi et al. (2012), the institutional dimension, in particular, has a prominent role in Brazil, due to the formal components that define the rules of implementation process and financing of the public services, and affect the peculiarities involved in the definition of local institutions and the distribution of political power. Considering the data structure, that consists in a cross section of Brazilian Municipalities, and the peculiarities of dependent variable (censored at 0 and 1), the econometric model used was a Tobit regression. The dependent variable of the model is the efficiency score (unbiased) obtained through DEA-BCC with 1,000 resampling for the municipal spending used in early childhood development.

The model equation has the following structure:

$$\theta_i^s = \alpha_0 + \sum_{k=1}^{K} \alpha_k \, ID_{ki} + \sum_{l=K+1}^{L} \alpha_l \, SE_{li} + \sum_{m=L+1}^{M} \alpha_m \, LD_{mi} + u_i \qquad (5)$$

Where: θ_i^s means the ECD spending efficiency score of the area *s* (education, health care) in the municipality *i*; ID represents the vector of institutional variables; SE is the vector of the socioeconomic characteristics of the municipality *i*; LD represents the dimension of locational factors. Table 5 presents the description in detail of the variables used in this analysis[13].

Table 5: Description of the variables used to estimate the determinants of technical efficiency in education and health care

Variables	Source
Dependent	
Efficiency score of ECD spending on education	Authors Elaboration
Efficiency score of ECD spending on Health care	Authors Elaboration
Covariates	
ID - Institutional dimension	
Revenue volatility: Ratio between the standard deviation and mean of total revenue	STN (2004-2011)
Specific Transfers (Agreement resources) per capita: education (FUNDEB)	STN (2004-2011)
Specific Transfers (Agreement resources) per capita: health care (SUS)	STN (2004-2011)
Total municipal spending per capita	STN (2004-2011)
Re-elected mayor	IBGE (2009-2011)
Mayor education	IBGE (2009-2011)
Voter turnout	Superior Court Election (TSE)
Political competition (margin of victory in the election)	TSE
Rate of valid votes	TSE
SE – Socioeconomic characteristics	
Per capita Income	CENSUS (2010)
Index of inequality income (Gini Index)	CENSUS (2010)
Proportion of individuals with tertiary school (equal or above 25 years old)	CENSUS (2010)

[13] We use the average values of the covariates: for example, information on revenue volatility is established by the average between 2004 and 2011.

Illiteracy rate of people between 11 and 14 years old	CENSUS (2010)
Population Groups	CENSUS (2010)
Demographic density	CENSUS (2010)
Composition of population equal or below 5 years old	CENSUS (2010)
Rate of enrollments in Private School (average)	INEP (2007-2011)
Rate of enrollments from students of the rural area (average)	INEP (2007-2011)
Urbanization rate	CENSUS (2010)
LD – Locational dimension	
Distance to State's capital	CENSUS (2010)
Regional dummies	Authors Elaboration

Source: Authors elaboration.

4. Results and discussions

4.1 Determinants of Education ECD spending

The estimates of the coefficients of the main variables of equation 3 are shown in Table . It is also shown the standardized coefficients of each model. Due to the spending in education represents almost 80% of total ECD spending, the results of the first and last morel are very similar. In general the results for all models suggest a U-shaped relationship between per child ECD expenditures and population. Per child ECD spending may be high in small cities, due to the fixed costs of education and health services. As the population growths and also the scale of ECD services provision, the per capita expenditures decrease. The upward trend for the per capita spending may occur because in the largest cities, education and health are more expensive. These results also mean that the smallest and the biggest municipalities have the similar per capita ECD spending. The standardized coefficients show that if Population increase by one standard deviation, logarithmic of total per child ECD spending would decrease 3.07 standard deviations. According to the standardized coefficients, population variables are those who most impact on ECD spending among all considered models.

Table 6: Estimate results for the determinants of Education ECD spending

Covariates	Total ECD Spending		Health ECD Spending		Education ECD Spending	
	Coefficients	Std. Coefs.	Coefficients	Std. Coefs.	Coefficients	Std. Coefs.
Population	-1.0027***	-3.07	-1.310***	-2.33	-1.4889***	-2.75
Population^2	0.0403***	2.42	0.048***	1.66	0.0577***	2.10
2000 Per capita median Income	0.1205***	0.18	0.185***	0.16	0.3998***	0.35
2000 Gini Index	-2.2959***	-0.43	0.505	0.05	-3.4115***	-0.38
2000 (Gini Index)^2	2.1853***	0.45	-0.372	-0.04	3.1951***	0.40
Re-elected mayor	-0.0135*	-0.02	0.003	0.00	-0.0207*	-0.02
Mayor education: Primary formation	0.0096	0.01	0.011	0.00	0.0253	0.01
Mayor education: Secondary formation	0.0306*	0.04	0.028	0.02	0.0586***	0.05
Mayor education: Tertiary formation	0.0256	0.04	0.014	0.01	0.0627***	0.05
Equal Federal Government Party	-0.0307**	-0.03	-0.042	-0.02	-0.0093	0.00
Equal State Government Party	0.0249***	0.03	0.032	0.02	0.0342***	0.02
Margin of victory in the election	0.0014***	0.07	0.001***	0.04	0.0020***	0.06
Voter tournout	0.0019*	0.03	-0.000	0.00	.0054384 ***	0.62
Transfers from Federal Government	0.0010***	0.00	-0.000	-0.01	0.0000	0.00
Transfers from State Government	-0.0000	0.07	0.002***	0.08	0.0017***	0.07
Share of taxes	0.3218*	0.05	0.127	0.01	0.8131***	0.08

Spending capacity	0.0112***	0.21	0.016***	0.17	0.0205***	0.23
Revenue volatility	-0.0833***	-0.04	-0.113**	-0.03	-0.1302***	-0.04
Lagged variables (Year 2000)						
Illiteracy rate	0.0052***	0.10			0.0035***	0.04
Mortality Rate	-0.0020***	-0.10	-0.005***	-0.14		
Children Poverty rate	-0.0041***	-0.27				
Constant	13.7535***		11.401***		14.9278***	
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	4296		4068		4281	
Adjusted R^2	0.5095		0.366		0.6703	

Legend:* p<.1; ** p<.0.05; ***p<.01

Source: Authors elaboration.

Income elasticity for total ECD spending is about 0.12, considering all controls and the income elasticity of education spending is almost 0.4. The estimates also reveal that total and Education ECD spending are negatively related to income inequality. If this result really represents a causal relation between ECD spending and income inequality, and not only a correlation, the regional differences of ECD spending may be contributing to the persistence of regional socioeconomic inequalities in Brazil, instead of narrowing it. Moreover, the estimated parameter for the quadratic gini coefficient reveals other perspective for this relationship. The U-shaped relationship suggests that total ECD spending is negatively related to inequality up to the turning point the curve (gini = 0.52) describing the relationship between ECD spending and inequality. From this value on, the relationship becomes positive. The same happen with the relationship of education ECD spending and inequality, with a turning point of 0.53 for the gini index.

With respect the lagged illiteracy rate variable, the sign of the coefficient estimate is positive in all versions of the model where this variable was included. Then, the Education ECD spending is higher where the illiteracy rate was higher in 2000, thereby apparently confirming the hypothesis of diminishing marginal utility of ECD public spending. Differently from the obtained results for the Education spending determinants, the health ECD spending is negatively related to the lagged children mortality rate. That is, the municipalities with the higher children mortality rate in 2000 spent more in primary health care for children during 2007 to 2011.

Regarding the variables representing the political environment, the reelection of the Mayor has no impact on ECD spending. It is worth noting that, excepting the margin of victory in the last elections, none of the political variables seems to explain the variability of health ECD spending across Brazilian municipalities. However, in the municipalities where the Mayor finished secondary and tertiary education, Education ECD spending is about 6% higher than the municipalities where the mayor is illiterate or has other education level. The fact that the Political Party of the Mayor is the same of the Governor of the President does not matter for determining Education ECD spending. Contrasting with this result, the ECD spending is positively related to the fact that the municipality receives transfers from the State Government as counterpart of Agreements between State and municipality. The margin of victory in the election has a positive effect on ECD spending.

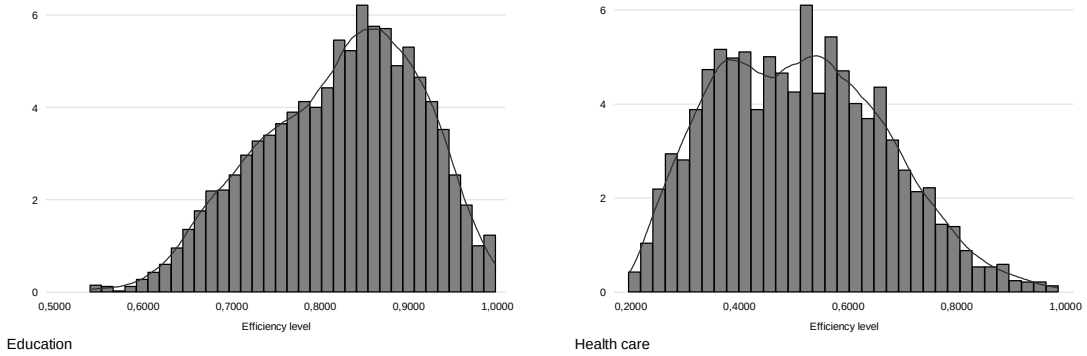
The estimate result for the variable Spending Capacity indicates that municipalities with higher share of locally collected taxes on total spending can spend more in Health. Fiscal decentralization variables play an important role for determining Education and health ECD spending. The estimates for spending capacity coefficient indicate an even larger effect on ECD spending: one standard deviation of spending capacity variable would raise health ECD spending by 0.17 standard deviation.

With respect the tax share variable, one standard deviation of the share of local collected tax in total receipts would increase Total ECD spending by 0.05 standard deviation. The estimates for spending capacity coefficient indicate an even larger effect on ECD spending: one standard deviation of spending capacity variable would rise ECD spending by 0.23 standard deviation. The revenue volatility negatively impacts education and health ECD spending. It means that, the municipalities presenting more stability in revenue over the years spend more in education and health.

4.2 Efficiency scores

This section presents the main results on the performance indicators of ECD public spending across Brazilian municipalities. Verifying the distribution of technical efficiency (unbiased score) in Figure 2, we identify important differences between the education and health care scores[14]. In education, we find DMUs operating with, on average, 82% of efficiency. In the sample of municipalities, 625 of them (about 16% of all DMUs) are at the left side of distribution (score below 72%) and 19% of DMUs present performance between 91% and 100%. For the health efficiency score, on average, the DMUs have 51% of efficiency. In general, the education efficiency score has a more left-skewed distribution, while the distribution of health score is right-skewed.

Figure 2: Distribution of Technical Efficiency on Education and Health Care



Source: Authors elaboration.

Table 7 shows the average of efficiency level for each region of the country, with information about unbiased score (obtained by bootstrap), confidence interval, biased score (without bootstrap), as well as information about the average of the inputs and outputs of each region. The average of technical efficiency index for ECD expenditures in Brazil is 82% in education and 51% in health care. We emphasize that the levels of efficiency does not necessarily imply that municipalities present good indicators in these two areas, because the efficiency indicator is generated simply by the comparison of DMUs close to the efficiency frontier (defined by benchmarking units).

Table 7: Average of technical efficiency index of ECD spending on education and health care by Brazilian regions

Education

	Region	North	Northeast	Southeast	South	Midwest	Total
Efficiency index	**Unbiased score***	73.69%	76.18%	86.91%	87.78%	83.95%	82.32%
	CI - Lower (95%)*	72.71%	75.32%	85.91%	86.93%	83.10%	81.42%
	CI - Upper (95%)*	74.78%	77.09%	88.07%	88.75%	84.89%	83.33%
	Bias	-1.49%	-1.28%	-1.67%	-1.41%	-1.35%	-1.45%
	Biased score	75.18%	77.46%	88.58%	89.19%	85.30%	83.77%
Input	**$SECD_E$**	1797.70	1970.78	2334.86	2449.88	2158.53	2185.83
Outputs	**ALS**	4.51	4.34	5.52	5.29	5.08	4.97
	AMS	4.96	4.78	6.30	6.02	5.64	5.58
	RTSA	30.66	43.14	40.42	41.09	34.84	40.36
	SII	61.65	63.59	73.44	75.34	73.83	69.73
	TFT	47.78	45.66	69.62	72.97	67.59	60.58

[14] We remember that efficiency index in Health Care is in terms of mortality indicators. We calculate the efficiency score that relates ECD expenditures per child with mortality rates in early childhood.

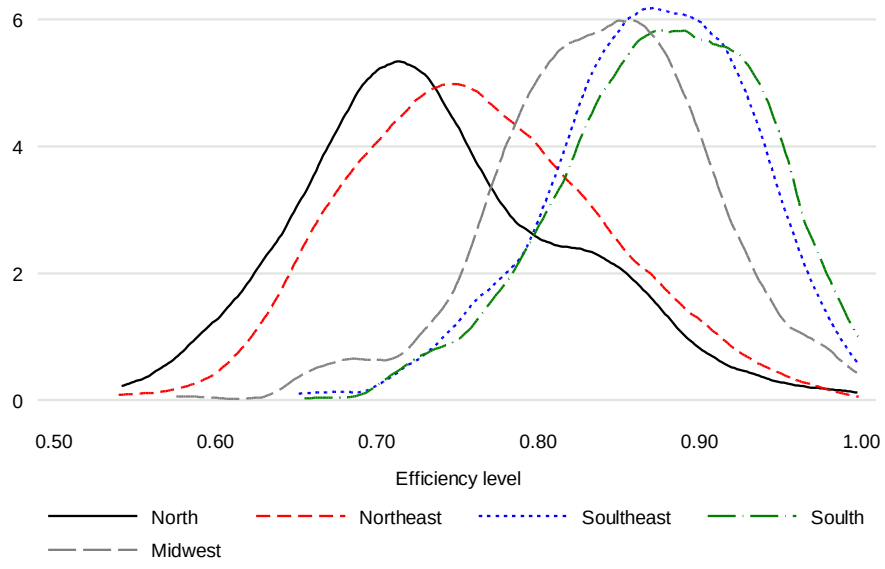
Health care							
	Region	North	Northeast	Soultheast	Soulth	Midwest	Total
Efficiency index	**Unbiased score***	46.87%	36.46%	57.33%	67.21%	54.37%	51.16%
	CI - Lower (95%)*	45.90%	35.77%	55.87%	65.80%	53.03%	50.03%
	CI - Upper (95%)*	47.49%	36.91%	58.40%	68.17%	55.51%	51.96%
	Bias	-0.74%	-0.52%	-1.27%	-1.17%	-1.54%	-0.97%
	Biased score	47.61%	36.98%	58.60%	68.38%	55.91%	52.13%
Input	**$SECD_H$**	215.50	230.20	254.21	319.39	287.04	259.87
Outputs	**IMTR**	21.05	26.94	15.62	13.08	16.03	19.48
	CMTR	22.60	29.06	18.11	15.28	19.27	21.76

Source: Authors elaboration.
Legend: **SECDe**=ECD spending on Education per child; ALS= Average of Language score; AMS= Average of Math score; RTSA= Rate of school attendance; SII= School infrastructure index; TFT= Proportion of teachers with 3rd degree. **SECDh**=ECD spending on Health per child; IMTR=Infant mortality rate; CMTR=Child mortality rate; PLBW=Prevalence of low birth weight; SPW= Share of pregnant women receiving pre-natal; IMT= Immunization, total. N=Number of observations
* Score found from 1,000 replications process.

Table 7 reveals that, the unbiased and biased scores are very similar. The difference (on average) is of 1.45% in the level of efficiency in education and 0.97% in the level of efficiency in health model. However, when we look the bias at level of the DMU, we find municipalities with a bias higher than 10% in their education scores and cases exceeding 20% in performance indicator for health care. Hence, the use of the technique provided by Simar and Wilson (1998, 2000) allows minimize the biases in efficiency score, especially in cities with high sensitivity to changes in the technological frontier.

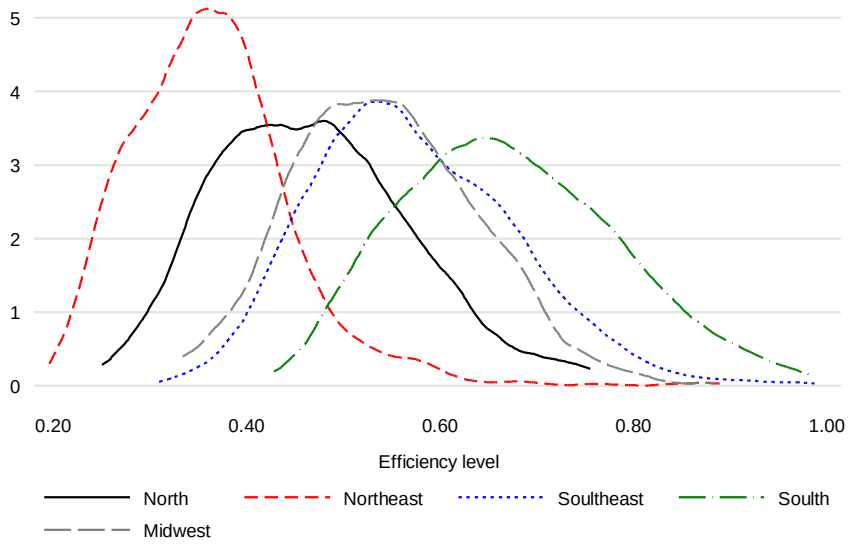
The Brazilian municipalities in the most developed regions (South, Southeast and Midwest) are, on average, more efficient in education ECD spending. While the North and Northeast (less developed) regions have the most inefficient DMUs, with scores below the country average and insignificant statistical differences between the regional results across these locations. Efficiency in heath spending is higher in South, Southeast and Midwest regions, when compared to North and Northeast regions, considering the biased and unbiased efficiency score. Figure and Figure 4, for example, illustrate the kernel density of efficiency scores within each region. Based on these findings, efficiency is higher in municipalities of the South, Southeast and Midwest regions due to the concentration of municipalities close to the efficiency frontier.

Figure 3: Distribution of Technical Efficiency on Education by Brazilian regions (Kernel Density)



Source: Authors elaboration.

Figure 4: Distribution of Technical Efficiency on Health Care by Brazilian regions (Kernel Density)



Source: Authors elaboration.

The shapes of Figures 3 and 4 results from the fact that the majority of the most efficient DMUs in ECD spending on education (86% of DMUs more precisely) are to the south of the country. The municipalities in the states of Santa Catarina (SC), Paraná (PR), São Paulo (SP) and Rio Grande do Sul (RS) have the highest levels of efficiency, respectively, on average, 88.5%, 88.3%, 88.0% and 86.5%. At the other extreme, the DMUs in the states of Acre (AC), Pará (PA), Amapá (AP) and Alagoas (AL) are the worst performers. In terms of inputs to education, we identify the less efficient units generally allocate less ECD resources per child and have even lower educational outcomes, specially, learning indicators. In this context, given the spending per child, the vector of educational outputs should increase by almost 30% to make efficient the municipalities located in the states of AC, PA, AP and AL.

Regarding the health spending, municipal units with the best performance are highly concentrated in states of South and Southeast regions (about 95% of DMUs in the best class belong to these regions). The other characteristic of efficiency on Heath Care is a great amplitude of the class intervals (the lowest value is 19.65% and the hightest value is 98.78%), this diffetence is considerably higher than performance on education, and evideces the existence of very inneficient municipalities in health spending. The results reveal that DMUs in the states of North and Northeast have relatively the worst combination of inputs and outputs.

4.3 Efficiency determinants

Table shows the estimated coefficients for the determinants of the efficiency of ECD spending in Brazil. Initially, jointly evaluating all coefficients, we find that not necessarily the signs, the magnitude and statistical significance of the parameters are the same. It is worth noting that we are analyzing two different types of services, which have their particularities in attendance and financing, for example. In education it is easier to identify the services offered for early childhood. Moreover, in health area, spillover effects may arise. In effect, it is quite common in Brazil transporting patients from one municipality to another, which can result in less expense (and higher efficiency) for the municipality that “exported” the patient and more costs (and lower efficiency) for the locality which received the patient.

Table 8: Estimation of Determinants of ECD spending efficiency on Education and health in Brazilian Municipalities by Tobit Regressions

Variables	Education	Health
ID - Institutional dimension		
Revenue Volatility	-0.0651***	0.0511*
Specific transfers per habitant (log)	-0.0168***	-0.0077**
Total spending per capita (log)	0.0166***	-0.0012
Re-elected mayor	0.0047**	-0.0003
Mayor education with Tertiary school	0.0022	0.0025
Voter turnout	0.0008***	0.0006**
Political competition (margin of victory)	0.0001	-0.0001
Rate of valid votes	0.0014***	0.0007
SE – Socioeconomic characteristics		
Per capita Income (log)	0.0206***	0.1481***
Index of income Inequality (Gini index)	-0.1018***	-0.0820***
Proportion of people with tertiary school (≥25 years)	0.0038***	0.0023***
Illiteracy rate (between 11 and 14 years old)	-0.0028***	-0.00001
Population Group		
between 10,000 and 20,000 habitants	-0.0089***	0.0053
between 20,000 and 50,000 habitants	-0.0155***	0.0219***
between 50,000 and 100,000 habitants	-0.0203***	0.0362***
above 100,000 habitants	-0.0346***	0.0631***
Demographic density (log)	0.0087***	-0.0037**
Composition of population (≤5 years)	-0.0040***	-0.0061***
Rate of enrollments in private schools	0.0003	
Rate of rural enrollments	-0.0004***	
Regional Dummies	Yes	Yes
Intercept	0.5693***	-0.2992***
N	3,872	3,633
Adjusted R2	0.55	0.7700

*Legend: *p<.10; **p<.05; ***p<.01*

Left-censoring limit=0; Right-censoring limit=1 (Censored limits)

Regarding the impacts of socioeconomic characteristics on efficiency scores, the municipalities with greater income inequality have lower spending efficiency. An increase of 1% in income inequality reduces the efficiency indicator of spending on education in 0.10%. This negative effect is also observed for the efficiency of health spending. The effects of per capita income and the proportion of adults with higher education in the city on efficiency is positive in all models for both areas. In education area, the coefficient for illiteracy for the population between 11 and 14 years old is negative and statistically significant suggesting that the municipalities with more illiterates in this age group tend to be more inefficient.

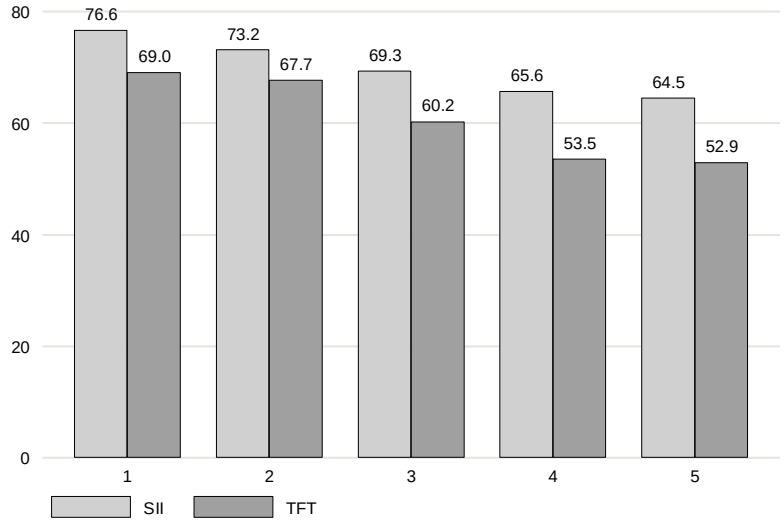
Looking at the DMUs demographic profile, we note that the population composition, population density and population size of the municipality generate statistically significant effects on the municipalities' performance, mainly in education spending. In general, larger shares of children under 5 years old in the total population result in lower efficiency. Probably, this finding can be associated with the difficulty of municipal management to offering adequate educational and health services when the population in this age group represents a considerable portion of the total population. In some Brazilian municipalities, especially in the Northern region of the country, the population with less than 5 years old exceeds a ratio of 15% of the total population.

Regarding the population group in the Table 8, the municipalities with larger populations have, on average, more difficult to efficiently allocate their resources in education when compared with DMUs with less than 10 thousand habitants (base regression). Differently we find that more populated municipalities tend to be more efficient than the localities of smaller population size for the performance indicator in health.

In the specific case of education, the share of total enrollment in private schools does not generate significant effects. However, the enrollment rate in rural areas in the municipality is negatively associated with efficiency of educational resources. At this point, an interesting fact in Brazil is the difference between the services provided to students from rural areas, which traditionally already have an unfavorable family

background (the illiteracy rate in rural areas is about twice the national average). When we checked the indicators of school quality, such as the index of school infrastructure (SII) and the proportion of teachers with higher education (TFT) by the quantiles of the rate of rural enrollments, we evidence that the greater is the share of enrollments in rural areas, the lower is the standard of school quality (see Figure 5). Moreover, the spending level of these five quantiles are similar, and the highest spending per child (R$ 2,336) occurs in the last quantile that refers to municipalities with the highest enrollment rate in rural area.

Figure 5: Average of School infrastructure index (SII) and proportion of teachers with tertiary school (TFT) by five quantiles of rate of rural enrollments in Brazilian Municipalities



Source: Authors Elaboration.
Legend: SII= School infrastructure index; TFT= Proportion of teachers with 3rd degree.

In general, the findings for the institutional dimension have better statistical adjustment (including coefficients with more statistical significance) for the analysis of the determinants of education spending efficiency. We highlight that municipalities with more volatility in their revenue have a lower education spending efficiency. For health sector, the effect of this variable is positive, but with statistical significance at the 10% level. More results in the educational and health care areas have to do with the impact of earmarked transfers on the efficiency score. According to the results, a higher Fundeb (for education) or SUS (for health care) transfer per capita decreases the level of efficiency. In effect, an analysis of the outcomes used in the estimation of efficiency scores shows that municipalities that receive more transfers are among the cities that have the worst indicators of learning and school quality. These findings may stem from the existence of misapplication and consequent lack of effectiveness of the transferred resources. In addition, the DMUs with the highest per capita total municipal expenditure maintained a positive relationship with performance in education. Here such information may be capturing the spending capacity of the municipality.

We can also see that some variables related to the electoral process (as the numbers of voters who voted in the election – voter turnout – and the rate of valid votes) impact the efficiency of health spending and, especially, education spending. The re-election of the mayor affects positively just the efficiency in education. In this case voters seem to recognize the DMU which showed some improvements in educational outcomes.

Finally, we point out that locational variables confirm its importance in explaining spending efficiency. Controlling for those institutional and socioeconomic covariates, the health efficiency scores in municipalities of the Northeast region are slightly lower than the results from the Southeast region. Concerning educational performance, DMUs in the Southeast and South regions have statistically significant superior results to those observed in the municipalities located in other regions.

5. Final Remarks

In the last two decades, undoubtedly, Brazil has been experienced several advances in the provision of ECD services. Concomitantly, to decentralization of the provision of public services, the spending in this area has been growing in all Brazilian regions even more than the GDP, but this growth in public spending has not been a specific trend for ECD services. Other spending categories have grown at the same rate over the period.

However, analyzing sub-national differences on ECD provision one can notice important differences mainly between the Northern and Southern municipalities. The Brazilian South Region has better socioeconomic indicators and per child ECD spending is high. In the North (and also Northeast region), poverty and inequality is high, but per child ECD spending is low. Apparently, this result suggests that the responsiveness of ECD spending to local needs is low.

The conditional analysis on the determinants of ECD spending shows that socioeconomic and demographic context of the municipality explain the major part of variation of ECD spending across Brazilian municipalities. With respect the responsiveness to local needs, controlling for a number of variables, ECD spending is higher in the municipalities which presented higher illiteracy rates in 2000, suggesting, politicians preferences were linked to the perceived local needs for ECD services. But, ECD spending is lower where inequality is high.

As pointed out earlier, an important feature of decentralization in Brazil was the high participation of transfers on municipal budgets. According to the findings, the municipalities with higher spending capacity (less transfers dependent) are more prone to spend on ECD.

In the efficiency analysis, the results show that the DMUs operating in a better socioeconomic environment (higher per capita income e lower inequality) can more efficiently allocate their resources to early childhood. As a result, the evaluation of technical efficiency must be viewed with more caution in locations with adverse social context. Certainly, in these localities, it necessary to implement policies aiming to improve management and find mechanisms to identify cases of misallocation of resources such as cases from rural areas that have high spending without counterpart of good indicators in school resources.

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