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Educational growth: An analysis of distribution among Brazilian municipalities

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Abstract

This study analyzes the distribution of education in terms of quality and quantity in Brazilian municipalities during the first decade of 2000 to investigate how educational improvement was distributed to municipalities with different levels of income and education. Given the considerable educational heterogeneity and the lack of studies at the municipal level, the aim is to contribute to this debate by (1) applying the pro-poor growth measurement methodology to indicators of educational quantity and quality (2) using the Brazilian municipalities as units of analysis, and (3) conducting estimations using the Growth Incidence Curve. The results indicate that there was an improvement in the quantity and quality of education and that, on average, educational growth can be considered pro-poor.

KEYWORDS

distribution, education, educational growth

JEL CLASSIFICATION

I21; I24; I31

1 | INTRODUCTION

Brazil remains one of the most unequal countries in the world despite the efforts made to change that situation. Much of the effort made by the Brazilian government has focused on education, which plays an important role in reducing poverty and income inequality (Barros, Henriques, & Mendonça, 2002; Barros, Carvalho, Franco, & Mendonça, 2010; Cruz & Braga, 2010; Curi & Menezes-Filho, 2005; Menezes-Filho, 2001; Menezes-Filho & Oliveira, 2014). However, despite the significant increase in average schooling in the Brazilian population, which grew from 5.6% to 8.5% between 200 and 2010

(IBGE, 2000), the country is still among the most unequal in the world. The existing educational disparities and their enduring nature have been pointed to as the cause of the persistent high levels of social inequality in the country.

Recent efforts and investments aimed at universalizing the access of children to schools have been insufficient to overcome historical educational inequalities that are perceptible both in the quantity and quality of education offered in the country. Even with the recognition of the universal right of access to basic education and advances in the average years of schooling, questions have increasingly been raised about the unequal quality of the education that has been offered (Castro, 2009; Cruz & Braga, 2010; Libâneo, 2012).

Such inequalities can be perceived both within and between the different regions (Akkari, 2001; Castro, 2009; Gracindo, 2010; Riggoti, 2001). For example, in 2009, among the poorest population, 36% had not completed any schooling, and 65% of the total population had less than 4 years of schooling (Menezes-Filho & Oliveira, 2014). In 2007, the Northeast region had a 2-year lag in relation to the Southeast region (Castro, 2009). In addition, there is educational inequality between metropolitan and non-metropolitan regions, between the rural and urban populations, between men and women, and between races.

In Brazil, the public or private sectors offer primary and secondary education. Public schools offer free education and are administered by the federal, state, and municipal governments. The municipalities are the biggest providers of the primary education, and the state governments provide the highest percentage of the secondary education. Before 2016, only primary education (*ensino fundamental* in Portuguese) was mandatory for children aged from 6 to 15. After 2016, education became mandatory for children aged from 4 to 17 years, which encompasses pre-school to secondary education (PNE, 2014). The federal government provides the least in terms of school places, only offering technical courses at the secondary level. Private and federal schools are available almost exclusively in medium-sized to large towns. Brazil is a huge country with 5,568 municipalities. They differ greatly in terms of population size, with 3,917 municipalities having fewer than 20,000 inhabitants, 1,368 between 20,001 and 100,000 inhabitants, and only 283 that have more than 100,000 inhabitants, while São Paulo has more than 12 million people (IBGE, 2010).

Given the proven importance of education in reducing social inequality and considering that the distributional pattern of education growth has implications for the evolution of the social inequality, this paper seeks to investigate how educational growth has evolved in Brazil and how it has been distributed among different income groups. In other words, we ask the following question: Is the quantity and quality of education growth in Brazilian municipalities proportionately benefiting the poor more than the non-poor?

In Brazil, the empirical studies in this field have focused on the role education plays in reducing income inequality (Barros et al., 2002; Barros et al., 2010; Cruz & Braga, 2010; Curi & Menezes-Filho, 2005; Menezes-Filho, 2001; Menezes-Filho & Oliveira, 2014). To date, no studies have sought to investigate the distribution of educational growth itself. This article seeks to address that gap by looking at the pattern of distribution growth of quantity and quality of education in relation to the different income and educational levels in Brazilian municipalities.

Traditionally, in this field, most studies use variables related to the quantity of schooling in particular regions or accessible to individuals. The present study adds variables that approximate educational quality. It is based on the idea that the number of years of schooling is not the only important factor in the inequality debate, but rather that school performance also has a strong impact on this issue. The inclusion of the qualitative variable will also make it possible to identify whether there is any similarity in the distribution patterns of the quantity and quality of education.

Although the average years of schooling are still widely used to measure both educational progress and inequality, important research has emphasized that the quality of education provided is as important as, or even more important than, the average years of schooling in explaining future income and the probability of remaining in school (Bishop, 1989; Hanushek & Kimko, 2000; Murnane, Willett, & Levy, 1995; Murphy & Peltzman, 2004; Rivkin, 1995). Thus, it is hoped the findings of the present study will contribute toward the literature on education and pro-poor growth.

The debate on the concept and measurement of pro-poor growth is ongoing in the literature. There is no single definition, but pro-poor growth can be basically structured into two fields, the relative and the absolute. Kakwani and Pernia (2000) adopt a relative pro-poor growth approach and define it as the growth in which the income of poor people grows at a higher rate than that of the others, emphasizing the distribution of income in favor of poor people. That is, growth is biased toward the poor. It is argued that this type of growth leads to a reduction in inequality between the poor and the nonpoor.

By contrast, Ravallion and Chen (2003) focus on reducing absolute poverty. This approach involves two concepts, weak absolute pro-poor growth and strong absolute pro-poor growth. The former can be said to exist when the growth rates for the poor are higher than 0. It is argued that the income growth of the poor, rather than the comparison with the growth rate of the nonpoor, is important to poverty reduction. By contrast, strong absolute pro-poor growth requires that the absolute increases in the income of the poor be higher than the average, implying a decline in absolute inequality. In a study on access to education, Harttgen, Klasen, and Misselhorn (2010) apply the tools developed by Grosse, Klasen, and Harttgen (2008) to identify which parts of the population have benefited from improvements in access to the education system. The authors identified pro-poor progress in countries with better access to early education. They also note that educational progress is generally greater and more pro-poor in Asia and Latin America than in Africa. In the analysis, the authors consider education, child survival, childhood vaccination, nutrition, and a well-being index composed of these components, from 1989 to 1998 for Bolivia. The study shows relative pro-poor growth in both the income and nonmonetary dimensions. On the contrary, using an alternative methodology, known as the Conditional Growth Incidence Curve (NGIC), Kacem (2013) studies Ethiopia between 2004 and 2009 and finds "anti-poor" growth in all the income dimensions, although in the nonmonetary sense, the poorest households present a better evolution. In light of recent studies that have intensified pro-poor growth analyses, broadening their approach to nonmonetary indicators, this study will use detailed data for Brazil and alternative educational variables to discern whether Brazil's educational growth has been pro-poor.

The article is structured as follows. Sections 2, 3, and 4 will deal with theoretical and methodological issues, the data used, and the descriptive statistics, respectively. In Sections 5 and 6, the results will be presented and discussed, and finally Section 7 will offer the concluding remarks.

2 | THEORETICAL AND METHODOLOGICAL FOUNDATIONS

The pro-poor framework has been much explored in both the international and national literature, and the methodologies are diverse. Among the tools used to assess the distribution pattern of income growth is the Growth Incidence Curve (GIC), which was initially proposed by Ravallion and Chen (2003). The GIC shows the average growth rate (g_t) of income (y) at each percentile (p) of the distribution between two points in time (t and $t-1$). The GICs are given by

$$\mathrm{GIC} = g_t y(p) = \frac{y_t(p)}{y_{t-1}(p)} - 1 \quad (1)$$

The GIC traces the percentiles of the population (1–100), classified by income, on the horizontal axis against the annual *per capita* income growth rate in the respective percentile. Together with the curve, the authors present the headcount index (proportion of poor people), which allows the identification of the average rate of income growth for the poor. This rate can be seen by the area under the GIC to the headcount index. Thus, for growth to be pro-poor, the area under the GIC up to the percentile defined by the headcount index must be greater than the end point of the same; that is, the GIC must have a negative slope.

If the GIC assumes positive values ($g_t\ (p) > 0$) in all the percentiles, then it can be assumed that there is weak absolute pro-poor growth. The negatively sloping GIC indicates relative pro-poor growth. If the GIC indicates absolute improvements on the vertical axis followed by a sharp downward slope, there is strong absolute pro-poor growth. Similarly, when income growth does not affect its distribution, the GIC should have a zero slope.

From the GIC, Ravallion and Chen (2003) define the pro-poor growth rate (PPGR) as the area under the GIC to the headcount index (H), and this rate is formally expressed as

$$\text{PPGR} = g_t^p = \frac{1}{H_t} \int_0^{H_t} g_t(p)\, dp \qquad (2)$$

To determine whether the growth was relatively pro-poor, Grosse et al. (2008) compare the PPGR rate with the growth rate in mean (GRIM), which in turn, is defined by

$$\text{GRIM} = \gamma_t = \frac{\mu_t}{\mu_{t-1}} - 1, \qquad (3)$$

where μ is the average income. In the case where PPGR exceeds GRIM, growth can be defined as pro-poor in relative terms. With regard to strong absolute pro-poor growth, absolute changes in the income of the percentiles of the population over two periods of time should be considered. Therefore, the absolute GIC traces the percentiles of the population against the change in *per capita* income of the respective percentile, and can be expressed as follows:

$$\text{GIC}_{absoluta} = c_t(p) = y_t(p) - y_{t-1}(p) \qquad (4)$$

If the absolute GIC is negatively sloped, there is strong absolute pro-poor growth.

Klasen (2008) and Grosse et al. (2008), in an effort to cover the multidimensionality of growth, add to the tools originally applied by Ravallion and Chen (2003) by introducing the new Non-Income Growth Incidence Curve (NIGIC) approach, which will be used in this paper. Grosse et al. (2008) have presented two versions of NIGIC, the unconditional and the conditional. The former aligns the percentiles according to the indicator in question (not referring to income), while the latter aligns the percentiles according to *per capita* income. This new version allows us to investigate how progress in welfare is distributed across the various income levels. Grosse et al. (2008) extend this methodology to nonmonetary indicators (NIGIC) and present the unconditional and conditional versions. These can be expressed by

$$\text{NIGIC} = g_t NI(p) = \frac{NI_t(p)}{NI_{t-1}(p)} - 1 \qquad (5)$$

where $g_t NI$ is the average growth rate of the used nonmonetary indicator between two time points (t and $t-1$), and p is the percentile in each. What differentiates the unconditional from the conditional version is that in the former, the percentiles of the nonmonetary indicator itself are used, while in the latter, the percentiles of income are used.

This study will present estimates based on the conditional and unconditional versions of Grosse et al. (2008) and those of Kacem (2013). The next section will describe the data used to achieve the proposed research objective.

3 | DATA

The unit of analysis adopted in this study is the municipalities, and the variables are *per capita* municipal income,[1] years of schooling,[2] and educational quality (proficiency in mathematics).[3] This paper analyzes all 5,568 Brazilian municipalities.

To assess the educational evolution, it is necessary to use at least two time periods. Accordingly, to measure the quantity of education, the average years of schooling in each municipality are used, based on the data on education obtained from the 2000 and 2010 census. Due to the partial compatibility of the information provided in the two census, it was necessary to enhance the compatibility of information as can be seen in the details provided in Appendix 1. This adjustment was necessary since in the database of the 2010 census there is no information on the years of schooling of each individual, but only the highest level (educational attainment) and test scores (*Prova Brasil*). As the 2000 database presents both the level completed and the years of schooling, it was possible to make the data compatible.

Educational quality is measured based on the proficiency of eighth/ninth-grade students in a mathematics exam, available from the *Prova Brasil* microdata.[4] These data are important due to their scope, since all students from Brazilian state schools must participate in this exam once every 2 years.

The exam is designed to assess the quality of the education offered by the Brazilian educational system–based standardized tests and socioeconomic questionnaires. In the latter, students provide information about factors that may be associated with performance. In the standardized tests, students answer Portuguese-language questions with a focus on reading and solving mathematical problems.

The use of the mathematics score is justified by the fact that mathematics is considered a universal language, which allows comparisons with international tests and studies. In addition, it is assumed that in the Brazilian case, when interpreting the problems proposed by mathematics, there is a certain command of the Portuguese language.

Analyzing the data from the *Prova Brasil*, we can see that the age group of students participating in the exam varies between 9 and 15 years. Therefore, to standardize the analysis, this article uses information from individuals in this age group to calculate the average variables of the municipality.

4 | DESCRIPTIVE STATISTICS

According the Brazilian Census Brazilian Institute of Geography and Statistics (IBGE, 2000, 2010), looking at the municipalities in terms of the average years of schooling of their populations, considering the ages from 8 to 25 years, we see there was significant change from 2000 to 2010. While in 2000, 99% of the sample reached a maximum of 7 years of schooling, in 2010, 46.75% of the municipalities had an average schooling of between 8 and 9 years, suggesting progress. The average schooling is not equally distributed in the country. In Figure 1, we plot the average schooling against the municipal *per capita* income.

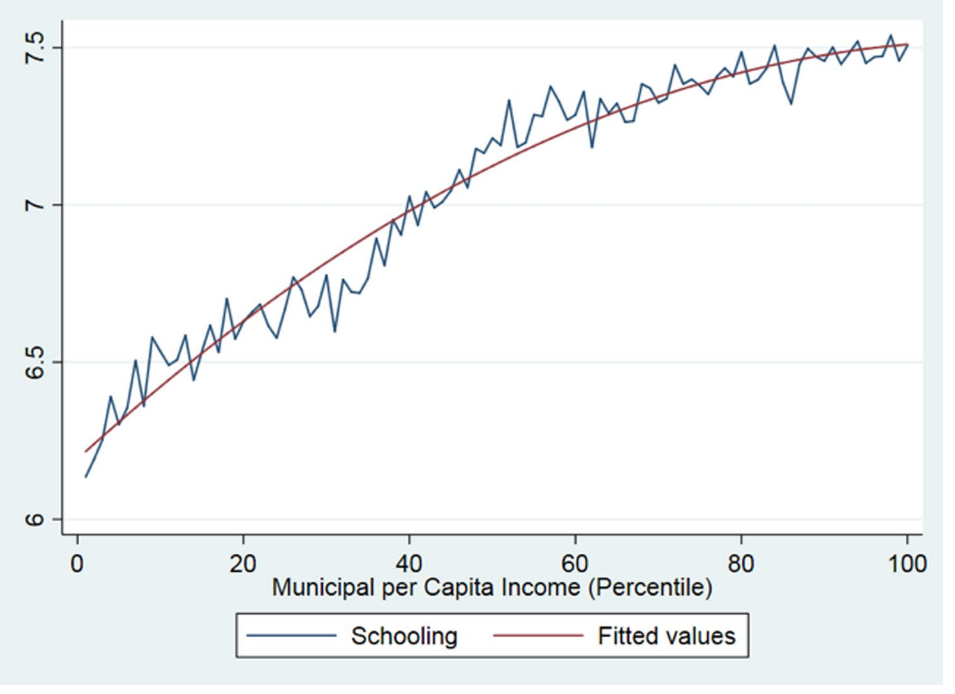

FIGURE 1 Evolution of schooling. *Source*: Elaborated by the authors (2010 Census and IBGE) [Colour figure can be viewed at wileyonlinelibrary.com]

Besides the quantity of education, which can be measured by the average years of schooling, the quality of education is important. In this paper, proficiency is the proxy for quality. Proficiency is known to be the numerical synthesis of the level of mastery in a certain competence. However, numbers alone may not contain all the necessary information, as they say very little when analyzed alone. Thus, it is essential to attribute those numbers to pedagogical interpretation, which then provide support, facilitating detailed study and possible interventions.

One way of assigning pedagogical interpretations is by distributing the public into four levels in the scale of proficiency measured by the *Prova Brasil* test. The levels considered are Advanced, Proficient, Basic, and Insufficient. Those students whose knowledge is below that expected for a certain stage of teaching comprise the insufficient level. At the basic level, knowledge is partial and limited. At the proficient level, the students present the knowledge necessary for the stage in which they find themselves. The advanced level corresponds to students who fully master their competencies and can solve questions involving topics considered complex for the stage. Given that scoring in the *Prova Brasil* ranges from 0 to 500, Table 1 presents the proficiency scale for eighth grade/ninth grade.

Table 2 shows the percentage of municipalities in each level of proficiency. There is a notable increase in the percentage of proficient municipalities over the years, with the exception of the year 2013. However, only 1% of the municipalities achieved the proficient level and, on average, 20% are at an insufficient level.

Given the scenario presented in Table 2, it is interesting to analyze the evolution of proficiency over time. It can be seen that between the years of 2007 and 2015, there was an average increase of 2.7% with each new edition of the *Prova Brasil*. Table 3 shows the average Brazilian proficiency and its growth rate throughout the editions of the test. There is, however, a downward trend in the rate.

TABLE 1 Proficiency scale

Knowledge level	Proficiency
Insufficient	0–224
Basic	225–299
Proficient	300–349
Advanced	≥350

Source: Elaborated by the authors (SAEB).

TABLE 2 Municipalities according to knowledge level (%)

Knowledge level	2007	2009	2011	2013	2015
Insufficient	24.05	22.57	17.13	17.6	6.13
Basic	75.71	76.99	82.31	82	93.4
Proficient	0.24	0.44	0.56	0.40	0.47
Advanced	0	0	0	0	0

Source: Elaborated by the authors (SAEB).

TABLE 3 Evolution of Brazilian proficiency

	2007	2009	2011	2013	2015
National average	225.49	235.84	236.01	244.5	250.3
Growth rate (%)	–	4.6	0.1	3.6	2.4

Source: Elaborated by the authors (SAEB).

When the average *per capita* income of the municipalities is considered in relation to their educational quality, the same pattern as in the years of schooling is identified. The higher the income of the municipalities, the higher the score. This relationship is shown in Figure 2.

In general, this section shows there were improvements in Brazilian education in both quantitative and qualitative terms. The next section will identify how this educational improvement has been distributed to the municipalities with different incomes and educational levels.

5 | ASSESSING EDUCATIONAL GROWTH

5.1 | Unconditional educational growth

When analyzing the distribution of educational growth, first, it is interesting to see if the increase in the average years of schooling was greater, less, or the equal for the municipalities with different average years of schooling. To do this, Figure 3 shows the growth rate of schooling between the years 2000 and 2010, and on the *x*-axis, it orders the municipalities with the lowest and the highest average years of schooling in 2010. Clearly, there is pro-poor growth, because the lower the education level of the municipality, the higher the growth rate obtained from 2000 to 2010.

The municipalities in the 5% with the least average years of schooling present an average growth rate of 100%; that is, in 10 years they doubled the average number of years of schooling. Whereas the municipalities in the 5% with the most average years of schooling saw a growth rate of 11.7%.

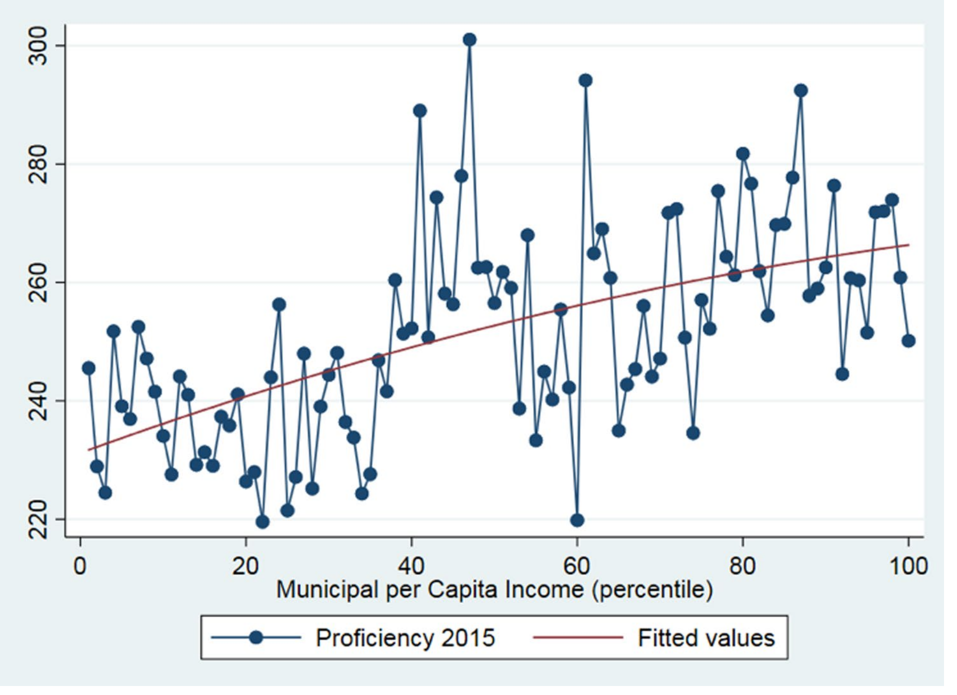

FIGURE 2 Proficiency and *per capita* income. *Source*: Elaborated by the authors (IBGE, 2010 and INEP, 2015 Census) [Colour figure can be viewed at wileyonlinelibrary.com]

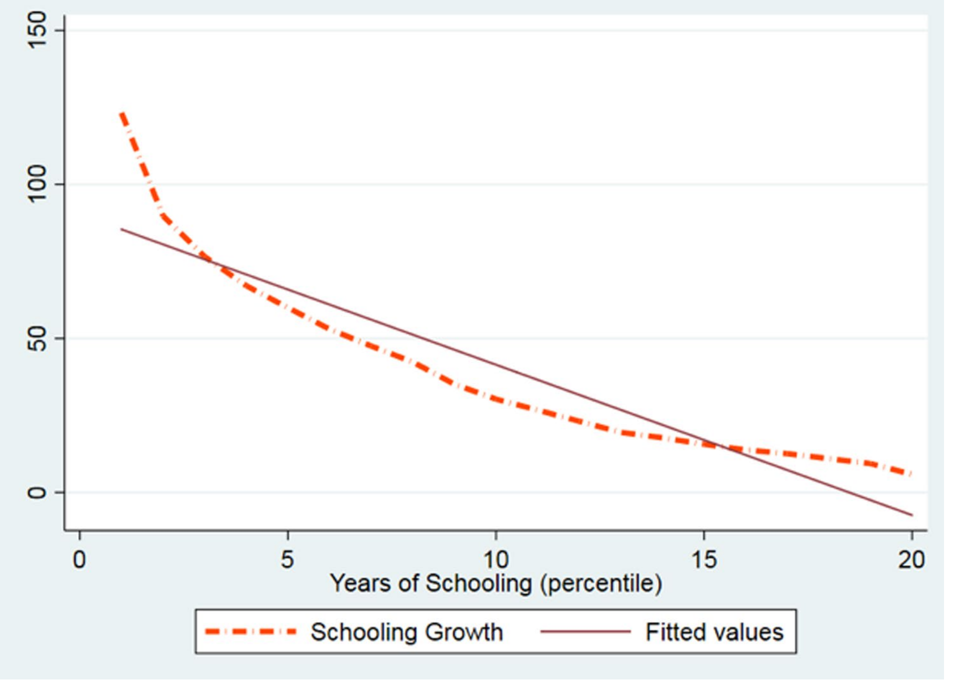

FIGURE 3 Unconditional NIGIC: Years of schooling. *Source*: Elaborated by the authors [Colour figure can be viewed at wileyonlinelibrary.com]

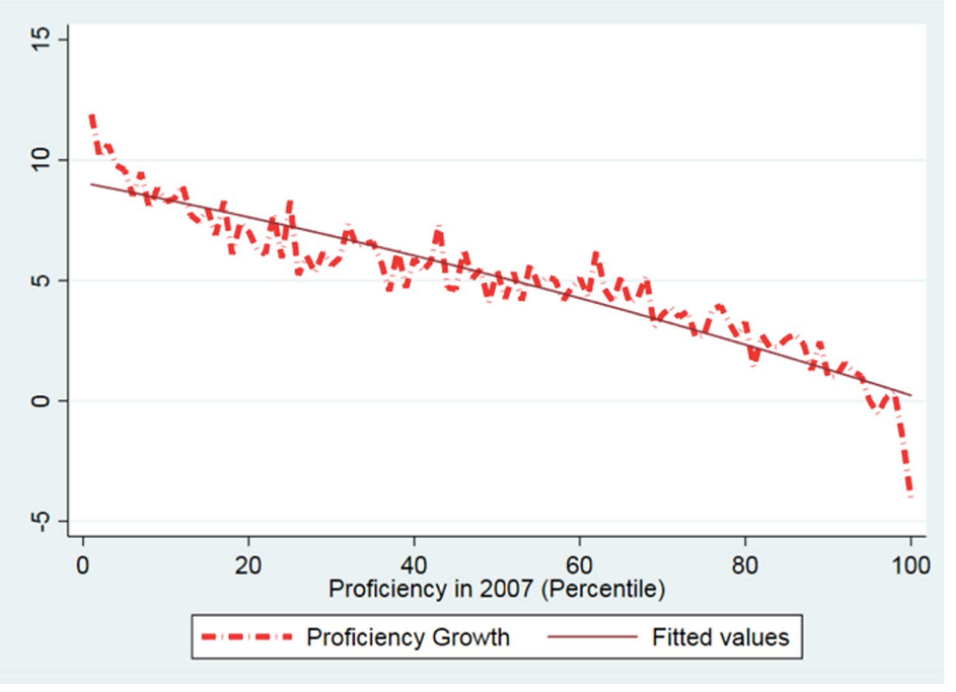

FIGURE 4 Unconditional NIGIC: Proficiency. *Source*: Elaborated by the authors [Colour figure can be viewed at wileyonlinelibrary.com]

As with Figure 3, Figure 4 shows the growth rate according to the schooling percentile of the Brazilian municipalities. What differs from Graph 3 is the education variable, which is now measured as educational quality, that is, proficiency. Thus, the *x*-axis presents the municipalities ordered according to the percentile of proficiency in the year 2007, while the *y*-axis shows the rate of growth in proficiency between the years from 2007 to 2015.

In general terms, the curve shows a decreasing trend; that is, poorly performing municipalities see a higher educational growth rate than high-performing municipalities. The poorest 5% of municipalities have an average growth of 10.4%, a rate 5.9% higher than the average for the period. The 5% of municipalities with the best performance saw a negative growth rate, on average –1.1%, that is, a decrease in the scores over the period.

This section concludes that, when studying educational growth using the unconditional method, quality and quantity of education show the same pattern. The increase in the average years of schooling and school performance during the period presented a pro-poor pattern in relative terms; that is, the growth rates were higher for the municipalities with low proficiency. The next section will expand this approach, with income being included in the analysis of educational growth.

5.2 | Conditional educational growth

The conditional NIGIC shows educational growth according to municipal *per capita* income. Thus, as in the analysis of the unconditional NIGIC, education will be investigated in two ways considering years of schooling and proficiency.

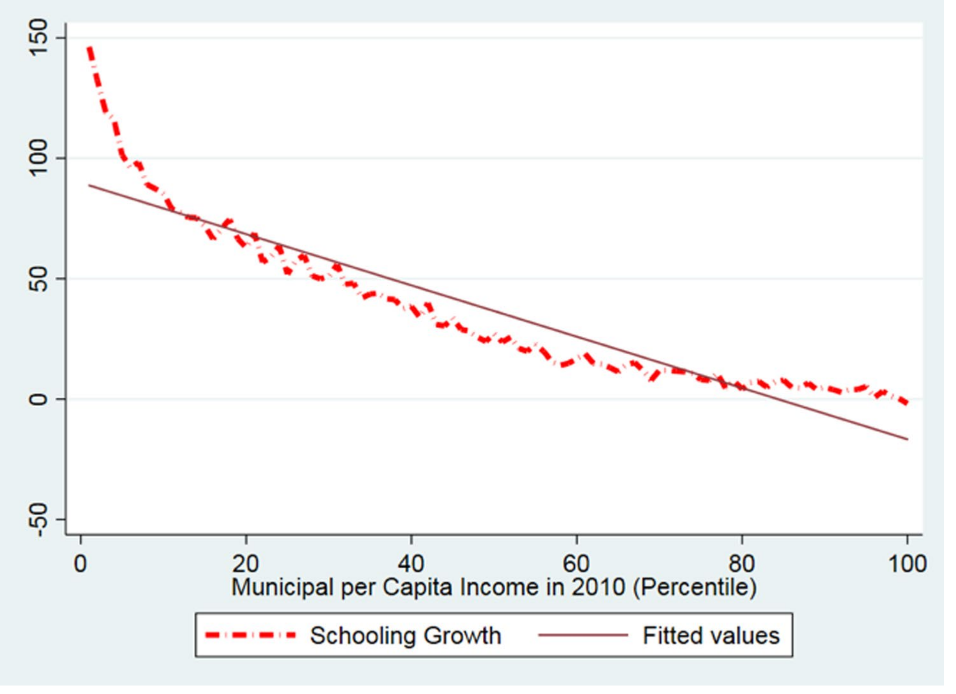

FIGURE 5 Conditional NIGIC: Years of schooling [Colour figure can be viewed at wileyonlinelibrary.com]

Figure 5 shows the growth rate curve for years of schooling in the municipalities over the period from 2000 to 2010. As with the unconditional NIGIC, the curve shows a decreasing trend for schooling, indicating that as *per capita* income increases, the rate of growth of average schooling decreases. While the 20% of municipalities with the lowest *per capita* income grew by an average of 80%, the 20% with the highest *per capita* income grew by around 13%.

The growth rate of school performance can be analyzed in relation to the various percentiles of municipal *per capita* income (Figure 6). Unlike the results found in the unconditional NIGIC, the conditional NIGIC does not show such a clear downward trajectory regarding proficiency. There appear to be two large groups, and that with the lowest income levels has the highest rate of educational growth; and that with the highest levels of income has the lowest rate of growth in proficiency. The rates were positive throughout the interval, indicating, on average, an improvement in school performance. A close observation reveals that the 20% of the municipalities with the lowest income had a growth rate of around 6%, while the 20% with highest income had rates of 4%.

When conditioning educational growth to the *per capita* income of the municipalities, the difference in the educational growth rate between municipalities with high and low incomes is found to be lower when education is analyzed according to proficiency, representing 2%. This seems to suggest that educational growth in terms of school performance is more homogeneous among municipalities than in terms of years of schooling, which presents a difference of 67%. However, in both cases, educational growth presented an “anti-poor” pattern, a phenomenon targeted by public policies aimed at reducing inequality.

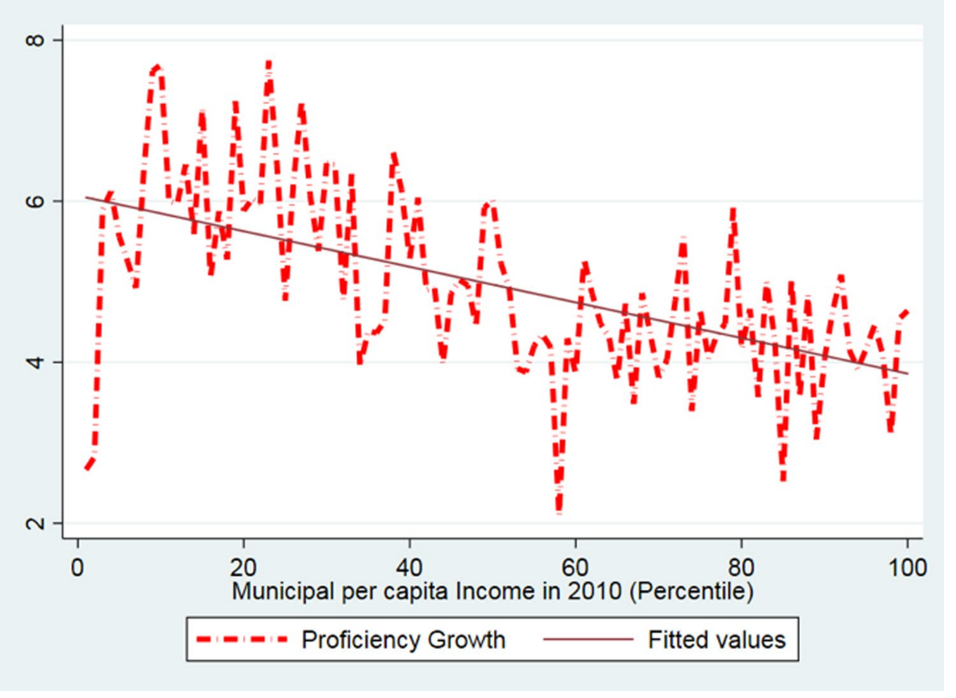

FIGURE 6 Conditional NIGIC: Proficiency [Colour figure can be viewed at wileyonlinelibrary.com]

6 | POTENTIAL GROWTH

In the previous section, the relationship between, on the one hand, the educational growth rate, and on the other, the initial income and the initial proficiency of the Brazilian municipalities was observed. The procedure allowed us to assess whether the educational growth was pro-poor in the period under analysis. This method shows whether, with the reproduction of the current growth rates, the municipalities with the worst educational indicators will, over time, reach or even exceed the best-placed municipalities. However, this information does not allow us to demonstrate the "effort" of each municipality. This assertion rests on the argument that for a municipality with a high educational level, it is more difficult to achieve a growth rate of, say, 10%, than for a municipality with a lower educational level.

Thus, to analyze educational growth from the perspective of its complexity, the effort rate (ER) is estimated, which is measured by the variation in the score in absolute terms in relation to the potential growth, which is also evaluated in absolute terms. Given that the maximum score students can obtain in the Basic Education Assessment System (SAEB) exam is 500 points, the ER can be expressed by the following equation:

$$\mathrm{ER} = \frac{nota_t - nota_{t-1}}{500 - nota_{t-1}} \tag{6}$$

The ER differs from the growth rate because it involves a maximum value. In this sense, the ER can show how much a municipality has grown in relation to its growth potential, while the growth rate can only show growth in relation to its previous value.

TABLE 4 Example for effort rate

	Proficiency in period *t*	Proficiency in *t*–1	"Effort rate"
Municipality *x*	450	445	0.09
Municipality *y*	475	470	0.16
Municipality *z*	495	490	0.50

Source: Elaborated by the authors.

Considering the hypothesis that to improve proficiency by, for example, 5 points demands different levels of effort depending on where the municipality is from the bottom to the top of the range, and that the closer the municipality is to the top, the greater effort needed will be. For example, take municipalities *x*, *y,* and z with the following proficiency levels in periods *t* and *t*–1 (Table 4).

$$\mathrm{ER}_X = \frac{450-445}{500-445} = \frac{5}{55} = 0.09$$

$$\mathrm{ER}_y = \frac{475-470}{500-470} = \frac{5}{30} = 0.16$$

$$\mathrm{ER}_z = \frac{495-490}{500-490} = \frac{5}{10} = 0.5$$

To calculate the ER, the strategy proposed by Ravallion and Chen (2003) is again adopted, and the new rate is applied to the GIC. In this way, it is possible to express the rate of effort attained by each municipality according to its initial stage of education. The Effort/NIGIC ratio therefore expresses the mean of the ER per percentile of school performance in period *t*–1.

$$\mathrm{Effort/NIGIC} = \mathrm{ER}\,(p)$$

Figure 7 presents the Effort/NIGIC for the period from 2007 to 2015. The mean ER was 4.2%, showing a downward trend as the proficiency of the municipalities increases. In other words, it is evident that the better the school performance of the municipalities in 2007, the lower was their ER. The 20% of municipalities with poorest performance presented an ER of 6.4%, while the 20% with best performance obtained a growth of 1%, on average.

As with the NIGIC estimation, it was possible to apply income conditionality. This section seeks to condition the ER to the percentile of income of the municipalities. By doing so, we can measure the "effort" of the municipalities in relation to the percentile of income. Figure 8 presents this relationship.

In general, Figure 8 indicates a decreasing trend in ER across the income percentiles. When grouping the municipalities that are within the 20 first percentiles, an average of 4.3% is found; while for the last 20, the rate is 4.1%. Thus, when comparing the performance of the Brazilian municipalities in relation to their place in terms of average income, there is a difference of 0.3%, representing a relatively small gap in relation to the gap of 5.4% observed in the unconditional Effort/NIGIC. The result identified for the municipalities with different incomes suggests a greater homogeneity in terms of income-conditioned "effort."

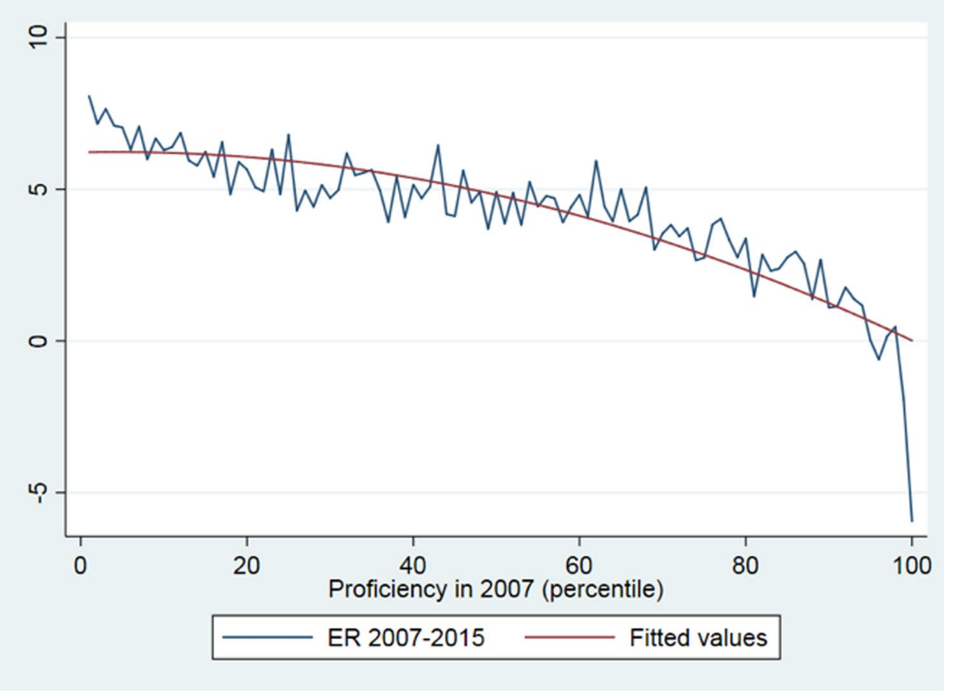

FIGURE 7 Unconditional Effort/NIGIC [Colour figure can be viewed at wileyonlinelibrary.com]

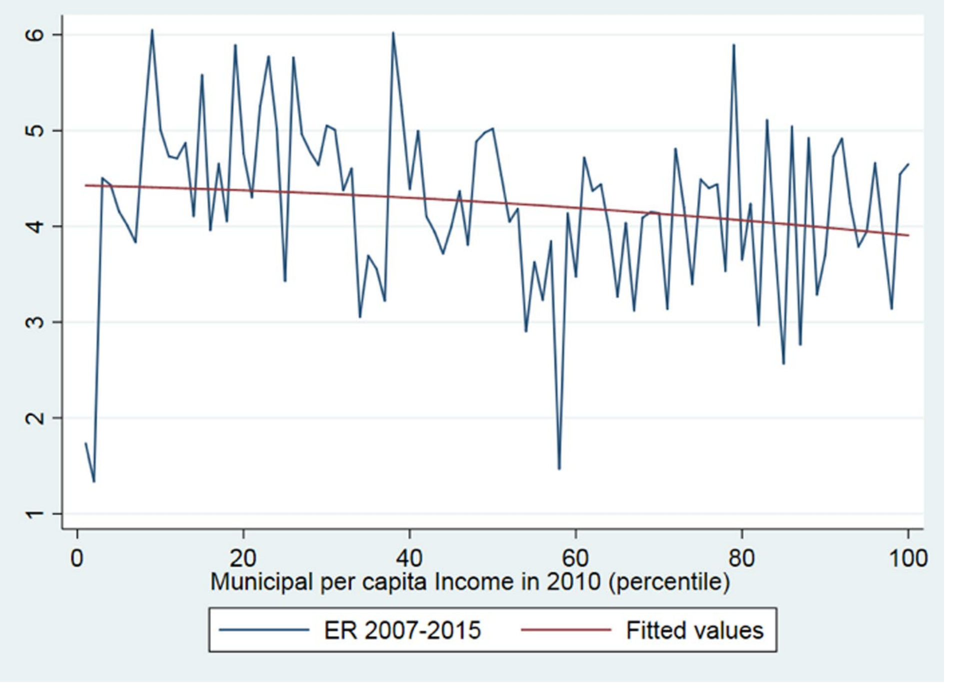

FIGURE 8 Conditional Effort/NIGIC [Colour figure can be viewed at wileyonlinelibrary.com]

7 | CONCLUDING REMARKS

The present study analyzed how the growth of education was distributed in the Brazilian municipalities during the early 2000s. It sought to identify whether the distribution process was egalitarian for the municipalities with different levels of income and school performance, in other words, whether educational growth in Brazilian municipalities was pro-poor or "anti-poor."

In addition to extending the pro-poor growth literature to educational indicators in Brazilian municipalities, this study adopted two variables as educational measures, years of schooling and proficiency. To achieve the proposed objective, different approaches toward the GIC were applied for the two education variables.

The first approach was the unconditional NIGIC: the estimated curve showed the educational growth rate for municipalities, ranked in percentiles of education. Applying this method, we found a pro-poor pattern in schooling and in school proficiency. In other words, educational growth rates were higher for municipalities with low proficiency and schooling, which is in line with the Harttgen et al. (2010) results for Asia and Latin America and Kacem (2013) results for Ethiopia.

Next, we estimated the conditional NIGIC; that is, the growth rates of education of municipalities were ordered according to income percentiles. As with the unconditional NIGIC, there was a pro-poor pattern of educational growth in the municipalities in relation to their average incomes.

The results found had shown that over time, with the reproduction of current growth rates, municipalities with low educational indicators might reach or even surpass the best-placed municipalities. To complement the study, we sought to investigate the "effort" of each municipality. As seen, the municipalities with the worst rankings, either in terms of education or income, were those with the highest rates of educational growth.

Even though it is easier to obtain a higher growth rate, the highest growth rates among the municipalities with the worst performance in 2007 were not exclusively the result of that phenomenon. According to the Effort/NIGIC, the worst-placed municipalities presented a higher effort rate than the others.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are freely available in INEP at http://inep.gov.br/microdados, reference number 13 and in IBGE at https://www.ibge.gov.br/estatisticas/sociais/populacao/22827-censo-2020-censo4.html?=&t=microdados, reference number 12.

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ENDNOTES

[1] Calculated from *per capita* household income available in the IBGE Census.

[2] Calculated from the 2000 and 2010 census data as detailed in Appendix 1.

[3] Data from INEP.

[4] The *Prova Brasil* is an educational assessment that is part of the Basic Education Assessment System (SAEB). Available at: http://inep.gov.br/microdados.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the Supporting Information section.

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