

Analysis of non-financial effects of the ICMS allocation policy for Education in Ceará

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Abstract

The state of Ceará has stood out for its good results in national basic Education evaluations, which the literature partly attributes to the change made in 2007 in the way ICMS (Tax on Circulation of Goods and Services) is distributed. This change began to reward municipalities with good performance in the early years of elementary Education. Despite substantial evidence attesting to the effectiveness of this legislation, the mechanisms of its functioning are not yet fully elucidated. Thus, this study investigated the non-financial effects of the policy by exploring a change in the law that included 9th-grade performance as a criterion for distribution but did not produce practical effects. A combination of the difference-in-differences model with genetic matching was used to verify whether this new change affected the performance of students in municipal schools. It was found that the “announced” change raised the scores of 9th-grade students by 1.2%, indicating that the distribution policy has effects independent of increased spending. The results remain consistent even when altering the estimation method and the control group used.

Keywords: ICMS Share. Basic Education. Ceará.

1 Introduction

The state of Ceará has gained prominence in recent years due to the significant results achieved in improving basic Education. According to a report by the

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Institute of Research and Economic Strategy of Ceará (Ipece), between 2005 and 2019, Ceará moved from 18th to 3rd place among Brazilian states in the Ideb (Basic Education Development Index) for the early years of elementary Education. This result seems to contrast with the state's investment capacity, being the fourth poorest in Brazil in terms of GDP *per capita* (Governo do Estado do Ceará, 2020).

Among the policies developed in Ceará, the change in the distribution of ICMS (Tax on Circulation of Goods and Services) among municipalities at the end of 2007 stands out. This change began to consider the performance of the network in the Permanent System for the Evaluation of Basic Education of Ceará (Spaee) in the early years of elementary Education as a criterion for resource distribution. This policy utilizes a constitutional provision that grants states discretion over how part of the resources is returned to municipalities. There is significant empirical evidence linking the approval of the law to the improvement of educational indicators in Ceará (Petterini, Irffi, 2013; Brandão, 2014; Carneiro, Irffi, 2018; Silva, 2021; Lautharte Junior, Oliveira, Loureiro, 2021; Irffi *et al.*, 2021; Carneiro *et al.*, 2022). The success of this approach led to the adoption of similar distribution rules in other states, especially after the enactment of Constitutional Amendment No. 108/2020, which addresses the new Fundeb.

Despite the robustness of the evidence attesting to the effectiveness of Ceará's ICMS distribution law, its transmission channels are still not well elucidated. The evaluation designs used so far do not allow the separation of the incentive effect itself from the change in resource availability since the results obtained by municipalities in 2007, before the change, were used as a basis for resource distribution in subsequent years (post-program). As a consequence, the municipalities that performed better in 2007 were also those that received more resources in 2008 and 2009, facing not only a change in incentives but also in budgeting.

In this sense, the present study aims to investigate the non-financial effect of the educational ICMS distribution policy by exploring an amendment to this legislation in 2015. On this occasion, the 9th-grade scores of elementary Education were included in addition to the 2nd and 5th-grade scores for the purpose of educational performance evaluation. However, since this norm was not regulated by the executive power, it did not produce financial effects. Thus, municipalities faced contradictory incentives, as they did not observe changes in funding rules but had the expectation that their results in the 2017 evaluation would influence future ICMS quota-part transfers.

This opened a window of opportunity to assess the change in incentives between the two models, keeping the manner in which resources were distributed constant. As a result, this study sought to identify the influence of incentives inherent in the ICMS quota-part distribution on the educational outcomes of Ceará's municipalities in the 9th grade of elementary Education. To this end, a combination of difference-in-differences methods with propensity score matching was used. The outcome indicator consisted of the average proficiency of municipal schools in the *Prova Brasil*, 2015 and 2017, taking as a control group schools from other northeastern states. The results show a positive effect of the announcement of the change on the average proficiency of schools at the end of elementary Education, suggesting anticipation by municipal managers.

2 The ICMS distribution law for Education in Ceará

The Federal Constitution of 1988, in its Article 158, item IV, stipulated that 25% of the ICMS a state tax, should be transferred by the state to its municipalities. Originally, the sole paragraph of that article established the following guidelines for the crediting of this revenue¹:

I - Três quartos, no mínimo, na proporção do valor adicionado nas operações relativas à circulação de mercadorias e nas prestações de serviços, realizadas em seus territórios;

II - Até um quarto, de acordo com o que dispuser lei estadual ou, no caso dos Territórios, lei federal.

The Value Added Fiscal (VAF), described in item I, corresponds to the net result of the inflows and outflows of goods, plus the value of the services provided in each municipality (Complementary Law No. 63 of January 11, 1990).

The wording of item II gives the states the prerogative to define their own distribution rules for part of the collected amount. This allowed for the development of state regulations that used the discretionary portion of the ICMS quota-share division to promote desirable practices by municipal administrators. Some of these regulations, exemplified by Ceará's legislation, achieved significant results in environmental, health, and especially educational indicators (Carneiro *et al.*, 2022).

¹ Constitutional Amendment No. 108/2020, among other changes, amended the wording of Article 158 of the Federal Constitution, reducing the percentages in items I and II to 65% and 35%, respectively.

In the 1990s, the state of Ceará enacted its first change in the ICMS distribution rule through Law No. 12.612, of August 7, 1996. This law established that half of the discretionary portion of the ICMS revenue (12.5%) would be distributed among municipalities in proportion to the ratio between Education expenditures and total municipal revenues. Carneiro and Irffi (2018) found no effects of this legislation on educational performance.

In 2007, the state of Ceará underwent a new reformulation of its ICMS distribution legislation with the enactment of State Law No. 14.023, of December 17, 2007. This new legislation adopted three performance indicators as criteria for the areas of Environment (2%), Health (5%), and Education (18%). Ceará's legislation innovated by introducing the Education Quality Index (IQE), based on approval rates and standardized proficiencies from the Spaece for the second and fifth grades of elementary Education. The IQE formula is given by:

$$IQE = 0.5 \times IQA + 0.45 \times IQF + 0.05 \times APROV$$

where IQA is the Literacy Quality Index, IQF is the Elementary Quality Index, and APROV is the relative approval rate in the first five grades of elementary Education. Each of these indicators is composed of a standardized average of the relative proficiencies of each municipality and the variation of this proficiency in relation to the previous evaluation, in their respective Education stages².

It is important to highlight that there are controversies regarding the effects of using large-scale assessments to guide educational policies. While some scholars argue that the results of these assessments provide valuable input for planning and evidence-based decision-making, others warn of the risks of unintended consequences, such as curriculum narrowing, teaching focused solely on test performance, and the management of school systems based on numerical indicators. These divergences reflect the complexity involved in interpreting and using data produced by broad assessments, especially when local contexts and structural inequalities between school systems and institutions are overlooked (Johansson, 2016).

To illustrate the magnitude of the rule change on municipal finances on Ceará, between 2007 and 2009, the average amounts received as ICMS quota-share by Ceará's municipalities varied by more than 30%. This quota-share variation represented, on average, 2.6% of the Current Revenue of municipalities from 2007

² For details, see Technical Note nº 33 (Governo do Estado do Ceará, 2008).

to 2009, equivalent to about 10% of the Education budget. Municipalities such as Penaforte, Independência, Massapê, Aratuba, Reriutaba, and Cruz more than doubled their ICMS revenues, while Ibaretama, Lavras da Mangabeira, Acaraú, and Abaiara had a reduction in this resource of more than 20%.

Carneiro *et al.* (2022) conducted an extensive review of the empirical literature on Ceará's ICMS distribution policy. This survey showed that the change led to a significant increase in the proficiencies of municipal network students in standardized exams, especially in the early years of elementary education (Petterini, Irffi, 2013; Brandão, 2014; Carneiro, Irffi, 2018; Silva, 2021; Lautharte Junior, Oliveira, Loureiro, 2021; Irffi *et al.*, 2021; Carneiro *et al.*, 2022). Furthermore, the policy seems to have led to an increase in educational investment by municipalities (Garcia, Simonassi, and Costa, 2015; Veloso, Barbosa, 2020).

The problem with these approaches, which use the year 2007 as a baseline, is that since the results obtained by Ceará's municipalities in 2007, that is, before the change, were used as the basis for resource distribution in 2008 (post-program), assessments based on the differential between these two periods are likely to capture both the rule change and the change in available resources. In other words, municipalities that showed better results in 2007 were also those that experienced greater resource variations in 2008.

Thus, when observing the post-treatment result, it accumulates not only the effects of the efforts employed by municipal networks to improve their educational results but also the variation in budget availability. This last point becomes particularly relevant for municipalities at the extremes of the pre-treatment resource distribution, as they were targets of a significant variation in their revenues.

In December 2015, the Ceará Legislative Assembly approved a modification to the ICMS distribution law, aiming to include the 9th-grade students' results as one of the criteria for ICMS distribution. This change was to take effect at the beginning of 2017; however, the state executive did not issue a decree regulating this change, so it was not implemented. Only at the end of 2019 did a new law validate the distributions from 2017 to 2020 according to the 2007 norm and extended the application period of the new criteria to 2021.

In the meantime, municipalities faced contradictory incentives, as they did not observe changes in funding rules but expected that their results in the 2017 evaluation would influence future transfers. This opens a window of opportunity to assess the change in incentives between the two models, keeping constant

the way resources were distributed. Therefore, this study sought to investigate whether there was a positive variation in the proficiency of 9th-grade students in Ceará's municipal schools due to the legislative change.

3 Methods

This section will describe the econometric strategy, detailing the matching and difference-in-differences methods, as well as the sources and description of the database.

3.1 Database

For the analysis, data from the *Prova Brasil* in 2015 and 2017 were used, before and after the change. The treatment group was selected as the set of municipal schools in Ceará with 9th-grade classes. The control group was composed of public schools from municipal networks in other northeastern states. The greater proximity in terms of socioeconomic, climatic, and cultural conditions increases the chances of this control group being considered an adequate counterfactual. Brandão (2014) and Carneiro and Irffi (2018) adopt a similar strategy, considering municipalities and students as the cross-sectional units, respectively.

Regarding regressors, the dimensions considered were the quality of the employed workforce (rate of teachers with at least a Higher Education degree: *Professor_Superior*), the quantity of available workforce (ratio between the total number of employees and the number of enrolled students: *Taxa_Funcionários*), the availability of infrastructure in public schools (*Ind_Infraestrutura*); the average socioeconomic background of 9th-grade students who took the *Prova Brasil* (*Ind_Socio_Econômico*); and the school commitment of students (ratio between the number of 9th-grade students who took the *Prova Brasil* and the total number of enrolled 9th-grade students: *Taxa_Participação*).

3.2 Empirical Strategy

To identify the effect of the variation in incentives derived from this legislative change on the educational performance of Ceará's municipalities, the difference-in-differences model was used (Angrist, Pischke, 2008). This approach allows for the identification of the treatment effect through the double difference in results, between treated and untreated, before and after the treatment, so that the difference-in-differences estimator is described by:

$$\beta_{DD} = \{E[Y \mid d = 1, t = 1] - E[Y \mid d = 0, t = 1]\} - \{E[Y \mid d = 1, t = 0] - E[Y \mid d = 0, t = 0]\}$$

Where Y is the outcome variable, d is a variable that takes the value one if the school belongs to the treatment group and zero if it belongs to the control group, and t is a dummy indicating the period, before and after the intention to change the law. Finally, under the hypothesis that the temporal variation in the average of the treated group's counterfactual is equal to the variation observed in the control group's average, β_{DD} reports the average treatment effect on the treated. The Difference-in-Differences estimator is represented by the equation:

$$Y = \alpha + \gamma_1 d + \gamma_2 t + \beta_{DD} (d \times t) + X' \Gamma + \varepsilon \quad [1]$$

where the vector X consists of a range of observable characteristics.

It is noteworthy that, since Ceará's municipal managers were already familiar with the policy based on the results in the 2nd and 5th grades, this concept would be easily extended to the 9th grade, even without defining how the new resource distribution rule would be.

Since the groups compared may not be equivalent in terms of observed characteristics, we opted to combine the differences-in-differences method with Genetic Propensity Score Matching, as proposed by Diamond and Sekhon (2005). This non-parametric technique is a variation of the matching method proposed by Rosenbaum and Rubin (1983), with the advantage of maximizing the balance between observable characteristics between treatment and control groups. The advantage of combining these two methods lies in the fact that it is sufficient for the assumptions of one of the methods to be satisfied to obtain a causal effect (Pinto, 2017).

Tsai and Peace (2012) indicate that, in addition to achieving an efficient balance between covariates, the genetic matching method also results in relatively more stable and unbiased causal effect estimates. As a result, we expect the matching between the two groups under analysis (treated and control) to mitigate the differences between the observed characteristics of the school units in the pre-treatment period, such that the difference between them can be attributed to the announcement of the legislative change in the ICMS sharing rule in the State of Ceará.

In addition to the combination of methods, as a falsification strategy, we chose to test the effect of the announcement of the change on the proficiency results in Portuguese and Mathematics for 5th-grade students. Initially, we do not expect a positive change in the performance of this group since there would be no incentives

for such. Moreover, a negative result could reflect the lower weight given to this stage, which would now compete for the division of efforts/investments with 9th-grade students.

4 Results

This section will present the descriptive analysis of the data, as well as the results of the estimations and tests performed.

4.1 Descriptive Analysis

As discussed in the previous sections, this application aims to infer the effect of a previously announced change in the ICMS share transfer to Ceará municipalities on the school performance of public school 9th-grade students. Although the change in the sharing rule was not actually implemented in 2017, it is hypothesized that the learning effect resulting from the change in the state distribution regime that occurred in 2007 motivated public managers to pay greater attention to 9th-grade students, anticipating the future change in the distribution rule. The evidence found in Brandão (2014) supports this hypothesis, reporting a relative importance equal to or greater than the management efforts rather than the availability of new revenues on the educational performance of Ceará municipalities.

It is worth noting that, at the time of the proposal to include the 9th grade in the IQE computation, this school stage was predominantly offered by municipal public schools. In 2015, according to School Census data, 73.3% of schools with classes from 5th to 9th grade in Ceará already belonged to the municipal network, representing 69.6% of enrollments in this final stage. A similar pattern is observed for other northeastern states, which in that year had approximately 60% of 9th-grade students enrolled in schools managed by municipalities.

Table 1 shows the evolution of enrollments in the 9th grade by administrative dependency from 2015 to 2017. During the period, the State of Ceará exhibited a growth rate in the total number of students enrolled in municipal networks above the Northeast average (an increase of 3.82% in Ceará compared to an increase of 2.56% in the Northeast), while there was a more intense reduction in state network enrollments than observed in the Northeast (a 29.00% drop in Ceará against a 16.00% decrease in the Northeast).

Table 1 – Evolution in the composition of school enrollments (9th grade), according to administrative dependencies from 2015 to 2017 – municipal and state public schools

Estates	Municipal schools (2015)	Municipal schools (2017)	Variation (%)	State schools (2015)	State schools (2017)	Variation (%)
Maranhão	95,31	93,09	-2.33%	11,79	8,77	-26%
Piauí	28,91	28,33	-2.02%	12,08	10,52	-13%
Ceará	89,54	92,96	3.82%	18,20	12,91	-29%
Rio Grande do Norte	18,03	19,31	7.11%	15,52	14,56	-6%
Paraíba	23,36	25,04	7.22%	19,26	18,14	-6%
Pernambuco	52,99	58,32	10.05%	51,32	42,36	-17%
Alagoas	27,35	26,49	-3.13%	11,19	10,66	-5%
Sergipe	12,05	11,70	-2.89%	11,17	9,67	-13%
Bahia	117,76	121,95	3.55%	52,60	43,21	-18%
Sudeste	323,54	270,51	-16.39%	677,74	55,94	-17%
Sul	81,02	85,32	5.30%	218,39	23,34	7%
Centro-Oeste	40,65	40,68	0.06%	138,28	14,37	4%
Norte	111,29	113,71	2.18%	135,77	13,43	-1%
Nordeste	465,29	477,19	2.56%	203,13	17,08	-16%
Brasil	1,021,80	987,41	-3.37%	1,373,31	12,42	-10%

Source: Prepared by the authors (2025)

It is possible that the change in the ICMS sharing rule contributed to the above-average regional advance in the municipalization of the final years of elementary Education. However, it is observed that the predominance in the offer of municipal network enrollments for the 9th grade was a pattern already observed in the pre-law change period, reflecting previous policies such as Fundeb.

To avoid problems associated with selection bias in the transition of schools from the state network to the municipal network, only school networks that maintained their administrative dependency from 2015 to 2017 were included in the database. We expect that the differences-in-differences technique captures only the effect of the incentive change in the management of the final years of elementary

Education, from the addition of the 9th grade, excluding the effect of transitions in the dependency regime on the average proficiency of school networks.

Table 2 contains a statistical summary of the variables used for the years 2015 (pre-implementation of the new ICMS sharing proposal) and 2017 (post-implementation period of the new ICMS sharing proposal) for public schools in Ceará and other northeastern states. The last column represents the difference between the average values of the variables observed for the treatment and control groups. Before entering the discussion of descriptive statistics, it is worth noting that after discarding school units that did not have the complete set of information, the sample includes 653 municipal schools in Ceará offering the 9th grade (treatment group) and 2218 municipal and state schools from other northeastern states (control group).

Except for the Staff Rate, the other variables express different averages between the treatment and control groups. Ceará schools exhibited better performance indicators and quality of human capital and school infrastructure in both periods. Notably, there is a difference of more than ten percentage points in the student participation rate in the *Prova Brasil*, indicating a more effective commitment of Ceará schools to the standardized school performance test.

It is also important to note that, on average, 9th-grade students in Ceará schools have relatively poorer socioeconomic conditions than other students in the Northeast. In terms of GDP *per capita*, the State of Ceará also has results below the Northeast average, both in 2015 and 2017.

Table 2 – Descriptive statistics for the sample of schools in Ceará and the Nordeste

		Ceará		Nordeste (excluding Ceará)		
		Mean	Standard Deviation	Mean	Standard Deviation	Difference of Means
2015	Ln Mathematics	5.533	0.083	5.463	0.067	0.070*
	Ln Portuguese	5.525	0.068	5.446	0.080	0.079*
	Ind_Infraestrutura	0.640	0.096	0.603	0.096	0.037*
	Ind_Socio_Economic	0.396	0.013	0.402	0.014	-0.006*
	Teachers_Higher_Educ	0.944	0.138	0.907	0.183	0.038*
	Employee_rate	0.568	0.222	0.556	0.205	0.011
	Participation_rate	0.968	0.066	0.842	0.121	0.126*

Continue

Continuation						
	Ln Mathematics	5.552	0.096	5.460	0.086	0.092*
	Ln Portuguese	5.560	0.075	5.468	0.083	0.092*
	Ind_Infrastructure	0.622	0.091	0.585	0.097	0.037*
2017	Ind_Socio_Economic	0.394	0.013	0.401	0.015	-0.008*
	Teachers_Higher_Educ	0.958	0.120	0.933	0.168	0.025*
	Employee_rate	0.621	0.274	0.601	0.377	0.020
	Participation_rate	0.970	0.069	0.862	0.114	0.108*

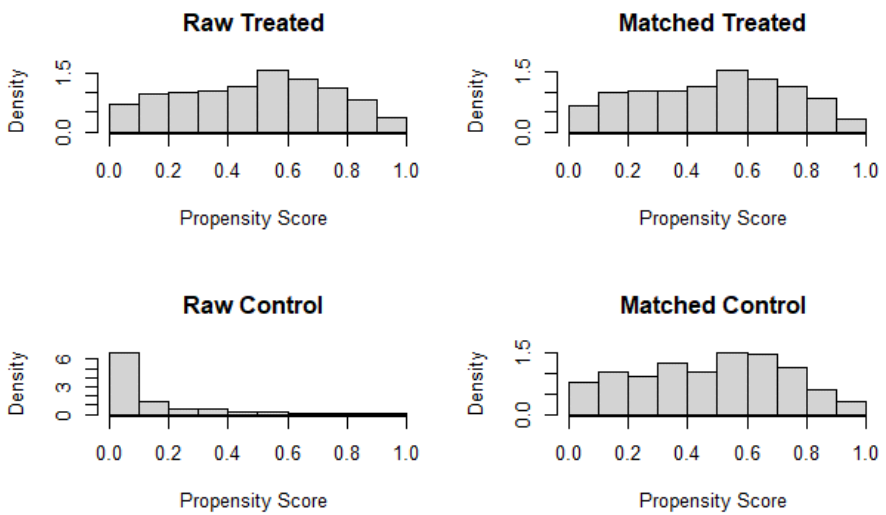
Source: Prepared by the authors (2025).

* p-value < 0,05

4.2 Quality of Matching

Before the causal analysis, to verify if the matching was successful in balancing the characteristics of the treatment and control groups, some diagnostic tests were performed. Figure 1 shows histograms of the propensity scores for the pre (Raw Matched and Raw Control) and post-matching (Matched Treated and Matched Control) samples. The results indicate a strong imbalance between the groups before the procedure, reinforcing the selection problem in the sample. On the other hand, the similarity of the propensity score distributions of the two groups after matching suggests equivalence in terms of the conditional probability of receiving the treatment, indicating that the matching was effective in minimizing the selection problem based on observable characteristics.

Figure 1 – Histogram of the propensity score of the treatment and control groups – 9th Grade

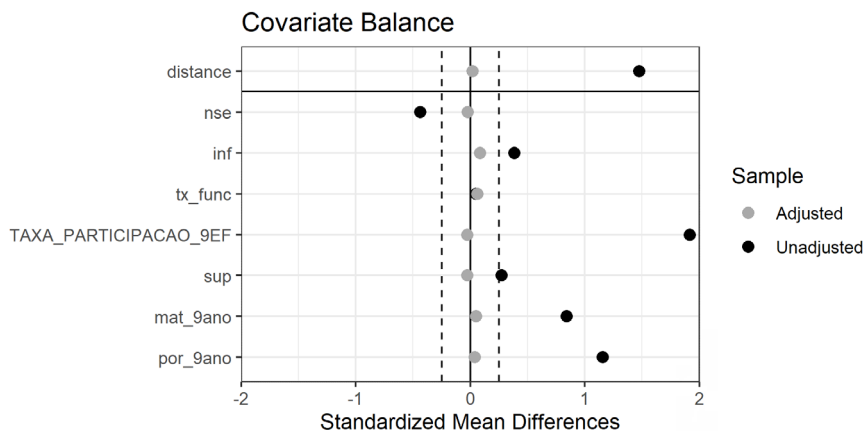


Source: Prepared by the authors (2025)

Moreover, Figure 2 shows the standardized mean difference³ between the observed characteristics for the two groups, before (unadjusted) and after (adjusted) matching. It is observed that after the procedure, the difference between the groups is around zero. In line with the balancing criterion proposed by Cochran and Rubin (1973), all covariates are limited to 0.25 standard deviations, indicating a good balance of observed characteristics. Thus, the idea emerges that the matching mitigated the bias from observable characteristics.

³ Standardized difference = (Mean of the Covariate in the Treatment Group – Mean of the Covariate in the Control Group) / Standard Deviation of the Covariate in the Control Group.

Figure 2 – Covariate balance statistics between treatment and control groups before and after matching



Source: Prepared by the authors (2025)

Note: The vertical dashed lines represent the limits of -0.25 and 0.25 – standard deviation

4.3 Impact Evaluation

Based on the results of the differences-in-differences models reported in Table 3, it can be inferred from Panel A (pre-generic matching sample) that the announcement of the change in the ICMS sharing rule in the State of Ceará had a positive effect on the average proficiency in Mathematics and Portuguese, 2.5% (0.025) and 1.7% (0.017), for 9th-grade elementary school students.

These results align with those found in the literature, particularly with Carneiro and Irffi (2018), who obtained relatively higher effect estimates in Portuguese (ranging from 2.3% to 5.1%) than in Mathematics (ranging from 1.7% to 4.6%) for 5th-grade students. However, these results must be viewed with caution due to selection bias concerning observable characteristics in the pre-matching sample.

Considering the results reported in Panel B, there is a significant reduction in the treatment effect for the Mathematics proficiency test (with the impact decreasing from 2.5% to 1.2%) and a slight increase in the treatment effect for the Portuguese test (where the impact increased from 1.7% in the pre-matching sample to 2.0% in the post-matching sample), suggesting an overvaluation of the treatment effect on school performance in Mathematics due to selection bias in the sample. It is noteworthy, however, that the “announcement effect” is still statistically significant, with values falling just below the lower bound of the

influence interval associated by Carneiro and Irffi (2018) for 5th-grade students due to the 2007 law.

Table 3 – Differences in differences model: effect of the announcement of changes to the ICMS distribution rule – 9th grade

Regressors	Coefficient	Standard Error	p-value	Coefficient	Standard Error	p-value
Panel A: Pre-Genetic Matching Sample						
	Mathematics			Portuguese		
Constant	5.223*	0.03	<0.001	5.132*	0.032	<0.001
Time	-0.007*	0.002	<0.001	0.019*	0.002	<0.001
Treatment	0.049*	0.004	<0.001	0.059*	0.003	<0.001
Time* Treatment	0.025*	0.005	<0.001	0.017*	0.004	<0.001
Ind_Infrastructure	0.047*	0.01	<0.001	0.041*	0.01	<0.001
Ind_Socio_Economic	0.091*	0.067	0.175	0.264*	0.071	<0.001
Teachers_Higher_Educ	0.058*	0.005	<0.001	0.067*	0.006	<0.001
Employee_rate	0.013*	0.007	0.06	0.008	0.004	0.068
Participation_rate	0.137*	0.009	<0.001	0.139*	0.01	<0.001
Observations	7126			7126		
R ² / R ² adjusted	0.190 / 0.189			0.222 / 0.222		
Panel B: Post-Genetic Matching Sample						
	Mathematics			Portuguese		
Constant	5.236*	0.065	<0.001	5.168*	0.055	<0.001
Time	0.005	0.005	0.291	0.015*	0.004	<0.001
Treatment	0.02*	0.004	<0.001	0.021*	0.004	<0.001
Time* Treatment	0.012*	0.007	0.065	0.02*	0.006	<0.001
Ind_Infrastructure	-0.004*	0.018	0.811	-0.018	0.016	0.251
Ind_Socio_Economic	0.174*	0.14	0.216	0.406*	0.121	0.001
Teachers_Higher_Educ	0.034*	0.011	0.002	0.053*	0.01	<0.001
Employee_rate	0.015	0.024	0.552	0.007	0.013	0.595
Participation_rate	0.176*	0.029	<0.001	0.136*	0.022	<0.001
Observations	2534			2534		
R ² / R ² adjusted	0.083 / 0.080			0.132 / 0.129		

Source: Prepared by the authors (2025)

* p-value < 0.05. Note: robust standard errors

4.4 Robustness Analysis

To provide empirical support for the reported evidence, additional specifications of the differences-in-differences model were estimated. An alternative way to capture the municipal management response to the change in incentives associated with the announcement of the IQE change in the State of Ceará is to adopt state schools in the federative unit as a control group. Since the educational policies in state schools are not directly exposed to changes in the design of transfer mechanisms to municipalities, they become a possible alternative counterfactual for the research problem.

Based on the subset of schools with proficiency results for 2015 and 2017, with 9th-grade classes, and information on infrastructure and equipment available in the respective school censuses of 2015 and 2017, a sample was formed with 108 state schools in Ceará against a total of 1,089 municipal schools. Given that the control group is significantly smaller than the treatment group, the full matching technique was used, a method considered optimal for minimizing the weighted average distance between treatment and control units without the need to discard cross-sectional units from the sample (Stuart, Green, 2008).

Table 4 presents the results of the differences-in-differences model for Portuguese and Mathematics tests for 9th-grade students. The estimates confirm the “announcement” effect on the average proficiency of schools in Portuguese and Mathematics. Again, all else being equal, the “announcement” is associated with a positive effect of 1-3% on the average proficiency of schools in Portuguese and Mathematics.

Table 4 – Effects of the announcement of changes to the ICMS quota distribution rule on proficiency in Portuguese Language and Mathematics of 9th grade students, control group: State schools in Ceará

	Coefficient	Standard Error	p-value	Coefficient	Standard Error	p-value
Panel A: Pre-Genetic Matching Sample						
	Mathematics			Portuguese		
Constant	5.289	0.061	0.001*	5.211	0.050	0.001*
Time	-0.012	0.007	0.105	0.020	0.007	0.006*
Treatment	-0.003	0.006	0.593	-0.010	0.006	0.128
Time* Treatment	0.026	0.008	0.002*	0.012	0.008	0.121
Ind_Infraestrutura	-0.051	0.02	0.01*	-0.045	0.016	0.005*

Continue

Continuation						
Ind_Socio_Economic	0.103	0.133	0.439	0.383	0.110	0.001*
Teachers_Higher_Educ	0.013	0.014	0.33	0.025	0.012	0.037*
Employee_rate	0.009	0.004	0.008*	0.005	0.003	0.062
Participation_rate	0.225	0.027	0.001*	0.184	0.024	0.001*
Observations	2.394		2.394			
R ² / R ² adjusted	0.052/0.048		0.096 / 0.093			
Panel B: Post-Genetic Matching Sample						
	Mathematics			Portuguese		
Constant	5.289	0.061	0.001*	5.216	0.050	0.001*
Time	-0.012	0.007	0.11	0.019	0.007	0.008*
Treatment	-0.003	0.006	0.608	-0.009	0.006	0.148
Time* Treatment	0.026	0.008	0.002*	0.013	0.008	0.096
Ind_Infrastructure	-0.051	0.020	0.01*	-0.044	0.016	0.006*
Ind_Socio_Economic	0.103	0.133	0.438	0.367	0.110	0.001*
Teachers_Higher_Educ	0.013	0.014	0.328	0.024	0.012	0.048*
Employee_rate	0.009	0.004	0.008*	0.005	0.003	0.059
Participation_rate	0.224	0.028	0.001*	0.191	0.024	0.001*
Observations	2.394		2.394			
R ² / R ² adjusted	0.053/0.049		0.096/0.093			

Source: Prepared by the authors (2025).
* p-value < 0.05. Note: robust standard errors.

Moreover, as suggested by Imbens (2004), to assess whether the results obtained are not spurious, a common practice in the causal inference literature is to estimate the results using a placebo treatment group that would not be affected by the intervention. To this end, we sought to verify the effect on the average proficiency of schools for 5th-grade students. Since the announcement of the ICMS law modification is not related to the performance of these students, a null treatment effect is expected for this sample.

Regarding the results of the announcement of the change in the ICMS sharing rule, it is verified in Table 5 that it does not affect the average proficiency of 5th-grade students in Portuguese and Mathematics. Therefore, it can be concluded that the announcement results are robust, given that the change was expected only for the 9th-grade results.

Table 5 – Effects of the announcement of changes to the quota distribution rule - part of the ICMS on proficiency in Portuguese Language and Mathematics of 5th grade students

	Coefficient	Standard Error	p-value	Coefficient	Standard Error	p-value
Panel A: Pre-Genetic Matching Sample						
	Mathematics			Portuguese		
Constant	5.126*	0.037	<0.001	4.931*	0.042	<0.001
Time	0.006*	0.002	0.013	0.026*	0.003	<0.001
Treatment	0.103*	0.005	<0.001	0.124*	0.005	<0.001
Time* Treatment	0.015*	0.007	0.039	0.006	0.006	0.326
Ind_Infrastructure	0.068*	0.013	<0.001	0.065*	0.014	<0.001
Ind_Socio_Economic	-0.429*	0.084	<0.001	-0.182*	0.094	0.054
Teachers_Higher_Educ	0.081*	0.006	<0.001	0.102*	0.007	<0.001
Employee_rate	0.019*	0.01	0.043	0.017*	0.007	0.019
Participation_rate	0.207*	0.013	<0.001	0.217*	0.014	<0.001
Observations	7.126			7.126		
R ² / R ² adjusted	0.276 / 0.275			0.310 / 0.309		
Panel B: Post-Genetic Matching Sample						
	Mathematics			Portuguese		
Constant	5.294*	0.088	<0.001	5.083*	0.082	<0.001
Time	0.014*	0.006	0.027	0.02*	0.006	0.001
Treatment	0.042*	0.006	<0.001	0.048*	0.006	<0.001
Time* Treatment	0.004	0.009	0.675	0.011	0.008	0.195
Ind_Infrastructure	0.009	0.03	0.76	-0.008	0.027	0.778
Ind_Socio_Economic	-0.660*	0.186	<0.001	-0.221	0.177	0.214
Teachers_Higher_Educ	0.044*	0.019	0.023	0.052*	0.018	0.004
Employee_rate	0.052*	0.011	<0.001	0.033*	0.01	0.001
Participation_rate	0.247*	0.036	<0.001	0.24*	0.035	<0.001
Observations	2.410			2.410		
R ² / R ² adjusted	0.105 / 0.102			0.136 / 0.133		

Source: Prepared by the authors (2025).

* p-value < 0.05. Note: robust standard errors.

The results suggest that, regardless of the actual financial transfer, the ICMS sharing law produced positive effects on educational performance in Ceará. Therefore, the policy's transmission channel seems to include, to some extent, changes in the school team's orientation to achieve a predetermined goal. Although there is the prospect of future financial returns, it is not possible to associate the observed result with a higher influx of resources, given that the change did not produce financial effects.

In general terms, the evidence is supported by two hypotheses established in the literature on intergovernmental resource transfers aimed at incentivizing the improvement of school performance in municipalities. The first, according to Brandão (2014), points out that the modification of the ICMS rules in Ceará in 2007 generated a positive convergence on educational performance for Ceará municipalities in general. Thus, even the "losing" municipalities (which had a reduction in ICMS resources from the IQE in 2007) saw increases in their proficiency indicators since the treatment. Therefore, it is conjectured that the predominant effect generated by the treatment was the increased management effort and not necessarily the greater availability of resources to the "winners".

The second, according to Carneiro and Irffi (2018), conditions the effectiveness of such programs on municipal educational performance, among other factors, to the perceived feasibility of achieving the goals set by managers. In this sense, it is postulated that the learning effect generated by past modifications in the ICMS law of the State of Ceará provides municipal managers with greater know-how on the necessary practices to improve educational performance.

5 Conclusion

Despite the enormous challenges faced by the Brazilian educational system, some experiences of subnational entities have proven successful in improving student learning, at least as measured in large-scale assessments. An emblematic example of these initiatives is the ICMS sharing law in Ceará. This legislative change made in 2007 began to reward municipalities whose students achieved better performance in Spaece with more resources.

Empirical evidence has unanimously attested to the effectiveness of this initiative in improving the performance of students in Ceará's municipal networks, particularly in the early years of elementary Education (Petterini, Irffi, 2013; Brandão, 2014; Carneiro, Irffi, 2018; Silva, 2021; Lautharte Junior, Oliveira, and Loureiro, 2021; Irffi *et al.*, 2021; Carneiro *et al.*, 2022). However, there is little evidence on how

the policy works, with part of this result attributed to increased investments by municipalities (Garcia, Simonassi, and Costa, 2015; Veloso, Barbosa, 2020).

However, the way these evaluations were designed does not allow separating the financial and non-financial effects of the policy. This is because the results of 2007, normally used as a baseline, were used for resource distribution in 2008. Therefore, municipalities that expressed better results in this first year were also those with greater resource variation the following year. To fill this gap in the literature, the effect of a change in the ICMS sharing law made in 2015, but which did not produce financial effects due to not being regulated, was investigated.

By investigating the impact of the law on 9th-grade performance, it was possible to isolate only the “announcement” effect. An increase of 1.2% and 2% was observed in the Mathematics and Portuguese scores in the 9th grade, respectively, due to the new change in the ICMS sharing rule. The result holds even when varying the estimation method and the control group used. Moreover, as expected, no effect was observed on 5th-grade scores, reinforcing that the change was indeed caused by the legislation.

It can be concluded that the policy’s transmission channel seems to include, to some extent, changes in the school team’s orientation to achieve the new goal. Therefore, it is plausible to assume that the sharing rule aimed at education has direct effects on the network’s management style, regardless of the amount of resources provided.

Análise dos efeitos não financeiros da política de rateio do ICMS para a Educação no Ceará

Resumo

O Ceará tem se destacado pelos bons resultados nas avaliações nacionais da Educação Básica, fato que a literatura atribui, em parte, à mudança realizada em 2007 na forma de distribuição do ICMS, que passou a premiar os municípios com bom desempenho nos anos iniciais do Ensino Fundamental. Embora haja bastante evidência atestando a eficácia dessa legislação, os mecanismos de seu funcionamento ainda não estão totalmente esclarecidos. Assim, este trabalho investigou os efeitos não financeiros da política, ao explorar uma alteração na lei que incluiu como critério de rateio o desempenho no 9º ano, mas que não produziu efeitos práticos. Utilizou-se uma combinação do modelo de diferenças em diferenças com pareamento genético para verificar se essa nova mudança afetou o desempenho dos alunos das redes municipais. Constatou-se que a mudança “anunciada” elevou as notas dos estudantes do 9º ano em 1,2%, indicando que a política de distribuição possui efeitos independentes do aumento do gasto. Os resultados permanecem consistentes mesmo ao alterar o método de estimação e o grupo de controle utilizados.

Palavras-chave: ICMS Educacional. Educação Básica. Ceará.

Análisis de los efectos no financieros de la política de distribución del ICMS para la Educación en Ceará

Resumen

Ceará se ha destacado por sus buenos resultados en las evaluaciones nacionales de la Educación básica, lo que se atribuye, en parte, por la literatura, al cambio realizado en 2007 en la forma de distribución del ICMS (Impuesto sobre la Circulación de Mercancías y Servicios), que comenzó a premiar a los municipios con buen desempeño en los primeros años de la Educación primaria. A pesar de que existe bastante evidencia que atestigua la eficacia de esta legislación, los mecanismos de su funcionamiento aún no están completamente aclarados. De esta manera, el presente trabajo investigó los efectos no financieros de la política, explorando una alteración en la ley que incluyó como criterio de distribución el desempeño en el 9º grado, pero que no produjo efectos prácticos. Así, se utilizó una combinación del modelo de diferencias en diferencias con emparejamiento genético para verificar si este nuevo cambio afectó el desempeño de los alumnos de las redes municipales. Se constató que el cambio “anunciado” elevó las calificaciones de los estudiantes del 9º grado en un 1,2%, lo que indica que la política de distribución tiene efectos independientes del aumento del gasto. Los resultados permanecen consistentes incluso al alterar el método de estimación y el grupo de control utilizados.

Palabras clave: ICMS Educativo. Educación Básica. Ceará.

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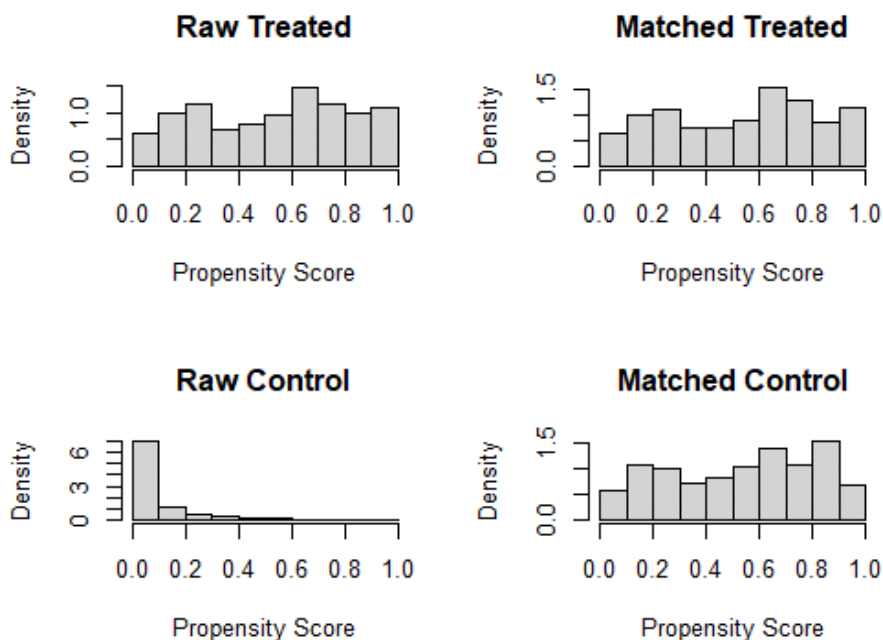
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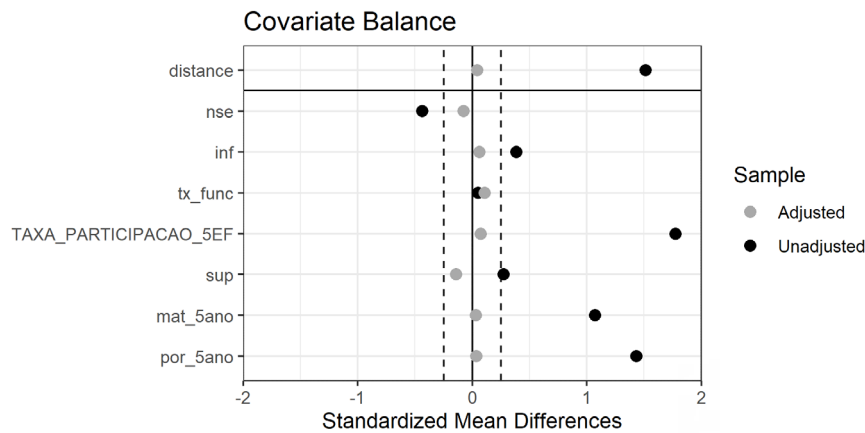
Appendix A - Balancing Tests for robustness analyses.

Figure A1 – Histogram of the propensity score of the treatment and control groups, 5th grade



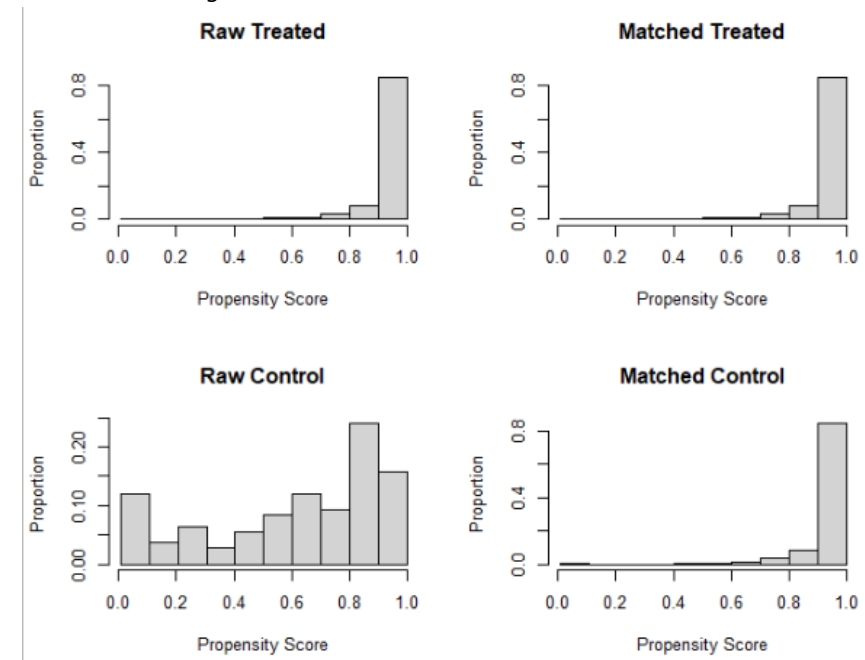
Source: Prepared by the authors (2025).

Figure A2 – Covariate balance statistics between treatment and control groups before and after matching.



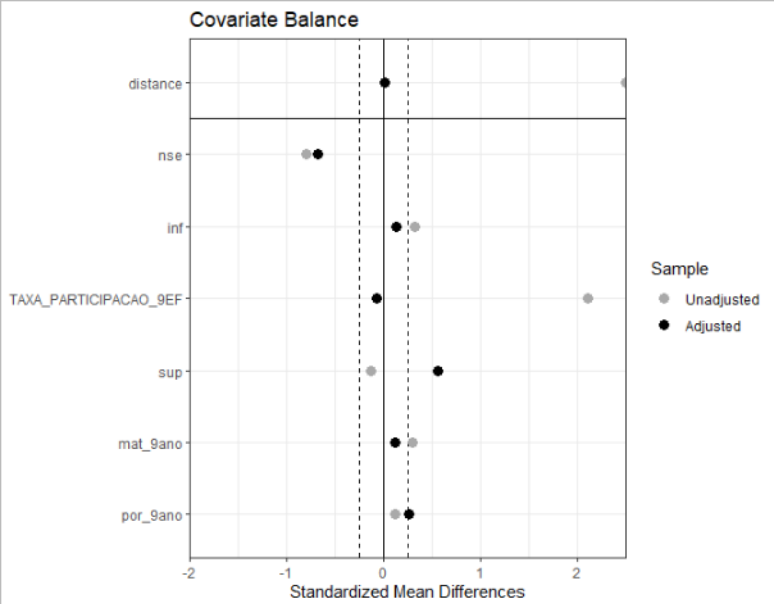
Source: Prepared by the authors (2025). Note: The vertical dashed lines represent the limits of -0.25 and 0.25 – standard deviation.

Figure A3 – Histogram of the propensity score of the treatment and control groups (state schools), 9th grade.



Source: Prepared by the authors (2025).

Figure A4 – Covariate balance statistics between treatment and control groups before and after matching.



Source: Prepared by the authors (2025). Note: The vertical dashed lines represent the limits of -0.25 and 0.25 – standard deviation.